

# Impact of COVID-19 mitigation strategies on asthma hospitalizations in Brazil



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**Background:** In 2020, a unique social experience was provided by the pandemic of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2. Interventions to tackle the pandemic may affect the burden of other respiratory diseases.

**Objective:** This study aims to assess the impact of the COVID-19 mitigation strategies on hospitalizations for asthma in children aged between 1 and 14 years, adults aged between 20 and 59 years, and elderly older than 60 years.

**Methods:** Data from hospital admissions for asthma were obtained from the Department of Informatics of Brazilian Public Health System database in the period between January 2016 and December 2020 and analyzed by age groups. To evaluate the effect of containment measures on the incidence of asthma and respiratory system diseases (total), the absolute reduction and relative reduction were calculated by analyzing the subsets from 2016 to 2019 versus 2020.

**Results:** There was a significant reduction in the average incidence of hospitalizations in 2020, with numbers ranging from  $-59\%$  (incidence rate ratio, 0.41 [0.37-0.45]) for age 1 to 14 years (prepandemic 1,393.2/100,000 vs pandemic 574.9/100,000),  $-37\%$  (incidence rate ratio, 0.63 [0.49-0.80]) for age 20 to 59 years (prepandemic 160.2/100,000 vs pandemic 101.1/100,000), and  $-60\%$  (incidence rate ratio, 0.40 [0.33-0.47]) for older than 60 years (prepandemic 460.6/100,000 vs pandemic 185.3/100,000).

**Conclusions:** Asthma hospitalizations decreased in 2020, especially in the pediatric group and the older group during the

COVID-19 pandemic, which may be associated with the reduction in the incidence of many respiratory viral infections. (*J Allergy Clin Immunol Global* 2022;1:106-11.)

**Key words:** COVID-19, asthma, hospitalization

A unique experience in the health system was provided by the pandemic of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), in 2020.<sup>1</sup> The rapid spread of SARS-CoV-2 has resulted in a global health emergency. The recommended measures to combat the disease provide a unique social experience, involving social distancing at various levels.<sup>2</sup> The COVID-19 pandemic has drastically changed patients' behavior and the environment worldwide.<sup>3</sup>

The new COVID-19 was officially registered in Brazil in February 2020, just before autumn through to spring in the Southern Hemisphere (March to September). Collective measures to contain the pandemic were implemented in the middle of March 2020, and in its conception was included social distancing, restriction of nonessential activities, in addition to cleaning strategies and mask use.<sup>4</sup> Such measures may impact the epidemiology of various respiratory diseases all around the world.<sup>3,5-10</sup>

Patients with chronic respiratory diseases can benefit from these measures. Chronic respiratory diseases are diseases of the airways and other structures in the lung. One of the most common chronic respiratory diseases is asthma, characterized by inflammation of the lower respiratory tract and a multifactorial etiology.<sup>11</sup> According to the World Health Organization, the disease affected an estimated 262 million people in 2019 and caused 461,100 deaths, globally.<sup>12</sup> Asthma exacerbations may be triggered by several factors, such as viral infections, allergen exposure, and environmental pollution.<sup>13</sup>

Given the uniqueness of the global social scenario in 2020 and considering its consequences on the health of the population in general, it is crucial to assess the impact of the pandemic on outcomes in chronic health conditions such as asthma, including non-COVID-19-related morbidity. This study aimed to assess the impact of mitigation strategies to contain COVID-19 in hospitalizations for asthma in Brazil.

## METHODS

### Study design and ethics

The study was based on the entire population of Brazil (Population Projections, version 2018 of Brazilian Institute of Geography and Statistics).<sup>14</sup> We performed an observational and epidemiological study, of the analytical and ecological type, with data on the incidence of hospitalizations for asthma, with the pandemic period being the exposure measure. Only hospitalization data were analyzed.

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**Abbreviations used**

COVID-19: Coronavirus disease 2019  
DATASUS: Informatics Department of the Unified Health System  
ICD-10: *International Classification of Diseases, 10th edition*  
IRR: Incidence rate ratio

The age groups of interest were stratified into subgroups: the child was defined as an individual aged between 1 and 14 years, an adult between 20 and 59 years, and an elderly person older than 60 years. We analyzed separately for children, adults, and the elderly to account for the difference in factors triggering asthma exacerbation.<sup>15</sup> The period between January 2016 and December 2020 was analyzed, considering the cutoff period the month when mitigation strategies started.<sup>12</sup> The hospital admission data come from the “Departamento de Informático do Sistema Único de Saúde (DATASUS)” (Informatics Department of the Unified Health System), which offers universal coverage for the Brazilian population.<sup>16</sup> On this platform, there is no access to clinical data, but the number of hospitalizations can be stratified by age (range) and location. The absolute numbers of admissions to the public network were obtained according to the *International Classification of Diseases, 10th edition (ICD-10)*, considering the main diagnosis at admission.

To ensure quality, 2 independent authors reviewed all hospitalization data and in case of a disagreement, a third evaluator would settle the discordance. This study does not contain personal or individual data, so it was considered exempt from evaluation by the Research Ethics Committee. Furthermore, the project was approved by the Pontifical University of Rio Grande do Sul’s research system (SIPESQ, in Portuguese).

**Statistics**

To calculate the difference in incidence rates between different social distancing periods, the incidence rate ratio (IRR) was used to assess statistical significance, considering a 95% CI. This data analysis methodology has been well documented in the literature.<sup>7,9</sup> The Brazilian National Health Agency provides the percentage of the population that has health insurance per year, which we excluded from the denominator.<sup>17</sup> To evaluate the effect of COVID-19–containment strategy on the incidence of asthma, the average incidence (hospitalizations per 100,000 inhabitants [Brazilian Institute of Geography and Statistics])<sup>14</sup> of each month (April–December) of the 2016–2019 set was compared with the incidence of asthma in the period April to December of 2020, in each age group analyzed (1–14 years, 20–59 years, and older than 60 years). For this analysis, the months from April to December were used, with March being chosen as the cutoff month because it was the period of implementation of the governmental measures to contain the pandemic in Brazil in 2020 and because a greater impact of the measures is expected from the month of April.<sup>18</sup> In June, there was a relaxation of mitigation strategies with an increase in recreational activities.<sup>19</sup> Hospital admissions for asthma were defined as those with a primary diagnosis of asthma recorded using J45 and J46 codes of the *ICD-10*. The mean number of hospital admissions each month per center in the period 2016 to 2019 was calculated and fixed at 100%, after which the relative percentage of admissions during each month in the period 2016 to 2020 was calculated.<sup>20</sup> In addition, data referred to respiratory system diseases (J00–J99) hospitalizations were also collected from the DATASUS, for the same age groups and period. To better demonstrate that avoidance of care did not have full impact on the reduction of asthma hospitalizations, data referred to leukemia hospitalizations were also collected (a noncommunicable disease [code C95.0 from *ICD-10*]) and was used as a comparison, because social distancing measures are not expected to have a major impact on these conditions.

**RESULTS**

In total, from January 2016 to December 2020, 1,434,144 respiratory admissions (all hospitalizations registered for diseases related to the respiratory system, codes J00–J99) were registered in children aged from 1 to 14 years in Brazil (DATASUS), with

asthma accounting for 15.9% (227,532) of these cases. In the same period, 1,208,287 respiratory admissions were recorded in adults (20–59 years), with asthma accounting for 6.5% (78,709) and the elderly (>60 years) had 2,012,270 respiratory admissions, with asthma accounting for about 2.5% (50,084) of these cases.

For children aged 1 to 14 years, the monthly distribution of the hospitalization incidence due to asthma in the months from January to March was similar, with a trend of increasing cases throughout the studied period (2016–2020) (Fig 1, A). The lowest incidence was observed in December 2019, with 76.3/100,000, and the highest in May 2016, with 231.4/100,000 hospitalizations. In the period from April to May of the years 2016, 2017, 2018, and 2019, there was an increasing trend, with a decrease beginning in June. When comparing the subsets April–December 2016–2019 versus April–December 2020, there was a 59% (IRR, 0.41 [0.37–0.45]) reduction in the incidence of hospitalizations at this age group, 1393.2/100,000 (prepandemic) versus 574.9/100,000 (pandemic), respectively (Table I).

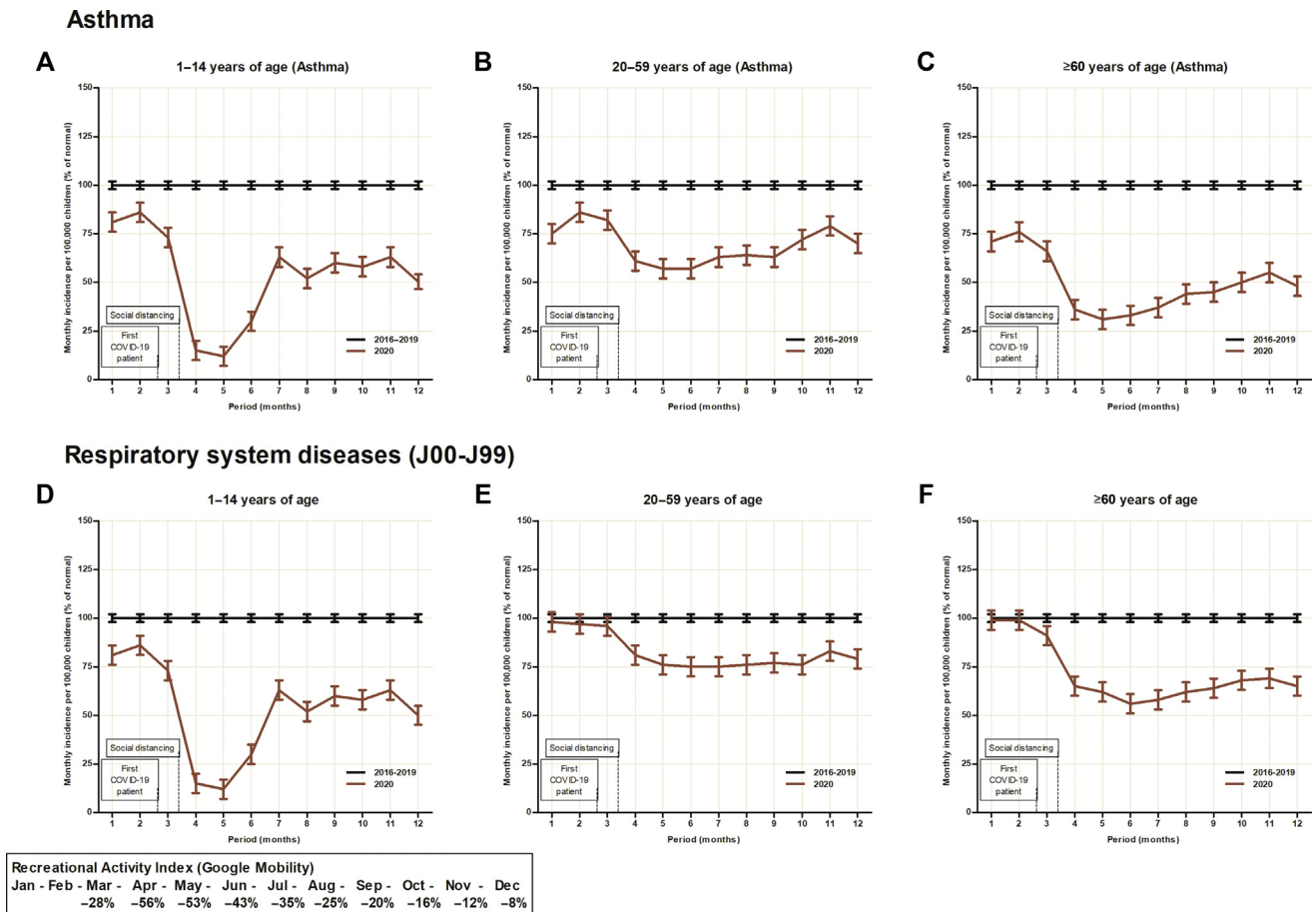
For adults aged 20 to 59 years, the monthly distribution of the hospitalization incidence due to asthma in the months from January to March was also similar, with a trend of increasing cases (2016–2020) (Fig 1, B). In the period studied, the lowest incidence was observed in December 2019, with 8.4/100,000, and the highest in May 2016, with 25.7/100,000 hospitalizations. In general, in this age group, the monthly distribution of incidence showed a small change when comparing the periods prepandemic with the pandemic period. When comparing the subsets April–December between the years 2016 and 2019 versus April–December in 2020, there was a 37% (IRR, 0.63 [0.49–0.80]) reduction in the incidence of hospitalizations in this age group, 160.2/100,000 (prepandemic) versus 101.1/100,000 (pandemic), respectively (Table I).

In the elderly (older than 60 years), the monthly distribution of the hospitalization incidence due to asthma in the months from January to March was also similar, with a trend of increasing cases throughout the studied period (2016–2020) (Fig 1, C). At this age group, when comparing the subsets April–December from 2016 to 2019 versus April–December 2020, there was a 60% (IRR, 0.40 [0.33–0.47]) reduction in the incidence of hospitalizations, 460.6/100,000 (prepandemic) versus 185.3/100,000 (pandemic), respectively (Table I).

For diseases of the respiratory system (*ICD-10* codes J00–J99), the greatest reduction was observed in children aged between 1 and 14 years, with an estimated reduction of –88% (IRR, 0.11 [0.07–0.17]) in May 2020 (Fig 1, D). In elderly, the greatest reduction was of –44% (IRR, 0.55 [0.52–0.59]) in June 2020 (Fig 1, F), whereas in adults it was of –26% (IRR, 0.73 [0.62–0.87]) in June 2020 (Fig 1, E). Conversely, hospitalizations for leukemia in children (a noncommunicable disease) showed small variation in the same periods (Fig 2).

**DISCUSSION**

This is one of the first studies to use a time trend analysis to assess the impact of mitigation strategies interventions in reducing hospitalizations due to asthma in Brazil. Furthermore, the dramatic decrease in transmissible infectious diseases leads to an opportunity to study the incidence of diagnoses that are assumed but not definitely proven to be triggered by infections or other environmental exposure conditions.



**FIG 1.** Monthly subsets' distribution of incidence (no social distance period vs social distance period) of hospitalizations for asthma and respiratory system diseases in (A and D) children aged 1 to 14 years, (B and E) adults 20 to 59 years of age, and (C and F) elderly older than 60 years in Brazil.

Our data suggest that hospitalizations for asthma exacerbation decreased during the COVID-19 pandemic. We hypothesized that 3 factors have influenced the reduction in hospitalizations for asthma: restrictions in the circulation of viral infections, suspension of classroom activities at all levels of education, and a reduction in patient's exposure to air pollutants and allergens.<sup>15</sup> Social distancing and constant hand hygiene are practices that may have had a homogeneous impact on all ages.<sup>21</sup> Viral infections are the main triggers of asthma exacerbations in all age groups.<sup>13,22</sup> All over the world, there is a growing body of evidence regarding the reduction during the pandemic of health care utilization for asthma,<sup>23-33</sup> and reductions in hospital admissions for seasonal respiratory diseases (upper airway infections, bronchiolitis, and pneumonia) were widely recorded.<sup>3,7,9,10,20,34,35</sup>

In addition, the decrease in recorded air pollutants must be considered, because exposure to air pollution is one of the external triggers for the onset of asthma, particularly in larger cities.<sup>13,15,36</sup> Data indicate a significant reduction in the concentrations of nitrogen dioxide and particulate matter with a diameter smaller than 2.5  $\mu\text{m}$  in large urban areas.<sup>37,38</sup> Furthermore, some studies have shown that face masks can not only protect against virus but also reduce the air pollutants exposure.<sup>39,40</sup>

The restrictions had a different impact on the age groups studied, with the most significant reductions occurring in the elderly and children. We believe that the impact observed in the child population (1-14 years old) is due to the suspension of face-to-face activities at all levels of education, because schools and day care centers are socially dense environments and can contribute to the transmission of infectious diseases. In adults, the slight reduction might be explained by the greater exposure of this age group to work activities even during the pandemic. In the elderly, the important reduction, also observed, can be explained by the restriction to this group, considering the recommendation as a risk group and the fear of searching for hospitals due to COVID-19.<sup>41</sup>

The general recommendation to maintain well-ventilated environments in the context of a COVID-19 pandemic may be related to fewer asthma attacks. Maintaining good internal ventilation is also a recommendation to contain COVID-19, so the dissipation of airborne allergens promoted by this practice may also be an explanation.<sup>42-46</sup> Hospitalizations for all respiratory conditions decreased substantially during the pandemic period in Brazil. This finding corroborates other studies, where reductions of up to 78% of hospitalizations for respiratory conditions were observed compared with the prepandemic period.<sup>32,33,47</sup>

**TABLE I.** Total absolute number and incidence of hospitalizations for asthma from 2016 to 2020 in Brazil by age groups

Period (mo)	Absolute no. of hospitalizations (no. of hospitalizations per 100,000*)					2016-2019 Monthly average incidence†	2016-2019† vs 2020 Change (%)	IRR (95% CI)‡
	2016	2017	2018	2019	2020			
<b>1-14 y</b>								
April	5,361 (193.3)	5,583 (202.1)	5,473 (199.5)	4,701 (171.9)	784 (28.8)	191.7	-85%	0.15 (0.10- 0.22)‡
May	6,419 (231.4)	6,221 (225.2)	6,033 (219.9)	5,200 (190.2)	690 (25.3)	216.7	-88%	0.11 (0.07-0.17)‡
June	5,564 (200.6)	5,167 (187.1)	5,427 (197.8)	4,415 (161.5)	1,549 (56.9)	186.7	-69%	0.30 (0.22-0.41)‡
July	4,253 (153.3)	4,084 (147.9)	4,204 (153.2)	3,716 (135.9)	2,545 (93.6)	147.6	-37%	0.63 (0.48-0.82)‡
August	4,858 (175.1)	4,748 (171.9)	4,790 (174.6)	4,965 (181.6)	2,477 (91.1)	175.8	-48%	0.51 (0.40-0.66)‡
September	4,139 (149.2)	3,613 (130.8)	3,659 (133.4)	3,768 (137.8)	2,254 (82.9)	137.8	-40%	0.60 (0.45-0.78)‡
October	4,054 (146.1)	3,578 (129.5)	3,959 (144.3)	3,664 (134.0)	2,177 (80.0)	138.5	-42%	0.57 (0.43-0.76)‡
November	3,373 (121.6)	3,314 (120.0)	3,541 (129.1)	3,098 (113.3)	2,091 (76.9)	121.0	-36%	0.63 (0.47-0.84)‡
December	2,157 (77.7)	2,108 (76.3)	2,227 (81.2)	2,087 (76.3)	1,072 (39.4)	77.9	-49%	0.50 (0.34-0.74)‡
April-December	40,178 (1,448)	38,416 (1,391)	39,313 (1,432)	35,614 (1,302)	15,639 (574.9)	1,393.2	-59%	0.41 (0.37-0.45)‡
<b>20-59 y</b>								
April	1,893 (26.0)	1,362 (18.3)	1,424 (18.8)	1,361 (17.7)	939 (12.1)	20.2	-40%	0.59 (0.29-1.22)
May	1,874 (25.7)	1,551 (20.8)	1,529 (20.2)	1,465 (19.1)	932 (12.0)	21.4	-44%	0.56 (0.27-1.13)
June	1,791 (24.6)	1,452 (19.5)	1,447 (19.1)	1,429 (18.6)	886 (11.4)	20.4	-44%	0.55 (0.27-1.15)
July	1,648 (22.6)	1,482 (19.9)	1,390 (18.3)	1,387 (18.0)	959 (12.3)	19.7	-37%	0.62 (0.30-1.27)
August	1,637 (22.4)	1,432 (19.2)	1,373 (18.1)	1,259 (16.4)	933 (12.0)	19.0	-37%	0.63 (0.30-1.29)
September	1,641 (22.5)	1,289 (17.3)	1,311 (17.3)	1,215 (15.8)	887 (11.4)	18.2	-37%	0.62 (0.29-1.31)
October	1,442 (19.8)	1,275 (17.1)	1,152 (15.2)	1,122 (14.6)	916 (11.8)	16.7	-29%	0.70 (0.33-1.49)
November	1,148 (15.7)	1,108 (14.8)	1,088 (14.3)	964 (12.5)	866 (11.1)	14.4	-22%	0.77 (0.35-1.69)
December	911 (12.5)	765 (10.2)	735 (9.7)	651 (8.4)	545 (7.0)	10.2	-31%	0.68 (0.26-1.79)
April-December	13,985 (191.8)	11,716 (157.1)	11,449 (151.0)	10,853 (141.1)	7,863 (101.1)	160.2	-37%	0.63 (0.49-0.80)‡
<b>≥60 y</b>								
April	1,144 (69.2)	1,036 (60.0)	949 (52.7)	876 (46.6)	397 (20.2)	57.1	-65%	0.35 (0.21-0.58)‡
May	1,177 (71.2)	1,182 (68.4)	1,037 (57.6)	946 (50.4)	376 (19.2)	61.9	-69%	0.31 (0.18-0.51)‡
June	1,263 (76.4)	1,170 (67.7)	1,028 (57.1)	913 (48.6)	399 (20.3)	62.4	-67%	0.32 (0.19-0.53)‡
July	1,251 (75.6)	1,185 (68.6)	973 (54.0)	944 (50.3)	441 (22.5)	62.1	-64%	0.36 (0.22-0.58)‡
August	1,117 (67.5)	1,005 (58.2)	873 (48.5)	887 (47.2)	476 (24.3)	55.3	-56%	0.43 (0.27-0.70)‡
September	997 (60.3)	907 (52.5)	807 (44.8)	807 (43.0)	436 (22.2)	50.1	-56%	0.44 (0.26-0.73)‡
October	1,007 (60.9)	885 (51.2)	717 (39.8)	703 (37.4)	458 (23.4)	47.3	-51%	0.49 (0.30-0.81)‡
November	736 (44.5)	737 (42.6)	640 (35.5)	590 (31.4)	413 (21.1)	38.5	-45%	0.54 (0.32-0.93)‡
December	551 (33.3)	471 (27.2)	397 (22.0)	381 (20.3)	240 (12.2)	25.7	-52%	0.47 (0.24-0.94)‡
April-December	9,243 (558.9)	8,578 (496.4)	7,421 (412.0)	7,047 (375.2)	3,636 (185.3)	460.6	-60%	0.40 (0.33-0.47)‡

\*Incidence number.

†Average of period.

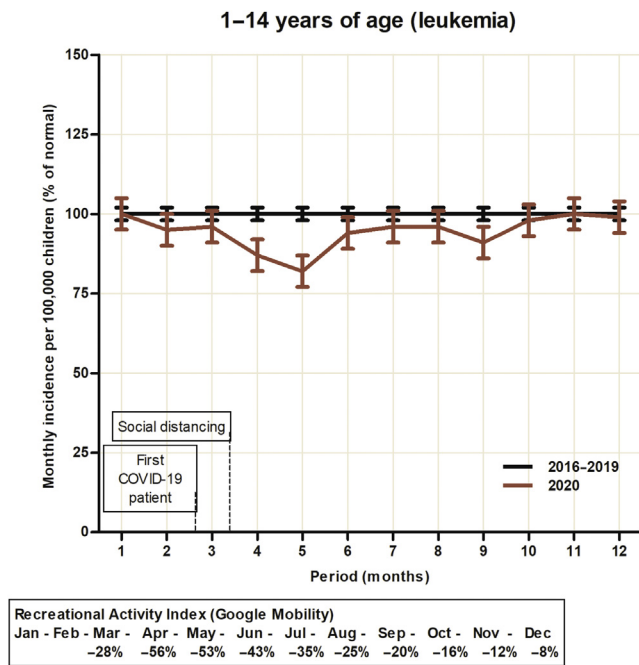
‡*P* < .05.

The limitations of this study regarding prevention measures are first, the impossibility of evaluating the interventions' individual effectiveness, as they occurred simultaneously, and second, the fact that they cannot be accurately quantified. Another limitation found is the use of a database populated by a third party. Therefore, we collected data after 2 months of the month of hospitalization, to ensure that the data were handled correctly. This period of 2 months is enough for the presentation of the final number in the DATASUS, because the data depend on the Hospitalization Authorizations forms, in Brazil AIH (Hospital Admission Authorization). Furthermore, it is not possible to quantify the exact level of individual adherence to COVID-19 prevention measures, yet the stratification by age group within the database does not allow us to use different age groups cutoffs, which could reduce the confidence of the data obtained.

However, we assume that the largest decrease in asthma hospitalizations was shown during the period of government containment measures and spans the Southern Hemisphere winter, where an increase in asthma hospitalizations was expected. In addition, no other country in the Southern

Hemisphere has such robust national and regional epidemiological data, considering the population size, which strengthens the findings and presents itself as an advantage over other recent studies. Despite the limitations, we believe that the results presented reflect the current situation, because they show an important reduction in the number of hospitalizations in the months in which health measures were operational in Brazil to prevent the dissemination of the coronavirus.

In conclusion, using an epidemiological platform of federal governmental health data of Brazil, we found a significant decrease in cases of asthma, especially among children and the elderly, during the COVID-19 pandemic. To our knowledge, such epidemiologic changes in asthma-related hospitalizations during the Southern Hemisphere autumn-spring season in Brazil have not been previously reported. Data presented here will be useful in the planning of further studies and may help clarifying how distancing measures or environmental protection of viral dissemination may affect the burden of asthma globally and whether any future personal behavioral recommendations on viral infection transmission should be definitely added to asthma management guidelines.



**FIG 2.** Monthly distribution of incidence of hospitalizations for children with leukemia aged 1 to 14 years in Brazil (2016–2020). ICD-10 code C95.0, a noncommunicable disease.

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