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Clinical and epidemiological characteristics of pediatric hospitalizations due to COVID-19 in the Brazilian Amazon: an observational study

Características clínicas e epidemiológicas das internações pediátricas por COVID-19 na Amazônia brasileira: um estudo observacional

Janaina Corrêa dos Santos[1]
ORCID: 0000-0002-2659-1975

Rosemary de Carvalho Rocha Koga[1]
ORCID: 0000-0003-17903794

Luzilena de Sousa Prudêncio[1]
ORCID: 0000-0003-3364-071X

Demilton Yamaguchi Pureza[1]
ORCID: 0000-0001-8336-2178

Maria Izabel Côrtes Volpe[1]
ORCID: 0000-0002-0642-0490

Valéria Silva[2]
ORCID:0000-0001-8621-2423

Silvana Rodrigues da Silva[1]
ORCID: 0000-0002-2838-868X

[1]Universidade Federal do Amapá, Macapá, AP, Brazil

[2]Prefeitura Municipal de Tailandia, Tailandia, PA, Brazil

Corresponding author:
Janaina Corrêa dos Santos
E-mail: janaina-correa-enf@hotmail.com

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ABSTRACT

Objective: To determine the clinical and epidemiologic aspects of children hospitalized for COVID-19 in a public hospital located in a state in the Brazilian Amazon. **Methods:** Observational, descriptive, retrospective, and documentary study with a quantitative approach to pediatric hospitalization cases due to COVID-19. **Results:** In the Hospital for Children and Adolescents, a total of 5016 suspected cases of COVID-19 in children were recorded. Of these, 666 were confirmed with the disease, resulting in 140 hospitalizations. We analyzed 136 reports of children hospitalized for COVID-19. Most patients were infants (39%) and preschool children (36%), with a prevalence of males (67.6%) and black/brown race/color (86%). In addition, 83.1% live in urban areas. Regarding the outcome, 96.67% were cured, and 3.33% resulted in death. **Conclusion:** In the Amazonian context, the analysis of this age group's clinical and epidemiologic characteristics is essential to guide clinical care, predict the severity of the disease, and determine the prognosis.
Descriptors: Coronavirus Infections; Child Health; Epidemiology.

RESUMO

Objetivo: Apontar os aspectos clínicos e epidemiológicos de crianças internadas por COVID-19 em um hospital público situado em um estado da Amazônia Brasileira. **Método:** Estudo observacional, descritivo, retrospectivo e documental com uma abordagem quantitativa dos casos de internação pediátrica por COVID-19. **Resultados:** No Hospital da Criança e Adolescente, foram registrados um total de 5016 casos suspeitos de COVID-19 em crianças. Destes, 666 foram confirmados com a doença e resultaram em 140 internações. Analisamos 136 notificações de crianças internadas por COVID-19. A maioria dos pacientes era lactente (39%) e pré-escolar (36%), com prevalência do sexo masculino (67,6%) e raça/cor preta/parda (86%). Além disso, 83,1% delas residem em área urbana. Quanto ao desfecho, 96,67% evoluíram para a cura e 3,33% resultaram em óbito. **Conclusão:** No contexto amazônico, a análise das características clínicas e epidemiológicas deste grupo etário é essencial para orientar os cuidados clínicos, prever a gravidade da doença e determinar o prognóstico.
Descritores: Infecções por Coronavírus; Saúde da Criança; Epidemiologia.

INTRODUCTION

Coronaviruses are RNA viruses of zoonotic origin, first discovered by Tyrell and Bynoe in 1966. They cause respiratory infections in various animals, including birds and mammals. Seven of these viruses have been implicated in human pathogenesis: HCoV-229E, HCoV-OC43, HCoV-NL63, HCoV-HKU1, SARS-COV (responsible for Severe Acute Respiratory Syndrome), MERS-COV (causing Middle East Respiratory Syndrome) and the most recent - SARS-CoV-2, the causative agent of COVID-19[1,2]. COVID-19 was first identified following the diagnosis of pneumonia of unknown origin in the Chinese province of Wuhan in December 2019. On January 30, 2020, the World Health Organization (WHO) declared the COVID-19 epidemic a public health emergency of international

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concern and later as a pandemic on March 11, 2020, due to its rapid spread around the world, affecting more than 100 countries and territories on five continents and causing high rates of morbidity and mortality in the population[3,4]. Although the elderly with low immunity are the most vulnerable to the new coronavirus, it is important to highlight that respiratory viruses are also a common cause of respiratory infections in children and are considered an essential reason for hospitalization[5].

Clinical manifestations in children are similar to those in adults. Some children present with gastrointestinal symptoms, but in generally, the course of the infection is mild to moderate[5]. Coronavirus infections in children in Amapá are a minority and generally mild, with the main symptoms being fever, cough, and sore throat. However, the possibility of a more severe course cannot be excluded, in which case hospitalization will be necessary[6].

Inflammatory syndromes associated with COVID-19 have also been identified, including childhood multisystem inflammatory syndrome (MIS-C), which requires hospitalization and intensive care[7].

At the beginning of the pandemic, the immediate threat of COVID-19 in children was considered low, but with the emergence of new virus variants, this risk has increased[3]. In Brazil, the number of deaths among children up to 11 years of age due to the new coronavirus reached 1,449. In addition, more than 2,400 cases of pediatric multisystem inflammatory syndrome (SIM-P) associated with COVID-19 were identified by December 2021, with 734 in 2020 and 716 in 2021. No confirmed cases were reported in 2022. Of the confirmed cases, most were reported in children aged 1-4 years (33.9% / n = 491), 86 died (6% lethality), and 1,220 were discharged from the hospital[8]. In Amapá, although the infection is asymptomatic or mild in most cases, one case of SIM-P was reported in 2021[6].

At the beginning of the pandemic, there was no official data on the specific epidemiological situation of infected children in the State of Amapá. According to the Epidemiological Bulletin No. 08 on the general population, by epidemiological week 23 (31 May to June 6, 2020), a total of 12,733 confirmed cases were reached, of which 269 people died, with one death recorded in the age group 10 to 19 years[9].

These data highlight the importance of vaccination in this age group to reduce the number of deaths due to COVID-19 in Brazil, whose indicators are higher than those of other countries[10]. Viral respiratory diseases are prevalent in pediatrics, and the emergence of COVID-19 has raised concerns about the disease's impact on this population. Therefore, knowing the clinical manifestation and outcome is the best way to control and prevent diseases. Therefore, the present study aims to highlight the clinical and epidemiologic aspects of children hospitalized for COVID-19 in a public hospital in the Brazilian Amazon.

METHOD

This is an observational, descriptive, retrospective, and documentary study with a quantitative approach. It was conducted from January 2021 to November 2022. The study site was the Hospital for Children and Adolescents (HCA), a public hospital of the Unified Health System (SUS), located in Macapá, a municipality in the Amazon region.

Cases of children hospitalized for COVID-19 in the State of Amapá were selected to define the study population. These cases were obtained from the records of the Severe Acute Respiratory Syndrome (SARS)/COVID-19/EPI-SUS database of the Ministry of Health. This database recorded a total of 489 cases of consolidated hospitalizations due to COVID-19 and 16 deaths (3.27% of the total) across the state.

In determining the sample for research analysis, the medical records of children under 12 years of age who were admitted to the HCA from February 2020 to February 2022 and had a positive diagnosis for the disease were selected. Thus, the sample selected consisted of 136 cases of hospitalized children and five deaths (3.67% of the total) related to the Children and Adolescents Hospital of Macapá-AP.

Data was collected for convenience, selecting all medical records of children aged 0 to 12 years hospitalized from February 2020 to February 2022 at the Hospital for Children and Adolescents in Macapá, capital of the State of Amapá. The data obtained through the forms were tabulated in electronic spreadsheets using the Excel version 2010 program (Microsoft Office). The statistical treatment was done using the Statistical Package for the Social Sciences (SPSS), version 22 for Windows (IBM- SPPS STATISTICS 20). Two databases were created, one with primary and the other with secondary variables. For both databases, a confidence interval (CI) of 95% and a significance level of 5% ($p<0.05$)

were considered for association analyses.
Since this is human subjects research, as described in Resolution No. 466 of December 12, 2012, the project was approved in 2021 by the Ethics Committee for Human Subjects Research of the Federal University of Amapá, with Opinion No. 5.103.121.

RESULTS

In 2020, 1450 suspected cases of COVID-19 infection were reported, of which 1,009 were negative and 441 were confirmed. Of these, 75 resulted in hospitalization at HCA. In 2021, 3052 suspected cases were reported, of which 2991 were negative, and 73 were confirmed, resulting in 21 hospitalizations at HCA.

In January and February 2022, 514 cases were reported, with 152 confirmations and 44 hospitalizations. Thus, during the period studied (from February 2020 to February 2022), 6,099 hospitalizations for various diseases were registered at the HCA. Of the 132 deaths that occurred in the hospital, five were due to COVID-19. In summary, a total of 5016 suspected cases of COVID-19 in children were recorded at the HCA, of which 666 were confirmed and resulted in 140 hospitalizations.
Table 1 summarizes the data by year of occurrence (n=140). In 2020, a prevalence of 17.0% (n=75) of hospitalizations was observed, which increased to 28.76% (n=21) in 2021 and remained stable at 28.94% (n=44) in 2022.

Table 1 – Prevalence of COVID-19 cases in HCA (n=140). Macapá, AP, Brazil, 2022

Cases	2020	Prevalence	2021	Prevalence	2022	Prevalence
Reported Cases	1450	-	3052	-	514	-
Positive Cases	441	30.41%	73	2.39%	152	29.57%
Hospitalized Cases	75	17.0%	21	28.76%	44	28.94%

To carry out this study, 136 medical records of children admitted to a public hospital in Amapá, in the Brazilian Amazon, with COVID-19 as the leading cause, were analyzed. The sociodemographic characteristics of these children are described in Table 2 below as a statistical summary. Most cases were observed in infants (39%, n=53) and preschool children (36%, n=49), with a higher concentration of cases in the first year of life (35.29%, n=47). There was a prevalence of males (67.6%, n=92) and an absolute majority of black/brown race/color (86%, n=117). Furthermore, 83.1% (n=113) live in urban areas, mainly in Macapá-AP (78.2%, n=107). The associations between the sociodemographic variables of HCA patients and the outcome variable cure/death (100%, n=136) are also presented.
The results show no association (p>0.05) between the outcome and the sociodemographic variables. Considering these aspects, other analyses with a longer time interval need to be performed to determine whether sociodemographic factors are related to the outcome of children hospitalized for COVID-19 in the HCA, as observed in this study.

Table 2 - Sociodemographic data of children hospitalized for COVID-19 at HCA, according to age group, sex, race/color, area of residence, and Chi-square association with the outcome variable of cure or death (n=136). Macapá, AP, Brazil, 2022

Variable			Outcome			
			Cure		Death	
	N	%	N	%	N	%
Age range						
Infant	53	39.0	51	37.5%	2	1.5%
Early childhood	49	36.0	49	36%	0	0%
Primary school	34	25.0	31	22.8%	3	2.2%
Total	136	100				
					p-value	0.110
Sex						
Male	92	67.6	87	64%	5	3.7%
Female	44	32.4	44	32.4%	0	0%
Total	136	100				
					p-value	0.115
Race/color						
Yellow	1	0.7	114	83.8%	3	2.2%
White	9	6.6	8	5.9%	1	0.7%
Indigenous	5	3.7	4	2.9%	1	0.7%
Mixed/Black	117	86.0	1	0.7%	0	0%
No registry	4	2.9	4	2.9%	0	0%
Total	136	100				
					p-value	0.217
Residence Zone						
Rural	23	16.9	22	16.2%	1	0.7%
Urban	113	83.1	109	80.1%	4	2.9%
Total	136	100				
					p-value	0.610

Regarding signs and symptoms, most children presented: fever (76.5%, n=104), cough (61%, n=83), dyspnea (50.7%, n=69), skin color changes (45.5%, n=61), and vomiting (32.4%, n=44). The chi-squared associations between these variables and outcome (cure/death) were also presented. Only the variable "vomiting" showed a significant statistical association ($p<0.001$), indicating that the number of deaths in patients with vomiting (4 deaths) was higher than the expected value for this category (1.6 deaths).

Regarding the length of stay, the average length of stay for patients in the HCA was 4.24 ± 4.57 days. A statistical difference was observed between male patients' average length of stay

(4.5 ± 5.03 days) and female patients (3.7 ± 3.43 days). Other variables were also considered: most children hospitalized for COVID-19 were in an isolation unit (43.6%, n=58), had an adequate nutritional status (85%, n=113), and had less than 14 days of symptoms on admission (n=115).

Regarding the risk factor/comorbidity, complication, severity, and clinical outcome variables, 85 children had some associated comorbidity/risk factor. Many of these children were younger than 2 years (56.39%, n=75), and the majority had no comorbidities (32.3%, n=43). Approximately 3.68% (n=5) died, and 96.32% (n=131) recovered from coronavirus infection.

In the results of the associations between outcome and risk factor variables and clinical variables, only the clinical variable "use of invasive ventilation" showed a significant association with outcome. In patients who used invasive ventilation, the observed incidence of death (2) was higher than expected (0.2), with a significance of p = 0.015.

DISCUSSION

Regarding the number of hospitalizations, there was a change in prevalence between 2020 and 2021, with an increase of 11%, and remained stable between 2021 and 2022. During the first year of the pandemic, the number of COVID-19 cases in the pediatric population increased as transmission in the general population increased. However, due to widespread and sustained immunization of the adult population, many cases were observed in children.

Brazilian data show that the frequency of hospitalized children with respiratory symptoms is lower in 2020 than in previous years. Nevertheless, regional epidemiological bulletins indicate an increase in the number of children diagnosed with COVID-19 in Brazil. By the last week of December 2020, 14,638 hospitalizations due to COVID-19 were reported in the 0-19 age group, and by August 2021, 16,246 hospitalizations had already been registered, representing an increase of almost 11% from one year to the next in hospitalizations in this age group in the country[11].

In Amapá, the most recent data from 2023 show a total of 5,829 confirmed cases of COVID-19 in children under five years of age in the state[12]. At the beginning of 2023, there was a fluctuation in new cases of COVID-19 hospitalization in epidemiological weeks 01 to 18, with high peaks in SE 03 and SE 05 [13].

In Brazil, it was not until 2022 that children aged 5 to 11 years were included in the PNO and thus vaccinated against SARS-CoV-2. However, due to the lack of broad and consistent vaccination coverage for all age groups and the persistent circulation of SARS-CoV-2, the resumption of activities without distancing measures and the emergence of new viral strains could still harm public health globally[14].

The results showed no association between the outcome and sociodemographic variables. However, regional disparities in access to health services in Brazil lead to unfavorable outcomes for economically vulnerable children[15].

Studies on the demographic variations of COVID-19 highlight a significant number of hospitalizations of children under 4 years of age, the data are even more pronounced for children under 1 year of age[16]. Gender data were presented by Meena et al.[17], who described a total of 4,857 pediatric cases, of which 1,014 (57%) were male. Factors associated with race/ethnicity suggest that African and Hispanic ethnicities are apparent risk groups for COVID-19[18].

In addition to the issue of age, sex, and race, Faria et al.[19] problematize social and territorial inequalities in Brazil, mainly in the northern and northeastern states, about children hospitalized for COVID-19. They come from population clusters, live with numerous family members, have precarious living conditions, and have inadequate basic sanitation.

In this context, Oliveira et al.[3] emphasize that Brazil is a middle-income country with significant socioeconomic inequalities, which may influence the quality of local health services (including the availability of pediatric hospital beds) and thus contribute to unfavorable clinical outcomes.

In addition, the data show that among the symptoms presented by the patients studied, only cases of vomiting were associated with an adverse outcome, with a higher number of deaths in patients presenting with such symptoms. Gastrointestinal involvement is more common in children, with vomiting being twice as common in children as in adults. This may be due to differences in the maturation of ECA-2[20]. Therefore, supportive care, such as medications that reduce this clinical symptom, is essential and unavoidable[21].

Regarding the most common symptoms in children, the results of the present study are consistent with the literature. Oliveira et al.[22] describe the most common signs and symp-

toms observed in children hospitalized with COVID-19, such as: fever, cough, respiratory distress, and dyspnea. Respiratory distress is strongly associated with low oxygen saturation ($p<0.001$), leading to a cyanotic state, especially in children with severe disease. In addition, young children, especially infants, appeared to be more susceptible to severe SARS-CoV-2 infection[23].

Regarding length of stay, the data showed that male patients spent more time in hospital than female patients. The average length of stay shown in the study is in line with the study carried out in a pediatric complex in the city of João Pessoa-PB[24], where it was found that most children had a hospital stay of 4 days, demonstrating the quality and adequate financial management of public resources in terms of resolving cases and, consequently, regulating beds.

The present study also aligns with other national and international studies that have reported a more extended hospital stay in male patients [23,24].

It is observed that the study hospital follows the recommendation of the Surveillance and Monitoring Management in Health Services in Brazil, considering that it has adopted cohorts and/or separation (isolation) of respiratory symptomatic patients, avoiding the risk of transmission to other most susceptible patients[25].

Regarding the nutritional issues of the study participants, the treatment of COVID-19 depends on the patient's immune system. Thus, nutrition becomes a critical factor in the regulation of immunologic homeostasis. Therefore, insufficient protein, energy, and subclinical deficiencies of some macro- and micronutrients may affect the immune response of these patients[26]. The population analyzed was within the maximum 14 days of viral incubation, a period in which they were symptomatic and without immunosuppression[23].

Although data from this study showed that most patients had no comorbidities, there is considerable attention to children with pre-existing medical conditions and risk factors for developing severe forms of COVID-19. These include metabolic disorders (such as obesity and type 2 diabetes), genetic disorders, asthma, heart and lung problems, neurological and neuromuscular problems, and immunosuppression. This is due to the higher risk of developing a severe illness compared to children without such medical conditions[27].

According to the review by Bezerra et al.[28], COVID-19 in children can present in different ways, from upper respiratory tract involvement in mild cases to pneumonia without complications and oxygen deficiency in moderate cases to severe pneumonia with respiratory distress or severe acute respiratory syndrome in severe cases. These severe cases may involve multiple organs and pose a risk of death.

Worldwide, deaths associated with SARS-CoV-2 infection in children have been rarely reported. In the present study, the use of invasive ventilation was associated with the fatal outcome of the patients, which may be due to the clinical condition of the patients as well as the fact that it is a procedure with a high risk of complications[29].

In short, the lower rate of symptomatic cases and lethality of infections caused by the SARS-CoV-2 virus in children should not distract attention from a highly vulnerable population with potential implications for critical outcomes[30]. COVID-19 presented many challenges, such as the need for mass diagnosis, hospital structures, professional overload, complications, and severe health outcomes[22]. Epidemiologic studies are essential to provide information that will contribute to the formulation of effective public policies and inform the scientific and health community about responses and measures to strengthen child health in the face of SARS-CoV-2 infection[31].

CONCLUSION

Analysis of the clinical and epidemiologic characteristics of children hospitalized with COVID-19 is essential to guide clinical care, predict disease severity, and determine prognosis. In this study, SARS-CoV-2 infections appear to have affected more boys, with greater exposure among those under four years of age, of mixed race and black, and living in the urban area of Macapá-AP.

Some limitations of the study must be considered, such as the fact that there is only one pediatric public health service in the entire state and the absence or incomplete/illegible completion of some medical records, which made the analysis of some variables difficult.

Investing in actions such as developing protocols, care flows, and specific strategies is necessary to reduce indicators related to pediatric hospitalizations due to COVID-19, especially in more vulnerable regions, such as the North of Brazil. This is because the disease can manifest itself in various ways, from a common cold to severe systemic symptoms, as identified in a public pediatric ward in Macapá-AP.

*Paper extracted from the master's thesis "Clinical and epidemiological characteristics of pediatric hospitalizations due to COVID-19 in a public hospital unit in Amapá, Brazilian Amazon", presented to the Universidade Federal do Amapá, Macapá, AP, Brasil.

CONFLICT OF INTERESTS

The authors have declared that there is no conflict of interests.

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AUTHORSHIP CONTRIBUTIONS
Project design: Santos JC dos, Koga R de CR, Prudêncio L de S, Pureza DY, Volpe MIC, Silva V, Silva SR da
Data collection: Santos JC dos, Koga R de CR, Silva V, Silva SR da
Data analysis and interpretation: Santos JC dos, Koga R de CR, Silva SR da
Writing and/or critical review of the intellectual content: Santos JC dos, Koga R de CR, Prudêncio L de S, Pureza DY, Volpe MIC, Silva SR da
Final approval of the version to be published: Santos JC dos, Prudêncio L de S, Pureza DY, Volpe MIC, Silva SR da
Responsibility for the text in ensuring the accuracy and completeness of any part of the paper: Santos JC dos, Koga R de CR, Prudêncio L de S, Pureza DY, Volpe MIC, Silva V, Silva SR da