



RESPIRATORY DISEASES: A PROFILE OF HOSPITALIZATIONS AMONG CHILDREN AND ADOLESCENTS IN A CEARÁ HOSPITAL

DOENÇAS RESPIRATÓRIAS: UM RETRATO DE INTERNAÇÕES DE CRIANÇAS E ADOLESCENTES EM HOSPITAL DO CEARÁ

Joaquina Fabyana Souza Araujo^{1*}, Tahissa Frota Cavalcante², Rafaella Pessoa Moreira², Vanessa Emille Carvalho de Sousa Freire², Huana Carolina Cândido Morais²

ABSTRACT: Objective: To analyze the characteristics of hospitalizations for respiratory diseases in children and adolescents admitted to a reference hospital in Ceará in 2023. **Method:** This is a descriptive, cross-sectional, quantitative study using secondary data from the SUS Hospital Morbidity Information System accessed via TABNET in July 2024. The study focused on children and adolescents (0-19 years old) hospitalized in 2023 with respiratory diseases. Variables such as age group, color/race, days of hospitalization and average length of stay were investigated. The data was analyzed using descriptive statistics. **Results:** In 2023, there were 2,785 pediatric hospitalizations for respiratory diseases, with a predominance of pneumonia (40%) and a higher incidence in boys (56.6%), totaling costs of R\$4.5 million, with peaks between March and May. **Conclusion:** The main causes of hospitalization were pneumonia, bronchitis, bronchiolitis and influenza, with a higher incidence in boys. It is necessary to implement strategies that intensify prevention, vaccination, hygiene education and appropriate treatment.

KEYWORDS: Adolescent. Child. Respiratory tract diseases. Hospitalization.

RESUMO: Objetivo: Analisar as características das hospitalizações por doenças respiratórias em crianças e adolescentes internados em 2023 em um hospital de referência no Ceará. **Método:** Pesquisa descritiva, transversal, quantitativa, com dados secundários do Sistema de Informação sobre Morbidades Hospitalares do SUS acessados pelo TABNET em julho de 2024. O estudo centrou-se em crianças e adolescentes (0-19 anos) hospitalizados em 2023, com doenças respiratórias. Foram investigadas variáveis como faixa etária, cor/raça, dias de internação e média de permanência. Os dados foram analisados por estatística descritiva. **Resultados:** Em 2023, ocorreram 2.785 internações pediátricas por doenças respiratórias, com predominância de pneumonia (40%) e maior incidência em meninos (56,6%), totalizando custos de R\$ 4,5 milhões, com picos entre março e maio. **Conclusão:** As principais causas de internação foram pneumonia, bronquite, bronquiolite e influenza, com maior incidência em meninos, sendo necessário implementar estratégias que intensifiquem a prevenção, vacinação, e educação em higiene e tratamento adequado.

PALAVRAS-CHAVE: Adolescente. Criança. Doenças respiratórias. Hospitalização.

¹Programa de Pós-Graduação em Enfermagem, Mestrado Acadêmico em Enfermagem, Universidade da Integração Internacional da Lusofonia Afro-Brasileira (UNILAB), Redenção (CE), Brasil. ²Instituto de Ciências da Saúde, Programa de Pós-Graduação em Enfermagem, Universidade da Integração Internacional da Lusofonia Afro-Brasileira (UNILAB), Redenção (CE), Brasil.

*Corresponding author: Joaquina Fabyana Souza Araujo – E-mail: fabyana.araujo@hotmail.com.

Received: 08 Sept. 2024

Accepted: 09 Nov. 2024

This is an open access article distributed under the terms of the Creative Commons License.



INTRODUCTION

Respiratory diseases in children and adolescents represent a significant global public health concern. These conditions encompass a wide range of acute and chronic disorders affecting the respiratory system, including bronchopulmonary infections, bronchiolitis, and bronchiectasis. The severity of these diseases is exacerbated by factors such as tobacco exposure, air pollution, adverse occupational conditions, malnutrition, low birth weight, and early pulmonary infections. Furthermore, socioeconomic determinants increase the prevalence and severity of these pathologies by influencing access to healthcare services.¹⁻³

In the United States, a rise in acute respiratory diseases among children and adolescents was observed during the summer of 2022. This increase was attributed to higher circulation of rhinovirus/enterovirus (RV/EV), particularly enterovirus D68 (EV-D68). Surveillance data indicated an uptick in emergency department visits by young individuals with acute respiratory infections and asthma/reactive airway disease, alongside a rise in RV/EV and EV-D68 positivity rates.⁴

Data from the Mortality Information System in Ceará, Brazil, indicate that 1,590 deaths due to respiratory diseases were recorded among children and adolescents between 2012 and 2022. The most affected age group was infants under one year old, accounting for 661 cases (41.57% of the total). Among children (under 10 years), there were 1,179 deaths, while 411 deaths were recorded among adolescents (10–19 years). The number of deaths was higher among children, representing 74.15% of cases, compared to 25.85% among adolescents.⁵

Studies on respiratory diseases in children and adolescents have been conducted worldwide. For instance, research in the United States analyzed the incidence and severity of influenza in individuals under 18 years old between October 1, 2022, and April 30, 2023, identifying 2,762 hospitalizations. Most infections were caused by influenza A virus (95.4%), predominantly H3N2. The average age of patients was 5 years, with 57.4% being male and 50.5% presenting underlying medical conditions.⁶

Hospitalizations due to respiratory diseases in children are a global concern, with studies reporting significant rates, such as 31% in Sri Lanka and 39.9% in Vietnam. Children under five years of age are particularly vulnerable, with high hospitalization rates for pneumonia observed among those under two years old. However, these studies face limitations, such as regional and socioeconomic variations, which may restrict the applicability of findings to other populations.⁷⁻⁹

In Brazil, recent studies have focused on hospitalizations of children due to respiratory diseases before and during the COVID-19 pandemic. Other research has reviewed the literature to identify the causes of hospitalizations among Brazilian children under five years old and conducted a temporal and financial analysis of pneumonia hospitalizations in this population. However, these studies present limitations, including a predominant focus on children rather than adolescents and analyses restricted to a single type of respiratory disease, making it challenging to conduct a comprehensive comparison of these conditions.¹⁰⁻¹²

Given this context, the present study aimed to describe the characteristics of hospitalizations due to respiratory diseases among children and adolescents admitted in 2023 to a referral hospital in Ceará. This research contributes to promoting the health of children and adolescents by identifying the primary respiratory diseases responsible for hospitalizations in 2023. Understanding these data enables the formulation of preventive strategies, such as vaccination and health education, which reduce morbidity, alleviate hospital burdens, optimize resources, and improve the quality of life for children and their families.

METHODOLOGY

This study is a descriptive, cross-sectional research with a quantitative approach, utilizing secondary data from the Hospital Morbidity Information System of the Unified Health System (SUS). Data were accessed through TABNET, available on the Department of Informatics of SUS (DATASUS) website, in July 2024.

The study included patients aged 0 to 19 years who were hospitalized in 2023 at the Albert Sabin Children's Hospital (HIAS), following the Ministry of Health's definition, which considers adolescence to extend until 19 years, 11 months, and 29 days.⁵ The year 2023 was selected as it recorded the highest number of hospitalizations due to respiratory diseases within the 2019–2024 period, according to the system's data.

The sample comprised all publicly accessible data on hospitalizations of children and adolescents for diseases classified under Chapter X of the International Classification of Diseases (ICD-10), specifically respiratory system diseases. Included hospitalizations were due to acute pharyngitis, acute tonsillitis, acute laryngitis and tracheitis, other acute upper respiratory infections, influenza, pneumonia, acute bronchitis, and acute bronchiolitis, as well as chronic diseases of the tonsils and adenoids and other upper respiratory tract diseases, such as bronchitis, emphysema, chronic obstructive pulmonary disease (COPD), and asthma. Data on sinusitis, bronchiectasis, and pneumoconiosis, which showed null values for the entire year of 2023, were excluded from the analysis.

The investigated variables included: respiratory diseases; age groups (under 1 year, 1–4 years, 5–9 years, 10–14 years, and 15–19 years); patients' race/skin color (White, Black, Brown, Yellow, Indigenous, or Unspecified); the value of approved Hospitalization Authorization (AIH in Portuguese) in Brazilian reais (BRL); total days of hospitalization corresponding to approved AIH; and the average length of hospital stay.

Data were collected by accessing the SIH/SUS platform on the DATASUS website (<https://datasus.saude.gov.br/>), navigating to TABNET, and selecting the "Epidemiology and Morbidity" section. Within this section, the "SUS Hospital Morbidity" option was chosen, followed by "General, by place of hospitalization - from 2008," with geographic coverage for Ceará. In the SIH/SUS platform, the ICD-10 morbidity list was selected for rows, while the variables of age group, sex, and race/skin color were selected for columns, resulting in the download of datasets in Comma-Separated Values (CSV) format for each variable. The analysis period covered January to December 2023, and age groups included under 1 year, 1–4 years, 5–9 years, 10–14 years, and 15–19 years. The dataset content varied based on the variable, including information on hospitalizations, total costs, days of hospitalization, or average length of stay.

Data were organized using Microsoft Excel 365 and subsequently imported into Jamovi 2.5.6 software. A descriptive statistical analysis was conducted, calculating relative (%) and absolute (n) frequencies and creating tables to present the results. To illustrate the distribution of the most prevalent respiratory diseases during the period (pneumonia, acute bronchitis, acute bronchiolitis, bronchitis/emphysema/COPD, asthma, and other respiratory diseases), a clustered bar chart was produced.

As the data used in this study are publicly available and do not include identifiable personal information about patients, submission to a Research Ethics Committee was not required, in accordance with Resolution 466/2012 of the Brazilian National Health Council.

RESULTS

In 2023, a total of 2,785 hospitalizations of children and adolescents were recorded at the Albert Sabin Children's Hospital (HIAS) (Table 1). The leading cause of hospitalization was pneumonia, accounting for 1,113 cases (40%), followed by acute bronchitis and acute bronchiolitis, with 682 cases (24.5%), and influenza, with 273 cases (9.8%). Other acute upper respiratory infections totaled 63 cases (2.3%), while asthma was responsible for 302 hospitalizations (10.8%). Less frequent conditions included acute laryngitis and tracheitis, with 24 cases (0.9%), and other respiratory diseases, totaling 278 cases (10%). Acute pharyngitis and acute tonsillitis, bronchitis/emphysema and other chronic obstructive pulmonary diseases, and other upper respiratory tract diseases were also recorded but in smaller numbers.

Table 1. Proportion of hospitalizations for respiratory diseases among children and adolescents at HIAS, 2023.

Morbidities	Hospitalizations	
	n	%
Acute pharyngitis and tonsillitis	3	0.1
Acute laryngitis and tracheitis	24	0.9
Other acute upper respiratory infections	63	2.3
Influenza (flu)	273	9.8
Pneumonia	1113	40.0
Acute bronchitis and bronchiolitis	682	24.5
Other diseases of the nose and sinuses	2	0.1
Chronic tonsil and adenoid diseases	1	0.0
Other upper respiratory diseases	18	0.6
Bronchitis, emphysema, and chronic obstructive pulmonary disease	26	0.9
Asthma	302	10.8
Other respiratory diseases	278	10.0

Source: adapted from the Ministry of Health - SUS Hospital Information System (SIH/SUS).

Data from Table 2 indicates that pneumonia was the leading cause of hospitalization, particularly among children under 1 year of age, representing 49.2% of cases in this age group. Acute bronchitis and acute bronchiolitis also showed high incidence, especially among children aged 1 to 4 years, accounting for 46.4% of hospitalizations. Influenza was most prevalent among children under 1 year, comprising 14.1% of cases. Other conditions exhibited lower hospitalization percentages, with chronic diseases of the tonsils and adenoids being the least frequent across all age groups.

Table 2. Age group distribution of hospitalizations for respiratory diseases among children and adolescents at HIAS, 2023.

Morbidities	Age range (years)									
	<1		1-4		5-9		10-14		15-19	
	n	%	n	%	n	%	n	%	n	%
Acute pharyngitis and tonsillitis	1	0.1	1	0.1	1	0.2	0	0.0	0	0.0
Acute laryngitis and tracheitis	7	0.7	13	1.3	3	0.6	1	0.6	0	0.0
Other acute upper respiratory infections	10	1.0	27	2.7	18	3.6	6	3.7	2	3.3
Influenza (flu)	14	14.1	84	8.3	31	6.1	9	5.5	2	3.3
Pneumonia	30	29.6	46	46.1	23	45.7	7	43.3	3	58.3
Acute bronchitis and bronchiolitis	9	6.2	8	3.0	0	5.0	1	3.5	5	3.3
Other diseases of the nose and sinuses	49	47.3	14	14.1	24	4.7	1	8.5	2	3.3
Chronic tonsil and adenoid diseases	3	2.9	9	8.8	0	0.0	1	0.6	1	1.7
Other upper respiratory diseases	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0
Bronchitis, emphysema, and chronic obstructive pulmonary disease	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0
Asthma	1	0.1	6	0.6	10	2.0	1	0.6	0	0.0
Other respiratory diseases	10	1.0	8	0.8	4	0.8	2	1.2	2	3.3
	11	1.1	13	13.0	12	23.1	3	19.0	1	1.7
	7	6.8	7	6.8	1	9.1	2	5.5	1	1.7
	56	5.4	11	11.1	64	12.2	2	15.0	1	25.0
	7	6.8	7	6.8	6	6.0	6	9.0	5	0.0

Source: adapted from the Ministry of Health - SUS Hospital Information System (SIH/SUS).

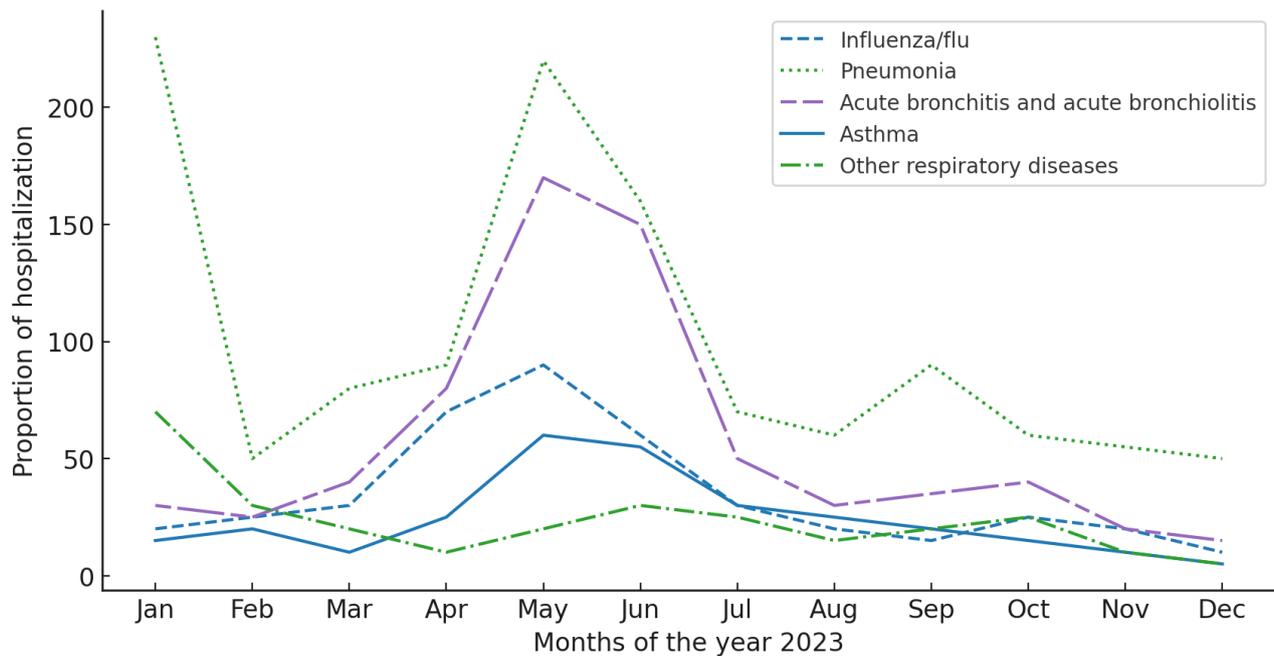
Regarding race/ethnicity, there were 5 cases among Black patients and 2,780 cases among Mixed-race (Pardo) patients. Among the leading diseases, the most notable were: pneumonia, with 2 cases among Black patients (0.18%) and 1,111 among Mixed-race patients (40%); acute bronchitis and acute bronchiolitis, with 1 case among Black patients (0.09%) and 681 among Mixed-race patients (24.5%); asthma, with 302 cases among Mixed-race patients (10.9%) and none among Black patients (0%); and influenza, with 1 case among Black patients (0.09%) and 272 among Mixed-race patients (9.8%).

Hospital stay durations varied across conditions. Patients with acute pharyngitis and tonsillitis had an average hospital stay of 2 days, totaling 6 days during the period. Acute laryngitis and tracheitis had an average stay of 3 days, summing up to 71 days, while other acute upper respiratory tract infections totaled 189 days, also with a 3-day average. Influenza had an average hospitalization duration of 7 days, totaling 1,922 days, and pneumonia had an average of 8.8 days, amounting to 9,782 days in total.

Patients with acute bronchitis and bronchiolitis had an average stay of 3.1 days, with a total of 2,087 days. Other nasal and paranasal sinus diseases had an average stay of 9.5 days, totaling 19 days. Chronic diseases of the tonsils and adenoids averaged 1 day, whereas other upper respiratory tract diseases had an average of 4.2 days, totaling 76 days. Chronic obstructive pulmonary diseases, including bronchitis emphysema, averaged 22.1 days, with a total of 574 days. Asthma had an average hospital stay of 3 days, summing to 894 days, while other respiratory diseases averaged 18.9 days, totaling 5,256 days.

The total hospitalization costs amounted to R\$ 4,499,829.51. Pneumonia accounted for the largest portion of the costs, totaling R\$ 2,079,061.22, approximately 46.2% of the total. Expenses related to influenza were R\$ 398,539.30 (8.9%), while costs for other acute upper respiratory tract infections totaled R\$ 24,194.29 (0.5%). Acute laryngitis and tracheitis incurred costs of R\$ 14,719.60 (0.3%). Other conditions, including acute bronchitis and bronchiolitis, contributed R\$ 291,367.88 (6.5%) to the total expenditures. Figure 1 illustrates the monthly distribution of respiratory diseases among children and adolescents hospitalized at HIAS in 2023.

Figure 1. Monthly distribution of respiratory disease hospitalizations among children and adolescents at HIAS, 2023.



Source: research data.

Figure 1 reveals distinct seasonal patterns in respiratory diseases among children and adolescents hospitalized at HIAS in 2023. Influenza cases peaked in April, with a significant increase starting in March, followed by a declining trend after May. Pneumonia exhibited pronounced peaks in May and October, with gradual decreases in subsequent months. Acute bronchitis and bronchiolitis cases rose in April, followed by a decline after May. Asthma showed a relatively stable incidence throughout the year, with a slight increase in May. The highest incidence of these respiratory diseases occurred between March and May, with early signs of rising cases appearing as early as February.

DISCUSSION

The results of this research revealed a total of 2,785 hospital admissions of children and adolescents at the Albert Sabin Children's Hospital (HIAS) in 2023, with pneumonia identified as the leading cause, accounting for 1,113 cases (40%). Acute bronchitis and bronchiolitis were responsible for 682 cases (24.5%), followed by influenza, with 273 cases (9.8%). Other acute upper respiratory tract infections totaled 63 cases (2.3%), while asthma accounted for 302 hospitalizations (10.8%). These findings align with national trends, where pneumonia is the primary cause of hospitalization, representing 44.2% of admissions in 2023, followed by acute bronchitis and bronchiolitis, which constituted 17.4% of hospitalizations in the same year.¹³

The predominance of pneumonia and bronchiolitis as major causes of hospitalization is consistent with existing literature, which often identifies these conditions as common among children and adolescents. Community-acquired pneumonia, frequently caused by pathogens such as *Streptococcus pneumoniae* and *Mycoplasma pneumoniae*, remains a significant cause of pediatric hospitalizations globally. Additionally, acute respiratory infections, including bronchiolitis, result in a considerable number of hospitalizations among children under five years old. The respiratory syncytial

virus (RSV), in particular, is a major contributor to hospitalizations in children under two years of age, emphasizing the importance of early diagnosis and management.¹⁴⁻¹⁶

In the Brazilian context, this situation is mirrored in the prevalence of chronic respiratory diseases. For instance, a study conducted between September 2013 and February 2014 reported a prevalence of 6.1% in children under six years, 4.7% in children aged six to twelve, and 3.9% in adolescents aged thirteen and above. The high prevalence among children under six highlights the need for intensive pharmacological treatment, with significant use of medications such as inhalers and spacers—56.6% of users relied on these devices. The most commonly used drug classes, including short-acting β 2 agonists and antihistamines, reflect the ongoing management of respiratory conditions in this vulnerable age group.¹⁷

However, a study on hospitalizations due to respiratory diseases in Brazil revealed a continuous decline in hospitalizations for pneumonia and other respiratory conditions after 2020. While the present research highlighted a 2023 scenario where these conditions remained predominant in pediatric admissions, the referenced study indicated a temporary impact of the pandemic. This included an initial reduction in hospitalizations, followed by a resurgence, particularly for acute bronchitis and bronchiolitis.²

There was also a higher incidence of hospitalizations among male patients, particularly for pneumonia and acute bronchitis/bronchiolitis. The literature suggests that boys may have a greater predisposition to respiratory diseases during childhood, possibly due to hormonal and physiological differences in lung development. Studies indicate that boys often experience more severe respiratory conditions and have a greater need for inhalation treatments.^{18,19}

An analysis of age groups revealed that children under one year of age had the highest prevalence of pneumonia, while acute bronchitis and bronchiolitis were more common in children aged 1 to 4 years. These findings are consistent with other studies highlighting respiratory diseases as significant causes of morbidity and mortality in children under five. The high susceptibility of children in this age group to respiratory infections reflects their vulnerability to such conditions.^{3,15,20}

Regarding racial and skin color differences, the study found that the majority of cases occurred among mixed-race patients, with fewer hospitalizations observed among Black patients. Other research has identified significant racial disparities in the incidence of infectious respiratory diseases, with minority groups often being more affected. Factors such as obesity, diabetes, and common pulmonary diseases in marginalized populations can worsen respiratory infection outcomes. Socioeconomic and racial disparities have been associated with higher rates of hospitalization and mortality.^{21,22}

The length of hospital stays varied, with bronchial emphysema and other chronic obstructive pulmonary diseases showing the longest average duration of 22.1 days. Other respiratory conditions, such as pneumonia, had an average stay of 8.8 days. The severity of the diseases, the need for respiratory support, and exacerbations (such as changes in arterial blood gas levels) are factors influencing the duration of hospitalizations. For instance, pneumonia and RSV infections are associated with longer hospital stays and higher costs.^{23,24}

The total hospitalization costs amounted to R\$ 4,499,829.51, with pneumonia accounting for 46.2% of these costs and influenza for 8.9%. Other expenditures were also significant, reflecting the considerable economic impact of hospitalizations due to respiratory diseases. On a global scale, the economic burden of pediatric hospitalizations for respiratory illnesses is notable, as demonstrated by studies conducted in the United States.^{25,26}

The increase in the incidence of respiratory diseases between March and May and again in October can be attributed to seasonal and environmental factors, such as increased humidity and lower

temperatures during the transition from summer to autumn, as well as temperature fluctuations and pollen levels in spring. These peaks reflect a trend observed in Brazil, where respiratory infections rise during winter due to the greater survival of pathogens and increased host susceptibility during colder months.^{27–28}

Despite the importance of these findings, some limitations should be considered, such as the quality and timeliness of secondary data and the scarcity of specific studies focusing on adolescents. Additionally, the absence of a time series analysis spanning multiple years limits the ability to establish long-term patterns of respiratory diseases.

Nevertheless, the results underscore the need for continuous monitoring and hospital resource planning for respiratory diseases in children and adolescents in Ceará. Implementing awareness campaigns and vaccination programs through the Brazilian Unified Health System (SUS), based on hospitalization peak data, could improve child health and the efficiency of the healthcare system. Such preventive interventions at the primary care level would support the prevention of respiratory diseases.

Overall, the results indicated that pneumonia, acute bronchitis, and influenza were the leading causes of hospitalizations at HIAS in 2023, with a higher incidence among male patients. An important finding was the identification of hospitalization peaks between March and May. Furthermore, pneumonia accounted for nearly half of the hospital costs, emphasizing the need for preventive strategies to reduce both morbidity and the financial burden associated with these hospitalizations.

Looking ahead, future research should explore the reasons behind the higher prevalence of hospitalizations among boys, considering biological, social, and behavioral factors. Additionally, time series studies could be valuable in confirming disease patterns in children. It is also important to assess the effectiveness of targeted seasonal interventions, such as vaccination campaigns and health education programs, to reduce the incidence of respiratory diseases during critical periods.

PRACTICAL IMPLICATIONS OF THE STUDY

The practical implications of this study for healthcare include enhancing hospital planning and management by focusing on anticipating periods of higher hospitalization demand (peak months). Standardizing protocols for managing pneumonia and bronchiolitis could improve care efficiency and reduce hospitalization times, thereby lowering associated costs.

Additionally, the findings highlight the need to strengthen vaccination campaigns and preventive actions in primary care to reduce the occurrence of respiratory diseases. The study also underscores the importance of training healthcare teams to address the specific needs of high-risk groups, such as infants under one year of age and male patients. These measures could lead to better resource utilization and improved pediatric care quality.

CONCLUSION

This research revealed that pneumonia is the leading cause of respiratory disease-related hospitalizations among children and adolescents at HIAS, accounting for the majority of financial resources expended. The higher prevalence of hospitalizations among male patients may indicate greater vulnerability of this group to respiratory diseases.

The observation of increased hospitalizations between March and May suggests the need for future investigations to explore possible seasonal or environmental influences. The findings can guide

resource allocation for prevention and treatment, highlighting the importance of targeted health campaigns, particularly for male populations.

REFERENCES

1. Chang AB, Zacharasiewicz A, Goyal V, et al. European Respiratory Society statement for defining respiratory exacerbations in children and adolescents with bronchiectasis for clinical trials. *Eur Respir J* 2022;60(5):2200300. <https://doi.org/10.1183/13993003.00300-2022>.
2. Quirino ALS, Costa KTDS, Ferreira AGL, Melo EBB, Andrade FBD. Internações na infância por doenças do aparelho respiratório no Brasil de 2013 a 2022. *Rev Ciênc Plur* 2024;10(1):1–15. <https://doi.org/10.21680/2446-7286.2024v10n1ID31414>.
3. Sharif H, Jan SS, Sharif S, Seemi T, Naeem H, Rehman J. Respiratory Diseases' Burden in children and adolescents of marginalized population: A retrospective study in slum area of Karachi, Pakistan. *Front Epidemiol* 2023;2:1031666. <https://doi.org/10.3389/fepid.2022.1031666.eCollection2022>.
4. Ma KC. Increase in Acute Respiratory Illnesses Among Children and Adolescents Associated with Rhinoviruses and Enteroviruses, Including Enterovirus D68 — United States, July–September 2022. *MMWR Morb Mortal Wkly Rep* [homepage on the Internet] 2022 [cited 2024 Aug 4];71. Available from: <https://www.cdc.gov/mmwr/volumes/71/wr/mm7140e1.htm>
5. Brasil. Mortalidade – desde 1996 pela CID-10 – DATASUS [Homepage on the Internet]. 2024 [cited 2024 Aug 10]; Available from: <https://datasus.saude.gov.br/mortalidade-desde-1996-pela-cid-10/>
6. Umasankar N. Burden of respiratory disease on hospital admission of children: experience from a tertiary care centre. *Sri Lanka J Child Health*. 2021;50(4):661. <https://doi.org/10.4038/slch.v50i4.9858>.
7. Nguyen T, Nguyen D, Truong T, Tran M, Graham SM, Marais BJ. Disease spectrum and management of children admitted with acute respiratory infection in Viet Nam. *Trop Med Int Health*. 2017;22(6):688-95. <https://doi.org/10.1111/tmi.12874>.
8. Glick AF, Tomopoulos S, Fierman AH, Elixhauser A, Trasande L. Association between outdoor air pollution levels and inpatient outcomes in pediatric pneumonia hospitalizations, 2007 to 2008. *Acad Pediatr*. 2019;19(4):414-20. <https://doi.org/10.1016/j.acap.2018.12.001>.
9. White EB. High Influenza Incidence and Disease Severity Among Children and Adolescents Aged 18 Years — United States, 2022–23 Season. *MMWR Morb Mortal Wkly Rep* [homepage on the Internet] 2023 [cited 2024 Aug 5];72. Available from: <https://www.cdc.gov/mmwr/volumes/72/wr/mm7241a2.htm>
10. Chacorowski ARP, Bertolini DA. Internamentos de crianças por doenças respiratórias pré e durante a pandemia. *Braz J Infect Dis* 2022;26:102192. <https://doi.org/10.1016/j.bjid.2021.102192>.
11. Megiani IN, Marmé HR, Prates ALM, et al. Análise temporal e financeira das internações por pneumonia na população infantojuvenil brasileira. *Res Soc Dev* 2024;13(2):e7713245031–e7713245031. <http://doi.org/10.33448/rsd-v13i2.4503>.
12. Pedraza DF, Araujo EMN de, Pedraza DF, Araujo EMN de. Internações das crianças brasileiras menores de cinco anos: revisão sistemática da literatura. *Epidemiol E Serviços Saúde* 2017;26(1):169–182. <https://doi.org/10.5123/S1679-49742017000100018>.
13. Brasil. Morbidade Hospitalar do SUS (SIH/SUS) – DATASUS [Homepage on the Internet]. 2024 [cited 2024 Aug 10]; Available from: <https://datasus.saude.gov.br/aceso-a-informacao/morbidade-hospitalar-do-sus-sih-sus/>
14. Cannesson A, Elenga N. Community-Acquired Pneumonia Requiring Hospitalization among French Guianese Children. *Int J Pediatr* 2021;2021:4358818. <https://doi.org/10.1155/2021/4358818.eCollection2021>.
15. Nascimento MS, Baggio DM, Fascina LP, Prado C do. Impact of social isolation due to COVID-19 on the seasonality of pediatric respiratory diseases. *PLoS One* 2020;15(12):e0243694. <https://doi.org/10.1371/journal.pone.0243694>.
16. Singh A, Vijaya K, Laxmi KS. A descriptive study of menopause and menopausal symptoms in a tertiary care centre. *J Evol Med Dent Sci* 2018;7(48):5216–5218. <https://doi.org/10.14260/jemds/2018/1157>.
17. Leal LF, Tavares NUL, Borges RB, et al. Prevalence of chronic respiratory diseases and medication use among children and adolescents in Brazil - a population based cross-sectional study. *Rev Bras Saúde Materno Infant* 2022;22:35–43. <https://doi.org/10.1590/1806-93042022000100003>.
18. Tan CD, El Ouasghiri S, Von Both U, et al. Sex differences in febrile children with respiratory symptoms attending European emergency departments: An observational multicenter study. *PLOS ONE* 2022;17(8):e0271934. <https://doi.org/10.1136/thx.54.12.1119>.
19. Zachariasse JM, Borensztajn DM, Nieboer D, et al. Sex-specific differences in children attending the emergency department: prospective observational study. *BMJ Open* 2020;10(9):e035918. <https://doi.org/10.1183/20734735.0222-2022>.

20. Sholeh B, Juliningrum PP, Rahmawati I. The Characteristic of Toddlers with ARI Disease in Kanigaran Public Health Center, Probolinggo City. *Nurs Health Sci J NHSJ* 2022;2(2):79–86. <https://doi.org/10.53713/nhs.v2i2.97>.
21. Agrawal M, Brenner EJ, Yan Mak JW, et al. COVID-19 Outcomes Among Racial and Ethnic Minority Individuals With Inflammatory Bowel Disease in the United States. *Clin Gastroenterol Hepatol* 2021;19(10):2210-2213.e3. <https://doi.org/10.1016/j.cgh.2021.05.060>.
22. Moran E, Kubale J, Noppert G, Malosh R, Zelner J. Inequality in acute respiratory infection outcomes in the United States: A review of the literature and its implications for public health policy and practice [Homepage on the Internet]. 2020 [cited 2024 Aug 5]; Available from: <http://doi.org/10.1101/2020.04.22.20069781>.
23. Gautam S, Kc SR, Sijapati MJ, Gyawali P, Kc G, Gurung SB. Correlation of Arterial Blood Gas Value with Outcome of Patient Admitted with Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *Nepal Med J* 2020;3(2):338–342. <https://doi.org/10.3126/nmj.v3i2.34880>.
24. Havdal LB, Boas H, Bekkevold T, et al. Risk factors associated with severe disease in respiratory syncytial virus infected children under 5 years of age. *Front Pediatr* 2022;10:1004739. <https://doi.org/10.3389/fped.2022.1004739>.
25. Bear NL, Wilson A, Blackmore AM, Geelhoed E, Simpson S, Langdon K. The cost of respiratory hospitalizations in children with cerebral palsy. *Dev Med Child Neurol* 2024;66(3):344–352. <https://doi.org/10.1111/dmcn.15714>.
26. Perry R, Braileanu G, Palmer T, Stevens P. The Economic Burden of Pediatric Asthma in the United States: Literature Review of Current Evidence. *Pharmacoeconomics* 2019;37(2):155–167. <https://doi.org/10.1007/s40273-018-0726-2>.
27. Fisman D. Seasonality of viral infections: mechanisms and unknowns. *Clin Microbiol Infect* 2012;18(10):946–954. <https://doi.org/10.1111/j.1469-0691.2012.03968.x>.
28. Pscheidt VM, Gregianini TS, Martins LG, Veiga ABGD. Epidemiology of human adenovirus associated with respiratory infection in southern Brazil. *Rev Med Virol* 2021;31(4):e2189. <https://doi.org/10.1002/rmv.2189>.
29. Stewart PD, Bach JL. Temperature dependent viral tropism: understanding viral seasonality and pathogenicity as applied to the avoidance and treatment of endemic viral respiratory illnesses. *Rev Med Virol* 2022;32(1):e2241. <https://doi.org/10.1002/rmv.2241>.