

Clinical epidemiological profile of complicated pneumonia acquired in the community in children at a reference maternity child hospital

Raul José Almeida Albuquerque¹, Camila Esteves Paredes¹, Ana Carolina de Souza Vasconcelos¹, Ítalo José Sampaio Vieira da Cruz², Renê Elias Gonçalves², Vitória Souza Araújo², Ilka Juliana Ferreira Rodrigues³, Yuri Francilane Carvalho Dos Santos⁴

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Abstract

Objective: To analyze the clinical-epidemiological profile of community-acquired pneumonia complicated in children to improve prevention and diagnostic strategies, thereby reducing morbidity and mortality caused by this condition. **Method:** A descriptive, cross-sectional, and prospective study was conducted at a maternal and child referral hospital, involving 130 children hospitalized for community-acquired pneumonia, aged under 10 years, over a 6-month period. The children were classified into two groups: uncomplicated pneumonia and complicated pneumonia. **Results:** Of the hospitalized children, 74.6% had Community-Acquired Pneumonia, and 25.4% were diagnosed with complications. Both groups presented similar socioeconomic profiles, with a predominance of mixed-race children, low income, and parents with 9 to 13 years of education. Although there was no statistically significant difference between the groups in terms of vaccination and the presence of comorbidities, the literature indicates that the introduction of the 10-valent pneumococcal conjugate vaccine in Brazil reduced mortality and hospitalizations due to pneumonia. This lack of statistical difference may be related to the emerging resistance of specific serotypes, such as 19A, which has shown significant resistance to penicillin. **Conclusions:** It is essential to increase vaccine coverage against other *Streptococcus pneumoniae* serotypes, monitor serotypes, and antimicrobial resistance to improve the control of pneumonia in children.

¹ Hospital Dom Malan / Instituto Social das Medianeiras da Paz, Residência em Pediatria - Petrolina - Pernambuco - Brazil.

² Universidade Federal do Vale do São Francisco, Curso de Medicina - Petrolina - Pernambuco - Brazil.

³ Hospital Santo Antônio/ Obras Sociais Irmã Dulce, Hematologia pediátrica - Salvador - Bahia - Brazil.

⁴ Universidade Federal de Pernambuco, Pediatra - Recife - Pernambuco - Brazil.

Correspondence to:

Raul José Almeida Albuquerque.

Hospital Dom Malan / Instituto Social das Medianeiras da Paz, Residência em Pediatria, Petrolina, Pernambuco, Brazil. Rua Joaquim Nabuco, s/n, Centro, Petrolina, PE, Brazil. CEP: 56.304-900. E-mail: raujalbuquerque@hotmail.com

INTRODUCTION

Community-acquired pneumonia (CAP) is a leading cause of morbidity and mortality in children worldwide, posing a significant challenge to healthcare systems, especially in resource-limited regions¹. Complicated Community-Acquired Pneumonia (CACP) in children is a serious clinical condition with local complications that requires special attention due to its complexity and potential impact on child health².

In developing countries, there has been a gradual decrease in infant mortality related to CAP over the past few years³. However, according to the Ministry of Health, during the pandemic in Brazil, there were 44,523 deaths from CAP from January to August 2022, compared with 31,027 deaths in the same period the previous year². In Pernambuco, as in the Northeast, annual mortality from pneumonia caused by an unspecified microorganism is responsible for the majority of deaths, representing approximately 60% of total cases during the period from 2013 to 2017, with its percentage decreasing over the years⁴.

Pneumonia in children presents a variety of associated risk factors, such as being under 5 years of age, prematurity and low birth weight, lack of breastfeeding in the first 4 months of life, malnutrition, unfavorable socioeconomic conditions and lack of adequate immunization, which contribute to the severity of the disease and the need for more aggressive therapeutic interventions⁷.

The reduction in infant mortality due to CAP began with the introduction of the *Haemophilus vaccine influenzae* type b (Hib) and some serotypes of *Streptococcus pneumoniae* in 1999 and 2010, respectively, by the National Immunization Program^{5,6}. However, there has been an increase in the number of children facing CAP-related complications, possibly resulting from a variety of factors, including colonization by different pneumococcal serotypes after the introduction of the pneumococcal vaccine, particularly type 19A^{3,8}.

This article aims to analyze the clinical and epidemiological profile of complicated and uncomplicated community-acquired pneumonia in children, based on data collected at a maternal and child referral hospital located in the Sertão region of Pernambuco. Understanding the epidemiological, clinical, and therapeutic aspects of this condition is essential to guide prevention strategies, early diagnosis, and effective treatment, thus contributing to the reduction of morbidity and mortality related to childhood pneumonia in this region.

METHODOLOGY

A descriptive, cross-sectional study with prospective data collection was conducted at a tertiary maternal and child hospital, including 130 children hospitalized for community-acquired pneumonia. The data collection period was from June 1, 2022, to December 31, 2022. The hospital is recognized as a reference center for emergency care in 55 municipalities in the Pernambuco backlands.

To be included in the study, children had to be hospitalized with a clinical and/or radiological diagnosis of community-acquired pneumonia (CAP), be under 10 years of age, and have parental consent. Data collection took place in both the pediatric emergency room and the general pediatric ward. Parents and/or guardians were invited to participate after signing the informed consent form (ICF) and were interviewed by the principal investigators or trained medical students from the Federal University of Vale do São Francisco (UNIVASF).

A form containing 23 questions about epidemiological and demographic characteristics, clinical manifestations of the disease and evolution during hospitalization was used as a data collection instrument.

Data were coded and entered into a database created in Microsoft Excel 2007 and subsequently statistically analyzed using Jamovi 2022 software - version 2.3. Patients were grouped into two categories: 1) Community-acquired pneumonia (CAP) and 2) complicated CAP. For statistical analysis, a significance level of 0.05 was considered to reject the null hypothesis.

The project was approved by the Research Ethics Committee of the Professor Fernando Figueira Institute of Integral Medicine, under a substantiated and approved opinion CAAE: 60399922.3.0000.5201.

RESULTS

Data from 130 patients admitted between June 1 and December 31, 2022, and who met the inclusion criteria were analyzed. Among these, 97 (74.6%) persisted with only uncomplicated pneumonia (CAP) and 33 (25.4%) were admitted or developed complicated pneumonia (CPAC).

Regarding patients who did not develop complications, 56 (57.7%) were male and 41 (42.3%) were female. Regarding race, 59 (62.8%) were declared as brown by their mothers and 65 (75.6%) had a family income below 1 minimum wage. Regarding the parents' education, 46 (56.8%) of the mothers and 33 (46.5%) of the fathers had between 9 and 13 years of study. Fourteen incomplete vaccination cards were observed, constituting 15.6% of the total uncomplicated cases. Regarding the pathological history, 38 patients (38.8%) lived with some comorbidity, the most frequent being deficiency anemia (36.8%), asthma (18.4%) and prematurity (13.2%).

Regarding patients who developed CCAP, there was also a predominance of male patients ($p = 0.749$), with 18 (54.5%) of hospitalizations, and the mean age was 3 years. Furthermore, a close relationship was observed between the social vulnerability of patients and their respective complications. Of the complicated patients, 27 (80.6%) had a family income below 1 minimum wage ($p = 0.553$) and 21 (62.5%) were declared as brown by their mothers ($p = 0.843$). Regarding the level of education and occupation of the mothers, 17 (51.5%) classified themselves as housewives or unemployed, with the majority having between 9-13 years of study (60%). This situation is similar with regard to the parent, since the

majority also had between 9-13 years of education (64%) and only 1 (4%) father had more than 13 years of education. Furthermore, the vaccination status of the patients was also analyzed, with 6 children with incomplete vaccination cards for the pneumococcal vaccine being observed, totaling 18.2% among those with complications ($p = 0.727$). Regarding the pathological history, 11 (33.3%) had some comorbidity, the most prevalent being prematurity (9.1%), deficiency anemia (9.1%) and asthma (6.1%).

In the socioepidemiological comparison between the two groups (complicated and uncomplicated), a similarity in social vulnerability is observed, given that the majority within

both groups belong to the brown race, have low family income and low level of education of their parents.

Regarding sex ($p 0.749$) and age ($p 0.115$), there was no significant statistical relevance between the two groups.

Regarding the vaccination record, there was a lower absolute number of complete vaccination records among those with complicated cases (81.8%) compared to those without (84.4%). However, the difference in this parameter between the groups was not statistically significant ($p 0.727$). Regarding the presence of comorbidities, the two groups had some pathologies in common, the main ones being asthma and deficiency anemia (Table 1).

Table 1. Comparison between groups of patients with uncomplicated CAP and complicated CAP.

Variables	Uncomplicated pneumonia	Complicated pneumonia	P-value	Odds Ratio (95% CI)
Sex			0.749	
Feminine	41 (42.3%)	15 (45.5%)		1.14(0.514-2.52)
Masculine	56 (57.7%)	18 (54.5%)		-
Race			0.843	
White	17 (18.1%)	7 (21.9%)		-
Black	18 (19.1%)	5 (15.6%)		0.675(0.179-2.539)
Brown	59 (62.8%)	20 (62.5%)		0.823(0.298-2.27)
Income			0.553	
<1	65 (75.6%)	25 (80.6%)		-
1 - 2	15 (17.4%)	3 (9.7%)		0.52(0.139-1.952)
2 - 3	6 (7.0%)	3 (9.7%)		1.3(0.302-5.601)
Mother's education			0.205	
5 – 9A	19 (23.5%)	10 (33.3%)		-
9 – 13A	46 (56.8%)	18 (60.0%)		0.743(0.2905-1.9)
> 13A	16 (19.8%)	2 (6.7%)		0.238(0.0453-1.25)
Father's education			0.113	
5 – 9A	23 (32.4%)	8 (32.0%)		-
9 – 13A	33 (46.5%)	16 (64.0%)		1.394(0.5119-3.796)
> 13A	15 (21.1%)	1 (4.0%)		0.192(0.0217-1.693)
Vaccination cards			0.727	
Complete	76 (84.4%)	27 (81.8%)		-
Incomplete	14 (15.6%)	6 (18.2%)		1.21(0.421-3.46)
Pathological History				
Deficiency anemia	14 (36.8%)	3 (9.1%)	0.006	0.171(0.0441-0.666)
Asthma	7 (18.4)	2(6.1)	0.118	0.286(0.055-1.49)
Prematurity	5 (13.2)	3(9.1)	0.589	0.660(0.145-3.00)
No priors	41 (42.3%)	15 (45.5%)	-	-

OR = odds ratio (Odds ratio); CI (confidence interval)

Source: Prepared by the author (2024).

DISCUSSION

The profile of hospitalizations for Community-Acquired Pneumonia (CAP) during the analyzed period demonstrated a predominance of male children, mixed-race children, with per capita family income below one and a half minimum wages, and whose parents had an average level of education between 9 and 13 years. There was no significant difference between the groups with and without complications (Complicated Community-Acquired Pneumonia - CAP) regarding socioeconomic conditions, sex, and age ($p>0.05$). These results are consistent with recent studies, which did not identify significant differences in the socioeconomic profile between children with and without complications. The predominance of cases in children under 4 years of age, males, and mixed-race children also reflects current epidemiological findings that point to the same trend in several regions of the country^{9,10}.

Despite the lack of significant differences between the groups, studies suggest that factors such as nutritional status and lifestyle habits may influence the progression of the disease, highlighting the protective role of breastfeeding in reducing respiratory infections such as pneumonia¹¹. Breastfeeding has been associated with a decrease in hospitalizations for pneumonia in children, particularly in vulnerable populations, as evidenced by a Brazilian study¹². Furthermore, younger children, especially those under 4 years of age, are more vulnerable due to an immature immune system, as highlighted in reviews of pneumonia risk factors^{13,14}. These findings reinforce the need for public policies aimed at preventing pneumonia in low-socioeconomic populations, with an emphasis on encouraging breastfeeding and improving living conditions.

The main etiologic agent of CAP in children aged 1 to 4 years in Brazil is *Streptococcus pneumoniae*. However, variation in the number of strains identified has been observed among different study populations, which may influence the severity and outcome of the reported cases^{7,10,15}. A limitation of the present study was the lack of precise identification of the etiologic agents involved in the CAP cases analyzed.

Regarding vaccination, although a higher number of unvaccinated individuals was observed among those who developed complications, no statistically significant difference was found between the groups. However, previous studies strongly suggest the effectiveness of vaccination since the implementation of the 10-valent pneumococcal conjugate vaccine (PCV 10) in the Ministry of Health's National Immunization Program in 2010, aimed at preventing severe cases of community-acquired pneumonia. The vaccine has been shown to substantially reduce the incidence of cases, hospital admissions, and mortality associated with pneumonia¹⁶⁻¹⁸. Furthermore, Camargos et al. (2020)²⁰ highlight that the introduction of vaccination had differentiated impacts on hospitalization rates across the country's regions, reflecting regional variations in

socioeconomic factors and health interventions over time. This context has led to a downward trend in CAP mortality in recent decades^{19,20}, also driven by the dissemination of modern diagnostic techniques, such as nucleic acid amplification (PCR - Polymerase Chain Reaction), which has facilitated the early identification of respiratory viral infections²¹. However, these advances are unevenly distributed, with disparities in access to prevention tools, risk factor control, early diagnosis, and appropriate treatment, such as antibiotic therapy, varying significantly between different regions^{10,15}.

Penicillin resistance of *Streptococcus pneumoniae* serotype 19A was observed, with only 5.2% penicillin sensitivity, according to data from the SIREVA (Regional Vaccine System) Program in 2023⁷. This phenomenon of antimicrobial resistance has raised concerns in the management of severe pneumonia cases, especially in regions with fewer resources for alternative therapies. The emergence of resistant strains, such as serotype 19A, has been largely associated with the selective pressure exerted by PCV 10, which does not include protection against these serotypes, highlighting the importance of continued surveillance and adaptation of vaccination strategies.

For this reason, several studies outside Brazil have investigated the use of the 13-valent pneumococcal conjugate vaccine (PCV 13) in childhood, which provides immunization against three additional serotypes of *Streptococcus pneumoniae*: 3, 6A, and 19A²¹. The inclusion of these serotypes aims to expand protection and mitigate the emergence of resistant strains. Studies such as that by Moore et al. (2021)²² have demonstrated that PCV 13 resulted in a significant reduction in invasive infections caused by these serotypes, suggesting a more comprehensive impact on reducing the burden of pneumococcal disease in children.

However, the study by Eichler et al. (2022)²³ observed that, although there was a significant decrease in the number of hospitalizations after the introduction of more serotypes into Israel's national immunization plan, the number of complications, such as severe cases or comorbidities, remained unchanged. This may indicate that, although expanded vaccination coverage reduces the need for hospitalization, factors such as antimicrobial resistance and the presence of comorbidities continue to pose challenges in the treatment of complicated pneumococcal infections.

When analyzing the comorbidities presented by children across groups, we observed that deficiency anemia, asthma, and heart disease were the most common disorders. Among the group that developed CAP, prematurity stood out as an important factor, in addition to the comorbidities already mentioned. In addition to the previously listed risk factors, such as male gender and age under 4 years, the presence of comorbidities such as anemia, asthma, and malnutrition constitute factors for the development of illness in the pediatric population²⁴. Although there was no significant difference in comorbidities between the complicated and uncomplicated

groups, the presence of pre-existing conditions, prior antibiotic use, and previous admissions for CAP are well-documented factors that increase the risk of complications. Furthermore, variables related to hospitalization, such as duration of fever and total length of stay, have also been associated with worse outcomes^{15,24}.

We conclude that nutritional and social factors, such as malnutrition and poor living conditions, increase the risk of pneumonia. Furthermore, given the changes in pneumonia epidemiology, especially with the increase in resistance associated with the new, more prevalent serotypes, it is essential to strengthen programs to expand vaccination coverage. This includes incorporating more serotypes into the pneumococcal conjugate vaccine, aiming to protect children's health and reduce the incidence of pneumococcal disease and its complications. Continuous monitoring of serotypes and antimicrobial resistance patterns is essential. This data is essential for developing effective strategies to control pneumonia in children and improving health policies, ensuring a better quality of life for the population.

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