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EPIDEMIOLOGICAL AND MEDICATION PROFILE OF PEDIATRIC BACTERIAL PNEUMONIA HOSPITALIZATIONS: A NARRATIVE REVIEW

PERFIL EPIDEMIOLÓGICO E MEDICAMENTOSO DAS INTERNAÇÕES POR PNEUMONIA BACTERIANA PEDIÁTRICA: UMA REVISÃO NARRATIVA

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ABSTRACT

Introduction: Among the infections that affect the lower respiratory tract, pneumonia stands out. Factors such as low birth weight, living in daycare centers, incomplete vaccination, previous episodes of pneumonia and environmental and socioeconomic issues lead to greater susceptibility to this disease and, consequently, an increase in infant morbidity and mortality. **Objective:** To identify the epidemiological and medication profile of hospitalizations for bacterial pneumonia in children, in order to facilitate early diagnosis and appropriate treatment. **Methodology:** This is a narrative, qualitative and descriptive review, using articles published between 2021 and 2023 that contain information on the epidemiological and drug profiles of pediatric bacterial pneumonia hospitalizations, searched in the following databases: BVS, Embase and PubMed. The following descriptors were used in the search: *Clinical Epidemiology, Drug Therapy, Chemotherapy, Bacterial Pneumonia, Bacterial Pneumonia, Pediatrics, Hospitalization and Hospitalization*. **Results:** 15 studies were included in this review. Regarding the epidemiological profile, there was a predominance of males and a mean age of 4.2 years, with heart disease and asthma as the most prevalent pre-existing comorbidities. As for the medication profile, treatment with macrolides prevailed, mainly azithromycin, for pneumonia caused by *Mycoplasma pneumoniae* and with aminopenicillins (amoxicillin and ampicillin) and cephalosporins for pneumonia caused by other bacteria. **Conclusion:** Pneumonia is a difficult disease to diagnose and often requires empirical treatment based on the possible causative agents. Therefore, knowledge of factors such as gender, age, immune status, the most common pathogens for the age group, the origin of the infection and pre-existing comorbidities is essential.

Keywords: Epidemiology, Drug Treatment, Bacterial Pneumonia, Children.

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RESUMO

Introdução: *Dentre as infecções que acometem o trato respiratório inferior, destaca-se a pneumonia. Fatores como baixo peso ao nascer, convívio em creches, vacinação incompleta, episódios anteriores de pneumonia e questões ambientais e socioeconômicas fomentam uma maior suscetibilidade a tal doença e, consequentemente, um aumento da morbidade e mortalidade infantil.* **Objetivo:** *Identificar o perfil epidemiológico e medicamentoso das internações por pneumonia bacteriana em crianças, com a finalidade de facilitar o diagnóstico precoce e o tratamento adequado.* **Metodologia:** *Trata-se de uma revisão narrativa, de caráter qualitativo e descritivo, utilizando artigos publicados entre 2021 e 2023 que contêm informações acerca dos perfis epidemiológico e medicamentoso das internações por pneumonia bacteriana pediátrica, pesquisados nas seguintes bases de dados: BVS, Embase e PubMed. Foram aplicados os seguintes descritores na busca das pesquisas: Epidemiologia Clínica, Drug Therapy, Quimioterapia, Bacterial Pneumonia, Pneumonia Bacteriana, Pediatrics, Hospitalização e Hospitalization.* **Resultados:** *Foram incluídos nesta revisão 15 estudos. Em relação ao perfil epidemiológico, houve predominância do sexo masculino e média de idade de 4,2 anos, com cardiopatias e asma como comorbidades pré-existentes mais prevalentes. Quanto ao perfil medicamentoso, prevaleceu o tratamento com macrolídeos, principalmente azitromicina, para pneumonias causadas por Mycoplasma pneumoniae e com aminopenicilinas (amoxicilina e ampicilina) e cefalosporinas para pneumonias causadas por outras bactérias.* **Conclusão:** *A pneumonia é uma doença de difícil diagnóstico etiológico que frequentemente demanda tratamento empírico com base nos possíveis agentes causadores. Assim, o conhecimento de fatores como sexo, idade, estado imunológico, patógenos mais comuns para a faixa etária, origem da infecção e comorbidades pré-existentes é imprescindível.*

Palavras-chave: *Epidemiologia, Tratamento Medicamentoso, Pneumonia Bacteriana, Crianças.*

RESUMEN

Introducción: *Entre las infecciones que afectan al tracto respiratorio inferior destaca la neumonía. Factores como el bajo peso al nacer, vivir en guarderías, vacunación incompleta, episodios previos de neumonía y aspectos ambientales y socioeconómicos favorecen una mayor susceptibilidad a esta enfermedad y, en consecuencia, un aumento de la morbimortalidad infantil.* **Objetivo:** *Identificar el perfil epidemiológico y de medicación de las hospitalizaciones por neumonía bacteriana en niños, para facilitar el diagnóstico precoz y el tratamiento adecuado.* **Metodología:** *Se trata de una revisión narrativa, cualitativa y descriptiva, utilizando artículos publicados entre 2021 y 2023 que contengan información sobre el perfil epidemiológico y farmacológico de las hospitalizaciones por neumonía bacteriana pediátrica, buscados en las siguientes bases de datos: BVS, Embase y PubMed. En la búsqueda se utilizaron los siguientes descriptores: Clinical Epidemiology, Drug Therapy, Chemotherapy, Bacterial Pneumonia, Bacterial Pneumonia, Pediatrics, Hospitalisation.* **Resultados:** *Se incluyeron 15 estudios en esta revisión. En cuanto al perfil epidemiológico, hubo un predominio de varones y una edad media de 4,2 años, con cardiopatía y asma como comorbilidades preexistentes más prevalentes. En cuanto al perfil farmacológico, predominó el tratamiento con macrólidos, principalmente azitromicina, para la neumonía causada por Mycoplasma pneumoniae y con aminopenicilinas (amoxicilina y ampicilina) y cefalosporinas para la neumonía causada por otras bacterias.* **Conclusión:** *La neumonía es una enfermedad difícil de diagnosticar etiológicamente y a menudo requiere un tratamiento empírico basado en los posibles agentes causales. Por lo tanto, es esencial conocer factores como el sexo, la edad, el estado inmunológico, los patógenos más frecuentes para el grupo de edad, el origen de la infección y las comorbilidades preexistentes.*

Palabras clave: *Epidemiología, Tratamiento farmacológico, Neumonía bacteriana, Niños.*

INTRODUCTION

Among the infections that affect the lower respiratory tract, pneumonia stands out. It affects the alveoli and the distal bronchial tree and its main symptoms are productive cough, high fever, chest pain, chills and dyspnea (Rossi *et al.*, 2023). This condition is broadly categorized into Community-Acquired Pneumonia (CAP) and Hospital-Acquired Pneumonia (HAP) (Moreno, Moura, 2023). CAP is described as a form of pneumonia that affects patients without recent exposure to healthcare, presenting a wide range of clinical manifestations that can vary from apparently healthy patients to cases of multilobar or necrotizing disease with sepsis and lung failure (Musher, Thorner, 2014).

Despite recent advances in the medical field, CAP still holds the status of the leading cause of death among children worldwide, with around 90% of deaths occurring in developing countries (Ranganathan, Sonnappa, 2009). In Brazil, pneumonia is the leading cause of death among children aged zero to five and the third leading cause of death among children in general, second only to perinatal conditions and diarrhea (Bueno *et al.*, 2020).

Despite the wide-ranging respiratory microbiota, the vast dissemination of possibly pathogenic agents, the occurrence of viral epidemics and the impact of the introduction of polysaccharide vaccines, *Streptococcus pneumoniae* remains the most recurrent bacterium in cases of CAP among the etiological agents. In a smaller number of patients, CAP is attributed to other bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and some gram-negative bacteria, such as *Pseudomonas aeruginosa* (Moreno, Moura, 2023; Corrêa *et al.*, 2018). In cases of childhood CAP or atypical pneumonia, the most common etiological agent is the bacterium *Mycoplasma pneumoniae*, which mainly affects infants aged between six and 12 years (World Health Organization, 2023; Lee *et al.*, 2010).

Age is an inversely proportional factor to respiratory diseases, indicating that the younger the child, the greater the chances of developing CAP, with an especially high incidence between six and 24 months of age (Hatisuka *et al.*, 2015). It is also known that factors such as low birth weight, living in daycare centers, absence of vaccination or incomplete vaccination, previous episodes of pneumonia and environmental and socioeconomic issues foster greater susceptibility to CAP and, consequently, an increase in infant morbidity and mortality due to this pathology (Pires *et al.*, 2020). In this sense, it is estimated that there are, on average, 150.7 million new cases of CAP per year among children up to five years old, of which 7 to 13% require hospitalization due to the greater severity of the case (Sociedade Brasileira de Pneumologia e Tisiologia, 2007).

The diagnosis is usually made by analyzing the findings of the clinical examination, pulmonary auscultation, chest X-rays and laboratory tests (Rossi *et al.*, 2023). As a treatment for CAP, antibiotic therapy and immediate initiation of appropriate antibiotics are crucial factors for effectively combating the etiological agents. In order to target typical and atypical bacteria, broad-spectrum

antibiotics such as amoxicillin, ampicillin and azithromycin are commonly prescribed as empirical therapy (Moreno, Moura, 2023).

In view of the above and bearing in mind that pneumonia is considered an important public health problem that is difficult to diagnose and requires health professionals to have not only clinical, but also socio-environmental and epidemiological knowledge in order to promote appropriate antibiotic therapy in the face of not uncommon cases of bacterial resistance and prescription errors, this study aims to characterize the epidemiological and medication profile of hospitalizations for pediatric bacterial pneumonia.

METHODOLOGY

CHARACTERISTICS OF THE STUDY

This is a narrative literature review, descriptive and qualitative in nature, with an emphasis on the epidemiological profile and drug treatment of pediatric patients with bacterial pneumonia. With this method, it was possible to summarize previous research and establish conclusions through the delineation of the research analyzed, thus allowing the evaluation and synthesis of research and scientific knowledge on the subject under investigation.

To carry out this review, the following operational steps were followed: 1) identification of the topic and formulation of the hypothesis or central research question; 2) designation of criteria for the inclusion and exclusion of studies; 3) definition of the variables to be extracted from the selected studies; 4) analysis of the studies included in the narrative review; 5) interpretation of the results obtained; 6) presentation of the synthesis of knowledge resulting from the review (Alecrim *et al.*, 2019).

CONDUCTING THE INVESTIGATION

For the study and development of this research, a search was carried out, in December 2023, in the Virtual Health Library (VHL®), Public Medline (PubMed®) and Embase® databases, without filtering by language and with restriction to articles published between 2021 and 2023.

We used the descriptors included in the VHL® Health Sciences Descriptor (DeCS), in English and Portuguese, and crossed them with the Boolean operators AND and OR for all the databases, formulating the following search strategy: ((Clinical Epidemiology) OR (Clinical Epidemiology)) AND ((Drug Therapy) OR (Chemotherapy)) AND ((Bacterial Pneumonia) OR (Bacterial Pneumonia)) AND ((Pediatrics) OR (Pediatrics)) AND ((Hospitalization) OR (Hospitalization)).

After searching the databases, the following selection stages were carried out: 1st - Search by descriptors; 2nd - Selection according to the inclusion criteria; 3rd - Full reading of titles and abstracts; 4th - Reading the articles in full.

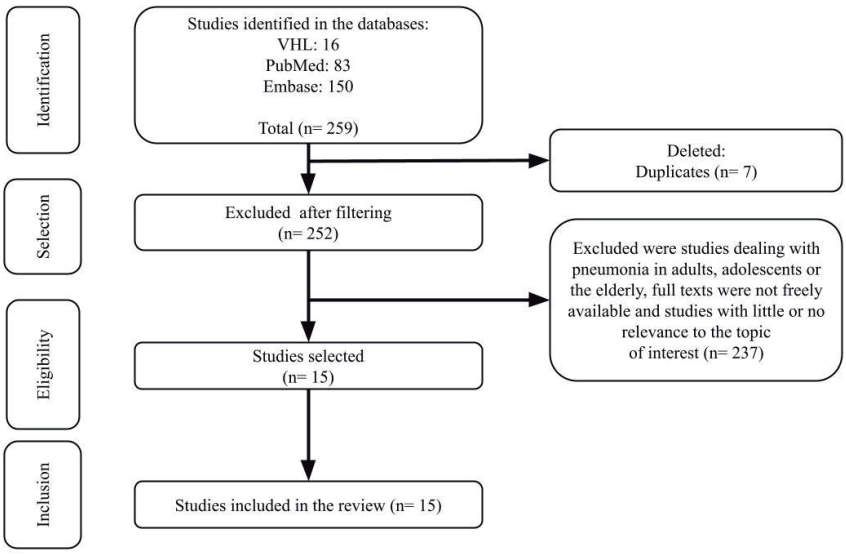
SELECTION CRITERIA

The inclusion criteria were: articles in English, Portuguese or Spanish; full texts available free of charge; and published between 2021 and 2023. The following were excluded: duplicates; studies with animals, adults, adolescents and the elderly; incomplete texts; and research with little or no relevance to the topic of interest.

A total of 259 articles were found, 16 in the VHL, 83 in PubMed and 150 in Embase. Of these, seven duplicates were discarded, leaving 252 for selection by title and abstract. After thorough reading, 15 articles were included in this study. Of the articles included, five were published in 2021, eight in 2022 and two in 2023. In terms of the type of research published, nine were retrospective cohorts, two were randomized trials, two were cross-sectional studies and two were case-control studies. Of the 15, six articles deal with pediatric CAP caused specifically by *M. pneumoniae*, since, according to Ocak M. *et al.* (2022), this bacterium is one of the most important etiological agents of pneumonia in children.

RESULTS

Figure 1 - Flowchart of the narrative literature review.



With regard to the epidemiological profile, as shown in Table 1, there was a predominance of males and an average age of 4.2 years. As for pre-existing comorbidities, the most prevalent conditions were heart disease, asthma, prematurity and genetic or chromosomal abnormalities. In most studies, the diagnosis was confirmed by chest X-ray, with the main findings being pulmonary infiltrates, consolidation and pleural effusion. Complementary to this, in a minority of cases, laboratory tests were carried out, which mainly detected leukocytosis, elevated C-reactive protein and co-infection.

Table 1 - Epidemiological Profile of Pediatric Pneumonia Hospitalizations in the articles analyzed.

Author	Age (average in years) [IQR]	Sex	Comorbidities	Complementary exams
Akahoshi, *et al.* (2021)	2 [0 - 18]	52,85% M 48,15% F	Neuromuscular-based diseases (1%) Genetic and chromosomal abnormalities (0,7%); Cardiovascular anomalies (0.7%).	Chest X-ray: Pulmonary infiltrate (59.1%); Pleural effusion (1%) Laboratory tests: Leukocytosis (47.5%); Neutrophilia (24%); Elevated CRP (26.5%)
Chen, Pan, Chen *et al.* (2021)	5,19 [0 - 14]	53,7% M 46, 3% F	Comorbid cardiovascular disease (50.9%%); Diabetes Mellitus (53.2%); Chronic lung disease (54.62%).	-
Tchagbele (2024)	2,74 [0,08 - 14]	62% M 38% F	Malaria (25.3%), Acute bacterial gastroenteritis (20.9%); Acute malnutrition (severe and moderate) (10%); Pediatric AIDS (9.2%); Sickle cell anemia vaso-occlusive crisis SS (1.5%); Heart disease (0,7%); Acute meningococcal meningitis (0.4%).	Chest X-ray: Squamous and linear opacity (44.2%); Laboratory tests: Blood count: anemia (88.2%); Hyperleukocytosis with neutrophilia (17.4%) and lymphocytosis (9%).
Chang *et al.* (2021)	6 [2 - 14]	43,2% M 56,8% F	-	-
Lee *et al.* (2021)	5 [3 - 7]	48% M 52% F	Total = 31.2% Most common: Premature birth; Asthma; Congenital heart disease; Neurological disorder; Chromosomal disorder.	Chest X-ray: Interstitial infiltrate (54.4%); Consolidation (39%); Pleural effusion (23%) Laboratory tests: Leukocytosis (11.4%); Co-infection (20.3%).
Williams *et al.* (2022)	2,94 [0 - 14]	51% M 48% F	-	-
Kuo *et al.* (2022)	6,6 [0 - 18]	50,3% M 49,7% F	Asthma (5.6%); Neurological disorders (2.6%) Prematurity (1.5%); Bronchopulmonary dysplasia (1.5%); Chronic kidney disease (1.5%); Congenital heart disease (1.5%).	Chest X-ray: Lobar pneumonia (51.3%); Bronchopneumonia (48.7%); Pleural effusion (4.1%); Laboratory tests: Leukocytosis (12.3%); Higher CRP (47.3 ± 50.8); Co-infection (5.6%).

			Asthma (19,3%).	Chest X-ray: Peribronchial infiltration 28.7%; Segmental-lobar consolidation 27.9%; Reticulonodular infiltration 16.8%; Pleural effusion 10.3%; Atelectasis 15.7%; Hilar lymphadenopathy 3.7%; PCR: Viral co-infection (65.4%).
Ocak *et al.* (2022)	6,7 [3.8 - 10]	57, 4% M 42,6% F		
Varela *et al.* (2022)	-	59,7% M 40,3% F	-	-
Castillo, Vella, (2022)	2,78 [0,25 - 14]	54% M 46% F	-	-
Yang *et al.* (2022)	3,12 [0,1 - 13]	59,8% M 40,2% F	Congenital or other heart defects (16.9%); Premature birth (14.3%); Recurrent respiratory infections (10%); Immunodeficiency disease (8%); Growth retardation (6%); Malnutrition (5.3%); Chromosomal abnormalities (3.5%); Neonatal respiratory distress syndrome (NRDS) (2.7%); Anemia (1.7%); Down syndrome (1.7%); Pyro Syndrome (1.7%).	mNGS positive (91%): Bacteria (26%); Viruses (19%); Mixed infections (42%).
Mauritz *et al.* (2022)	6,1 [0,4 - 21,5]	60%M 40% F	-	-
Huang *et al.* (2022)	5,7 [0,4 - 14,1]	47,2% M 52,8% F	-	Chest X-ray: Pleural effusion (56.7%); Lobar atelectasis (29%); Lung consolidation (55.4%); Pleural thickening (34.6%).
Bayhan *et al.* (2023)	1 [0 - 18]	51,2 M 48,8% F	-	-
Vasconcelos *et al.* (2023)	3,04 [0,5 - 14]	52,2% M 47,8% F	-	Chest X-ray: Lobar consolidation and irregular infiltrates (5.1%); Lobar consolidation only (33.3%); Irregular infiltrates only (34.1%); Inconclusive infiltrates (5.8%). Laboratory tests: Elevated C-reactive protein (23.2%).

Legend: M-male; F-female
Source: Research data (2024)

As for the medication profile, as can be seen in Table 2, it was observed that in pneumonia caused by *M. pneumoniae*, the treatment of choice was macrolides, mostly azithromycin. With regard to the treatment of pneumonia caused by other types of bacteria, the use of aminopenicillins

(amoxicillin and ampicillin) and cephalosporins prevailed, and in some cases the treatment consisted of amoxicillin in combination with a β-lactamase inhibitor, clavulanic acid.

Table 2 - Medication profile of pediatric pneumonia hospitalizations in the articles analyzed.

Author	Etiological agent	Antibiotics used in treatment
Akahoshi, *et al.* (2021)	*S. pneumoniae* (76%) *Haemophilus influenzae* (12%) *Streptococcus mitis e outros* (12%)	Ampicillin Cefotaxime Amoxicillin/clavulanic acid
Chen, Pan, Chen (2021)	MRSA 21/216; MSSA 20/216; MDR-PA 20/216; PA 19/216; MDRAB 19/216; AB 17/216; ESBL KP 23/216; KP 10/216; ESBL E. coli 27/216; *Escherichia coli* 40/216	Sulfasan, Fodaxin, Butylcana, Imipenem, Ampicillin, Cefazolin Ciprofloxacin, Bactrim
Tchagbele, (2024)	-	Antibiotics for hospital use: 3rd gen cephalosporins and aminoglycosides (64.3%), penicillin A (27.8%), macrolides (16.1%)
Chang *et al.* (2021)	*M. pneumoniae* (26%)*; Não M. pneumoniae* (74%)	Azithromycin, Doxycycline
Lee *et al.* (2021)	*M. pneumoniae*	Macrolide; Doxycycline; Fluorquinolone
Williams *et al.* (2022)	-	Amoxicillin; Amoxicillin/ac. Clavulanic acid; Cefdinir
Kuo *et al.* (2022)	*M. pneumoniae*	Macrolides
Ocak *et al.* (2022)	*M. pneumoniae*	Macrolides
Álvaro *et al.* (2022)	*M. pneumoniae*	Azithromycin 60.2 %; Levofloxacin 10.6 %; Amoxicillin+azithromycin 10.6 %; Ceftriaxone+azithromycin 2.4 %; Amoxicillin+clavulamic 8.1 %
Mauritz, *et al.* (2022)	*P. aeruginosa* (13), *E. coli* (13), *Klebsiella pneumoniae* (13), *Haemophilus influenzae* (8,7), *Proteus* mirabilis (8,7) *Serratia marcescens* (8,7), *Achromobacter xylosoxidans* (4,6), *Acinetobacter baumannii* (4,6), *Enterobacter aerogenes* (4,6), *Enterobacter kobei* (4,6), Estreptococos do Grupo C (4,6), MRSA (4,6), *S. aureus* (4,6), *Streptococcus spp.* (4,6)	Broad-spectrum and extended-spectrum penicillins (n = 13; in n = 5 cases, in combination with β-lactamase inhibitors); cephalosporins (n = 13: n = 4 second generation and n = 9 third generation; n = 5 in combination with other substances); ciprofloxacin (n = 3); meropenem plus vancomycin (n = 2); meropenem (n = 1)
Huang *et al.* (2022)	*M. pneumoniae*	Azithromycin; Azithromycin + β-lactams (52%)
Bayhan *et al.* (2023)	*S.aureus*	Sulbactam; ampicillin/amoxicillin clavulanate; third generation cephalosporins; clindamycin Teicoplanin; vancomycin

Source: Research data (2024).

DISCUSSION

In this study, we carried out a descriptive and qualitative analysis of the existing literature on epidemiological data and the pharmacological treatment used to combat pneumonia. As discussed above, the delineation of an epidemiological profile is necessary to verify the main factors surrounding pneumonia, which allows the best preventive and therapeutic management to be selected.

EPIDEMIOLOGICAL ASPECTS

It is interesting to note that the focus of the research was on children due to their greater susceptibility to lower respiratory tract infections (LRTI), which is justified by the immaturity of the immune system, as it is still developing, incomplete or absent immunization and greater exposure to pathogens. We observed a predominance of pneumonia in male children, with a proportionality (Rossi *et al*., 2023; Chang *et al*., 2021).

Of the 15 articles selected, only three authors reported a greater incidence of the disease in female patients (Kuo *et al*., 2022; Chang *et al*., 2021; Lee *et al*., 2021). With regard to age, children under 5 years of age are characterized as the main target group for bacterial pneumonia (Kuo *et al*., 2022). We did not find a specific explanation for this information.

It also addresses the seasonality of these infections, which prevails at the beginning of the school term, between April and June, in Asian countries, whose regions have carried out studies on this parameter. In addition, Tsai *et al.* (2022) report a higher mortality rate (59%) due to pneumococcal meningitis after survival to treatment in low-income countries, highlighting the socioeconomic aspect of the disease as an important risk factor.

In addition, there is a greater predisposition to contracting bacterial pneumonia when the child has some pre-existing comorbidity, especially heart disease and asthma, as well as prematurity and genetic or chromosomal abnormalities (Jiang *et al*., 2022; Kuo *et al*., 2022). However, Jiang *et al.* (2022) presented an interesting perspective related to pediatric pneumococcal disease (PPD), whose research analyzed clinical characteristics, antibiotic susceptibility and risk factors for mortality of the disease in Beijing, from 2012 to 2017. This research found that a large proportion, around 44%, of children with ILD have some underlying disease, confirming the risk factors. In addition, they collected data showing that mortality was higher in children who did not have comorbidities, as patients with an underlying disease underwent more intensive treatment than others, which strengthened infection control.

With regard to the tests used, the request for a chest X-ray in cases of pediatric pneumonia stands out, in order to rule out other diagnostic hypotheses, since the symptoms of the disease are quite common. According to the literature surveyed, seven of the eight articles mentioned that tests were carried out, and that chest X-rays were essential to prove pneumonia infections in the group assessed (Tchagbele, 2024; Kuo *et al*., 2022; Ocak *et al*., 2022; Zhang *et al*., 2021; Akahoshi *et al*., 2021; Lee *et al*., 2021). In addition, in some cases they show the need for other complementary tests in order to detect the severity of the pneumonia, such as the presence of leukocytosis associated with bacteremia or antimicrobial resistance (Tchagbele, 2024).

MEDICINAL ASPECTS

During the investigation, *S. pneumoniae e M. pneumoniae* (MP) stood out as the main microbial agents triggering pneumonia. According to previous studies, PM is characterized as the most prevalent bacterium in cases of Community-Acquired Pneumonia (CAP) in children under 1 year of age. Nowadays, the treatment of choice is macrolides, with an emphasis on azithromycin, especially when there is no serious condition, comorbidities or history of recent antibiotic treatment. This drug stands out for its high efficacy in eliminating the pathogen, low toxicity and no contraindications for prescribing it to young children, in addition to the fact that azithromycin is administered in just one dose, making it easier to carry out drug therapy (Tchagbele, 2024; Tsai *et al.*, 2022).

A relevant point to be discussed is the growing resistance to macrolides, especially in the last 10 years, which can be attributed to the indiscriminate and exacerbated use of antibiotic therapy. According to Chang *et al.* (2021), in southern Taiwan, the rate of *M. pneumoniae* infection in children not susceptible to macrolides is 54.3%. In view of this, we observed that the pediatric group with this resistance, when not identified and treated with this antibiotic class, presents more severe and prolonged cases of pneumonia, especially CAP, increasing the number of hospital admissions.

Lee *et al.* (2021) attested to more severe findings on chest X-rays and extrapulmonary involvement compared to patients without resistance. In this context, we note the indication of second-line antibiotics to be used in cases of non-susceptibility to macrolides, such as doxycycline (ultra-long-acting tetracycline), even in children under 2 years of age. We also mention the use of fluoroquinolones in cases of pediatric intensive care, with an effective effect in the treatment of pneumonia (Tsai *et al.*, 2022; Chang *et al.*, 2021; Lee *et al.*, 2021).

With regard to infections by other types of bacteria, such as *S. pneumoniae*, the literature suggests that pharmacological therapy should be carried out with aminopenicillins - amoxicillin and ampicillin - and cephalosporins. However, Tsai *et al.* (2022) report that in the presence of non-susceptibility to penicillin, cefotaxime and cefepime, whose rates have increased over time, ceftriaxone is used. Although this drug is indicated, there have been reports of CNSP (Pneumonia Not Susceptible to Ceftriaxone), and the combination with vancomycin is recommended, as the use of ceftriaxone in these situations can lead to subsequent mortality. In addition, the use of fifth-generation cephalosporins, such as ceftaroline (intravenous application), is recommended for cases of penicillin-resistant *S. pneumoniae* (PRSP).

There are limitations to our study. Firstly, we briefly discussed the temporality and social and economic aspects surrounding pediatric bacterial pneumonia. Secondly, most of the articles selected, after filtering according to the purposes described in the methodology, are from Asian regions, such as Beijing, Taiwan and Tunisia, which delimits the scenario studied, as it does not allow a global view of the proposed theme.

Thus, there is a scarcity of studies carried out in other parts of the world or the fact that articles on the subject are not freely available. Lastly, there was no specific explanation as to why children aged 4.2 years are more affected by bacterial pneumonia, apart from the anatomical and pathophysiological relationship between comorbidities and the disease.

Thus, we can conclude that the strengths of our narrative review refer to the gathering of information selected from the texts highlighted, obtaining a well-defined epidemiological profile in the pediatric context, which includes male children, aged 4.2 years, with underlying diseases such as heart disease, asthma and genetic and chromosomal alterations. In addition, we drew up an appropriate outline for the drug treatment of pediatric bacterial pneumonia hospitalizations, with a prevalence of azithromycin prescriptions for *M. pneumoniae* infections and amoxicillin, ampicillin and ceftriaxone, associated or not with clavulanic acid, in cases of other microbial agents, such as *S. pneumoniae*. In addition, we conducted a search for studies whose content addresses drug alternatives in the presence of antibiotic resistance, with emphasis on doxycycline, vancomycin, fluoroquinolones and fifth-generation cephalosporins.

CONCLUSION

Pneumonia is a disease that is difficult to diagnose and often requires empirical treatment based on the possible causative agents. In the meantime, knowledge of factors such as gender, age, immune status, the most common pathogens for the age group, the origin of the infection and pre-existing comorbidities is essential, as it provides clinical and epidemiological information for establishing appropriate antibiotic therapy.

From the data obtained, we can infer that the epidemiological profile of children hospitalized for bacterial pneumonia consists of infants with an average age of 4.2 years, mainly males, and a considerable proportion with some pre-existing condition, such as heart disease and asthma. As for the medication profile, the use of azithromycin, ampicillin and amoxicillin seems to be well tolerated and effective, with no side effects demonstrated in any study.

Early diagnosis and treatment are essential to avoid complications and tend to result in positive outcomes. Therefore, correct antibiotic therapy can reduce the chances of worsening and minimize the number of hospitalizations, which still represent a major challenge for public health.

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