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ORIGINAL

Prevalence of post-pandemic pneumonia in children under 10 years of age at Ambato General Hospital

Prevalencia de neumonía postpandemia en niños menores de 10 años en el Hospital General Ambato

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ABSTRACT

Introduction: community-acquired pneumonia (CAP) remains a significant cause of pediatric hospitalization in Latin America. Following the COVID-19 pandemic, changes in the seasonality of respiratory viruses and a predominance of viral etiologies have been observed. Local factors such as altitude and the rainy season in the Andean region of Ecuador may influence incidence and severity.
Method: a retrospective case series study was conducted based on the clinical records of children <10 years old hospitalized for pneumonia at Ambato General Hospital between March 2023 and January 2024. The denominator comprised total pediatric discharges (n = 1,720). Cumulative prevalence, temporal distribution, and demographic, clinical, etiologic, and therapeutic variables were calculated using descriptive statistics.
Results: ninety-five cases were identified (5,52 % of pediatric discharges). Cases were concentrated between September 2023 and January 2024, peaking in December. The median age was 3,9 years; 61,1 % were female, and 67 % were <5 years old. The most frequent symptoms were respiratory distress (70,5 %), wet cough (69,5 %), and hypoxemia (52,6 %). The main etiologic agents were influenza A (33,7 %) and rhinovirus/enterovirus (15,8 %). Two-thirds of patients required oxygen, and the majority received empiric antibiotics. No deaths were recorded.
Conclusions: post-pandemic pediatric pneumonia in Ambato presented moderate prevalence, delayed seasonality, and viral predominance. Most patients had favorable outcomes. The study, limited by its retrospective and single-center design, highlights the urgency of strengthening vaccination, optimizing antibiotic use guided by biomarkers, and improving seasonal surveillance, recommending prospective multicenter research for results validation.
Recommendations: under the One Health approach, it is urgent to restore vaccination coverage and implement integrated surveillance to anticipate seasonal peaks.

Keywords: One Health; Pneumonia; Post-Pandemic; Prevalence; Respiratory Viruses; Seasonality.

RESUMEN

Introducción: la neumonía adquirida en la comunidad sigue siendo una causa importante de hospitalización pediátrica en América Latina. Tras la pandemia de COVID-19 se han observado cambios en la estacionalidad de los virus respiratorios y un predominio de etiologías virales. Factores locales como la altitud y la estación lluviosa en la región andina del Ecuador pueden influir en la incidencia y gravedad.
Método: se realizó un estudio de series de casos retrospectivo, en base a los expedientes clínicos de niños <10 años hospitalizados por neumonía en el Hospital General Ambato entre marzo de 2023 y enero de 2024.

El denominador fueron los egresos pediátricos totales (n = 1,720). Se calcularon la prevalencia acumulada, la distribución temporal y las variables demográficas, clínicas, etiológicas y terapéuticas mediante estadística descriptiva.
Resultados: se identificaron 95 casos (5,52 % de los egresos pediátricos). Los casos se concentraron entre septiembre de 2023 y enero de 2024, con un pico en diciembre. La mediana de edad fue de 3,9 años; el 61,1 % fueron niñas y el 67 % tenían <5 años. Los síntomas más frecuentes fueron dificultad respiratoria (70,5 %), tos húmeda (69,5 %) e hipoxemia (52,6 %). Los principales agentes etiológicos fueron influenza A (33,7 %) y rinovirus/enterovirus (15,8 %). Dos tercios de los pacientes requirieron oxígeno y la mayoría recibió antibióticos empíricos. No se registraron fallecimientos.
Conclusiones: la neumonía pediátrica pospandemia en Ambato presentó prevalencia moderada, estacionalidad tardía y predominio viral. La mayoría de los pacientes evolucionó favorablemente. El estudio, limitado por su diseño retrospectivo y unicéntrico, resalta la urgencia de fortalecer la vacunación, optimizar el uso de antibióticos con biomarcadores y mejorar la vigilancia estacional, recomendando investigaciones prospectivas multicéntricas para la validación de los resultados.
Recomendaciones: bajo el enfoque One Health, urge recuperar coberturas de vacunación e implementar vigilancia integrada para anticipar picos estacionales

Palabras clave: Salud; Neumonía; Pospandemia; Prevalencia; Virus Respiratorios.

INTRODUCTION

Community-acquired pneumonia (CAP) in children is defined as an acute infection of the pulmonary parenchyma acquired outside the hospital setting, with symptoms appearing within the first 48 hours of admission or without recent hospitalization.[1] This condition, which has multiple etiologies (bacterial, viral, or fungal), affects the alveoli, causing inflammation and limiting gaseous exchange, resulting in symptoms such as productive cough and dyspnea.[2] In children, SARS-CoV-2 pneumonia is mild; however, the post-pandemic period has introduced complications such as long COVID and multisystem inflammatory syndrome.[3,4]

Epidemiology

Pneumonia represents a global public health challenge, standing as the leading cause of child mortality. According to UNICEF, it causes one death every 43 seconds, accounting for 725 000 deaths in children under 5 years of age in 2022.[5] In Latin America, the incidence is 919 cases per 100 000 children <5 years old, with a high impact in countries like Peru, which reports 2,2 million annual consultations. In Ecuador, it was the third leading cause of pediatric death in 2019. During the pandemic, 317 pediatric COVID-19 cases were reported from March to April 2020, with a lethality rate of 7,4 % in children <4 years old (1). Post-pandemic, the 2024 Epidemiological Gazette shows a higher incidence in the 1–4-year age group, predominantly in males. Recent studies indicate a bacterial resurgence despite PCV10 vaccination.[6]

In the Sierra (highlands) region, the combination of high altitude, low nocturnal temperatures, and humidity peaks favors the stability of viruses such as influenza and rhinovirus during non-traditional months. Deficient ventilation in schools and daycare centers during the rainy season increases the risk of indoor aerosols. Urban overcrowding, indoor air pollution from biomass fuels, and barriers to immunization access increase the risk of episodes and readmissions.[7]

Etiology

The etiology of pediatric pneumonia in post-pandemic Ecuador is multifactorial, with a predominance of viral agents that have resurged following isolation measures during COVID-19. Respiratory syncytial virus (RSV) is identified as the most frequent pathogen in children under 2 years of age, accounting for up to 39,2 % of severe cases in Ecuadorian studies, followed by human metapneumovirus and adenovirus (1). Other common viruses include influenza A and B, parainfluenza, rhinovirus, and endemic coronaviruses, which collectively cause 60–70 % of CAP cases in this population (8).

Regarding bacterial etiologies, *Streptococcus pneumoniae* persists as the main agent despite PCV13 vaccination, with non-vaccine serotypes emerging in 20–30 % of complicated cases.[9] Other bacterial agents include *Streptococcus pyogenes*, *Staphylococcus aureus*, and *Haemophilus influenzae* type b (Hib), although their incidence has decreased with universal immunization.

Atypical etiologies such as *Mycoplasma pneumoniae* and *Chlamydia pneumoniae* are relevant in school-aged children, contributing to 10–15 % of cases. In Ecuadorian contexts, altitude (>2,500 masl) is associated with greater viral severity, due to chronic hypoxia exacerbating the inflammatory response.[1] Fungi such as *Pneumocystis jirovecii* are rare except in immunocompromised patients, and post-COVID viral-bacterial

coinfection has increased by 15–20 %, complicating the prognosis.[10]

Risk factors for pediatric pneumonia in post-pandemic Ecuador include: a higher incidence in males (1,2 cases for every case in females), attributed to hormonal immunological differences; chronic malnutrition in 20–30 % of rural children, which triples the risk by weakening mucociliary immunity; immunodeficiencies due to HIV or chemotherapy, which increase susceptibility to opportunistic infections fivefold, in addition to vitamin D and C deficiencies (3); other factors include asthma, which increases viral exacerbations by 40 %; post-pandemic "immunity debt," which favors outbreaks and coinfections; and urban overcrowding, which doubles the transmission of respiratory pathogens.[11,12]

Clinical Presentation

The clinical presentation of childhood pneumonia manifests with acute respiratory symptoms, varying by etiology and age, but commonly begins with high fever (>38,5°C), productive cough (in 70–80 % of viral cases), and dyspnea. In children <2 years old, predominant signs include tachypnea (>50 breaths/min), intercostal and subcostal retractions (up to 60 % of cases), nasal flaring, and perioral cyanosis, indicative of moderate-to-severe respiratory distress.[4,10]

Systemic symptoms include chills, anorexia, lethargy, and pleuritic chest pain in school-aged children (20–30 %), while infants may present with irritability and feeding refusal. Auscultation reveals bibasilar crackles in 70–80 % of cases, wheezing in viral etiologies (50 %), and decreased breath sounds over lobar consolidations. In post-COVID contexts, atypical symptoms such as headache and macular rash occur in 10–15 % of coinfections. Oxygen saturation <90 % and dehydration due to tachypnea are predictors of hospitalization, with scales like the Pediatric Early Warning Score (PEWS) >4 indicating severity. In Ecuador, recurrent episodes are associated with high altitude, with a higher frequency of chronic hypoxemia exacerbating symptoms.[1]

Diagnosis

The diagnosis of pediatric pneumonia is primarily clinical, supplemented by examinations to confirm etiology and severity.[10] Chest radiography is the diagnostic standard for detecting alveolar consolidations, interstitial infiltrates, or effusions, recommended in cases of hypoxemia (<90 %) and useful for follow-up. Biomarkers such as procalcitonin (PCT) > 0,5 µg/L suggest bacterial etiology and guide antibiotic therapy, reducing unnecessary use in 30–50 % of cases. A complete blood count (CBC) may show leukocytosis (>15,000/mm^3) with neutrophilia (>70 % left shift) versus lymphocytosis in viral cases. Etiological tests include PCR for viruses/bacteria via nasopharyngeal swab (95 % sensitivity for RSV/influenza) and sputum cultures in severe cases.[13]

Treatment

Empirical treatment is based on age, severity, and local epidemiology. Antibiotics are not used in preschoolers with suspected viral etiology (60–70 % of cases) (13). For bacterial etiology, oral amoxicillin (80–90 mg/kg/day for 5–7 days) is the first-line outpatient treatment, with >85 % efficacy against *S. pneumoniae*.[14] In hospitalized patients, intravenous ceftriaxone (50–100 mg/kg/day) provides empirical coverage; azithromycin (10 mg/kg/day for 3 days) is used for atypical pathogens in children >5 years old.[15] Corticosteroids, such as dexamethasone (0,6 mg/kg/day) with β-agonist inhalers, reduce the length of stay in cases with viral wheezing. Supportive care includes oxygen (if SpO_2 <92 %), IV hydration, and ICU monitoring (5–10 % of cases involve complications). Total treatment duration is 7–10 days, with de-escalation guided by procalcitonin levels.[11]

Objective

To estimate the prevalence of post-pandemic pneumonia in children under 10 years of age treated at the Ambato General Hospital between March 2023 and January 2024, and to describe their clinical, radiological, etiological, and therapeutic characteristics, as well as their outcomes.

METHOD

Study design

An observational, descriptive, and retrospective case series study was conducted at the Ambato General Hospital, which provides general pediatric care to an urban population in the province of Tungurahua, Ecuador. The study period covered March 2023 to January 2024, corresponding to the gradual return to normalcy following the COVID-19 pandemic.

Population and inclusion criteria

All patients under 10 years of age hospitalized with a diagnosis of pneumonia (ICD-10: J12, J13–J16, J18, J20–J22) who met a standardized case definition were consecutively included. This definition required the simultaneous presence of (1) a clinical criterion: acute onset of compatible respiratory symptoms plus at least one systemic manifestation, fever or lethargy, and (2) a supplementary criterion: radiological evidence

of consolidation or infiltrate on the admission chest X-ray, or etiological confirmation by microbiological tests within the first 48 hours. Patients older than 10 years, those whose primary diagnosis was not pneumonia, and records with insufficient documentation to confirm the diagnosis were excluded.

Variables and data sources

Pediatric discharge records (N = 1,720) were used to identify pneumonia cases. Demographic, clinical, etiological, therapeutic, and outcome data were extracted from the clinical charts. For the prevalence calculation, the total number of pediatric discharges during the study period was used as the denominator.

Statistical analysis

Data were analyzed using descriptive statistics, employing measures of central tendency and dispersion for continuous variables, and frequencies for categorical variables. Prevalence was expressed as the percentage of pneumonia discharges relative to the total, and 95 % confidence intervals were calculated. The monthly temporal distribution was plotted, and frequency tables were created for clinical and therapeutic characteristics. The analysis was performed using SPSS software v25.

Ethical considerations

The study was approved by the Ethics Committee for Research in Human Beings (CEISH) of the Technical University of Ambato (Universidad Técnica de Ambato). Being a retrospective analysis, it was considered minimal risk. All data were anonymized, and information management was conducted in accordance with the principles of the Declaration of Helsinki and national health research regulations.

RESULTS

This chapter presents the results from the analysis of 95 pneumonia cases in the population under 10 years of age hospitalized at the Ambato General Hospital during the period from March 2023 to January 2024. The main demographic, clinical, radiological, etiological, and therapeutic characteristics are described, as well as hospital outcomes. The information is organized into tables and figures, accompanied by their respective interpretations, to offer a clear and structured view of the disease burden in the study population.

Demographic characteristics

Table 1. Demographic characteristics of the patients (<10 years, n = 95)

Variable	Category	n	%	Statistic
Total, cases	-	95	100,0	-
Age (years)	-	-	-	Mean ± SD = 3,97 ± 2,05, median [IQR] = 3,90 [2,55–5,30]; range = 0,08–9,60
Age group	<1 year	5	5,3	-
	1–4 years	62	65,3	-
	5–9 years	28	29,5	-
Sex	Female	58	61,1	F:M ratio = 1,57:1
	Male	37	38,9	-

The cohort included 95 pediatric patients, concentrated in preschoolers (1–4 years: 65,3 %); 67–70 % of the series is <5 years old, as expected for pediatric CAP. A female predominance was observed (61,1 %), with a Female: Male ratio of 1,57:1. The central age of 4 years confirms that the greatest burden falls on the initial stages of childhood.

Clinical Presentation

Table 2. Signs and symptoms at admission in children <10 years (n = 95)

Sign / Symptom	n	%
Respiratory distress	67	70,5
Wet (productive) cough	66	69,5
Wheezing/Broncho-obstruction	55	57,9

SpO_2 < 92 % (hypoxemia)	50	52,6
Retractions	41	43,2
Dry cough	26	27,4
Tachypnea	21	22,1

The clinical presentation was dominated by respiratory distress (70,5 %) and wet cough (69,5 %), which were the most frequent findings, followed by wheezing/broncho-obstruction (57,9 %). More than half presented with hypoxemia at admission (52,6 %), justifying the use of oxygen therapy. Nearly half showed retractions (43,2 %), whereas dry cough (27,4 %) and tachypnea (22,1 %) were less common.

Temporal distribution and monthly prevalence

Table 3. Cases and monthly prevalence of pneumonia relative to pediatric discharges (March 2023 - January 2024)

Month	Cases	Discharges	Prevalence (%)	95 % CI (Wilson)	p-value (vs 5,52 % overall)
March 2023	0	161	0	0,00-2,33	0,0002
April 2023	0	159	0	0,00-2,36	0,0002
May 2023	0	104	0	0,00-3,56	0,0045
June 2023	0	139	0	0,00-2,69	0,0006
July 2023	0	142	0	0,00-2,63	0,0006
August 2023	0	158	0	0,00-2,37	0,0003
September 2023	23	160	14,37	9,77-20,65	0,0000
October 2023	13	175	7,43	4,39-12,29	0,2470
November 2023	16	174	9,2	5,74-14,41	0,0442
December 2023	37	193	19,17	14,24-25,30	0,0000
January 2024	6	155	3,87	1,79-8,19	0,4809

The monthly prevalence was compared to the overall period prevalence (5,52 %) using a two-tailed binomial test; 95 % confidence intervals (Wilson method) are shown per month. The months of September–January concentrated the burden, with December as the peak and $p<0,05$ versus the overall value, confirming a real increase in the proportion of pneumonia cases compared to the rest of the year.

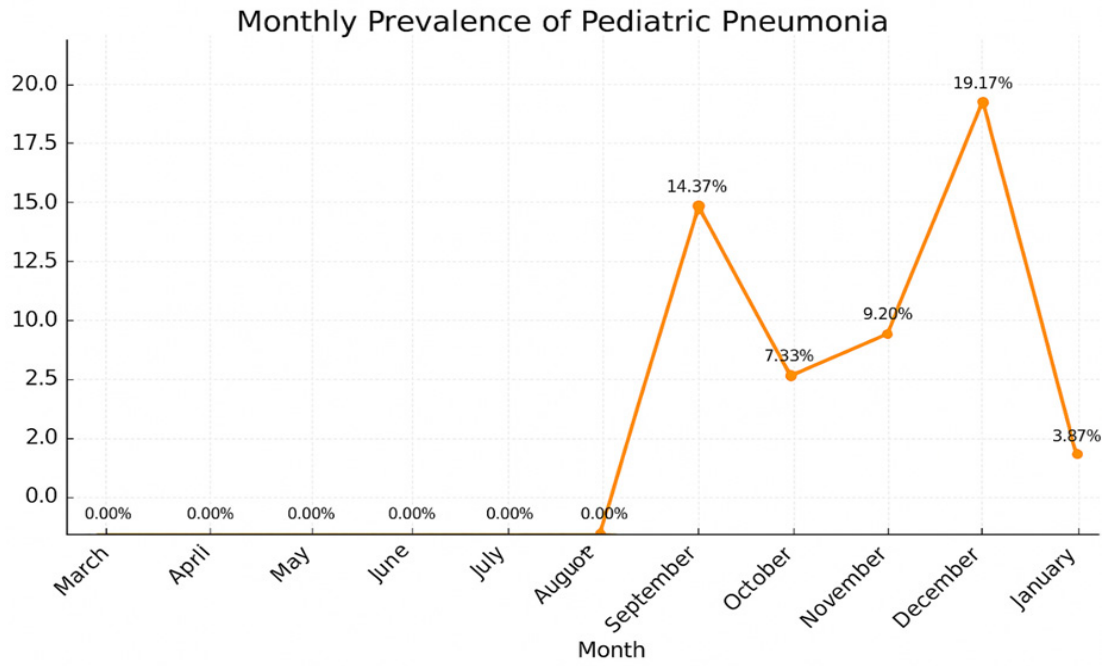

Figure 1. Monthly prevalence of pneumonia in children under 10 years of age. Ambato General Hospital, March 2023 - January 2024

Note: Cumulative prevalence: 95 cases among 1,720 pediatric discharges (5,52 %). The temporal distribution showed a late outbreak peaking in December 2023.

During the analyzed period (March 2023 – January 2024), a marked seasonality was observed. No cases were registered between March and August, but an outbreak emerged in September with 23 cases (14,4 %). The prevalence partially decreased in October (7,4 %), rebounded in November (9,2 %), and reached its maximum in December (37 cases; 19,2 %), where nearly 1 in 5 pediatric discharges was for pneumonia. In January 2024, a clear decline to 3,9 % was registered.

Overall, the cumulative prevalence of hospital-acquired pneumonia was 5,52 % (95 cases out of 1 720 discharges). This is equivalent to 55 pneumonia cases per 1 000 pediatric discharges. The epidemic pattern was concentrated in the last quarter of 2023, reflecting the typical winter seasonality of respiratory viruses in the Ecuadorian Sierra.

Etiological Agents

Table 4. Etiological agents detected in patients with pneumonia (n = 95)

Agent	n	% of cohort
Influenza A	32	33,7
Rhinovirus/Enterovirus	15	15,8
Parainfluenza 3	9	9,5
Respiratory Syncytial Virus (RSV)	7	7,4
Metapneumovirus	4	4,2
Influenza B	2	2,1
SARS-CoV-2	2	2,1
Mycoplasma pneumoniae	1	1,1
Adenovirus	1	1,1

In most patients (76,8 %), a viral agent was identified, confirming the post-pandemic predominance of viral pneumonia. The most frequent agent was Influenza A (33,7 %), followed by rhinovirus/enterovirus (15,8 %), parainfluenza 3 (9,5 %), and RSV (7,4 %). Less common agents included metapneumovirus, influenza B, SARS-CoV-2, *Mycoplasma pneumoniae*, and adenovirus, all with proportions ≤5 %. Nearly 1 in 4 cases (23,2 %) had no identified viral etiology, suggesting a probable bacterial origin in this subgroup.

Treatment

Table 5. Therapeutic interventions used in children with pneumonia (n = 95)

Intervention	n	%
Oxygen therapy	63	66,3
Systemic corticosteroid	89	93,7
Ceftriaxone	73	76,8
Clarithromycin	52	54,7
Bronchodilator	65	68,4
Amoxicillin/clavulanic acid	13	13,7

The 66,3 % of the children required supplemental oxygen, while 33,7 % remained on room air without needing additional support. The use of systemic corticosteroids (93,7 %) and bronchodilators (68,4 %) confirms the relevance of the obstructive component in this cohort. Regarding antibiotic therapy, the majority received ceftriaxone (76,8 %), with clarithromycin (54,7 %) to cover atypical pathogens. The use of amoxicillin/clavulanic acid was lower (13,7 %), reserved for selected cases. The overall regimen reflects a broad empirical approach, adapted to the initial difficulty in discriminating between viral and bacterial etiologies, with universal respiratory support.

DISCUSSION

The cumulative prevalence of hospital-acquired pneumonia (5,52 %; 95/1 720 discharges; 95 % CI 4,44–6,60), with 94 % of cases occurring between September 2023 and January 2024 and a peak in December

(37/95), describes a late pattern of high respiratory virus circulation. This seasonal shift is expected in the post-confinement period, as school and community interactions resume, and it aligns with reports documenting altered seasonality and intense winter waves following the withdrawal of non-pharmacological interventions.[16,17] Recent climatic variability, with warmer, more humid episodes or unusual rainfall, may prolong the survival of indoor aerosols and favor peaks in non-traditional months, which helps explain the concentration of cases at the end of the calendar year in this case series.[16]

The viral predominance in the cohort, with viral detection in approximately 77 % of cases, aligns with systematic reviews and syntheses from low- and middle-income countries (LMICs), which estimate that most hospitalized childhood pneumonias are of viral etiology and that, following the introduction of conjugate vaccines, the classic bacterial fraction has proportionally decreased.[18] This etiological shift from *pneumococcus* and *H. influenzae* to respiratory viruses is consistent with Latin American and global evidence.[19] In our setting, the "immunity debt" accumulated from reduced pathogen exposure during 2020–2022, added to pandemic-related interruptions or delays in vaccination (particularly seasonal influenza and Expanded Program on Immunization (EPI) boosters), increased susceptibility in infants and preschoolers. Furthermore, the national immunization schedule does not confer cross-protection against most respiratory viruses (RSV, rhinovirus, metapneumovirus, parainfluenza); therefore, even with acceptable PCV/Hib coverage, the risk of viral waves persists.[20]

Among the agents, influenza A (33,7 %) was reported as the most frequent virus, followed by rhinovirus/enterovirus (15,8 %), parainfluenza 3 (9,5 %), and RSV (7,4 %). The preponderance of influenza A during the last quarter of 2023 coincides with global surveillance, which reported an increase in influenza hospitalizations and a predominance of A-H1N1pdm09 towards late 2023 and early 2024.[17] Concurrently, the significant role of rhinovirus is consistent with modern series (2019–2024) showing detection rates around 25–30 % in pediatric acute respiratory infection (ARI) and pneumonia, with year-round circulation and peaks during the school season. In several post-pandemic studies, rhinovirus has emerged as the most common virus in childhood respiratory infections, with increasing findings of associated pneumonia.[21,22]

Regarding RSV, although it represented 7–8 % in this series, the literature maintains RSV as the leading individual cause of lower acute respiratory tract infection (ALRI) in children under 5 globally, with burdens that rebounded in 2021–2023 and seasonality adjustments in 2022–2023. This suggests that the low proportion of RSV here could be explained by the age structure (mean 4 years) and the observation period, which was more heavily weighted with influenza and rhinovirus. The relevance of RSV as a public health priority is reinforced by the recent recommendation for maternal immunization.[23,24,25]

The observed treatment, based on the administration of ceftriaxone (76,8 %) and clarithromycin (53,7 %), reflects the broad empirical approach given the difficulty of discriminating bacterial etiology at admission. However, when contrasted with recent syntheses, there is a trend toward shortening antibiotic duration (3–5 days) in uncomplicated pneumonia, without loss of efficacy compared to traditional 7–10-day regimens; integrating biomarkers like PCT and chest radiography can reduce antibiotic exposure. These antibiotic stewardship strategies could be considered in future local guidelines, especially when the pre-test probability of viral infection is high.[26,27]

Regarding respiratory support, the database showed that not all patients required supplemental oxygen; it was estimated that 66,3 % received O_2 (>0 L/min), and 33,7 % remained on room air (RA). Current evidence on high-flow nasal cannula (HFNC) in pediatric pneumonia/hypoxemic failure suggests its utility as early support; however, debate persists regarding its overuse outside of bronchiolitis. Recent meta-analyses report selective clinical benefits versus conventional oxygen or CPAP depending on the setting and severity.[28,29,30]

The good prognosis of the cases presented (no lethality, median stay of 5 days) is consistent with post-pandemic series which, despite the healthcare volume, have not observed substantial increases in pediatric pneumonia mortality. Nonetheless, the hospitalization burden from respiratory viruses, particularly RSV, increased in 2021–2022 and remained high in 2023–2024, warning of the need to improve vaccination coverage (influenza, SARS-CoV-2) and sustain surveillance.[25]

From a population perspective, this study quantifies the post-pandemic burden and characterizes its seasonality and etiological mix in a high-altitude hospital, providing regional context. National bulletins from 2024 report >19 000 pneumonia cases, with the highest burden in Sierra (highland) provinces, consistent with our year-end peak.[31] In parallel, reviews on invasive pneumococcal disease (IPD) emphasize that *pneumococcus* remains a priority severe bacterial agent; therefore, sustaining the Pneumococcal Conjugate Vaccine (PCV) and monitoring emerging serotypes remain key to containing outbreaks and antimicrobial resistance.[32,33]

Under the One Health framework, the interaction between environmental factors (altitude, humidity, school ventilation), social factors (overcrowding, indoor pollution), and programmatic factors (vaccination gaps, lack of EPI cross-protection against viruses) explains why pneumonia continues to be the leading cause of child mortality in multiple contexts. Translating these findings into vaccination policies, integrated surveillance, and antibiotic optimization could buffer future peaks and improve clinical outcomes in the pediatric population.[34]

CONCLUSIONS

Post-pandemic pneumonia in children under 10 years treated at the Ambato General Hospital showed a moderate prevalence, with a late seasonality concentrated in the last quarter of 2023 and a predominance of viral agents, especially influenza A and rhinovirus/enterovirus. Although most patients required oxygen and received empirical antibiotics, outcomes were favorable, and no deaths were registered. These findings support the need to reinforce vaccination, optimize antibiotic use guided by biomarkers, and strengthen epidemiological surveillance to anticipate outbreaks and improve the health response.

RECOMMENDATIONS

It is recommended to strengthen catch-up childhood vaccination campaigns, especially against influenza and pneumococcus; implement integrated epidemiological surveillance under the One Health approach, considering environmental and climatic factors; and, in the hospital setting, optimize the rational use of antibiotics and criteria for oxygen therapy using rapid tests and biomarkers. In the community, ventilation measures in schools and daycare centers must be reinforced, along with educating parents and caregivers on the importance of vaccination and the early detection of signs of respiratory distress.

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