Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Medicine

Pneumonia-Related Mortality in Individuals Under 15 Years of Age in Ecuador

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DOI: https://doi.org/10.36347/sjams.2026.v14i07.004 | **Received:** 23.05.2026 | **Accepted:** 04.07.2026 | **Published:** 09.07.2026

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Abstract | **Original Research Article**

Objective: Pneumonia remains a leading cause of preventable mortality among children worldwide, particularly in low- and middle-income countries. Comprehensive national estimates of pneumonia-related mortality in children remain limited. To describe the epidemiology of pneumonia-related mortality in individuals under 15 years of age in Ecuador in 2023. ***Methods:*** A cross-sectional analysis was conducted using mortality data from the National Mortality Registry, administered by the Instituto Nacional de Estadística y Censos (INEC) of Ecuador. Pneumonia-related deaths were identified based on the International Classification of Diseases, 10th Revision (ICD-10), codes J12–J18. Crude mortality rates for pneumonia in children under 15 years of age were calculated using registered deaths and 2023 population projections. ***Results:*** Out of 3,843 pneumonia deaths nationwide, 303 (7.9%) occurred in individuals under 15 years, corresponding to a crude mortality rate of 6.6 per 100,000 (95% CI: 5.9–7.4). Children <5 years accounted for 52.5% of deaths, with the highest frequencies at ages 1–3 years. Males comprised 53.1% of cases. Most deaths (79.5%) were coded as unspecified pneumonia (J18). Mortality rates were highest in high-altitude Andean provinces such as Chimborazo (20.4/100,000; 95% CI: 12.4–28.4) and Cotopaxi (20.3/100,000; 95% CI: 12.3–28.3). Indigenous children represented 11.9% of deaths. ***Conclusions:*** Pneumonia remains an important cause of childhood mortality in Ecuador, particularly among young children, high-altitude provinces, and indigenous populations. These findings highlight the urgent need to strengthen preventive strategies vaccination, nutritional support, and early detection while addressing diagnostic limitations and ensuring equitable access to care.

Keywords: Pneumonia, Ecuador, Child, Mortality, Epidemiology, Altitude.

INTRODUCTION

Pneumonia remains one of the most significant causes of morbidity and mortality in children globally, particularly in low and middle-income countries [1]. Between 2000 and 2015, global mortality due to pneumonia in children under five declined by more than 50%, yet the condition still resulted in approximately 900,000 deaths in 2015 alone [2]. Key risk factors identified in systematic reviews include young age (especially under six months), hypoxemia, malnutrition, and comorbid illness, which consistently predict poor outcomes and increased mortality in pediatric pneumonia [3].

In Latin America, the burden of childhood pneumonia continues to be substantial, with an estimated 12,000 to 28,000 annual deaths in the region, despite public health efforts [4]. In Ecuador, comprehensive and consolidated epidemiological data on pneumonia mortality in children and adolescents are limited. This gap limits the capacity to design targeted public health interventions, particularly in vulnerable subgroups such as those living in high-altitude regions or in historically marginalized populations.

The objective of this study was to describe the epidemiology of pneumonia-related deaths individuals under 15 years of age in Ecuador for the year 2023, using data from the national death registry.

METHODS

This is a cross-sectional, descriptive, observational study based on secondary data obtained from the *Registro Estadístico de Defunciones Generales*,

compiled by the Instituto Nacional de Estadística y Censos (INEC) of Ecuador (5). This registry compiles all officially recorded deaths that occurred and were registered within Ecuador. The anonymized data are publicly accessible through the official INEC website in SPSS-compatible format [5]. The present analysis included all deaths registered in 2023, the most recent year available. Pneumonia-related deaths were identified using ICD-10 codes J12–J18. From the total records, only deaths occurring in individuals under 15 years of age were included in the final count. To estimate the crude mortality rate, the population under 15 years of age was calculated using age-specific population projections published by INEC in 2024 [6]. The total projected population under 15 years for 2023 was 4 590 425. The crude mortality rate was calculated as follows:

Crude Mortality Rate = (Number of pneumonia deaths under 15 years of age/Population under 15 years of age) × 100000

Ninety-five percent confidence intervals (95% CI) were estimated assuming a Poisson distribution. Analyses were conducted using IBM SPSS Statistics (version 30.0.0, IBM Corp., Armonk, NY, USA). This study was exempt from ethics committee review, as it was based solely on anonymized and publicly accessible mortality data obtained from the Instituto Nacional de Estadística y Censos (INEC) national registry, in accordance with national regulations and institutional policies.

RESULTS

In 2023, a total of 3,843 deaths due to pneumonia (ICD-10 J12–J18) were recorded in Ecuador. Of these, 303 deaths (7.9%) occurred in individuals under 15 years of age, while 3,540 deaths (92.1%) corresponded to individuals aged 15 years or older. Based on the projected national population of 4,590,425 inhabitants under 15 years, the crude mortality rate for pneumonia in this age group was 6.6 deaths per 100,000 population.

Among the 303 deaths under 15 years of age, the mean age at death was 4.31 years (95% CI: 3,95–4,68), with a median of 3 years. The minimum and maximum ages were 1 and 14 years, respectively, and the standard deviation was 3.23 years. The interquartile range was 4 years. The highest frequencies were observed at 1 year (21.1%), 2 years (16.8%), and 3 years (14.5%), which together accounted for 52.5% of all pneumonia-related deaths in this age group. After age 4, the frequency progressively declined, representing less than 5% per year from age 7 onwards, with the lowest proportions between 12 and 14 years of age (≤1.3% each year). With respect to sex, 161 deaths (53.1%) occurred in males, while 142 deaths (46.9%) occurred in females.

According to ICD-10 classification, 79.5% (n=241) of deaths were registered as unspecified pneumonia (J18), 15.5% (n=47) as bacterial pneumonia not classified elsewhere (J15), 4.3% (n=13) as viral pneumonia not classified elsewhere (J12), and 0.7% (n=2) as pneumonia due to Streptococcus pneumoniae (J13).

When analyzing the province of death, the largest number of cases occurred in Guayas with 79 deaths (26.1%) and Pichincha with 65 deaths (21.5%), followed by Chimborazo with 23 deaths (7.6%), Cotopaxi with 21 deaths (6.9%), and Manabí also with 21 deaths (6.9%). Lower but relevant frequencies were observed in Azuay (3.6%), Esmeraldas (4.0%), Tungurahua (4.0%), Imbabura (2.6%), Loja (2.6%), Los Ríos (3.3%), and El Oro (2.0%), while other provinces registered fewer than five cases.

When considering the province of residence, the highest frequencies were found in Guayas with 63 deaths (20.8%) and Pichincha with 47 deaths (15.5%), followed by Cotopaxi and Chimborazo with 25 deaths each (8.3%), and Manabí with 23 deaths (7.6%). Intermediate proportions were recorded in Los Ríos (5.9%), Esmeraldas (5.0%), and Tungurahua (5.0%), while lower frequencies were observed in provinces such as Imbabura, Loja, Santa Elena, El Oro, and Azuay, and fewer than five cases in the remaining provinces.

The analysis of mortality rates by province of residence showed the highest values in Chimborazo (20.4 per 100,000; 95% CI: 12,4–28,4) and Cotopaxi (20.3; 95% CI: 12,3–28,3), followed by Pastaza (13.3; 95% CI: 1,6–24,9) and Tungurahua (10.6; 95% CI: 5,2–15,9). Intermediate rates were observed in Santa Elena (9.1; 95% CI: 3,4–14,7), Esmeraldas (8.3; 95% CI: 4,1–12,5), Imbabura (7.4; 95% CI: 2,5–12,2), Loja (7.0; 95% CI: 2,4–11,5), and Pichincha (6.7; 95% CI: 4,8–8,6). When grouping provinces according to geographical altitude, the median mortality rate was 6.9 per 100,000 in high-altitude provinces (Andean region), compared with 5.2 per 100,000 in low-altitude provinces (coastal, Amazon, and insular regions). With respect to self-identified ethnicity, most pneumonia-related deaths in individuals under 15 years occurred among the mestizo population, with 217 cases (71.6%). Other groups reported were indigenous (36; 11.9%), Afro-Ecuadorian / Afro-descendant (5; 1.7%), Black (4; 1.3%), Montubio (2; 0.7%), and White (2; 0.7%). In 37 cases (12.2%), no information on ethnic identification was available.

DISCUSSION

This study provides an updated description of pneumonia-related mortality in Ecuadorian children and adolescents under 15 years, based on national mortality data for 2023. The crude mortality rate observed (6.6 per 100,000 population under 15 years) falls within the intermediate range of estimates reported for Latin

America, although important differences by age, geographic region, and ethnic background were identified.

The predominance of deaths in younger children, particularly those under five years, is consistent with global and regional evidence showing that up to 80% of pneumonia deaths occur in this age group (2,4). Our data show that more than half of the deaths were concentrated between 0 and 3 years of age, aligning with international reports that emphasize the vulnerability of infants and toddlers due to immature immunity, higher prevalence of malnutrition, and greater exposure to environmental risk factors (2).

Regarding sex, we observed a slight predominance of deaths in males. This finding is in line with multicenter studies suggesting a modest male excess in pneumonia mortality, although other reports from South Asia and Africa have shown variable sex patterns (7,8).

The ICD-10 distribution revealed that most deaths were coded as unspecified pneumonia (J18), followed by bacterial and viral pneumonia. Similar trends have been described in other Latin American countries, where diagnostic limitations and restricted access to microbiological confirmation frequently result in nonspecific classification of pneumonia deaths (9). In a recent study, mixed viral-bacterial infections were common and respiratory viruses, particularly respiratory syncytial virus, predominated as causative agents (9). This highlights the challenge of relying on mortality registries to fully capture the underlying etiology.

Geographic analysis revealed notable disparities. Provinces located at higher altitudes in the Andean region, such as Chimborazo and Cotopaxi, presented the highest mortality rates, in contrast with lower rates in coastal and Amazonian provinces. A similar pattern has been reported in Peru, where Andean regions maintain higher pneumonia incidence and mortality compared with coastal areas, partially explained by climatic conditions, socioeconomic disadvantage, and reduced access to timely health care (10). This finding suggests that geography-related structural inequities may contribute significantly to pediatric pneumonia mortality in Ecuador.

From an ethnic perspective, most deaths occurred among mestizo children, reflecting the population distribution in Ecuador. However, the proportion of deaths among indigenous groups was substantial (11.9%), echoing evidence that socially and economically disadvantaged populations, including indigenous and Afro-descendant groups, face higher risk due to barriers in health care access and higher prevalence of risk factors (4,10,11).

Our results are consistent with the regional trends described by Fuchs et al. (4), who reported heterogeneity across Latin America, with countries such as Chile and Uruguay achieving lower mortality rates, while Bolivia, Peru, and Guyana remain among the highest. Furthermore, our findings of higher pneumonia mortality in high-altitude provinces align with Ortiz-Prado et al, confirming elevated mortality above 2,500 meters. That study attributes this to limited healthcare access and geographic isolation in these regions (11).

This study has several strengths, including the use of a comprehensive, nationwide mortality registry and a large sample that allowed stratified analyses by age, sex, province, and ethnicity. However, certain limitations should be acknowledged. First, reliance on death certificates may lead to misclassification, particularly given that most cases were coded as unspecified pneumonia (J18). Second, underreporting may occur in rural and indigenous communities, potentially underestimating the true burden. Finally, the cross-sectional design precludes assessment of temporal trends. Despite these limitations, the findings provide valuable evidence to guide public health strategies aimed at reducing pneumonia-related mortality in Ecuador.

Furthermore, comparing our findings with global estimates, the crude mortality rate observed in Ecuador is lower than that reported in high-burden regions such as Sub-Saharan Africa or South Asia but remains significant given the preventable nature of most pneumonia deaths. Global analyses demonstrate that reductions in mortality over the past two decades have been largely driven by vaccination programs, improved case management, and declines in malnutrition (12,13). Continued investment in these strategies, particularly in ensuring equitable access across geographic and ethnic groups, will be essential to further reduce pneumonia-related mortality in Ecuador.

CONCLUSION

Pneumonia remains a preventable yet important cause of childhood mortality in Ecuador, with the greatest impact on children under five years of age. The higher mortality observed in Andean provinces and among indigenous populations highlights persistent structural inequities in healthcare access. Urgent action is needed to strengthen vaccination programs, improve nutritional support, ensure timely case detection, and expand diagnostic capacity. Addressing these disparities will be essential to accelerate progress toward reducing pneumonia-related mortality in Ecuador.

Table 1: Demographic and clinical characteristics of pneumonia-related deaths in individuals under 15 years of age, Ecuador, 2023

Characteristic	n (%) or Value
Total pneumonia-related deaths	303
Crude mortality rate (per 100,000)	6.6 (95% CI: 5.9–7.4)
Age, mean ± SD (years)	4.31 ± 3.23
Median age (IQR), years	3 (4)
Age range (years)	1–14
Age group	
1–3 years	159 (52.5)
4–14 years	144 (47.5)
Sex	
Male	161 (53.1)
Female	142 (46.9)
ICD-10 classification	
J18 – Unspecified pneumonia	241 (79.5)
J15 – Bacterial pneumonia	47 (15.5)
J12 – Viral pneumonia	13 (4.3)
J13 – *Streptococcus pneumoniae* pneumonia	2 (0.7)
Self-identified ethnicity	
Mestizo	217 (71.6)
Indigenous	36 (11.9)
Afro-Ecuadorian	5 (1.7)
Black	4 (1.3)
Montubio	2 (0.7)
White	2 (0.7)
Not reported	37 (12.2)

Abbreviations: SD, standard deviation; IQR, interquartile range; CI, confidence interval; ICD-10, International Classification of Diseases, Tenth Revision.

Los datos corresponden a 303 defunciones por neumonía (códigos J12–J18) en menores de 15 años registradas en Ecuador durante 2023.

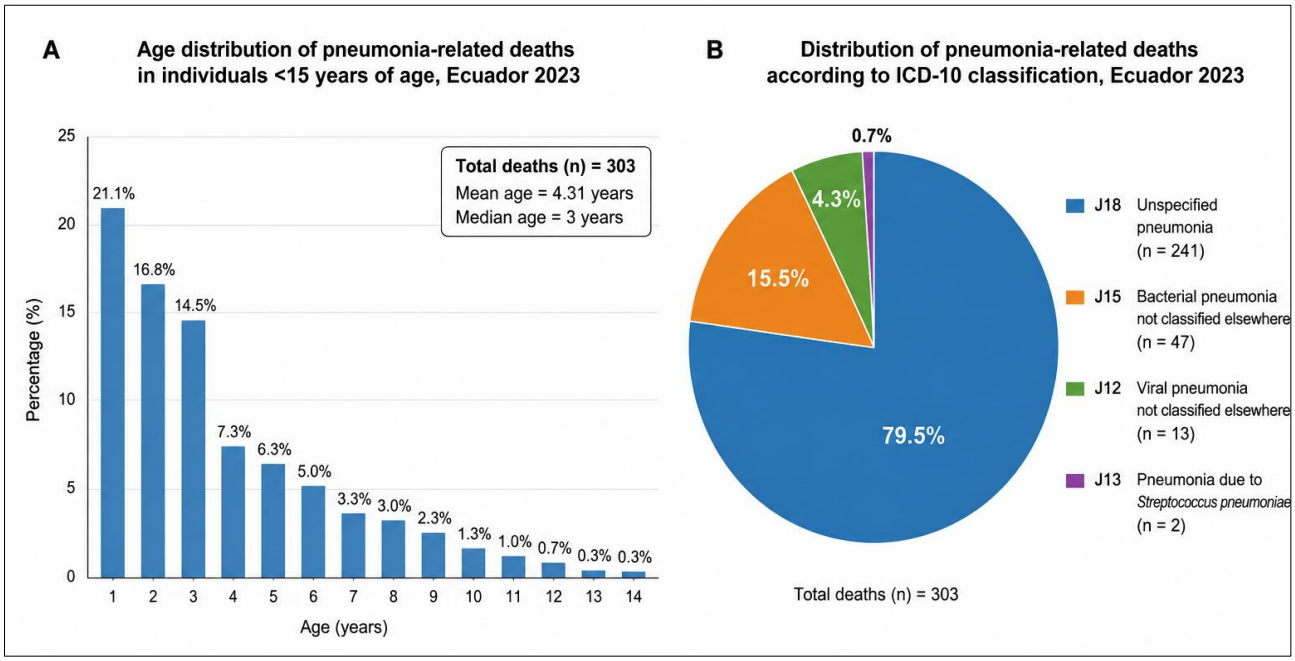

Figure 1: Distribution of pneumonia-related deaths in individuals under 15 years of age, Ecuador 2023. (A) Age distribution of deaths, expressed as percentage frequency. (B) Distribution of deaths according to ICD-10 classification; unspecified pneumonia (J18), followed by bacterial pneumonia not classified elsewhere (J15), viral pneumonia not classified elsewhere (J12), and pneumonia due to *Streptococcus pneumoniae* (J13)

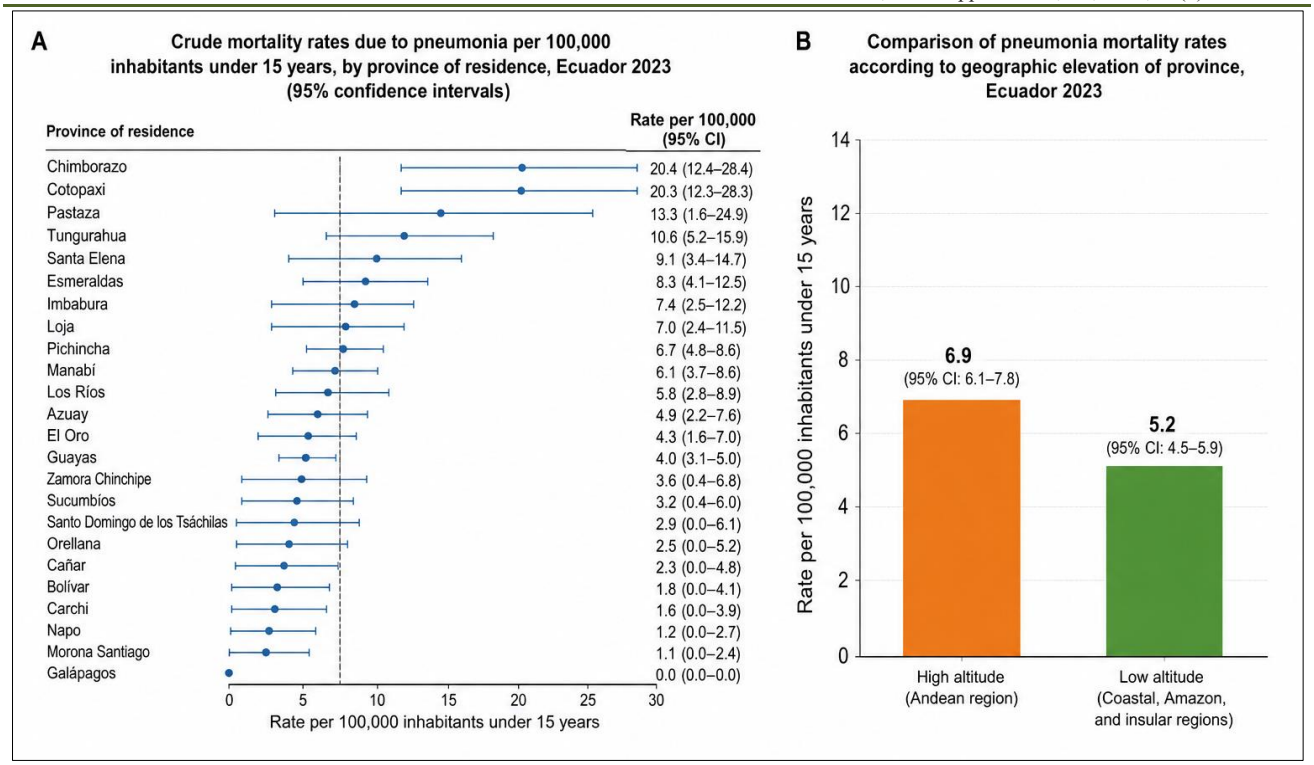

Figure 2: Mortality rates due to pneumonia in individuals under 15 years of age in Ecuador, 2023. (A) Crude mortality rates per 100,000 inhabitants under 15 years (with 95% confidence intervals), stratified by province of residence. (B) Comparison of mortality rates according to the geographic elevation of the province of residence. Provinces at high altitude (Andean region) compared to provinces at low altitude (Coastal, Amazon, and insular regions)

Commercial Relationships Disclosure:

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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