Open Access Library Journal
2025, Volume 12, e14252
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Clinical and Radiologic Profile of Acute Lower Respiratory Tract Infections in Hospitalized Children in the Bamenda Regional Hospital

Ghangha Lizette Nambu[1], Laah Njoyo[1], Njiandock Fomenky[1], Mah Evelyn[2], Tanlaka Lucas Mengnjo[3], Lukong Hubert Shalanyuy[4*], Leonard Nyuyseni Randze[5]

[1]Faculty of Health Sciences, The University of Bamenda, Bamenda, Cameroon
[2]Faculty of Health Sciences, The University of Yaoundé , Bamenda, Cameroon
[3]The Cameroon Baptist Convention (CBC) Health Services, Bamenda, Cameroon
[4]School of Medical and Biomedical Sciences, National Polytechnic University Institute Bamenda, Bamenda, Cameroon
[5]Eastern State Hospital, Medical Lake, Washington State, USA
Email: *lukong.hubert@gmail.com

How to cite this paper: Nambu, G.L., Njoyo, L., Fomenky, N., Evelyn, M., Mengnjo, T.L., Shalanyuy, L.H. and Randze, L.N. (2025) Clinical and Radiologic Profile of Acute Lower Respiratory Tract Infections in Hospitalized Children in the Bamenda Regional Hospital. *Open Access Library Journal*, **12**: e14252.
https://doi.org/10.4236/oalib.1114252

Received: September 8, 2025
Accepted: October 13, 2025
Published: October 16, 2025

Abstract

Acute lower respiratory tract infections (ALRTIs) remain a major cause of hospitalization among children and are a leading contributor to mortality in children under five years. Globally, there are approximately 156 million new cases annually, with over 151 million occurring in low-resource settings. This study aimed to describe the clinical and radiologic presentation, associated risk factors, and outcomes of ALRTIs in hospitalized pediatric patients. A prospective cohort study was conducted between January and May 2024. Data were gathered on demographics, comorbid conditions, clinical signs, chest radiographic findings, and patient outcomes. Descriptive statistics such as frequencies and percentages were used to present the results. Associations were analyzed using adjusted odds ratios (aOR) with 95% confidence intervals (CI); a p-value of less than 0.05 was considered statistically significant. Among 440 pediatric admissions at the Bamenda Regional Hospital, A total of 105 children with acute lower respiratory tract infections (ALRTIs) were analyzed, with the majority aged 7 - 36 months (48.6%) and 58.1% being male. Most children resided in urban areas (61.9%), and parental education was predominantly secondary or tertiary. Pneumonia was the most common ALRTI (81.0%, prevalence 19.3%), followed by bronchiolitis (10.5%) and bronchitis (8.6%). The most frequent symptoms included cough (100%), fever (93.3%), difficulty breathing (69.5%), and noisy breathing (52.4%), with systemic inflammatory response syndrome and respiratory distress syndrome being common. Radiological findings showed alveolar consolidation in 96.7% and bilateral lung involvement in 45%.

Bivariate analysis revealed that maternal age > 20 years significantly reduced the odds of severe ALRTIs (OR = 0.27, p = 0.043), while malnutrition increased severity risk (p = 0.025). Multivariate analysis confirmed maternal age > 20 years (AOR = 0.21, p = 0.030) as protective and malnutrition (AOR = 1.91, p = 0.045) as a significant risk factor. Gastroenteritis showed borderline significance in bivariate analysis (p = 0.049) but was not significant after adjustment (AOR = 0.84, p = 0.825). Overall, 97.1% of children were successfully treated and discharged, while 2.9% died. ALRTIs accounted for 24.0% of pediatric hospitalizations. SIRS, consolidation, and respiratory distress were the main clinical syndromes, while alveolar consolidation and bronchial thickening were the primary radiologic findings. Maternal age and acute malnutrition significantly influenced disease severity.

Subject Areas

Infectious Diseases, Radiology & Medical Imaging

Keywords

Acute Lower Respiratory Tract Infections, Clinical Features, Radiologic Findings, Risk Factors, Outcomes, Pediatric Population

1. Introduction

Acute lower respiratory tract infections (ALRTIs) refer to infections affecting areas of the respiratory system below the larynx, including tracheitis, bronchitis, bronchiolitis, and pneumonia [1]. Although significant progress has been made over the years—thanks to improvements in vaccination programs, nutrition, socioeconomic conditions, and control of the HIV epidemic [2]—ALRTIs still represent the primary cause of death in children under the age of five, excluding the neonatal period. Globally, these infections are responsible for more than 20% of pediatric deaths, with pneumonia alone accounting for up to 15% of under-five mortality [3]. It is estimated that between 11 and 20 million children are hospitalized annually due to ALRTIs, and over 2 million die as a result [4].

The burden of ALRTIs is particularly severe in low-income regions, especially sub-Saharan Africa, which accounts for over half of global cases. Reported prevalence in these settings varies between 1.6% and 60.1%, with an associated mortality rate of approximately 15%. In Cameroon, recent data indicate a national ALRTI prevalence of 11.5% [5]. A 16-year mortality review in Northern Cameroon found that children accounted for 67% of all deaths, with ALRTIs—predominantly pneumonia—being the leading cause (24%), followed by malaria (21%) and diarrheal illnesses (19%) [6]. On average, children under five years' experience about five episodes of ALRTIs annually, most of which are mild and self-limiting. However, ALRTIs are still responsible for 20% - 40% of hospitalizations and 30% - 50% of outpatient visits in paediatric health settings [7]. These infections signif-

icantly contribute to childhood morbidity and mortality, influenced by environmental, socio-demographic, and cultural determinants.

Timely identification of clinical symptoms and interpretation of radiological signs are key to early diagnosis and effective intervention. Despite the significant burden of ALRTIs in young children globally, limited data exist in Cameroon regarding their clinical and radiologic presentation. This study, titled "The Clinical and Radiologic Profile of ALRTIs in Hospitalized Children," aims to describe the diagnostic features, associated risk factors, and outcomes of ALRTIs among hospitalized children, thereby enriching current understanding and guiding more effective prevention and management strategies.

2. Materials and Methods

This cohort study was conducted in the pediatric unit of the Bamenda Regional Hospital over a five-month period, from January 1st to May 31st, 2024. Ethical approval was granted by the hospital's review board, and written informed consent was obtained from all parents or guardians before participation. The sampling frame comprised all children aged 3 months to 16 years who presented to the paediatric unit with clinical features suggestive of acute lower respiratory tract infections (ALRTIs) during the study period. A total of 111 children were initially recruited. Of these, six were excluded: two because caregivers declined consent, two due to incomplete clinical records, and two because chest radiographs were of insufficient quality for interpretation. This left 105 children who were included in the final analysis. Children with pre-existing chronic cardio-respiratory conditions such as asthma, congenital abnormalities, or bronchopulmonary dysplasia were excluded a priori to avoid confounding by underlying disease. Data collection involved face-to-face interviews with caregivers or patients (where applicable), clinical examination of the children, review of their medical records, and interpretation of chest radiographs by a radiologist. To minimize information bias, the radiologist was blinded to detailed clinical data, having access only to age and sex of the child. ALRTI diagnoses were confirmed by a paediatrician, and patient outcomes were recorded at discharge. Information on socio-demographics, clinical findings, comorbidities, and radiologic characteristics was gathered using a structured questionnaire. The data was securely stored in coded electronic format and entered into CSPro version 7.3. For statistical analysis, the data was exported into R software version 4.2.3. Associations were considered statistically significant at a p-value of less than 0.05.

3. Results

A total of 111 children were recruited for the study; 105 children were included in the analysis and 6 children excluded. A total of 105 children diagnosed with acute lower respiratory tract infections (ALRTIs) were included in the study. The majority of the children (48.6%) were aged between 7 and 36 months, followed by those above 60 months (28.6%). Infants under 6 months constituted 8.6% of the

sample, while children aged 37 - 60 months represented 14.3%. In terms of gender distribution, 58.1% of the children were male and 41.9% female. With respect to place of residence, a larger proportion of the children (61.9%) resided in urban areas, compared to 38.1% from rural settings. Regarding parental education, 46.7% of mothers had attained secondary education, 33.3% had tertiary education, and 20.0% had only primary education. Similarly, most fathers (49.5%) had completed secondary education, while 35.2% and 15.2% had primary and tertiary education respectively. Notably, the vast majority of mothers (88.6%) were older than 20 years, with only 11.4% below this age (See Table 1).

Table 1. Sociodemographic characteristics of the children.

Variable	Frequency (n)	Percentage (%)
Age group in months		
<6	9	8.6
7 - 36	**51**	**48.6**
37 - 60	15	14.3
>60	30	28.6
Gender		
Male	**61**	**58.1**
Female	44	41.9
Residence		
Rural	40	38.1
Urban	**65**	**61.9**
Level of education of mother		
Primary	21	20.0
Secondary	49	46.7
Tertiary	35	33.3
Level of education father		
Primary	37	35.2
Secondary	52	49.5
Tertiary	16	15.2
Age of the mother (in years)		
<20	12	11.4
>20	93	88.6

The most common type of acute lower respiratory tract infection (ALRTI) among the children studied was pneumonia, accounting for 81.0% of cases with a prevalence of 19.3%. This was followed by bronchiolitis (10.5%, prevalence 2.5%) and bronchitis (8.6%, prevalence 2.1%). Overall, ALRTIs had a total prevalence of 24.0% among the hospitalized children, highlighting pneumonia as the predominant clinical form (See Table 2).

Table 2. Prevalence of ALRTI.

Type of lower respiratory tract infection	Frequency(n)	Percentages	Prevalence
Pneumonia	85	81.0	19.3
Bronchiolitis	11	10.5	2.5
Bronchitis	9	8.6	2.1
Total	105	100.0	24.0%

The most frequent found symptoms are shown in **Figure 1** below. The bar chart shows that cough (100%) and fever (93.3%) were the most common symptoms among children with ALRTIs, followed by difficulty in breathing (69.5%) and noisy breathing (52.4%). Less frequent symptoms included refusal to feed (35.2%), vomiting (28.6%), chest pain (19%), and convulsions (10.5%) (See **Figure 1**).

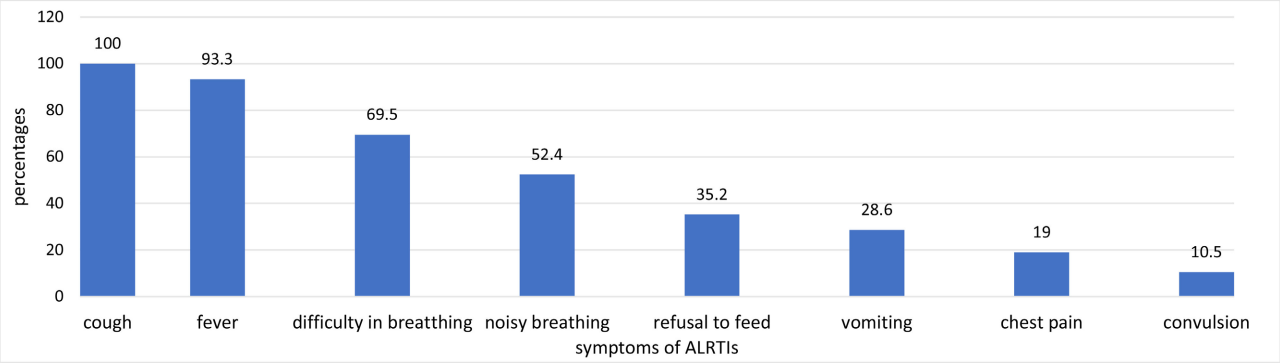

Figure 1. Symptoms of ALRTIs.

The most predominant syndromes were systemic inflammatory response syndrome (69.5%) and respiratory distress syndrome (42.9%) (See **Figure 2**).

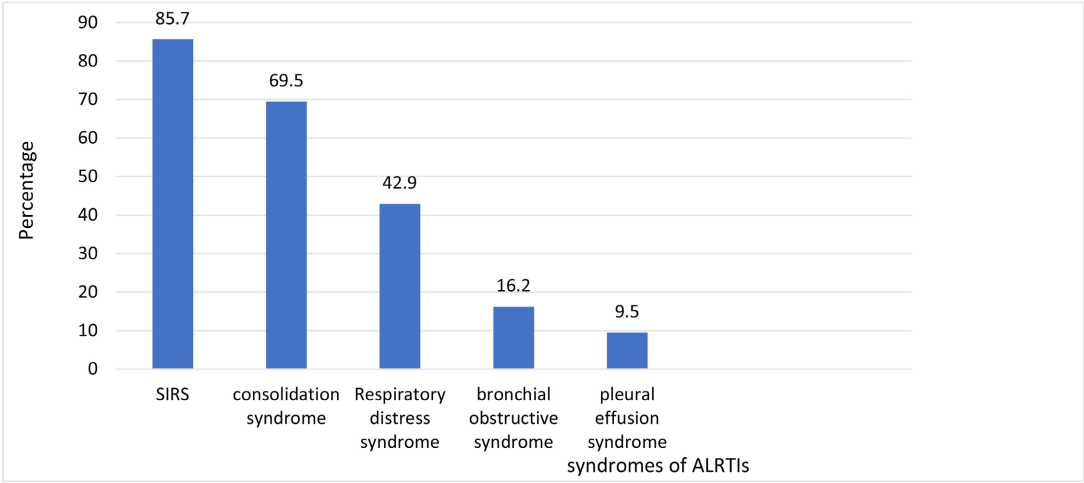

Figure 2. clinical syndromes of ALRTIs.

More than half of the patients had alveolar consolidation (96.7%, n = 70), on CXR, followed by bronchial thickening at 38.1% (n = 40) (See **Figure 3**).

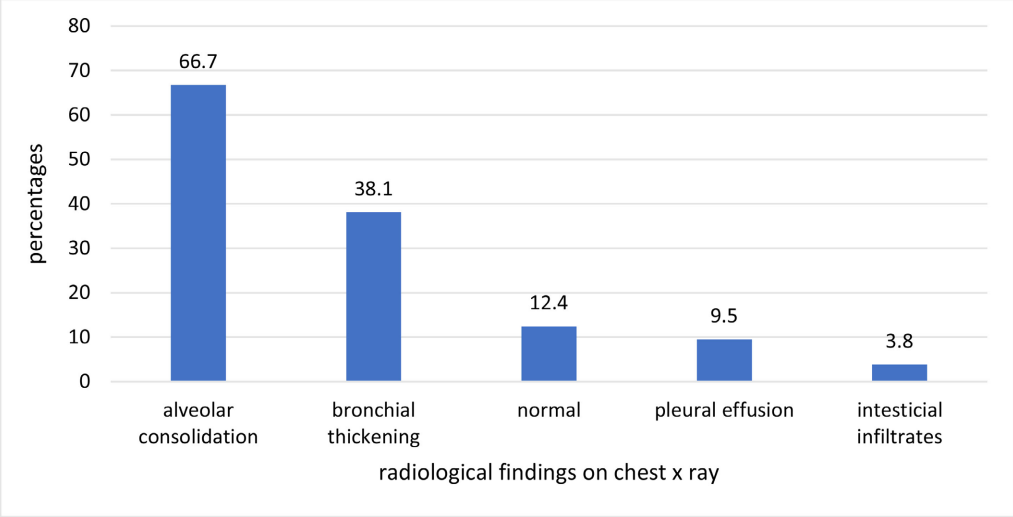

Figure 3. Findings on CXR of children admitted for ALRTIs.

Bilateral lung involvement was the most frequent in our participants (45%, n = 37), followed by right lung involvement at 39.6% (See **Figure 4**).

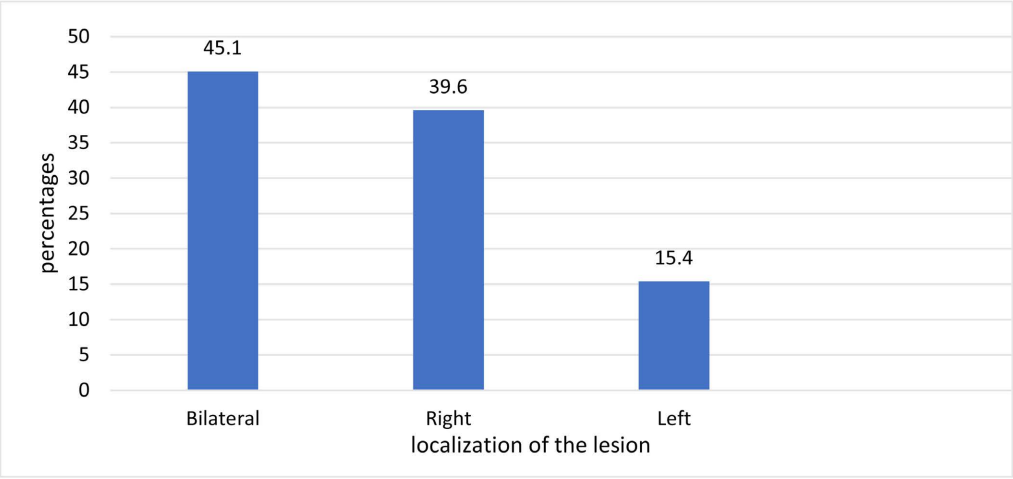

Figure 4. Localizations of lesions on CXR.

The analysis of factors associated with severity of ALRTIs showed no statistically significant association for age group, sex, residence, or maternal education. Although children aged > 60 months appeared more likely to have non-severe ALRTIs, the odds ratio (OR = 1.50, p = 0.651) was not statistically significant. Similarly, female sex (OR = 1.93, p = 0.191) and urban residence (OR = 0.70, p = 0.481) were not significantly associated with disease severity. The level of maternal education also showed no significant difference between severe and non-severe groups. However, maternal age > 20 years was significantly associated with reduced odds of severe ALRTIs (OR = 0.27, 95% CI: 0.08 - 1.01, p = 0.043), suggesting that children born to older mothers may have a lower risk of developing severe forms of the disease (See **Table 3**).

Table 3. Association between sociodemographic variables and severity of acute lower respiratory tract infections (bivariate analysis).

Variable	Severe n (%)	Non-severe n (%)	OR (95% CI)	p-value
Age in months				
<6	7 (8.2)	2 (10.0)	—	
6 - 36	44 (51.8)	7 (35.0)	0.56 (0.11 - 4.24)	0.515
36 - 60	13 (15.3)	2 (10.0)	0.54 (0.05 - 5.29)	0.575
>60	21 (24.7)	9 (45.0)	1.50 (0.29 - 11.4)	0.651
Sex				
Male	52 (61.2)	9 (45.0)	—	
Female	33 (38.8)	11 (55.0)	1.93 (0.72 - 5.27)	0.191
Residence				
Rural	31 (36.5)	9 (45.0)	—	
Urban	54 (63.5)	11 (55.0)	0.70 (0.26 - 1.92)	0.481
Mothers level of education				
Primary	18 (21.2)	3 (15.0)	—	
Secondary	37 (43.5)	12 (60.0)	1.95 (0.54 - 9.32)	0.346
Tertiary	30 (35.3)	5 (25.0)	1.00 (0.22 - 5.34)	> 0.999
Mothers age				
<20	7 (8.2)	5 (25.0)	—	
>20	78 (91.8)	15 (75.0)	0.27 (0.08 - 1.01)	**0.043**

OR = Odds Ratio, **CI =** Confidence Interval, **Non-severe ALRTI:** Cough and/or difficult breathing with tachypnea for age, but without danger signs. [Tachypnea thresholds*:* ≥50 breaths/min (2 - 11 months), ≥40 breaths/min (12 - 59 months], **Severe ALRTI:** Cough and/or difficult breathing plus at least one danger sign.

Among the various risk factors assessed, malnutrition showed a statistically significant association with severe ALRTIs (p = 0.025), with children who were malnourished being more likely to develop severe disease. Gastroenteritis also showed a borderline significant association (p = 0.049). Other comorbidities, including meningitis, HIV, sickle cell disease (SCD), and low birth weight, were not significantly associated with severity. Additionally, vaccination status, exposure to secondary smoke, exclusive breastfeeding, and family size (overcrowding) did not significantly influence the severity of ALRTIs. Although most children had up-to-date vaccinations and were exclusively breastfed, these factors did not show a protective effect against disease severity in this study (See Table 4).

After adjusting for confounding factors in the multivariate analysis, maternal age above 20 years was found to be significantly protective against severe ALRTIs (AOR = 0.21, p = 0.030), indicating that children of older mothers had lower odds of developing severe illness. Malnutrition emerged as a significant risk factor for severity, with malnourished children being nearly twice as likely to develop severe ALRTIs compared to well-nourished children (AOR = 1.91, p = 0.045). In con-

trast, gastroenteritis did not retain a significant association in the adjusted model (AOR = 0.84, p = 0.825), suggesting its effect was not independent when other variables were considered (See Table 5).

Table 4. Association between comorbidities, environmental factors and acute lower respiratory tract infection (bivariate analysis).

Variable	Severe n (%)	Non-severe, n (%)	OR (95% CI)	p-value
Malnutrition				
Yes	20 (23.5)	1 (5.0)	—	
No	65 (76.5)	19 (95.0)	0.85 (0.16 - 20.4)	**0.025**
Meningitis				
Yes	8 (9.4)	2 (10.0)	—	
No	77 (90.6)	18 (90.0)	0.94 (0.21 - 6.54)	0.936
HIV				
Yes	4 (4.7)	1 (5.0)	—	
No	81 (95.3)	19 (95.0)	0.94 (0.13 - 18.9)	0.956
SCD				
Yes	3 (3.5)	2 (10.0)	—	
No	82 (96.5)	18 (90.0)	0.33 (0.05 - 2.63)	0.242
Gastroenteritis				
Yes	11 (12.9)	3 (15.0)	—	
No	74 (87.1)	17 (85.0)	0.84 (0.23 - 4.020	0.049
Vaccination up to date				
Yes	72 (84.7)	17 (85.0)	—	
No	13 (15.3)	3 (15.0)	0.98 (0.21 - 3.36)	0.974
Secondary smoker				
Yes	10 (11.8)	3 (15.0)	—	
No	75 (88.2)	17 (85.0)	0.76 (0.20 - 3.63)	0.693
Exclusive breastfeeding				
Yes	73 (85.9)	18 (90.0)	—	
No	12 (14.1)	2 (10.0)	0.68 (0.10 - 2.78)	0.628
Birthweight				
<2500	16 (18.8)	4 (20.0)	—	
>2500	69 (81.2)	16 (80.0)	0.93 (0.29 - 3.57)	0.904
Family size				
Overcrowding	35 (41.2)	10 (50.0)	—	
Undercrowding	50 (58.8)	10 (50.0)	0.70 (0.26 - 1.88)	0.474

OR = Odds Ratio, CI = Confidence Interval, Non-severe ALRTI: Cough and/or difficult breathing with tachypnea for age, but without danger signs. [Tachypnea thresholds*:* ≥50 breaths/min (2 - 11 months), ≥40 breaths/min (12 - 59 months], **Severe ALRTI:** Cough and/or difficult breathing plus at least one danger sign.

Table 5. Factors associated with severity of ALRTIs (multivariate analysis).

Variable	Bivariate analysis		Multivariate analysis	
	OR (95% CI)	p value	Aor	p value
Mothers age (>20 years)	0.27 (0.08 - 1.01)	0.043	0.21 (0.05 - 0.88)	**0.030**
Malnutrition	0.85 (0.16 - 20.4)	0.025	1.91 (0.97 - 3.76)	**0.045**
Gastroenteritis	0.84 (0.23 - 4.02)	0.049	0.84 (0.20 - 4.52	0.825

OR = Odds Ratio, CI = Confidence Interval.

The outcomes of the study revealed that the vast majority of children diagnosed with ALRTIs were successfully treated and discharged (97.1%), while 3 children (2.9%) unfortunately died, indicating a relatively low but significant mortality rate associated with severe cases (See Table 6).

Table 6. Outcome on discharge.

Outcome	Frequency (n)	Percentage (%)
Discharged	102	97.1
Death	3	2.9

4. Discussion

The occurrence of acute lower respiratory tract infections (ALRTIs) among children admitted to Bamenda Regional Hospital was 24.0%. This elevated rate may be attributed to the fact that the research was conducted during the dry season (January to March), characterized by dry, cold, and dusty environmental conditions. Our results align closely with prevalence figures reported by Abduk-Aziz *et al.*, which documented rates of 23.7% in Burundi, 24.2% in Ghana, and 23.4% in Sierra Leone [5]. However, this is lower compared to the 40.3% prevalence found in Ethiopia by Birhanu *et al.* [8], likely due to differences in the age groups studied, larger sample sizes, and varying study contexts, as well as the 57.5% rate reported in Congo by Owusu *et al.*, possibly influenced by socioeconomic and living condition disparities [5]. Our observed prevalence is higher than that reported by Tazinya *et al.* in Bamenda (17.35%) [6], 17.4% in Cameroon's Far North region, and 9.5% in the Northwest region based on Demographic and Health Surveys [9].

Pneumonia was the predominant form of ALRTI, with a prevalence of 19.3%, closely matching the 19.4% reported for Cameroon's Northwest region by Tchatchou [10] and 19% found in India by Matthew *et al.* [11]. Bronchiolitis was the second most frequent ALRTI, occurring in 2.5% of cases, consistent with Addisu *et al.*'s report of 1.9% [12]. This contrasts with a higher 28% reported by Nandimalla *et al.* in India, which may reflect differences in study populations, as their cohort predominantly consisted of infants, who are more susceptible to bronchiolitis [13]. Bronchitis prevalence was low at 2.3%, comparable to 2% reported by Alok *et al.* in India [14] and 3% by Birhanu *et al.* in Ethiopia [8], who noted that most bronchitis cases tend to be mild and treated on an outpatient ba-

sis, with fewer requiring hospitalization.

The chief symptoms observed among hospitalized children with ALRTIs were cough (100%), fever (93.3%), and difficulty breathing (69.5%). These symptoms likely arise due to a combination of airway obstruction, immune response, and age-related vulnerability [15]. Similar symptom prevalence was reported by Nandimalla *et al.* in India (100%, 96.5%, and 92% respectively) [13] and by Alok *et al.* (96.5%, 93%, and 80%) [14]. Among clinical signs, tachypnea was most frequently recorded (85.7%), followed by hypoxia (42.9%). Most children also exhibited systemic inflammatory response syndrome (85.7%), consolidation syndrome (69.5%), and respiratory distress syndrome (42.9%), reflecting the body's immune reaction to infection and fluid accumulation in the lungs. To our knowledge, no other studies have documented similar detailed findings.

Chest X-rays were abnormal in 87.6% of patients, with 13.4% showing normal results. The normal radiographs may be explained by the viral etiology of many ALRTIs, as viral infections often produce less pronounced lung consolidation compared to bacterial infections, resulting in either normal or minimally altered X-rays [16]. This abnormal rate is higher than the 70% reported by Bourama *et al.* in Mali, who noted 30% normal X-rays [17], and substantially exceeds the 42% pathological X-rays found by Bach *et al.* in children with lower respiratory infections [18]. These discrepancies may stem from differences in radiologists' expertise and interpretive variability. The most common radiological abnormalities observed were alveolar consolidation (66.7%), bronchial wall thickening (38.1%), and pleural effusion (9.5%). These figures surpass those reported by Alok *et al.* in India (26%, 8%, and 4%, respectively) [14], but contrast with Bourama *et al.* in Mali, who observed higher bronchial thickening (75.4%) but lower alveolar consolidation (25.7%) and pleural effusion (0.9%) [17], with no clear explanation provided for these differences.

Bilateral infiltrates were present in 44.3% of cases, similar to the 40.5% reported by Alok *et al.* in India [14]. This bilateral pattern is likely due to children's smaller airways, which facilitate the spread of infection throughout both lungs, compounded by immature immune systems leading to more extensive lung involvement [19].

Our bivariate logistic regression identified maternal age, malnutrition, and gastroenteritis as significant factors associated with severe ALRTIs. After adjusting for confounders in multivariate analysis, only maternal age and malnutrition remained significantly linked to severe disease. Children of mothers younger than 20 years faced higher risks of severe ALRTIs, potentially due to younger mothers' limited experience and knowledge regarding childcare, hygiene, and nutrition—key factors in preventing ALRTIs. Additionally, younger maternal age is linked to a higher incidence of low birth weight infants, who have immature immune defenses and greater susceptibility to respiratory infections. Similar findings were reported by Azad *et al.* in Bangladesh [20] and Cardoso *et al.* in Brazil [21].

Malnutrition also showed a strong association with severe ALRTIs, likely be-

cause it compromises immune function, increasing vulnerability to infections. This relationship has been underscored in studies by Harley *et al.* in South Africa [22], Alok *et al.* in India [21], and Azad *et al.* in Bangladesh [20].

In this study, 97.0% of children improved, with a mortality rate of 3.0%. The low death rate may reflect the urban origin of most patients, facilitating better access to quality healthcare and timely treatment, thus improving outcomes. This is comparable to the 2.9% mortality found by Alok *et al.* in India, who also had a predominance of urban patients [14]. Conversely, higher mortality rates have been reported—12.8% by Harley *et al.* in South Africa where many children were admitted to intensive care [22], and 11.6% by Mohammadreza *et al.* in Iran, where delayed medical care was common [15]. Early identification of severe symptoms, proper management of comorbid conditions like malnutrition, and parental education are crucial to further reducing mortality.

5. Conclusion

ALRTIs affected 24.0% of hospitalized children in this study. The primary clinical manifestations were cough, fever, and difficulty breathing, with systemic inflammatory response syndrome, consolidation syndrome, and respiratory distress syndrome being the most prevalent syndromes. Radiologically, alveolar consolidation, bronchial thickening, and pleural effusion were the dominant findings. Maternal age under 20 years and acute malnutrition were significant risk factors for severe ALRTIs after multivariate adjustment.

6. Study Limitations

This research only included hospitalized cases, which may overestimate disease severity and affect prevalence calculations. Furthermore, no cultures were performed to identify causative pathogens of severe ALRTIs. Lastly, chest radiographs were interpreted by a single radiologist, which could introduce interpretation bias. The study was conducted exclusively during the dry season, a period associated with higher respiratory infection incidence; this may have led to an overestimation of ALRTI prevalence and limits the generalizability of results across all seasons.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Bicer, S., Giray, T., Çöl, D., Erdağ, G.Ç., Vitrinel, A., Gürol, Y., *et al.* (2013) Virological and Clinical Characterizations of Respiratory Infections in Hospitalized Children. *Italian Journal of Pediatrics*, **39**, 22-26. https://doi.org/10.1186/1824-7288-39-22

[2] World Health Organization (2014) Integrated Management of Childhood Illness (IMCI): Chart Booklet. https://apps.who.int/iris/bitstream/handle/10665/104772/9789241506823

[3] GBD 2016 Lower Respiratory Infections Collaborators (2018) Estimates of the Global, Regional, and National Morbidity, Mortality, and Aetiologies of Lower Respiratory Infections in 195 Countries, 1990-2016: A Systematic Analysis for the Global Burden of Disease Study 2016. *The Lancet Infectious Diseases*, **18**, 1191-1210.

[4] Rudan, I., Boschi-Pinto, C., Biloglav, Z., Mulholland, K. and Campbell, H. (2008) Epidemiology and Etiology of Childhood Pneumonia. *Bulletin of the World Health Organization*, **86**, 408-416.

[5] Sarfo, J.O., Amoadu, M., Gyan, T.B., Osman, A., Kordorwu, P.Y., Adams, A.K., *et al.* (2023) Acute Lower Respiratory Infections among Children under Five in Sub-Saharan Africa: A Scoping Review of Prevalence and Risk Factors. *BMC Pediatrics*, **23**, article No. 225. https://doi.org/10.1186/s12887-023-04033-x

[6] Tazinya, A.A., Halle-Ekane, G.E., Mbuagbaw, L.T., Abanda, M., Atashili, J. and Obama, M.T. (2018) Risk Factors for Acute Respiratory Infections in Children under Five Years Attending the Bamenda Regional Hospital in Cameroon. *BMC Pulmonary Medicine*, **18**, Article No. 7. https://doi.org/10.1186/s12890-018-0579-7

[7] Divyarani, D.C., Patil, G.R. and Ramesh, K. (2014) Profile on Risk Factors of Pneumonia among Under-Five Age Group at a Tertiary Care Hospital. *International Journal of Current Microbiology and Applied Sciences*, **3**, 750-754.

[8] Demissie, B.W., Amele, E.A., Yitayew, Y.A. and Yalew, Z.M. (2021) Acute Lower Respiratory Tract Infections and Associated Factors among Under-Five Children Visiting Wolaita Sodo University Teaching and Referral Hospital, Wolaita Sodo, Ethiopia. *BMC Pediatrics*, **21**, Article No. 413. https://doi.org/10.1186/s12887-021-02888-6

[9] Ins, I. (2012) Enquête Démographique et de Santé et à Indicateurs Multiples du Cameroun 2011. https://ins-cameroun.cm/wp-content/uploads/2023/06/EDSMICS2011.pdf?utm_source=chatgpt.com

[10] Tchatchou, N.D. (2009) Variations Regionales de la Survenance des Infections Respiratoires Aigues chez les Enfants de Moins de Cinq Ans au Cameroun. Master's Dissertation, Universite de Yaounde II.

[11] Mathew, J.L., Patwari, A.K., Gupta, P., Shah, D., Gera, T., Gogia, S., *et al.* (2011) Acute Respiratory Infection and Pneumonia in India: A Systematic Review of Literature for Advocacy and Action: UNICEF-PHFI Series on Newborn and Child Health, India. *Indian Pediatrics*, **48**, 191-218. https://doi.org/10.1007/s13312-011-0051-8

[12] Addisu, A., Getahun, T., Deti, M., Negesse, Y. and Mekonnen, B. (2012) Association of Acute Respiratory Infections with Indoor Air Pollution from Biomass Fuel Exposure among under Five Children in Jimma Town. Southwestern Ethiopia. *Journal of Environmental and Public Health*, **2021**, Article 7112548.

[13] Maruti, P. and Vinaykumar, N. (2020) Clinical Profile of Acute Lower Respiratory Tract Infections in Children Aged 2-60 Months: An Observational Study. *Journal of Family Medicine and Primary Care*, **9**, 5152-5157. https://doi.org/10.4103/jfmpc.jfmpc_624_20

[14] Nandimalla, V. and Pawae, J. (2018) Clinical Profile and Outcome of Acute Lower Respiratory Tract Infection in Children Aged between 2 Months to 5 Years. *International Journal of Contemporary Pediatrics*, **8**, 51-57.

[15] Mirkarimi, M., Alisamir, M., Saraf, S., Heidari, S., Barouti, S. and Mohammadi, S. (2020) Clinical and Epidemiological Determinants of Lower Respiratory Tract Infections in Hospitalized Pediatric Patients. *International Journal of Pediatrics*, **2020**, Article 8844420.

[16] World Health Organization Pneumonia Vaccine Trial Investigators' Group (2001) Standardization of Interpretation of Chest Radiographs for the Diagnosis of Pneumonia in Children. https://apps.who.int/iris/bitstream/handle/10665/66956/WHO_V_and_B_01.35.pdf?utm_source=chatgpt.com

[17] Kané, B., Maiga, M., Koné, O., Diallo, K.W., Sangaré, A., Camara, M.A., *et al.* (2016) Etiological and Radiological Profile of Acute Lower Respiratory Infections during the Pre-COVID Period in the Paediatric Ward of the Teaching Hospital of Mali and in the Community Health Centre of Yirimadio in Bamako. *Open Journal of Pediatrics*, **13**, 262-275. https://doi.org/10.4236/ojped.2023.132032

[18] Bach, N., Cuvillon, D., Brouard, J., Lafay, F., Freymuth, F., Legrand, L., *et al.* (2004) Infections respiratoires aiguës à métapneumovirus humain chez l'enfant: Études descriptive et comparative avec le virus respiratoire syncytial. *Archives de Pédiatrie*, **11**, 212-215. https://doi.org/10.1016/j.arcped.2003.12.009

[19] Muller, N.L., Fraser, R.S., Coleman, N.C. and Pare, P.D. (2001) Radiologic Diagnosis of Diseases of the Chest. W.B. Saunders Company.

[20] Azad, K.M.A.K. (2008) Risk Factors for Acute Respiratory Infections (ARI) among Under-Five Children in Bangladesh. *Journal of Scientific Research*, **1**, 72-81. https://doi.org/10.3329/jsr.v1i1.1055

[21] Cardoso, A.M., Coimbra, C.E.A. and Werneck, G.L. (2013) Risk Factors for Hospital Admission Due to Acute Lower Respiratory Tract Infection in Guarani Indigenous Children in Southern Brazil: A Population-Based Case-Control Study. *Tropical Medicine & International Health*, **18**, 596-607. https://doi.org/10.1111/tmi.12081

[22] Hutton, H.K., Zar, H.J. and Argent, A.C. (2019) Clinical Features and Outcome of Children with Severe Lower Respiratory Tract Infection Admitted to a Pediatric Intensive Care Unit in South Africa. *Journal of Tropical Pediatrics*, **65**, 46-54. https://doi.org/10.1093/tropej/fmy010