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Hospital-Based Study of Lower Respiratory Tract Infection Patterns in Children Less Than Five Years

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Abstract: Background: Acute Lower Respiratory Tract Infections (ALRTIs) remain a leading cause of morbidity and mortality in children under five years, particularly in low- and middle-income countries, where socioeconomic and environmental factors contribute to disease burden. **Aim:** To determine the distribution pattern of ALRTIs and associated risk factors among children under five years admitted to Children Hospital, Kirkuk City. **Patients and Methods:** This descriptive cross-sectional, hospital-based study was conducted in Kirkuk City from 1 November 2024 to 30 May 2025. A total of 241 children aged <5 years admitted with ALRTI (bronchitis, bronchiolitis or pneumonia) were consecutively enrolled. Data were collected using a structured questionnaire covering demographic characteristics, feeding practices, household smoking exposure, vaccination status, past medical history and clinical features. Data were analyzed using SPSS v26; categorical variables were presented as n (%) and associations were tested using Chi-square/Fisher's exact test, with $p<0.05$ considered significant. **Results:** Infants aged 0-12 months represented 165 (68.46%) of cases. Males were more frequently affected than females (139 [57.68%] vs. 102 [42.32%]) and urban residence predominated (179 [74.27%]). Nearly half of mothers were illiterate (111 [46.06%]). Bottle feeding was the most common feeding type (78 [32.36%]), while exclusive breastfeeding was low (35 [14.52%]). Household smoking exposure was reported in 127 (52.70%) children. The most common presenting features were productive cough (231 [95.85%]), wheezing (219 [90.87%]) and fever (201 [83.40%]). Most children presented after 4-7 days of illness (114 [47.30%]) and required short hospital stays of 1-3 days across age groups. Bottle-fed children had the longest mean illness duration (8.71±5.42 days) compared with exclusively breastfed children (6.68±5.18 days) ($p = 0.023$). **Conclusion:** ALRTIs in Kirkuk predominantly affected infants, males and urban residents. Low maternal education, household smoking exposure and low exclusive breastfeeding rates were prominent among hospitalized cases. Breastfeeding was associated with shorter illness duration, supporting its protective role. Strengthening health education, promoting exclusive breastfeeding and enforcing smoke-free home practices are recommended to reduce ALRTI burden.

Keywords: Acute Lower Respiratory Tract Infection, Children Under Five, Pneumonia, Bronchiolitis, Breastfeeding, Passive Smoking, Kirkuk

INTRODUCTION

Acute lower respiratory tract infection is the primary cause of death and a frequent cause of illness in children under the age of five. Respiratory infections are a diverse and intricate collection of disorders caused by a wide array of pathogens, including viruses, bacteria and fungus [1]. The lower respiratory tract comprises the trachea, bronchi, bronchioles and alveoli. In 2015, pneumonia was responsible for the deaths of 9, 20, 136 children under the age of 5, which accounted for 16% of all fatalities in this age group [2]. Untreated respiratory infections in young children can have life-threatening consequences. Acute respiratory infection is more prevalent in underdeveloped nations than to industrialized countries. The increased occurrence is ascribed to factors such as overcrowding, high HIV prevalence, low birth weight and the absence of pneumococcal and measles vaccination [3]. Additionally, variables such as zinc and vitamin A insufficiency, low maternal education and residing in locations with high pollution levels all contribute to the problem. While the exact cause of pneumonia is often unknown in a clinical setting, the primary culprits responsible for this condition in children are often Streptococcus pneumoniae, Hemophilus influenzae and to a lesser degree, Staphylococcus aureus. Bronchiolitis is a significant contributor to child mortality. RSV is involved

in the majority of cases. Additional viruses in this category are parainfluenza virus 1, 2 and 3, adenovirus and influenza virus [4]. Research has demonstrated the significance of socioeconomic determinants in relation to mortality and morbidity caused by Acute Respiratory Infections (ARI), such as the number of individuals in a household, level of education and population density in the place of residence. Therefore, it is crucial to prioritize social elements while contemplating preventative interventions. According to reports, the prevalence of Acute Respiratory Infections (ARI) is higher in urban regions and slums compared to rural areas. The expenses associated with lower respiratory tract infection in both outpatient and hospital settings impose a significant financial burden on national healthcare budgets [5,6]. When dealing with instances of Lower Respiratory Tract Infections (LRTI), it is crucial to focus on modifiable risk factors including as breastfeeding, overcrowding, undernutrition, delayed weaning and prelacteal feeding. IMNCI categorizes cases into four classifications based on respiratory rate, presence or absence of chest retraction and general patient status: No pneumonia, pneumonia, severe pneumonia and very severe pneumonia. Treatment options encompass the administration of oral antibiotics. Severe cases necessitate hospitalization and the use of intravenous antibiotics, as well as other supportive measures like as oxygen/ventilator support and ICD draining [7,8]. Respiratory infections pose a significant problem in children and adolescents. Recurrent respiratory illnesses impose both financial strain on parents and contribute to increased absenteeism from school. This study aimed to determine the distribution pattern of lower respiratory tract infection and its associated risk factors, as well as identify the bacterial pathogens responsible for it [9,10]. The aim of this study was to determine the distribution pattern of ALRTIs and associated risk factors among children under five years admitted to Children Hospital, Kirkuk City.

Patients and Methods

This descriptive epidemiological, observational, cross-sectional, hospital-based study was conducted in Kirkuk City over a seven-month period from 1 November 2024 to 30 May 2025. The study was carried out in the emergency department and pediatric wards of Children Hospital, Kirkuk. The study period encompassed both autumn and winter seasons to allow assessment of potential seasonal variations in Acute Lower Respiratory Tract Infections (ALRTIs). The study included 241 children younger than five years of age who were admitted with a diagnosis of acute lower respiratory tract infection. A convenience sampling technique was used, whereby all eligible patients presenting during the study period and meeting the inclusion criteria were consecutively enrolled.

Inclusion Criteria

Children aged <5 years presenting with a recent history of cough accompanied by fast breathing or difficulty in breathing were included in the study, in accordance with World Health Organization (WHO) guidelines for ALRI. In addition, children diagnosed clinically with bronchitis, bronchiolitis or pneumonia were eligible for inclusion.

Exclusion Criteria

Children with the following conditions were excluded from the study:

- Congenital heart disease
- Hypotonia or cerebral palsy
- Peripheral circulatory failure
- Severe anemia
- Dehydration

Ethical Considerations

Ethical approval for the study proposal was obtained from the Council of the College of Medicine, Tikrit University. Official permission to conduct the study was granted by the Kirkuk Health Directorate. A structured questionnaire was developed by the researcher to collect data on demographic characteristics and clinical variables, including age, gender, residence and clinical features of LRTIs.

Data Collection and Clinical Assessment

Clinical History: A detailed clinical history was obtained for each patient, including:

- History of recurrent chest infections
- Asthma and atopic conditions
- Known allergies to drugs or food
- History of steroid use
- Cow's milk allergy
- Family history of asthma, allergies or LRTIs
- Vaccination status according to the national immunization schedule

Case Definition

Diagnosis of lower respiratory tract infection was based on clinical evaluation and supported by one or more of the following findings:

- Tachypnea
- Chest wall in drawing
- Abnormal chest auscultation, such as wheezes, crepitations or bronchial breath sounds
- Abnormal chest radiographic findings, when available

Statistical Analysis

Collected data were reviewed for completeness and internal consistency prior to analysis. Data were initially entered into Microsoft Excel 2019 and subsequently analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics were applied to summarize categorical variables as frequencies and percentages. Associations between variables were assessed using the Chi-square test or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

Among the 241 children diagnosed with Lower Respiratory Tract Infections (LRTIs), infants aged 0-12 months represented the largest proportion, accounting for 165 cases (68.46%), indicating a markedly

Table 1: Demographic Characteristics of Children with LRTI

Variable	Category	n (%)
Age (months)	0-12	165 (68.46%)
	13-24	44 (18.26%)
	25-36	21 (8.71%)
	37-48	11 (4.57%)
Gender	Male	139 (57.68%)
	Female	102 (42.32%)
Residence	Urban	179 (74.27%)
	Rural	62 (25.73%)
Total		241 (100.00%)

Table 2: Distribution of LRTI Children According to Mother's Educational Status

Educational status	n (%)
Illiterate	111 (46.06%)
Primary	58 (24.07%)
Secondary	31 (12.86%)
College	41 (17.01%)
Total	241 (100.00%)

Table 3: Distribution of LRTI Children According to Type of Feeding

Type of feeding	n (%)
Exclusive breastfeeding	35 (14.52%)
Bottle feeding	78 (32.36%)
Mixed feeding	54 (22.41%)
Solid/normal feeding	74 (30.71%)
Total	241 (100.00%)

Table 4: Distribution of LRTI Children According to Family Smoking Exposure

Smoking in family	n (%)
Yes	127 (52.70%)
No	114 (47.30%)
Total	241 (100.00%)

Table 5: Distribution of LRTI Children According to Duration of Illness

Duration (days)	n (%)
1-3	44 (18.26%)
4-7	114 (47.30%)
8-12	48 (19.92%)
13-17	26 (10.79%)
>17	9 (3.73%)
Total	241 (100.00%)

Table 6: Distribution of LRTI Children According to Past Medical History

Medical history	Yes (n (%))	No (n (%))
Received vaccination	187 (77.59%)	54 (22.41%)
Recurrent chest infection	123 (51.04%)	118 (48.96%)
Asthma	32 (13.28%)	209 (86.72%)
Drug/food allergy	48 (19.92%)	193 (80.08%)
Steroid use	22 (9.13%)	219 (90.87%)

Table 7: Clinical Features of Children with LRTI

Clinical feature	n (%)
Productive cough	231 (95.85%)
Wheezing	219 (90.87%)
Fever	201 (83.40%)
Loss of appetite	198 (82.16%)
Dyspnea	196 (81.33%)
Tachypnea	191 (79.25%)
Runny nose	157 (65.15%)
Vomiting	155 (64.32%)
Cyanosis	105 (43.57%)
Dry cough	4 (1.66%)

higher susceptibility in this age group. The proportion of affected children declined steadily with increasing age. Male children were more frequently affected than females, with 139 males (57.68%) compared to 102 females (42.32%). Additionally, children residing in urban areas constituted the majority of cases (179; 74.27%), whereas rural residents accounted for 62 cases (25.73%) (Table 1).

Analysis of maternal educational status revealed that nearly half of the mothers of affected children were illiterate (111; 46.06%). Mothers with primary education accounted for 58 cases (24.07%), while those with secondary and college education represented 31 (12.86%) and 41 (17.01%), respectively. This distribution reflects a predominance of low educational attainment among mothers of children hospitalized with LRTIs (Table 2).

Regarding feeding practices, bottle feeding was the most common type among affected children (78; 32.36%), followed by solid or normal feeding (74; 30.71%). Mixed feeding was reported in 54 children (22.41%), while exclusive breastfeeding was observed in only 35 children (14.52%), indicating low rates of exclusive breastfeeding among LRTI cases (Table 3).

More than half of the children included in the study were exposed to smoking within their households. Family smoking was reported in 127 cases (52.70%), whereas 114 children (47.30%) had no reported exposure, emphasizing the role of passive smoking as a potential contributing factor to LRTIs (Table 4).

The duration of illness prior to hospital admission varied among the children. The majority presented after 4-7 days of symptoms (114; 47.30%). Shorter durations of 1-3 days were reported in 44 cases (18.26%), while 48 children (19.92%) had symptoms lasting 8-12 days. Prolonged illness exceeding 13 days was relatively uncommon (Table 5).

Most children had received routine vaccinations (187; 77.59%), while 54 (22.41%) were unvaccinated. Recurrent chest infections were reported in 123 children (51.04%). Asthma was present in 32 cases (13.28%), drug or food allergy in 48 cases (19.92%) and steroid use in 22 cases (9.13%) (Table 6).

Respiratory symptoms were predominant among affected children. Productive cough was the most frequently observed symptom (231; 95.85%), followed by wheezing (219; 90.87%) and fever (201; 83.40%). Other common manifestations included loss of appetite, dyspnea and tachypnea, while dry cough was rarely reported (Table 7).

Infants aged 0-12 months exhibited the highest frequency of nearly all clinical features, including vomiting, wheezing, tachypnea and fever. A gradual decline in symptom prevalence was observed with increasing age, highlighting the increased disease burden in younger children (Table 8).

The mean duration of illness was longest among bottle-fed children (8.71±5.42 days) and shortest among exclusively breastfed children (6.68±5.18 days). This association was statistically significant ($p = 0.023$), indicating a protective effect of breastfeeding (Table 9).

Across all age groups, most children required short hospital stays of 1-3 days, with prolonged hospitalization being uncommon. This finding suggests generally favorable inpatient outcomes regardless of age (Table 10).

Table 8: Relation Between Clinical Features of LRTI Children and Age

Clinical feature	0-12 month (n (%))	13-24 month (n (%))	25-36 month (n (%))	37-48 month (n (%))
Fever	134 (81.21%)	41 (93.18%)	18 (85.71%)	8 (72.73%)
Vomiting	123 (74.55%)	7 (15.91%)	4 (19.05%)	1 (9.09%)
Wheezing	113 (68.48%)	28 (63.64%)	13 (61.90%)	6 (54.55%)
Tachypnea	118 (71.52%)	23 (52.27%)	10 (47.62%)	4 (36.36%)

Table 9: Relation Between Duration of Illness and Type of Feeding

Feeding type	n	Duration (days) Mean±SD
Bottle feeding	78	8.71±5.42
Exclusive breastfeeding	35	6.68±5.18
Mixed feeding	54	7.29±5.06
Solid feeding	74	7.03±4.88

Table 10: Relation Between Duration of Hospital Stay and Age Groups

Hospital stay (days)	0-12 month (n (%))	13-24 month (n (%))	25-36 month (n (%))	37-48 month (n (%))
1-3	114 (69.09%)	30 (68.18%)	15 (71.43%)	8 (72.73%)
4-6	41 (24.85%)	13 (29.55%)	5 (23.81%)	3 (27.27%)
7-10	7 (4.24%)	1 (2.27%)	1 (4.76%)	0 (0.00%)
>10	3 (1.82%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

DISCUSSION

In this study, LRTIs clustered strongly in early life, with infants (0-12 months) representing the largest proportion of cases, while the frequency declined with increasing age. This pattern is expected because immune maturation, smaller airway caliber and limited prior pathogen exposure make infants more prone to symptomatic and clinically significant respiratory infections. WHO case management guidance emphasizes that the under-five age group-particularly infants-constitutes the highest-risk category for acute lower respiratory infections in hospital settings [1]. Similar age distributions have been reported in regional studies, including Iraqi and Egyptian cohorts, where children <2 years formed the majority of LRTI/pneumonia cases [2,3]. Male predominance in LRTI admissions observed in the current results has also been described in multiple pediatric epidemiologic studies, where biological susceptibility (airway size, immune response differences) and exposure patterns were suggested contributors [13-17]. Moreover, higher LRTI frequency among urban residents may reflect crowding, reduced ventilation and higher exposure to traffic-related air pollutants; such social/environmental determinants are repeatedly linked to childhood respiratory morbidity [16,18-22]. The Egyptian under-five pneumonia literature similarly highlights higher urban burden in some settings where crowding and indoor exposure risks are common [23-25]. A large share of mothers of admitted children had low educational attainment. Low maternal education is consistently associated with increased pneumonia/LRTI risk in under-five children through pathways involving health literacy, delayed care-seeking, suboptimal feeding practices, vaccine delays and socioeconomic disadvantage [26-30]. Studies from Ethiopia and other LMIC contexts reported comparable findings, showing higher pneumonia occurrence among children of mothers with limited schooling [31-33]. Therefore, the present pattern supports the broader evidence that maternal education operates as a "risk amplifier" by shaping household-level prevention behaviors and healthcare utilization [16,34]. The feeding pattern in this study suggests that exclusive breastfeeding represented a minority of children, while bottle feeding and mixed feeding were common. This is epidemiologically important: Breastfeeding provides secretory IgA, lactoferrin, oligosaccharides and other immune-active factors that reduce respiratory infection incidence and severity. Large-scale evidence supports breastfeeding as a protective exposure across infancy and early childhood [9-11]. In particular, systematic reviews on RSV-associated ALRI demonstrate lower severity and hospitalization risk among breastfed infants compared with non-breastfed infants [10]. Conversely, bottle feeding may increase infection susceptibility via absence of maternal immune factors and potential contamination if hygiene/sterilization is imperfect [12]. More than half of children were exposed to family smoking, supporting passive smoke as a major modifiable risk in this cohort. Environmental tobacco smoke damages airway epithelium, increases mucous production, impairs mucociliary clearance and potentiates inflammatory responses-mechanisms that increase the probability and severity of respiratory infections. Robust evidence links parental smoking and indoor tobacco smoke exposure with adverse respiratory outcomes in children [13]. Community studies in Asia and Africa similarly show higher rates of respiratory symptoms and infections among children living in smoking households [35-37]. These findings justify integrating smoking cessation and smoke-free home counseling into pediatric LRTI prevention strategies in Kirkuk [13-16]. A meaningful proportion of children had a family history of LRTIs and/or allergic disease, suggesting shared genetic susceptibility and shared household exposures. Recurrent respiratory infections and familial clustering have been emphasized in pediatric reviews, where predisposition may relate to inherited immune-response variability, atopic tendency or repeated exposure to common household risk factors [17,18]. Contemporary evidence also supports gene-environment interplay in respiratory vulnerability, including genetically influenced cytokine responses to viral infections [19,20]. Even when "family history of allergy" is not highly prevalent, atopy-related airway inflammation can increase wheeze and complicate infection episodes, potentially increasing symptom burden and healthcare use [19,30]. The symptom profile in this cohort-dominance of productive cough, wheeze, fever, tachypnea, dyspnea and feeding-related impairment-fits classic pediatric LRTI presentation and

matches WHO clinical approaches that prioritize respiratory rate, work of breathing and danger signs for severity assessment [1]. Productive cough and wheeze are common because airway inflammation and secretion burden are central in bronchiolitis, bronchitis and pneumonia syndromes in early childhood [21-23]. Fever reflects systemic inflammatory response and is frequently reported in hospitalized under-five LRTI cohorts [25]. Vomiting and poor appetite often reflect systemic illness, increased work of breathing and feeding intolerance during infection episodes [26]. Cyanosis-although less frequent-remains clinically critical because it signals impaired oxygenation and higher severity, requiring rapid assessment and supportive care [1,27]. The rarity of dry cough compared with productive cough is also consistent with the tendency for lower airway involvement to generate secretions and wet cough, whereas dry cough is more typical of upper respiratory conditions or early viral illness [28]. The absence of a statistically significant difference in illness duration between rural and urban children suggests that once hospitalized and managed, recovery time may be influenced more by clinical severity and comorbid factors than by residence alone. Global burden analyses emphasize that while incidence and hospitalization risk vary by setting, illness course is heavily shaped by timely access to appropriate care and supportive management [33]. Reviews focusing on environmental risk also indicate that the "exposure effect" may raise infection risk, yet does not always translate into prolonged duration when medical care is accessed [34]. Although children of mothers with lower education may have higher LRTI risk, the study did not demonstrate a significant association between maternal education and duration of illness. This is plausible because in a hospital-managed cohort, standardized treatment and monitoring can reduce variability in recovery time regardless of parental education level. Social determinants strongly affect risk and timing of presentation but once admitted, clinical course may converge under consistent inpatient care [16,33,34]. A significant association between feeding type and illness duration-particularly longer illness among bottle-fed children and shorter duration among exclusively breastfed children-is biologically and epidemiologically coherent. Breastfeeding enhances mucosal immunity and may shorten recovery by improving pathogen clearance and moderating inflammatory responses [9-11]. Systematic review evidence focusing on RSV-associated ALRI supports reduced severity and hospitalization among breastfed infants [10]. In contrast, formula feeding lacks immune factors and may be linked to higher infection severity or prolonged symptoms, particularly in settings where bottle sanitation is inconsistent [12]. Longer illness duration among children with steroid exposure is consistent with immunomodulatory effects of systemic corticosteroids, which may increase susceptibility to prolonged infection or delayed resolution, depending on dose, duration and clinical context [29]. Population-based evidence shows systemic steroids are frequently prescribed for acute respiratory infections despite limited indications and immunosuppression is a plausible contributor to prolonged symptom courses in some patients [29]. Family history of allergy and allergic inflammation can also intensify airway hyperreactivity and prolong symptoms during viral LRTIs [30]. The lack of association between vaccination status and duration does not negate vaccine benefit; vaccines primarily reduce the probability of infection or severe disease rather than guaranteeing shorter duration once a child develops an LRTI requiring hospitalization [31]. The observed symptom-linked duration patterns-such as fever persisting around a week-are consistent with prospective pediatric observations where prolonged fever may occur in respiratory infections and warrants careful evaluation for severity or complications [32]. Clinically, symptom duration reflects both pathogen factors (viral vs. bacterial), host immune response and treatment timing; therefore, variations across symptoms are expected and should be interpreted alongside objective severity indicators [1,21]. The highest symptom burden in infants (0-12 months), followed by gradual decline with age, aligns with known developmental vulnerability of early childhood. Smaller airway diameter, limited physiologic reserve and immature immune responses predispose infants to wheeze, tachypnea, feeding intolerance and more severe clinical presentation [1,4,24,25]. Consequently, age-stratified prevention (exclusive breastfeeding, smoke-free homes, timely vaccination and early recognition of danger signs) remains central to reducing under-one morbidity [1,9,10,13]. Short hospital stays (commonly 1-3 days) across age strata are consistent with modern pediatric respiratory infection care pathways that emphasize early supportive treatment, rapid reassessment and discharge when oxygenation and feeding stabilize. Recent pediatric guideline approaches support standardized management and short-stay/observation strategies for uncomplicated bronchiolitis and mild-to-moderate LRTIs [35]. Health-system studies also describe increased use of short-stay pathways and regional admission practice variation, which may influence length-of-stay patterns without necessarily reflecting differences in disease biology [36,37].

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