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Clinical Outcomes and Duration of Hospital Stay among Age Groups in Recurrent Pneumonia Cases in Children

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Abstract

Background: *Recurrent pneumonia poses a significant challenge in pediatric healthcare, particularly in resource-limited settings like Bangladesh. This study aimed to evaluate clinical outcomes and hospital stay durations among children with recurrent pneumonia, focusing on age-related variability and associated factors.*

Methods: *A cross-sectional observational study was conducted at Bangladesh Shishu Hospital & Institute, Dhaka from January to June 2022. Fifty children aged 2 months to 5 years with recurrent pneumonia were included. Data were collected on socio-demographics, feeding practices, clinical presentations, radiological findings, and outcomes. Statistical analyses were performed using SPSS version 24.0.*

Results: *The majority of participants were aged 7–12 months (42%) with a mean age of 19±15.7 months. Males accounted for 66% of the population. Only 28% of children were fully immunized, and exclusive breastfeeding was reported in 36%. Chest in-drawing (74%) and bronchopneumonia (72%) were the most common clinical and radiological findings, respectively. Congenital heart disease (22%) was the leading underlying illness. ICU care was required in 14% of cases, and the mean hospital stay was longest in children aged ≤12 months (15.42±4.34 days). Mortality was observed in 4% of participants.*

Conclusion: *Recurrent pneumonia in children is influenced by socio-demographic, nutritional, and clinical factors, with younger children experiencing greater severity. Targeted interventions, including improved immunization and early management of underlying conditions, are essential to reduce morbidity and mortality*

Keywords: *Recurrent Pneumonia, Pediatric, Hospital Stay, Congenital Heart Disease*

1. Introduction

Pneumonia remains one of the leading infectious causes of death among children under five globally, contributing to approximately 14% of all deaths in this age group, despite advancements in healthcare and preventive strategies. The disease is particularly burdensome in low- and middle-income countries (LMICs), where socio-economic factors, healthcare limitations, and environmental conditions exacerbate its prevalence and severity. Estimates indicate that pneumonia accounts for nearly 1.4 million annual childhood deaths, a significant proportion of which occur in resource-constrained settings like South Asia and Sub-Saharan Africa (1,2).

In Bangladesh, childhood pneumonia contributes substantially to pediatric morbidity and mortality, with an estimated 4 million episodes annually, of which many result in hospitalization or death due to delayed diagnosis and insufficient access to timely medical intervention (3,4).

Recurrent pneumonia, defined as two or more episodes in a year or three episodes over any duration with radiographic resolution between occurrences, is a growing public health concern. Unlike single acute episodes, recurrent pneumonia is often indicative of underlying chronic conditions, including congenital heart disease, cystic fibrosis, immune deficiencies, or aspiration syndromes (5,6). The prevalence of recurrent pneumonia is exacerbated in LMICs, where environmental exposures such as indoor air pollution, malnutrition, and limited vaccination coverage intersect with healthcare resource constraints to impede effective management and prevention strategies (7,8). In Dhaka, Bangladesh, recurrent and persistent pneumonia has been attributed to tuberculosis, congenital heart disease, and bronchial asthma, among other causes, emphasizing the need for targeted diagnostic and therapeutic approaches (9).

The clinical presentation and outcomes of pneumonia are significantly influenced by age. Younger children, particularly those under two years of age, tend to experience more severe manifestations due to their immature immune systems, higher susceptibility to respiratory pathogens, and frequent association with comorbidities such as severe malnutrition (10). A study conducted in Dhaka highlighted that hypoxaemia—a strong predictor of mortality—is more prevalent in younger children, further underscoring the need for early diagnosis and intervention in this vulnerable subgroup (4). Moreover, older children often present with different risk profiles, including higher rates of obesity and exposure to pollutants, indicating the necessity for age-specific management strategies (11). Recurrent pneumonia not only threatens the health of children but also imposes a significant burden on healthcare systems and families. Prolonged hospital stays, high bed occupancy rates, and repeated readmissions strain limited healthcare resources, particularly in pediatric wards in LMICs. For instance, in rural Bangladesh, the variability in climatic factors such as temperature and humidity has been shown to prolong hospitalization for pneumonia, further escalating healthcare costs (12). Additionally, the economic burden of direct medical expenses and indirect costs, such as caregivers' lost income, disproportionately affects impoverished households, perpetuating cycles of poverty and poor health outcomes (13,14). Bangladesh serves as a crucial setting to study recurrent pneumonia due to its high prevalence rates and unique socio-environmental challenges. Factors such as overcrowded living conditions, poor sanitation, malnutrition, and low immunization coverage contribute to the disease's persistence (15). Local studies have also revealed disparities in care-seeking behaviors and treatment outcomes, often driven by socio-economic inequalities and cultural norms favoring male children over females in accessing healthcare (16). These findings highlight the urgent need for context-specific interventions and health system reforms to address the recurrent pneumonia burden effectively. Despite global efforts to reduce child mortality, the burden of recurrent pneumonia in settings like Bangladesh remains inadequately addressed in the literature. This study aims to fill this gap by examining the clinical outcomes and hospital stay durations among different pediatric age groups with recurrent pneumonia in Bangladesh. The findings are expected to inform policy, enhance clinical guidelines, and improve healthcare delivery for one of the most vulnerable populations in LMICs.

2. METHODS

This cross-sectional observational study was conducted at Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh, from January to June 2022. Children aged 2 months to 5 years with recurrent pneumonia, defined as two or more pneumonia episodes within a year or more than three episodes over any period with radiographic clearance between episodes, were included. Exclusion criteria were a history of prolonged neonatal mechanical ventilation and known bronchial asthma. Fifty children were selected through convenience sampling. Data were collected using structured questionnaires, caregiver interviews, and medical record reviews. Investigations included chest X-rays, echocardiography, blood cultures, serum immunoglobulin assays, sweat chloride levels, and flow cytometry as needed. Key variables included clinical features, underlying causes, and hospital stay durations. Data analysis was conducted using SPSS version 24.0. Descriptive statistics summarized categorical variables as percentages and continuous variables as means with standard deviations. ANOVA tests assessed associations between age groups and hospital stay durations, with significance set at $p<0.05$. Ethical approval was obtained, and written informed consent was provided by parents or guardians. All data were anonymized to ensure confidentiality.

3. RESULTS

Table 1. *Distribution of the participants by baseline characteristics (N=50)*

Parameters	Frequency	Percentage
Age (months)		
≤6	6	12%
7-12	21	42%
13-24	10	20%
25-36	4	8%
37-48	5	10%
49-60	4	8%
Mean±SD	19±15.7	
Range (min-max)	3-60	
Sex		
Male	33	66%
Female	17	34%
Family income (Taka)*		
Low-income (≤7400 TK)	5	10%
Lower-middle (7401-29000 TK)	31	62%
Upper-middle (29001-89920 TK)	14	28%
Mean±SD	21220±14532.9	
Range (min-max)	4500-70000	
Consanguinity		
Present	10	20%
Absent	40	80%
Family history of bronchial asthma		
Present	4	8%
Absent	46	92%
Immunization record		
Completely Immunized	14	28%
Not completely immunized	36	72%

Among the 50 participants, the majority (42%) were aged between 7-12 months, with a mean age of 19±15.7 months, ranging from 3 to 60 months. Male participants constituted 66%, resulting in a male-to-female ratio of approximately 2:1. Most families (62%) belonged to the lower-middle-income group (7,401-29,000 Taka), with a mean family income of 21,220±14,532.9 Taka, ranging from 4,500 to 70,000 Taka. Consanguinity was present in 20% of cases, and a family history of bronchial asthma was noted in 8%. Regarding immunization status, only 28% of the participants were completely immunized, while the majority (72%) had incomplete immunization records.

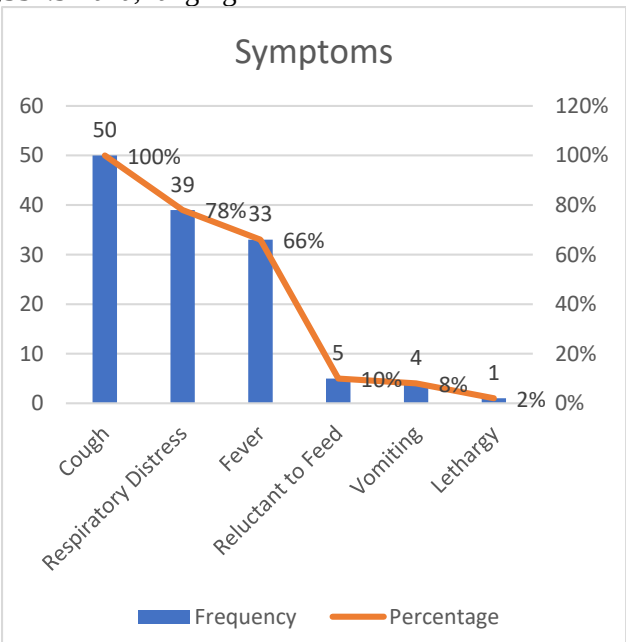

Figure 1. *Distribution of participants by presenting symptoms (N=50)*

All participants (100%) presented with cough as the primary symptom, followed by respiratory distress observed in 78% and fever in 66% of cases. Less common symptoms included reluctance to feed (10%), vomiting (8%), and lethargy (2%), highlighting the varied clinical presentations of recurrent pneumonia in the study population.

Table 2. *Distribution of the study patients according to feeding status (N=50)*

Variable	Frequency	Percentage
Exclusive breast feeding (up to 6 months)		
Yes	18	36%
No	32	64%
Complementary feeding		
Adequate	15	30%
Inadequate	30	60%
Not started	5	10%
Feeding technique/position		
Sitting	22	44%
Supine	28	56%

Among the study participants, only 36% were exclusively breastfed up to 6 months, while 64% were not. Complementary feeding was found to be adequate in 30% of the cases, inadequate in 60%, and not started in 10%. Regarding feeding techniques, 56% of children were fed in the supine position, whereas 44% were fed while sitting, indicating potential feeding-related risk factors for recurrent pneumonia.

Table 3. *Distribution of participants by physical characteristics (N=50)*

Patient physical characteristics	Frequency	Percentage
Physical findings		
Chest in-drawing	37	74%
BCG mark	31	62%
Skin-Eczema/Allergy	8	16%
Cleft Lip/Palate	6	12%
Cyanosis	4	8%
Temperature (°F)	99.6±1.5	
Heart rate (beats per minute)	132.3±18.5	
Respiratory rate (breaths per minute)	54±13.1	
SpO2 (%)	93.1±5.8	
Birth weight		
Average	32	64%
Low birth weight	18	36%
Mean±SD	7.4±3.0	
Range	3.5-19.0 kg	

Among the participants, chest in-drawing was observed in 74%, and 62% had a visible BCG mark. Other notable physical findings included skin eczema or allergy (16%), cleft lip/palate (12%), and cyanosis (8%). The mean temperature was 99.6±1.5°F, heart rate was 132.3±18.5 beats per minute, respiratory rate was 54±13.1 breaths per minute, and SpO2 was 93.1±5.8%.Regarding birth weight, 64% of children had an average birth weight, while 36% were classified as having low birth weight, with a mean current weight of 7.4±3.0 kg (range: 3.5–19.0 kg).

Table 4. *Distribution of the study patients according to underlying illness (N=50)*

Underlying illness	Frequency	Percentage
Congenital heart disease	11	22%
Developmental delay	8	16%
Cystic fibrosis	5	10%

Primary immunodeficiency	4	8%
Malnutrition	4	8%
Floppy child	3	6%
Cleft lip and cleft palate	3	6%
Gastro-esophageal reflux disease (GERD)	2	4%
Aspiration pneumonia	2	4%
CP with development delay	2	4%
ILD	1	2%
Unknown	11	22%

Among the study participants, congenital heart disease was the most common underlying illness, affecting 22% of cases. Developmental delay was observed in 16%, while cystic fibrosis accounted for 10%. Other conditions included primary immunodeficiency and malnutrition (8% each), floppy child syndrome and cleft lip/palate (6% each), and gastro-esophageal reflux disease (GERD) and aspiration pneumonia (4% each).

Cerebral palsy with developmental delay was found in 4%, interstitial lung disease (ILD) in 2%, and the underlying cause remained unknown in 22% of cases.

Table 5. *Distribution of the study patients according to blood culture (N=50)*

Blood culture	Frequency	Percentage
No growth	46	92%
Organism isolated	4	8%
Klebsiella pneumoniae	2	4%
Pseudomonas	1	2%
Streptococcus	1	2%

Blood cultures revealed no microbial growth in 92% of the participants. Among the 8% with isolated organisms, Klebsiella pneumoniae was the most commonly identified pathogen (4%), followed by Pseudomonas (2%) and Streptococcus (2%), indicating a low rate of detectable bacteremia in the study population.

Table 6. *Distribution of the study patients according to radiological findings (N=50)*

Test Method	Frequency	Percentage
Chest x-ray		
Bronchopneumonia	36	72%
Consolidation	7	14%
Aspiration pneumonia	2	4%
Collapse	2	4%
Collapse & consolidation	1	2%
Hyperinflation	2	4%
Echocardiography		
Not done	2	4%
Normal	33	66%
Abnormal	15	30%
Atrial septal defect (ASD)	4	8%
Ventricular septal defect (VSD)	6	12%
Pulmonary HTN	1	2%
Patent ductus arteriosus (PDA)	2	4%
VSD + ASD	1	2%
CT scan of the chest		
Abnormal	3	6%
Normal	1	2%
Done	46	92%

Radiological findings from chest X-rays revealed bronchopneumonia as the most common condition, present in 72% of participants, followed by consolidation in 14%. Aspiration pneumonia, collapse, and hyperinflation were each observed in 4% of cases, while collapse with consolidation was noted in 2%. Echocardiography identified abnormalities in 30% of patients, including ventricular septal defect (12%), atrial septal defect (8%), pulmonary hypertension (2%), patent ductus arteriosus (4%), and combined VSD + ASD (2%). CT scans of the chest showed abnormal findings in 6% of cases, while 92% underwent the test overall, highlighting its extensive use in the diagnostic workup.

Table 7. *Distribution of participants by clinical outcomes (N=50)*

Variables	Frequency	Percentage
Required ICU Care		
Yes	7	14%
No	43	86%
Mechanical Ventilation Needed		
Yes	2	4%
No	48	96%
Overall Outcome		
Improved	43	86%
Died	2	4%
DORB	5	10%

Among the participants, 14% required ICU care, while 86% did not. Mechanical ventilation was necessary in 4% of cases, with the remaining 96% not requiring it. Regarding overall outcomes, 86% of the patients showed improvement, 4% died, and 10% were discharged on request before completing treatment (DORB).

Table 8. *Association between age group with hospital stay (n=45*)*

Age (months)	Total	Hospital stay (days)		P value
		Mean±SD	Range	
≤12	24	15.42±4.34	10.0-27.0	0.075ns
13-36	13	13.61±3.52	9-19.0	
37-60	8	11.87±2.69	7.0-16.0	

** DORB babies were not included*

P value reached from ANOVA test

The mean hospital stay varied across age groups, with children aged ≤12 months having the longest average stay of 15.42±4.34 days (range: 10–27 days), followed by those aged 13–36 months with a mean stay of 13.61±3.52 days (range: 9–19 days), and children aged 37–60 months with the shortest stay of 11.87±2.69 days (range: 7–16 days). However, the difference in hospital stay duration between the age groups was not statistically significant (p=0.075).

4. Discussion

The present study analyzed the clinical outcomes and duration of hospital stays among pediatric patients with recurrent pneumonia in Bangladesh, offering important insights into the demographic, clinical, and healthcare challenges associated with this condition. The findings align with global trends in pediatric pneumonia but also highlight unique local dynamics shaped by socio-economic and healthcare constraints. The majority of participants in this study were aged 7–12 months, with a mean age of 19±15.7 months, and males constituted 66% of the population, reflecting a male-to-female ratio of approximately 2:1. This male predominance is consistent with findings by Wang et al., who reported similar gender distribution patterns in pediatric pneumonia cases in China (17). Additionally, lower-middle-income families dominated the socio-economic profile, paralleling observations by Dicko-Traoré et al., who found socio-economic challenges as a key determinant in pneumonia outcomes in Mali (18). Alarmingly, only 28% of participants in our study were fully immunized, a finding that corroborates Srivastava et al.'s study, which identified incomplete vaccination as a significant

risk factor for pediatric pneumonia in low-resource settings (19). Clinically, all participants presented with cough, followed by respiratory distress (78%) and fever (66%). These findings align with the PERCH study, which emphasized cough and respiratory distress as hallmark symptoms of severe pneumonia (20). Feeding practices emerged as an important factor, with only 36% of participants exclusively breastfed for six months, while 60% had inadequate complementary feeding. These trends are in line with Lamberti et al.'s observations, which highlighted the protective role of breastfeeding in reducing pneumonia severity (21). Radiological findings revealed bronchopneumonia in 72% of cases and echocardiographic abnormalities in 30%, including ventricular septal defects (12%) and atrial septal defects (8%). The prevalence of bronchopneumonia aligns with findings by Guo et al., who identified similar patterns in pediatric radiological evaluations (22). Furthermore, Jat et al. emphasized the significant association between congenital heart disease and recurrent pneumonia, supporting our findings of a high prevalence of cardiac abnormalities among participants (23). Blood culture analysis showed no microbial growth in 92% of cases, with *Klebsiella pneumoniae* (4%), *Pseudomonas* (2%), and *Streptococcus* (2%) isolated in the remaining. This aligns with Droz et al.'s systematic review, which reported low blood culture positivity rates in pediatric pneumonia but highlighted *Klebsiella* and *Streptococcus* as common pathogens when identified (24). These findings underscore the diagnostic challenges in identifying bacterial etiologies in low-resource settings. Clinical outcomes revealed that 14% of participants required ICU care, while mechanical ventilation was necessary in only 4% of cases. These results align with other studies of similar nature, who found a similar ICU admission rate but noted higher mechanical ventilation needs in severe cases (25,26). Most participants (86%) improved after treatment, while 4% died, and 10% were discharged on request before completing treatment. Mortality rates in our study were comparable to those reported by Kaiser et al., who found prolonged ICU stays as a predictor of poorer outcomes in ventilated pneumonia cases (27). The mean hospital stay was longest in children aged ≤12 months (15.42±4.34 days), followed by 13–36 months (13.61±3.52 days) and 37–60 months (11.87±2.69 days). Although this difference was not statistically significant, it aligns with findings from other studies that younger children are often hospitalized longer due to greater disease severity and complications (28,29). In conclusion, our study highlights the interplay of socio-demographic factors, feeding practices, clinical symptoms, and underlying conditions in shaping the outcomes of recurrent pneumonia in children. Comparative analysis with existing literature underscores the need for tailored interventions, including enhanced vaccination coverage, improved diagnostic capabilities, and targeted management of comorbidities. These findings offer critical insights for policymakers and healthcare providers aiming to address the burden of recurrent pneumonia in resource-constrained settings like Bangladesh.

5. Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

6. Conclusion

This study highlights the significant burden of recurrent pneumonia in children, emphasizing the interplay of socio-demographic factors, feeding practices, clinical presentations, and underlying conditions in determining outcomes. Key findings revealed male predominance, incomplete immunization, and poor feeding practices as critical risk factors. Radiological abnormalities, congenital heart defects, and other underlying illnesses were frequently observed. While ICU care and prolonged hospital stays were more common in younger children, mortality rates were relatively low. These findings underscore the urgent need for targeted interventions, including improved vaccination coverage, early diagnosis, and comprehensive management strategies. Such efforts are essential to reduce the burden of recurrent pneumonia, particularly in resource-limited settings like Bangladesh.

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