



A STUDY OF THE ASSOCIATION BETWEEN SEVERITY OF PNEUMONIA AND CHEST X RAY FINDINGS IN CHILDREN BETWEEN 6 MONTHS AND 5 YEARS OF AGE

Paediatrics

Dr. Shantarupa Mohanty	Junior Resident, Department of Paediatrics, Rajshree Medical Research Institute, Bareilly.
Dr. Monica Agarwal	Professor & HOD, Department of Paediatrics, Rajshree Medical Research Institute, Bareilly.
Dr. Priyanka Kumari	Assistant Professor, , Department of Paediatrics, Rajshree Medical Research Institute, Bareilly.

ABSTRACT

Introduction: Pneumonia is an inflammatory process that involves lung parenchyma. There are over 15 million cases of pneumonia annually, or 7-13% of cases severe enough to necessitate hospitalization. The World Health Organization estimates that pneumonia killed 740,180 children in 2019- 14% of all children under the age of five and 0.13 million of those deaths occurred in India. Despite advancements in imaging modalities, the chest X-ray has remained the gold standard for determining the severity of pneumonia because clinical findings can be subjective and clinical definitions of pneumonia can be nonspecific. **Objectives:** To study the correlation between severity of pneumonia and chest x ray at presentation. **Methods:** There were 100 people in the sample. The study comprised 100 children who met the inclusion criteria and were admitted to the Rajshree Medical Research Institute Hospital between the ages of 6 months and 5 during the study period. All children's parents or guardians were given a thorough explanation of the study method before providing their written informed permission. A thorough history, demographic information, a clinical examination, the severity of pneumonia based on WHO guidelines, pneumonia-related abnormalities on a chest X-ray, arterial oxygen saturation as determined by pulse oximetry (SpO₂), hemoglobin (g/dl), and total white blood cell counts were all recorded. **Results:** In accordance with WHO guidelines for community-acquired pneumonia, cases were divided into two categories: pneumonia and severe pneumonia. There were fifty-nine male and forty-one female children among the one hundred cases included in the current study. The results of a chest x-ray show a favorable link with the severity of pneumonia. **Conclusion:** The results of chest x-rays and the severity of community-acquired pneumonia have a good association, indicating that the chest x-ray can predict the severity of pneumonia.

KEYWORDS

Community acquired pneumonia , IMNCI guidelines, WHO , Consolidation , chest indrawing , chest x-ray

INTRODUCTION

An inflammatory condition involving the lung parenchyma and typically brought on by microorganisms is known as pneumonia. One of the leading causes of disease and death among children under five, particularly in low and middle-income countries (LMICs), is pneumonia.^{1,2} Either a viral or bacterial aetiology can cause pneumonia. *Streptococcus pneumoniae* and *Hemophilus influenza* type B are the bacteria most frequently linked to pneumonia in young children, whereas respiratory syncytial virus and influenza A or B are the viruses, according to a 2020 study.³

The WHO (2018 statistics) reports that there are over 15 million cases of pneumonia annually, or 7-13% of cases severe enough to necessitate hospitalization.⁴ According to estimates, more than half of all children in Uttar Pradesh under the age of five have pneumonia (565 cases per 1000 children).⁵ In resource-constrained countries, pneumonia is diagnosed using the World Health Organization's (WHO's) Integrated Management of newborn and Child Illnesses (IMNCI) guidelines, which focus on non-specific clinical 2 characteristics such as cough, trouble breathing, rapid breathing for age, and chest indrawing. Chest radiography (CXR) continues to be the gold standard when imaging is medically warranted in children suffering suspected pneumonia.¹

Only a few research have demonstrated a relationship between chest x-ray findings and severity of pneumonia and WHO scoring of X-ray chest, whereas other investigations have not demonstrated such a relationship. No such Prospective Cohort study has been carried out in Bareilly district or nearby areas. There the results of this study would be a boon for the patients of pneumonia. This study will throw light on better knowledge of diagnosis, treatment, prognosis, immunization and prevention of pneumonia among children. Henceforth the index study will be carried out to study the relationship between a chest x-ray and the severity of pneumonia in children aged 6 months to 5 years with pneumonia-related signs and symptoms.⁶

AIM & OBJECTIVES

To study the association between the severity of pneumonia and chest X-ray findings in children between 6 months to 5 year of age.

To study the pattern of chest x-ray abnormalities among children with a clinical diagnosis of pneumonia and severe pneumonia.

MATERIAL & METHODS

This prospective cohort hospital-based study was conducted in the Department of Pediatrics at Rajshree Medical & Research Institute, Bareilly, from January 2023 to December 2023. The study included 100 children ages 6 months to 5 years who were admitted to the paediatrics department at RMRI with clinical symptoms of pneumonia in either sex. Convenient sampling was used.

Inclusion Criteria:

Children between 6 months & 5 years of age admitted to RMRI with signs and symptoms of pneumonia according to WHO Criteria. Those who gave consent to have their children participate in the study's research.

Exclusion Criteria:

A- Individuals with severe congenital heart, lung, and other disorders, including cleft lip, cleft palate, primary ciliary dyskinesia, various congenital cardiac problems, and cystic fibrosis.

B- Patients suffering from severe chronic underlying diseases like Bronchial Asthma, Bronchopulmonary dysplasia, and Tuberculosis, with Immunosuppression and Immunosuppressive drugs.

C- Children with Congestive heart failure, Children who have aspirated a foreign body or have aspiration pneumonia or those who had been hospitalized during the previous 14 days, have been coughing for more than 14 days.

D- Patient's not giving consent for the study.

METHODS

Before starting the study, the institutional ethics committee gave its approval. Legal guardians of all patients were given a thorough explanation of the study's protocol before providing written informed consent. A detailed general examination was done, including anthropometry, a thorough systematic examination, a clinical examination, and pneumonia severity as determined by WHO criteria. Socioeconomic history and immunization status were also recorded. Investigations such as a chest X-ray, a pulse oximeter measurement of arterial oxygen saturation (SpO₂), and total WBC counts, and CBC were noted, and blood culture was done. According to

WHO recommendations, the relationship between the first results of the chest x-ray and the degree of pneumonia was evaluated.

RESULTS

A total of 100 cases were studied and analyzed. The age range was from 6 month to 5 years. Majority of the cases belonged to age group of 6-12 months 50% (n=50) followed by age group of 13-24 months 20% (n=20). There was a male preponderance in our study comprising 59% (n=59) of males and 41% (n=41) of females. 75% had pneumonia whereas 25% had severe pneumonia. Fever and cough were the most common symptoms present in all cases, fever being present in 95% (n=95) cases and cough was present in 98% (n=98) cases. Chest indrawing was present in 47% (n=47) cases, followed by fast breathing in 27% (n=27) cases, refusal of feeds in 18% (n=18) cases, wheeze in 17% (n=17) cases, altered sensorium in 9.0% (n=9) cases, cyanosis in 6% (n=6) cases and stridor was seen in 2% (n=2) cases. Chest x-rays were obtained for the subjects in my study, discussed with radiologists, and radiological reports were then obtained in accordance. That said, twelve of the instances exhibited no radiological abnormalities. Bilateral diffuse heterogeneous opacities were seen in 39 instances. Hilar opacities were seen in 17 instances. The zone opacity was homogeneous in 24 occasions. In five cases, the costophrenic angle was blunted and the same side's opacity was uniform. Three patients showed homogeneous opacity on the identical side air pocket in the chest x-ray along with blunting of the cardiophrenic angle. The p-value is less than 0.05, hence radiological findings have significant association with pneumonia among children.

Table 1: Radiological Findings Distribution Of Cases

Chest X-ray Findings	Frequency	Percentage	p-value
No radiological abnormality	12	12%	0.047
Bilateral heterogenous diffuse opacity	39	39%	
Hilar opacity	17	17%	
Homogenous zone opacity	24	24%	
CP angle Blunting with Homogenous opacities on same side	05	05%	
CP angle Blunting with Homogenous opacities on same side along with air pockets	03	03%	
Total	100	100%	

Nine children experienced pleural effusion, 12 cases developed empyema thoracis, 5 cases had concomitant sepsis, and 71 cases had no problems at all. The p-value is more than 0.05, hence complications of pneumonia has insignificant association with pneumonia among children.

Table 2: Distribution Of Study Population Based On Complications

Complications	Frequency	Percentage	p-value
No complication	71	71%	1.863
Sepsis	10	10%	
Pleural effusion	09	09%	
Empyema thoracis	12	12%	
Total	100	100%	

Based on the length of the patient's hospital stay. Twelve instances remained for less than five days, sixty-nine cases lasted for six to ten days, sixteen cases stayed for eleven to fifteen days, and three cases stayed for fifteen days or more. The p-value is less than 0.05, hence hospital stay duration has significant association with pneumonia among children.

Table 4: Severity Of Pneumonia Distribution As Per Chest X-Ray Findings.

		Pneumonia	Severe Pneumonia	Total
Chest X-Ray	No Radiological Findings	frequency 12	04	16
		% 75%	25%	100%
	Bilateral Diffuse & non Homogenous	frequency 25	10	35

		%	71.42%	28.57%	100%
	Opacity	frequency	11	07	18
	Hilar Opacity	%	61.11%	38.88%	100%
	Homogenous Zone	frequency	10	13	23
		%	43.47%	56.52%	100%
	Opacity	frequency	00	05	05
	Blunting of CP angle	%	0%	100%	100%
	CP Angle	frequency	02	01	03
	Blunting with air pockets	%	66.66%	33.33%	100%
Total	60	40			

Table 3: Distribution Of Cases As Per Hospital Stay Duration

No of days	Frequency	Percentage	p-value
< 5days	12	12%	0.001
6 - 10 days	69	69%	
11 - 14 days	16	16%	
>14 days	03	03%	
Total	100	100%	

DISCUSSION

Pneumonia is too complex to define in one way. It is a clinical condition with specific indications, symptoms, and a timeline. According to the WHO, pneumonia is defined as a acute respiratory infections typically caused on by bacteria or viruses.⁴ When a previously healthy child has an acute lung parenchymal infection outside of a hospital and is not admitted within 14 days after the onset of symptoms, the condition is known as community-acquired pneumonia (CAP); symptoms include fever with/or respiratory symptoms, along with consolidation and pulmonary infiltrates on the film of chest X-ray.² Despite improvements in care and prevention, pneumonia goes on to be the most common cause of mortality among children outside of the newborn period. The gold standard for diagnosing pneumonia has been thought to be changes in chest radiologic examinations.⁷ In the index study, maximum study population belonged to 6 to 12 months whereas minimum study population belonged to 49 to 60 months. The p-value is more than 0.05, hence age has insignificant association with pneumonia 46 among children. 683 children were enrolled in a research by Susan C. et al. during a 2-year duration, with median age = 3.1 years.⁸

In this study, maximum study population belonged to males (59%) whereas females belonged to 41% of study population. The p-value is more than 0.05, hence gender has insignificant association with pneumonia among children. 75 cases in all were studied by M. N. Tsolia et al. Of those, 49.3% were males & the remaining 50.7% were female.⁹

The median WBC count in the study by M. N. Tsolia, S. Psarras, et al. was $12,600 \times 10^9$ cells/L.⁹ In our study, Out of 100 cases, There were five cases with a WBC count of less than 5000/mm³, 39 with a count between 5000/mm³ and 9999/mm³, 18 with a count between 10000/mm³ and 14999/mm³, and 24 with a count over 15000/mm³ out of the total instances. The p-value is more than 0.05, hence WBC count has insignificant association with pneumonia among children. In a research, by Goldman L and colleagues Four to six days is the typical length of stay in a healthcare facility for the treatment of pneumonia.¹⁰

In present study, out of 100 cases, Twelve instances remained for less than five days, seventy-nine cases lasted for six to ten days, sixteen cases stayed for eleven to fifteen days, and three cases stayed for fifteen days or more. The p-value is less than 0.05, hence duration of hospital stay has significant association with pneumonia among children.

In a research by Rishi Pasary and colleagues Approximately 0.7% child admitted to hospitals due to CAP will experience empyema, and 68% of cases in which a causal organism is identified (roughly 37.7% to 58.5% of cases using conventional techniques) include S. pneumoniae, mostly serotype 1.¹¹

In the present study, Out of 100 cases, 71 instances had no

complications , 5 instances had associated sepsis, 12 instances had empyema thoracis, 8 instances had pleural effusion. The p-value is more than 0.05, hence complications of pneumonia has insignificant. In our study, 75% study population had pneumonia whereas 25% study population had severe pneumonia. The p-value is more than 0.05, hence severity of pneumonia has insignificant association with pneumonia among children.¹¹

In the research that Susan C. Lipsett and Michael C. It was determined that a negative Chest X-ray eliminates severe pneumonia in a large percentage of children, since a total of 457 children having negative Chest X-rays, 44 of whom had clinical diagnosis of severe pneumonia.⁸ Chest X-Rays were obtained for the subjects in my study, discussed with radiologists, and radiological reports were then obtained in accordance. That said, twelve of the instances exhibited no radiological abnormalities. Bilateral diffuse heterogeneous opacities were seen in 39 instances. Hilar opacities were seen in 17 instances. The zone opacity was homogeneous in 24 occasions. In five cases, the costophrenic angle was blunted and the same side's opacity was uniform. Three patients showed homogeneous opacity on the identical side air pocket in the chest x-ray along with blunting of the cardiophrenic angle. The p-value is less than 0.05, hence radiological findings have significant association with pneumonia in children.

According to a study by Shahla Afshar rahman et al, the underlying illness type directly affects the occurrence of pleural effusion in children. Approximately 0.6–2% of infants with bacterial pneumonia may develop a massive pleural effusion that results in empyema.¹² In all, 337 patients were analyzed in the research conducted by Bueno M et al. There were 34 patients suffering from pleural effusion (10.08%). There are one hundred instances in total in the current research. In 6% of the patients, pleural effusion was discovered. The occurrence of pneumonia complications varies slightly by the geographic location & seasonal considerations are also taken into account, particularly for empyema thoracis.¹³

CONCLUSION

In children in the 6 months to 5 years age range, there is a favorable correlation between the results of the chest x-ray taken at the time of admission and pneumonia. The majority of cases (50%) of pneumonia & severe pneumonia involved infants of ages of six and twelve months. There is no statistically significant difference in the sex distribution (p-value = 2.069), with 41% of cases being female and 59% being male. The age distribution of the cases that were taken has no statistical importance; p-value = 5.724, majority of the cases are between age group of 6 to 12 months. A p-value = 4.539 indicates that no statistical significant association is there with severity of pneumonia. Complications of pneumonia do not significantly correlate as p-value = 1.863.

The degree of pneumonia does not significantly correlate with age group (p-value = 5.724). A substantial connection (p-value = 0.047) has been found between the chest x-ray and the pneumonia severity. There is positive correlation between pneumonia severity & the length of hospital stay (p-value is 0.001). WBC Counts of pneumonia patients do not significantly correlate as p-value = 0.074.

LIMITATIONS

No organism isolation was carried out. Antibiotic effects were not compared. Small sample size. Less study duration. Non random sampling technique hence entire universe of population could not be covered for study.

Conflict Of Interest

The authors declare no conflicts of interest.

REFERENCES

1. Mvalo T, McCollum ED, Fitzgerald E, Kamthunzi P, Schmicker RH, May S, et al. Chest radiography in children aged 2-59 months enrolled in the Innovative Treatments in Pneumonia (ITIP) project in Lilongwe Malawi: a secondary analysis. *BMC Pediatr* 2022;22(1):31.
2. Kelly MS, Crotty EJ, Rattan MS, Wirth KE, Steenhoff AP, Cunningham CK, et al. Chest radiographic findings and outcomes of pneumonia among children in Botswana. *Pediatr Infect Dis J*. 2016;35(3):257–62.
3. Awasthi S, Rastogi T, Mishra N, Chauhan A, Mohindra N, Shukla RC, et al. Chest radiograph findings in children aged 2-59 months hospitalised with community-acquired pneumonia, prior to the introduction of pneumococcal conjugate vaccine in India: a prospective multisite observational study. *BMJ Open*.2020;10(5):e034066.
4. Sah VK, Giri A, Niraula N. Association between the clinical findings and chest radiographs in children with severe pneumonia aged 1 month to 5 years. *J Nobel Med Coll*.2018;7(2):15–9.
5. Pandey A, Galvani AP. The burden of childhood pneumonia in India and prospects for

control. *The Lancet Child & Adolescent Health*. 2020;4:643–5.

6. Chethan, Assistant Professor, Department of Pediatrics, JJM Medical college Davanagere Karnataka, INDIA. A study of association between chest X ray findings and severity of pneumonia in children between 2 to 59 months of age. *MedPulse International Journal of Pediatrics*. 2020;16(3):44–9.
7. Hassen M, Toma A, Tesfay M, Degafu E, Bekele S, Ayalew F, et al. Radiologic diagnosis and hospitalization among children with severe community acquired pneumonia: A prospective cohort study. *Biomed Res Int*. 2019;2019:6202405.
8. Lipsett SC, Monuteaux MC, Bachur RG, Finn N, Neuman MI. Negative chest radiography and risk of pneumonia. *Pediatrics*. 2018;142(3):e20180236.
9. Tsolia MN, Psarras S, Bossios A, Audi H, Paldanius M, Gourgiotis D, et al. Etiology of community-acquired pneumonia in hospitalized school-age children: evidence for high prevalence of viral infections. *Clin Infect Dis*. 2004;39(5):681–6.
10. Severity of pneumonia in under 5-year-old children from developing countries: A multicenter, prospective, observational study. *Am J Trop Med Hyg*. 2017;97(1):68–76.
11. Goldman L, Schafer AI. 2015. *Goldman–Cecil Medicine*, 25th edition. New York: Elsevier Saunders.
12. Afshar paiman S, Izadi M, Ajudani R, Khosravi MH. Pleural effusion in children: a review article and literature review. *Int J Med Rev*. (2022)3:365–70.
13. Bueno Campana M, Agundez Reigosa B, Jimeno Ruiz S, et al. Is the incidence of parapneumonic pleural effusion increasing? *A Pediatr Barc* 2008;68:92–98.