

Original Research Article

FACTORS ASSOCIATED WITH SEVERE PNEUMONIA IN CHILDREN OF AGE 2-MONTHS TO 5-YEARS AND RELATION OF SEVERITY OF PNEUMONIA WITH X-RAY FINDINGS

Saritha Cheruku¹, Jagadish Naidu Velamala², Ragam Shalini Yadav³

¹Assistant Professor, Department of Pediatrics, Patnam Mahender Reddy Medical College and Hospital, Chevella, Rangareddy, Telangana, India

²Assistant Professor, Department of Pediatrics, Malla Reddy Medical College for Women, Suraram, Hyderabad, Telangana, India

³Assistant professor, Department of Pediatrics, Malla Reddy Medical College for Women, Suraram, Hyderabad, Telangana, India

Received : 09/04/2025
Received in revised form : 49/05/2025
Accepted : 06/06/2025

Corresponding Author:

Dr. Saritha Cheruku,
Assistant Professor, Department of Pediatrics, Patnam Mahender Reddy Medical College and Hospital, Chevella, Rangareddy, Telangana, India
Email: sarithacheuku333@gmail.com

DOI: 10.70034/ijmedph.2025.2.477

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (2); 2635-2638

ABSTRACT

Background: There are various risk factors of pneumonia. They can be undernutrition, air pollution inside house, lack of ventilation, exposure of children to second hand smoke, overcrowding, low literacy of parents, low birth weight etc. Chest radiograph is also useful to differentiate between the severity of pneumonia in children. Some studies show that clinical and X-ray findings match to some extent while some studies observed that it is not the case. The objective is to study various factors associated with severe pneumonia compared to pneumonia and to study the relation of severity of pneumonia with X-ray findings.

Materials and Methods: Hospital-based-single-centre cross-sectional study was carried out among 100 children of age two months to five years diagnosed to have pneumonia or severe pneumonia. World Health Organization (WHO) criteria for classification of pneumonia were used. All cases underwent the X-ray chest as per the standard protocol and guidelines.

Results: Majority 73% children belonged to 13-60 months. Males were slightly more than females. Proportion of Severe pneumonia was 59.2% in 2-12 months compared to 35.6% in 13-60 months. Taking (WHO) classification of pneumonia as gold standard, X-ray had sensitivity=83.7% and specificity=68.4%. Positive predictive value was 66.7%. Being malnourished and not immunized properly were significant risk factors for severe pneumonia.

Conclusion: One can rely on clinical examination and history for diagnosis of pneumonia rather than X-ray chest as later had low diagnostic accuracy. Parents should take care of vaccination and nutrition of children to prevent severe forms of pneumonia.

Keywords: Association, pneumonia, children.

INTRODUCTION

Among under five children, pneumonia is the most important reason for deaths and morbidity all over the world. Most part of this burden is seen in the developing world. However, in the developed world there are cost issues related to the pneumonia in under five children.^[1]

It has been estimated that globally there might be 120 million pneumonia cases. These are said to be

causing around 13 lakh deaths annually.^[2] In the developing countries, around 80% of the deaths among pediatric age group of less than two years are attributed to pneumonia.^[3] The mortality is lesser in the developed countries; however, the morbidity is higher. They report about 25 lakh cases every year. Among these cases, almost 33% to 50% needs hospitalization.^[4]

In pneumonia, there is entry of the organism beyond the larynx. This happens when the barriers are

broken including the immunity. There is inflammation at the alveoli. The inflammatory cells migrate to the infection site. This leads to exudative process and damages the oxygenation.^[5]

There are various risk factors of pneumonia. They can be undernutrition, presence of air pollution inside the house due to lack of ventilation, exposure of the children to the second hand smoke, overcrowding, low literacy of parents, low birth weight etc.^[6]

Pneumonia classification was revised by World Health Organization (WHO) 7 as no pneumonia, pneumonia and severe pneumonia. This classification is based on the fast breathing and chest indrawing. Hence, this classification is considered as gold standard against which we can compare the validity of the X-ray in the clinical settings.

Chest radiograph is also useful to differentiate between the severity of pneumonia in children. Some studies 8 show that the clinical and X-ray findings match to some extent while some studies 9 observed that it is not the case.

With this background, present study was undertaken to study the various factors associated with severe pneumonia compared to pneumonia and to study the relation of severity of pneumonia with X-ray.

MATERIALS AND METHODS

This was a hospital based single centre cross sectional study carried out among children of age two months to five years of age in the Department of Pediatrics over a period of two years.

Institutional Ethics Committee permission was obtained vide letter number ECR/834/1ST/TG/2016/PEDIATRICS. Child assent was obtained from the parents or guardian as the case may be.

In the present study, children aged two months to five years of either gender diagnosed with

pneumonia and severe pneumonia as per WHO criteria for the diagnosis and classification of acute respiratory infections (ARI) were included. Children with any chronic diseases, those with immunocompromised states, using steroids, having leukaemia were excluded from the present study.

During the study period, a total of 100 children fulfilling the eligibility criteria were included in the present study. Any child coming to the out-patient department with symptoms suggestive of ARI was assessed for eligibility. If found eligible to be included in the present study, child assent was obtained from the parents. Detailed history, thorough clinical examination was carried out for each such case in the pre-designed, pre-tested, semi-structured study questionnaire. All cases underwent the X-ray chest as per the standard protocol and guidelines.

World Health Organization guidelines and criteria were used for the diagnosis of acute respiratory infections (ARI). 7 The children were classified as having pneumonia if they had either fast breathing or chest indrawing or both. They were classified as having severe pneumonia if they presented with danger signs like difficult to wake, stopped feeding well, continuous vomiting, not able to drink, or severe malnutrition.

The data was entered in the Microsoft Excel worksheet and analysed using proportions. For comparison of proportions, chi square test was used and the p value less than 0.05 was taken as statistically significant.

RESULTS

Majority i.e. 73% of the children belonged to the age group of 13-60 months and only 27% of them were younger. Males were slightly more than females i.e. 59% vs. 41% respectively [Table 1].

Table 1: Age and sex wise distribution of patients (n=100)

Characteristics		Number of patients	%
Age (months)	2-12	27	27
	13-60	73	73
Sex	Male	59	59
	Female	41	41

Table 2: Distribution of patients according to severity of pneumonia.

Age (months)	Pneumonia	Severe pneumonia	Total
2-12	11(40.8%)	16 (59.2%)	27
13-60	47(64.4%)	26 (35.6%)	73

In the present study the proportion of Severe pneumonia was 59.2% in the children belonging to the age group of 2-12 months compared to 35.6% in the age group of 13-60 months [Table 2]

Table 3: Severity of pneumonia and correlation with X-ray findings.

X-ray findings	Severe pneumonia	Pneumonia	Total	p
Abnormal	36 (66.7%)	18 (33.3%)	54	0.000
Normal	7 (15.2%)	39 (84.8%)	46	
Total	43	57	100	

Sensitivity=83.7%; specificity=68.4%; positive predictive value=66.7%

In the present study taking WHO classification of pneumonia as gold standard, the X-ray had a sensitivity of 83.7% and a specificity of 68.4%. the positive predictive value was 66.7%. [Table 3]

Table 4: Association of various factors with Severity of pneumonia

Various factors		Severe pneumonia	Pneumonia	Total	p
Nutritional status	Malnutrition	13 (76.5%)	4 (23.5%)	17	0.0052
	Normal	30 (36.1%)	53 (63.9%)	83	
Feeding pattern	Top milk	28 (43.8%)	36 (56.2%)	64	0.993
	Exclusive breast feeding	15 (41.7%)	21 (58.3%)	36	
Indoor air pollution	Yes	30 (50%)	30 (50%)	60	0.1272
	No	13 (32.5%)	27 (67.5%)	40	
Immunization status	Not immunized for age	39 (49.4%)	40 (50.6%)	79	0.0246
	Immunized for age	4 (19.1%)	17 (80.9%)	21	
Hygiene	Poor	35 (49.3%)	36 (50.3%)	71	0.0772
	Good	8 (27.6%)	21 (72.4%)	29	

Among the factors studied for association with severe pneumonia, being malnourished and not immunized properly were significant risk factors. 76.5% of those malnourished had severe form of disease compared to only 36.1% of those with normal nutritional status. ($p < 0.05$). Other factors were not found to be significantly associated severe pneumonia ($p > 0.05$). [Table 4]

DISCUSSION

Majority i.e. 73% of the children belonged to the age group of 13-60 months and only 27% of them were younger. Males were slightly more than females i.e. 59% vs. 41% respectively. In the present study the proportion of Severe pneumonia was 59.2% in the children belonging to the age group of 2-12 months compared to 35.6% in the age group of 13-60 months. In the present study taking WHO classification of pneumonia as gold standard, the X-ray had a sensitivity of 83.7% and a specificity of 68.4%. the positive predictive value was 66.7%. Among the factors studied for association with severe pneumonia, being malnourished and not immunized properly were significant risk factors. 76.5% of those malnourished had severe form of disease compared to only 36.1% of those with normal nutritional status. ($p < 0.05$). Other factors were not found to be significantly associated severe pneumonia ($p > 0.05$). Sutriana VN et al,^[10] conducted a case control study among 176 children 10-59 months. WHO criteria were used for diagnosis of pneumonia. They observed that the risk of pneumonia was 7.95 times more in those who were not given the exclusive breast feeding which we did not find significant. They reported that incomplete immunization was significantly associated with pneumonia which is in accordance with the present study. The risk of pneumonia was 7.12 times more in those with exposure to indoor air pollution and the risk was significant, however we did not report any such significant association. The odds of pneumonia were 3.27 times more in those with low birth weight compared to those with normal birth weight. We did not find any significant association. The authors

found that wasting was associated with pneumonia and we reported that malnutrition was associated with it. They did not find any association between malnutrition, gender, age and education with pneumonia.

Madhusudhan K et al,^[11] included 110 patients of pneumonia aged 2-60 months. WHO criteria were used for the diagnosis of pneumonia. They found that 42.7% of cases had severe pneumonia and 57.3% had pneumonia. Younger age was associated with severe pneumonia, but we did not find any such association. They did not find any association between gender and severity of pneumonia which is in accordance with the present study. They did not find any association between malnutrition and severity of pneumonia which is not in accordance with the present study. They did find association between exclusive breast feeding and severity of pneumonia which is in accordance with the present study. Similarly, there was a significant association between vaccination and severe pneumonia which is in accordance with the present study.

Chen L et al,^[12] found that the prevalence of community acquired pneumonia was 16.4% among the 20,174 cases included. 14% needed admission to intensive care unit. The predictors of severe community acquired pneumonia and the intensive care unit admissions were being younger, from rural area, had premature birth, birth weight less than normal, given top feeding, past history of jaundice etc.

Chethan KB et al,^[13] carried out a prospective study among children of age 2-59 months. They tried to correlate the findings of the clinical examination as per WHO criteria with that of the Chest X-ray findings. They found that 48.5% of the cases had severe pneumonia and those with pneumonia were 51%. They noted that 53% of the cases had chest X-ray abnormalities.

Goyal DK et al,^[14] studied 150 cases of pneumonia among the children of age 2-60 months. In addition to clinical examination, they also did the Chest X-ray for all cases. Based on the radiological findings, it was observed that 54% were suggestive of pneumonia. The younger children had more incidence of interstitial pneumonia and the older

children had more incidence of the lobar pneumonia. Among the severe pneumonia cases, the bronchopneumonia was the most common radiological findings.

Bénet T et al,^[15] carried out a multi centric study in five hospitals of India among 405 children of age 2-60 months having the confirmed diagnosis of pneumonia. The prevalence of hypoxemia was 17.3%. The organisms like respiratory syncytial virus and the human metapneumovirus were significantly associated with the hypoxemia. The risk of hypoxemia was 2.4 times more in these cases. Similarly, the odds of developing hypoxemia were 2.3 times more in those with chest indrawing. The hazard of dying was 4.6 times more in those who were infected with *Streptococcus pneumoniae*. Chisti MJ et al,^[16] carried out a case control study. Cases were those with severe acute malnutrition with fatal outcome. The odds of having fatal outcome among severely malnourished children was 23.15 times more. The odds of having fatal outcome among those with clinical dehydration was 9.48 times more. The odds of having fatal outcome among those with abdominal distension was 4.41 times more and among those who were given blood transfusion it was 5.5.

Limitations: The study was a single centre with limited sample size. The findings of the study may not be generalizable due to this and the lack of probability sampling. However, the results are comparable to most of the previously published studies. Information bias on X-ray reading may be present as agreement test (Kappa statistics) was not applied.

CONCLUSION

One can rely on clinical examination and history for diagnosis of pneumonia rather than X-ray chest as later had low diagnostic accuracy. Parents should take care of vaccination and nutrition of children to prevent severe forms of pneumonia.

REFERENCES

1. Gupta GR. Tackling pneumonia and diarrhoea: the deadliest diseases for the world's poorest children. *Lancet*. 2012 Jun 09;379(9832):2123-4.
2. Rudan I, O'Brien KL, Nair H, Liu L, Theodoratou E, Qazi S et al. Child Health Epidemiology Reference Group (CHERG). Epidemiology and etiology of childhood pneumonia in 2010: estimates of incidence, severe morbidity,

- mortality, underlying risk factors and causative pathogens for 192 countries. *J Glob Health*. 2013 Jun;3(1):010401.
3. Garenne M, Ronsmans C, Campbell H. The magnitude of mortality from acute respiratory infections in children under 5 years in developing countries. *World Health Stat Q*. 1992;45(2-3):180-91.
4. Howie SRC, Murdoch DR. Global childhood pneumonia: the good news, the bad news, and the way ahead. *Lancet Glob Health*. 2019 Jan;7(1): e4-e5.
5. Zar HJ. Bacterial and viral pneumonia: New insights from the Drakenstein Child Health Study. *Paediatr Respir Rev*. 2017 Sep; 24:8-10.
6. Fekadu GA, Terefe MW, Alemie GA. Prevalence of pneumonia among under-five children in Este Town and the surrounding rural Kebeles, Northwest Ethiopia: a community based cross sectional study. *Sci J Pub Health*. 2014; 2:150-5
7. World Health Organization. Revised WHO classification and treatment of childhood pneumonia at health facilities. Available from: https://iris.who.int/bitstream/handle/10665/137319/9789241507813_eng.pdf Accessed on: 25-11-2018
8. Swingle GH. Radiologic differentiation between bacterial and viral lower respiratory infection in children: A systematic literature review, *Clin Pediatr (Phila)* 2000; 39(11):627-33.
9. Kerby GS, Accurso FJ. Respiratory tract and mediastinum. In: William W. Hay, Jr., Myron J. Levin et al. *Current diagnosis and treatment in paediatrics*, 18th ed. USA: Appleton and Lange, 2007; 517-518.
10. Sutriana VN, Sitaresmi MN, Wahab A. Risk factors for childhood pneumonia: a case-control study in a high prevalence area in Indonesia. *Clin Exp Pediatr*. 2021 Nov;64(11):588-595.
11. Madhusudhan K, Sreenivasaiah B, Kalivela S, Nadavapalli SS, Ramesh BT, Jampana VR. Clinical and bacterial profile of pneumonia in 2 months to 5 years age children: a prospective study done in a tertiary care hospital. *International Journal of Contemporary Pediatrics* 2016; 4(1):90-95.
12. Chen L, Miao C, Chen Y, Han X, Lin Z, Ye H, Wang C, Zhang H, Li J, Tang Q, Dong Y, Bai M, Zhu Y, Liu G. Age-specific risk factors of severe pneumonia among pediatric patients hospitalized with community-acquired pneumonia. *Ital J Pediatr*. 2021 Apr 23;47(1):100.
13. Chethan KB, Nandakumar V, Spoorthi SM, Basanth Kumar GR. 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*. December 2020; 16(3): 44-49.
14. Goyal DK, Sareen D. Can chest x-ray predict pneumonia severity and its outcome in children aged 2 months - 5 years? *International Journal of Contemporary Pediatrics* 2020; 7(3):704-709.
15. Bénet T, Picot VS, Awasthi S, Pandey N, Bavdekar A, Kawade A et al. Severity of Pneumonia in Under 5-Year-Old Children from Developing Countries: A Multicenter, Prospective, Observational Study. *Am J Trop Med Hyg*. 2017 Jul;97(1):68-76.
16. Chisti MJ, Salam MA, Ashraf H, Faruque AS, Bardhan PK, Hossain MI et al. Clinical risk factors of death from pneumonia in children with severe acute malnutrition in an urban critical care ward of Bangladesh. *PLoS One*. 2013 Sep 9;8(9): e73728.