

Risk Factors and Outcome of IMNCI classified severe and very severe pneumonia among under five children in tertiary care hospital

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Abstract

Background: Pneumonia continues to be one of the leading causes of mortality among children under five years of age despite effective vaccines and nutritional and environmental interventions. This study designed to study the risk factors and outcome of IMNCI classified severe and very severe pneumonia in under five children.

Methods: Children between 2-60 months, fulfilling inclusion criteria were enrolled as cases. Baseline clinical assessment and physical examinations findings recorded. Lab and radiological investigations done. Reassessment done at 48 hrs for the cases of treatment failure.

Results: There were 75 out of 119 with incomplete immunization, 73 out of 83 with lack of exclusive breast feeding, 104 out of 185 with poor and 125 out of 136 malnourished develops very severe pneumonia. There was significant association between incomplete immunization, lack of exclusive breast feeding, lower socioeconomic status and malnutrition for risk of severe pneumonia ($p=0.00$). Consolidation (241) over X ray chest PA view was most common finding followed by interstitial infiltration (49) and pleural fluid/air (10). The most common complication observed was empyema followed by meningitis and septicemia and 12 out 136 having very severe pneumonia died, while 124 were successfully discharged and there was significant association between very severe pneumonia with outcome as death ($p=0.0056$) and 41 out 136 having very severe pneumonia were having treatment failure, while 95 were successfully treated for illness.

Conclusion: Early identification of these risk factors and anticipation of treatment failure may have therapeutic implication for starting more intensive therapy, thereby preventing complications and reducing childhood mortality and morbidity due to pneumonia.

Key words: Pneumonia, IMNCI, breastfeeding, immunization, under 5 children

Introduction

Deaths in children accounted for a major bulk of total deaths worldwide, with worsening of the proportion in the developing countries since olden days; pneumonia being the leading killer ^[1]. Pneumonia continues to be one of the leading causes of mortality among children under five years of age despite effective vaccines and nutritional and environmental interventions. Pneumonia deaths in health facilities might appear as the ‘tip of the iceberg’ because most of the deaths are taking place even before these children reach a health facility ^[2]. Pneumonia, defined as inflammation of lung parenchyma, is the leading cause of death in children less than 5 years globally ^[3]. The biggest killers are pneumonia, diarrhoea and neonatal causes ^[4, 5]. Pneumonia is the most common illness affecting infants and children globally. World Health Organization (WHO) data indicate that acute respiratory infections (ARIs) are the second most common cause of disability-adjusted life years lost around the world. Studies from low/middle-income countries (LMICs) have tried to identify the risk factors for severe pneumonia, but only a few studies from India have reported the risk factors for severe pneumonia ^[6].

The previous guidelines classified the respiratory symptoms of children 2 to 59 months of age into four categories. Children with cough and cold who did not have signs of pneumonia were classified as “no pneumonia” and their caregivers were advised on appropriate home care. Children with fast breathing were classified as “pneumonia” and were given an oral antibiotic to take at home for five days. Children who had chest in drawing with or without fast breathing were classified as “severe pneumonia” and were referred to the closest health facility for treatment with injectable penicillin. Children who had any general danger signs were classified as “severe pneumonia or very severe disease” ^[7]. Newborns with pneumonia commonly present with poor feeding and irritability, as well as tachypnea, retractions, grunting, and hypoxemia ^[8].

There are many risk factors associated with IMNCI classified severe and very severe pneumonia. Childhood clinical pneumonia is caused by exposure to risk factors related to the host, the environment and infection. Risk factors like lack of exclusive breastfeeding, low birth weight, under-nutrition, indoor air pollution, overcrowding and lack of measles immunization are associated with pneumonia. These risk factors are categorized as definite, likely and possible based on the evidence pointing to their role in pneumonia. Reduction of these risk factors is suggested as a primary strategy to protect against pneumonia. Community-Based Interventions (CBI) including mother’s education for reduction of risk factors is an important intervention measure for the long-term sustainability. In India, there is a lack of evidence on epidemiology and etiology of pneumonia posing as an important barrier for effective planning and implementation of preventive measures ^[9, 10].

The term pneumonia as used refers to ‘suspected pneumonia’ identified by its clinical symptoms. It is a severe form of acute lower respiratory infection specifically affecting lung parenchyma and presenting with symptoms of cough and fast or difficulty in breathing ^[11]. WHO has defined fast breathing as respiratory rate of >60 per minute for infants less than 2 months, >50 per minute for infants of 2-12 months and >40 per minute for children more than 12-59 months. Fast breathing alone was categorized as pneumonia, fast breathing with chest in drawing as severe pneumonia, and fast breathing with chest indrawing along with any of the danger signs, namely inability to feed, drowsiness or altered consciousness, convulsion, cyanosis, as very severe disease ^[12, 13]. Hence the present study was aimed to assess the risk factors and outcome of IMNCI classified severe and very severe pneumonia in under five children.

Material and Methods

Study design: Observational cross-sectional study.

Study area: Pediatric ICU at tertiary care hospital, Nanded, Maharashtra, India.

Study population: All patients of 2 months to 5 years of IMNCI classified severe and very severe pneumonia admitted in pediatric ICU at tertiary care hospital.

Study duration: from August 2020 to September 2021.

Inclusion criteria: children of age between 2-60 months, admitted in pediatric ICU of tertiary care hospital with severe and very severe pneumonia as per IMNCI guidelines.

Exclusion criteria

1. Children with history of asthma, hyper reactive airway disease.
2. Children with k/c/o congenital heart disease, congestive cardiac failure,
3. Children with k/c/o tuberculosis, HIV.
4. Children with non-severe pneumonia as per IMNCI guidelines.
5. Parents not willing for participation.

The approval from the Institutional ethics committee was obtained before starting of the study.

Operational definitions

Severe Pneumonia: Lower chest in drawing (LCI).

Very Severe Pneumonia: Any general danger sign along with Lower chest in drawing.

Danger signs include

1. Not able to drink/breastfeed
2. Convulsions.
3. Vomiting.
4. Lethargy or Unconsciousness.
5. Oxygen saturation <90%.
6. Central cyanosis.
7. Stridor in calm child.

Statistical analysis: Data analysis was done with the help of SPSS version 20.0.

Method of assessment

After admission cases were enrolled and following steps were taken.

1. Baseline clinical assessment

- a) Demographic variables like age, sex and area of residence (rural, urban) were recorded.
- b) Detailed standardized medical history.
- c) Immunization Status was assessed for routine immunizations by National Immunization Schedule and for some specific immunizations like Measles, Pneumococcal vaccine and Hib vaccine.
- d) Breast feeding practice at the onset of illness was recorded if applicable (<2yrs age), whether the child is given breast feed at the onset of illness or not. For children below 6 months, whether they are given exclusive breast feeding or it is suboptimal.
- e) Assessment of nutritional status by Weight for Age Z score.

2. **Physical examination:** Physical examination included detailed general examination for vitals like temperature, respiratory rate, heart rate, blood pressure and for lower chest in drawing (LCI), presence of cyanosis and respiratory system examination for signs like crepitation, wheeze, bronchial breathing and other systemic examination. The respiratory rate was measured twice within 5 minutes or as quickly as possible while child is quiet. If the first two measurements differ by more than 5 breaths per min or the second reading is below cut off, the respiratory rate will be measured again.
3. **Laboratory investigations:** Blood sampling was done under aseptic precautions within 1 hour, before first dose of antibiotic for laboratory investigations.
4. **Radiographic examination:** Radiograph were taken in all the patients and assessed with the help of two consultant radiologists independently according to the standardized WHO Guidelines to evaluate chest radiographs, no clinical information was made available to them. Then reassessment was done at 48 hours for occurrence of treatment failure if present. Strict observation was made for occurrence of failure of Standard Treatment. Subsequently patient will be followed till discharge or death for assessing their outcome as improvement, development of complications and co morbidities and death.

Results

The mean age of 300 study sample was 15.97 months, with the highest 60 months and lowest of 2 months. There were 183(61%) males and 117(39%) females in the study, while 153(51%) were from 1-10 months age group followed by 59(19.67%) in 11-20 months age group.

Table 1: Socio-demographic details among study population

Socio-demographic Variables	Classification of Pneumonia		Total	P-value	
	Severe	Very severe			
Gender	Female	56	61	117	0.058
	Male	108	75		
Age group	≤12 months	114	96	210	0.840
	≥13 months	50	40		
Residence	Rural	100	92	192	0.230
	Urban	64	44		
Immunization	No	44	75	119	0.000
	Yes	120	61		
Measles	No	79	85	164	0.013
	Yes	85	51		
Exclusive breast feeding	No	10	73	83	0.000
	Yes	154	63		
Hib & Pneumococcal	No	33	64	97	0.000
	Yes	131	72		
Breastfeeding	No	47	39	86	0.997
	Yes	117	97		
BPL	No	83	32	115	0.000
	Yes	81	104		
Malnutrition	No	131	11	164	0.000
	Yes	11	125		

It was observed from Table 1 that 75 out of 119(63.02%) with incomplete immunization, 73 out of 83(87%) with lack of exclusive breast feeding, 104 out of 185(56.21%) with below poverty line and 125 out of 136(91.19%) malnourished develops very severe pneumonia.

There was significant association between incomplete immunizations, lack of exclusive breast feeding, lower socioeconomic status and malnutrition for risk of severe pneumonia ($p=0.00$). In present study, Refusal to feed (37) followed by Vomiting (36), Drowsy (26), Lethargy (26) were most common danger signs observed in children with very severe pneumonia while Convulsions (09), Central cyanosis (02) were less common in the study sample.

Table 2: Clinical parameters in study population

Parameters	Pneumonia	No.	Mean	P-value
Respiratory rate (rate/min)	Severe	164	48.59	0.002
	Very severe	136	51.4	
SpO ₂ (%)	Severe	164	93.94	0.000
	Very severe	136	92.26	
Hb (gm%)	Severe	164	11.0165	0.000
	Very severe	136	8.2971	
TLC (cell/mm ³)	Severe	164	9317.79	0.000
	Very severe	136	12713.97	
RR after 48 hour	Severe	164	39.68	0.002
	Very severe	136	42.29	
SpO ₂ after 48 hour	Severe	164	97.84	0.000
	Very severe	136	96.3	

It was seen from Table 2 that mean respiratory rate, TLC & respiratory rate after 48 hours was higher in very severe pneumonia cases in comparison with severe pneumonia cases and difference was statistically highly significant (p value 0.002, 0.00 0.002 respectively) while oxygen saturation, hemoglobin & oxygen saturation after 48 hour was lower in very severe pneumonia cases in comparison with severe pneumonia cases and difference was statistically highly significant ($p=0.00$).

Table 3: Clinical finding after 48 hrs in study population

Variable		Type of Pneumonia		Total	P-value
		Severe	Very Severe		
Fever after 48 hrs	No	157	104	261	0.000
	Yes	7	32	39	
Chest in drawing after 48 hr	No	152	94	246	0.000
	Yes	6	42	54	

It was observed from Table 3 that chest in drawing (77.77%) and persistence of fever (82.05%) after 48 hours were associated with very severe pneumonia suggestive of treatment failure to first line injectable antibiotics used in treatment & needed to change in antibiotics. Blood culture showing positive for organism with antibiotic resistance were also associated with very severe pneumonia. Streptococcus pneumoniae (5%) was the most common organism found over culture followed by Staph aureus (4%) & Hemophilus influenza B (1%) in 30 samples sent for blood culture & sensitivity.

Table 4: Chest X-ray findings on admission among study population

X-ray finding	Severe Pneumonia	Very Severe Pneumonia	Total
Consolidation	135 (45%)	106 (35.33%)	241 (80.33%)
Interstitial infiltration	25 (8.33%)	24 (8%)	49 (16.33%)
Pleural fluid/air	04 (1.33%)	06 (2%)	10 (3.33%)
Total no. of cases with x-ray findings	164 (54.66%)	136 (45.33%)	300 (100%)

It was seen from Table 4 that majority 80.33% of total patients shows consolidation (241) over X-ray chest PA view was most common & significant finding followed by interstitial infiltration in 49(16.33%) and pleural fluid/air in 10(3.33%) children and 18(6%) children with severe pneumonia develops complications. The most common complication observed was Empyema 9(3%) followed by Meningitis 6(2%) and Septicemia 3(1%).

Table 5: Treatment Failure at 48 hours in study population

Variable		Secondary Outcome (treatment)		Total	P-value
		Failure	No failure		
Type of Pneumonia	Severe	10	154	164	0.000
	Very severe	41	95	136	

As Table 5 shows that, 41 out 136(30.14%) having very severe pneumonia were having treatment failure, while 95 were successfully treated for illness and there was significant association between very severe pneumonia with failure for treatment ($p=0.000$).

Table 6: Primary Clinical Outcome in study population

Variable		Primary outcome		Total	P-value
		Death	Discharge		
Type of Pneumonia	Severe	03	161	164	0.0056
	Very severe	12	124	136	

As shown in Table 6 that, 12 out 136(8.82%) were having very severe pneumonia died while 124(91.17%) were successfully discharged. There was significant association between very severe pneumonia with outcome as death ($p=0.0056$).

Discussion

In the study, there were 183(61%) males and 117(39%) females. According to the Srivastav P *et al.* ^[12] study, more male children affected than girls (68.33% vs. 31.67%). In a study by Chatterjee S *et al.* ^[13], it was discovered that sex-specific attack rates were higher in males than females across all age groups. These findings were in concordance with our studies. The demographic parameters revealed that the average age of the 300 participants in the study was 15.97 month (standard deviation: 16.03 months). According to the Srivastav P *et al.* ^[12] study, the majority of children with pneumonia (61.67%) were infants under the age of one year. In a study by Chatterjee S *et al.* ^[13], it was discovered that the age-specific attack rate of ARI decrease with the child's age and the worst sufferers were in the age group of 6-11 months. 61% of total children were given up to date immunization which is compared to other studies by SPEAR study group ^[14] in which 68% patients were fully immunised and Singh MK *et al.* ^[15] in which 54.7% were fully immunised according to NIS. WHO recommends routine immunization programs in all countries which includes 4 vaccines to prevent pneumonia and its mortality-measles, pertussis, Hib, pneumococcal conjugate vaccine.

In present study, only 72.33% children were receiving exclusive breast feeding up to 6 months while rest 27.67% were either given suboptimal breastfeeding or no breast feeding. This is high compared to a study done by Tiewsoh K *et al.* ^[16] in which 59.5% children received exclusive breastfeeding. The World Health Organization (WHO) analysed a number of research on the influence of breast-feeding on child survival and found that the protective effect is best in the first six months of life, with breast-fed newborns having a 4-6-fold survival advantage. The benefit lasts for the first year of life, with a 1.4-1.8-fold increase in mortality protection from months six to twelve. In the present study 71% of children less than 2 years were breastfed while in studies done by NOSHOTS study group ^[17] and APPIS study group ^[18] 74% and 78% children less than 2 years were breastfed respectively.

In present study, 45% children had their weight for age z score <-3 and 55% had weight for age z score >-3 . In total children with weight for age z score <-3 only 08% children had severe pneumonia while remaining 92% belongs to very severe pneumonia group. This showed strong association of malnutrition with very severe pneumonia than severe pneumonia. The studies from developing countries like Asghar R *et al.* [14] and APPIS study group [18] reported malnutrition between 13-25%. In this study, 62% of children were belong to below poverty line. A study from Karnataka, Kumar AMK *et al.* [19] discovered 76.5% of pneumonia cases in people with low socio-economic status (class 3 & 4). A study by Nabanita N *et al.* [20] and Gupta N *et al.* [21] also found that prevalence of pneumonia is more in low socio-economic status. Malnutrition, lack of exclusive breast feeding, history of diarrhoea or ARI in the preceding 3 months, hypoxemia on admission, type of first contact health facility, institution of antibiotic at first contact, and time to initiation of treatment were all found to be predictors of severe pneumonia and mortality in Chakraborty S *et al.* [22] study of 95 cases of pneumonia. This was in line with our findings. The patients were split into two groups: those with severe pneumonia (n=164) and those with very severe pneumonia (n=136). Fever was prevalent in 191 patients at baseline, based on symptom evaluation. The most prevalent danger signs found in children with very severe pneumonia were refusal to feed (n=37), vomiting (n=36), drowsiness (n=26), and lethargy (n=26), while convulsions (n=09) and central cyanosis (n=02) were less common. Hypoxia or sepsis could cause convulsions. The clinical and analytical data of the study sample revealed that 13 percent (n=39) of the patients had fever after 48 hours, whereas 18 percent (n=54) had chest in drawing. Our findings were comparable to those of Singh MK *et al.* [15], who found that cough (90.7%), fever (88%), trouble breathing (81.3%), and unwillingness to feed were the most common symptoms (41.3%).

In terms of clinical parameters, mean respiratory rate, TLC and respiratory rate after 48 hours were all higher in very severe pneumonia cases compared to severe pneumonia cases, whereas oxygen saturation, hemoglobin and oxygen saturation after 48 hours were all lower in very severe pneumonia cases compared to severe pneumonia cases and difference was statistically highly significant (p=0.00). The outcome was assessed based on the treatment. The study's end points were either recovery or death. In total, 15 patients (5%) died while undergoing treatment. 12 of the 136 patients with very severe pneumonia died, while 124 were successfully discharged, and there was a statistically significant association between very severe pneumonia and death (p=0.0056). Study by Kumar AMK *et al.* [19], found a 3% mortality rate in their study, treatment failure occurred in 41 of the 136 patients with very severe pneumonia, whereas 95 were effectively treated for their disease. Another study by Champatiray J *et al.* [11] found that 31 of the 141 cases had a death rate of 21.98%. Severe pneumonia resulted in 9(6.38%) deaths, whereas very severe pneumonia resulted in 22(15.6%) deaths.

Conclusion

The median age of patients affected by pneumonia was 15.97 months, with a male preponderance among the affected cases. Lack of immunization, lack of exclusive breastfeeding, lower socioeconomic status, malnutrition and lack of Pneumococcal & H. influenza vaccination were significant risk factors of pneumonia. A high TLC count, hypoxemia, and low Hemoglobin were major risk factors in very severe pneumonia. The most common bacteria isolated were streptococcus pneumoniae, followed by Staphylococcus aureus and haemophilus influenzae. X-ray findings were present in almost all patients with consolidation being the most common finding. The mortality rate was 5% with majority of cases in very severe pneumonia patients. Early identification of these risk factors and anticipation of treatment failure may have therapeutic implication for starting more intensive therapy, thereby preventing complications and reducing childhood mortality and morbidity due to pneumonia.

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