



Post Covid Trends in Pneumonia Associated Cough and Rapid Breathing in Children (Ages 2 Months To 14 Years): A Clinical Study

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Abstract

Background: *Pneumonia remains a leading cause of mortality among children worldwide, particularly in developing countries. Accurate diagnosis of pneumonia in children is crucial for timely and appropriate treatment. This study aimed to observe and establish associations between clinical and laboratory parameters and radiographically confirmed pneumonia in children, potentially reducing the reliance on chest radiographs for diagnosis in resource-limited settings.*

Methods: *A prospective observational study was conducted at a tertiary care teaching hospital over 18 months, involving 251 children aged 2 months to 14 years. Clinical parameters, including symptoms and vital signs, were recorded, and laboratory investigations were performed. Associations between these parameters and radiographically confirmed pneumonia were analyzed using statistical tests.*

Results: *Most patients were male (59%) and aged 1-5 years (48.2%). Fever, wheeze, refusal to feed, and vomiting were common symptoms. Clinical parameters such as temperature $\geq 99.5^{\circ}\text{F}$, nasal flaring, grunting, retractions, and crepitations showed significant associations with radiographically confirmed pneumonia. Laboratory parameters, including leucocytosis and C-reactive protein, were also significantly associated. History of fever, refusal to feed, crepitation, and chest retractions had high sensitivity and positive predictive value for predicting pneumonia.*

Conclusion: *Fever, refusal to feed, grunting, crepitation, wheeze, retractions, leucocytosis, anemia, and elevated C-reactive protein were significantly associated with radiographically confirmed pneumonia. These findings contribute to better understanding the characteristics of children with respiratory symptoms and aid in the diagnosis of pneumonia, particularly in resource-limited settings. Further research is needed to validate these associations and explore their applicability in diverse populations.*

Keywords: *Children, Clinical parameters, Laboratory parameters, Pneumonia.*

Introduction

Globally, the mortality rate for children under the age of 5 (U5MR) has declined to 37 deaths per 1000 live births in the years. Among the various causes of death in this age group, notable factors include birth complications, pneumonia, diarrhea, and malaria. Pneumonia, characterized as an acute respiratory infection, primarily stems from viral or bacterial sources. It poses a spectrum of risks, ranging from mild to life-threatening, affecting individuals across all age groups. Regrettably, pneumonia stands as the foremost infectious cause of death among children worldwide. In particular, it contributes significantly to under-5 mortalities, with estimations revealing that 23% of global pneumonia cases transpire in India, accounting for approximately 400,000 pneumonia-related deaths each year. [1]

Acute Lower Respiratory Infections (ALRI) encompass a range of conditions, including pneumonia, acute bronchitis, and bronchiolitis, all of which affect the lungs and airways. Influenza and whooping cough are identified as the leading causes of morbidity and mortality among children globally, particularly in developing countries (2). When diagnosing pneumonia, physicians rely on various criteria in clinical practice, such as the patient's clinical and epidemiological history, chest radiography findings, and laboratory tests (3). Traditional indicators of pneumonia include symptoms like cough, fever, wheezing, difficulty in breathing, and abdominal pain (4). The World Health Organization (WHO) defines pneumonia as an acute episode characterized by cough and rapid breathing, with specific cut-off values for increased respiratory rate based on the child's age (5). The WHO proposes that in developing countries, the diagnosis of Community Acquired Pneumonia (CAP) is based on clinical suspicion, radiological confirmation of infiltrates, and various parameters from the patient's history and examination (6). While chest x-rays are the preferred diagnostic test in tertiary care centers, there are cases where patients clinically diagnosed with community-acquired pneumonia exhibit normal chest radiographs. In such situations, physicians are still required to treat pneumonia despite the absence of radiologic findings (7). Therefore, accurate diagnosis of pneumonia in children remains an important yet challenging clinical problem. The present study aims to observe and establish associations between clinical and laboratory parameters and radiographically confirmed pneumonia. If significant associations are found, it could potentially reduce the number of chest radiographs necessary for diagnosing pneumonia in resource-limited settings within developing countries.

Objectives

To study association of clinical, lab and vital parameters of Pneumonia with radiographically confirmed cases.

Methods

This prospective observational study was conducted at a tertiary care teaching hospital over a period of 18 months, involving a sample size of 251 patients. Prior to commencing the study, ethical approval was obtained from the Institutional Review Board (IRB) of the college. The study included children aged 2 months to 14 years who were admitted with symptoms of cough and fast breathing. Exclusions comprised children with chronic respiratory illnesses (e.g., cystic fibrosis or Bronchopulmonary dysplasia), congenital anomalies (e.g., cleft lip, cleft palate, and CHD), conditions that may predispose to pneumonia (e.g., sickle cell anemia, immunosuppression, and malignancy), children who underwent chest radiography for reasons unrelated to pneumonia evaluation (e.g., trauma or foreign body aspiration), and cases where caregivers/parents refused to provide consent. Cases were selected based on predetermined inclusion and exclusion criteria, and informed verbal consent was obtained from parents/caregivers in the local language. A detailed history of the present illness was recorded, and a comprehensive examination of the children was conducted, along with interviews of the parents/caregivers using a structured questionnaire-based proforma. During the general physical examination, particular attention was given to assessing the child's general condition, recording axillary temperature using a digital thermometer, counting the respiratory rate for one full minute, measuring oxygen saturation using pulse oximetry, and evaluating the nutrition status based on weight. Signs such as nasal flaring, grunting, and pallor were noted. A detailed systemic examination, with a focus on the respiratory system, was performed, observing for signs such as chest retractions, tachypnea, wheezing, and crepitation. Patients admitted to the respective ward had already received treatment according to the standard management protocol for pneumonia. Hemoglobin levels, total count, and C-reactive protein values were recorded from the patients' case sheets. Chest radiograph findings were also noted from the case sheets based on the interpretation of the radiographs. Definitions for fever, chest retractions, crepitation, wheezing, cough, tachypnea, nasal flaring, grunting, malnutrition, anemia, leukocytosis, and C-reactive protein were based on the Integrated Management of Neonatal and Childhood

 Illness (IMNCI) guidelines. [8]

Statistical Analysis

The data was entered into the MS Excel 2019 registered version and SPSS version 26.0 was used for the analysis. Chi-square test was used to find the association between the clinical parameters, laboratory findings with the Chest X-ray confirmed cases of Pneumonia. P value less than 0.05 was considered as statistical significant.

Results

A total of 251 children with cough and fast breathing were studied in the age group 2 months to 14 years. 59% of the patients were male and rest were female child. Majority of the children were between 1-5 years i.e. 48.2%. Majority of the patients had fever, wheeze(71.3%), refusal for feed (21.51%) and Vomiting(13.1%). Age wise distribution of clinical parameters in the study population is shown in Table no. 1.

Table 1: Age and Sex distribution in the study population

Age	Male	Female	Total
2months- 1year	53	37	90
1-5 year	77	44	121
6-10 year	16	16	32
11-14 year	4	4	8
Total	150	101	251

At the time of examination, temperature was more than 37.5 degree Celsius in 68.1% of children. 12.7% of children in the study population had oxygen saturation less than 95%. Age wise distribution of Vital Signs among Study Population is shown in Table. 2

Table 2. Distribution of clinical parameters in the study population

Clinical parameter	Yes	No
Fever	179	72
Vomiting	33	218
Wheeze	179	72
Refusal feed	53	198

Table 3. Age-wise distribution of laboratory parameters among study population

Laboratory parameters		Age categories							
		2months- 1year		1-5 year		6-10 year		11-14 year	
		N	%	N	%	N	%	N	%
Anemia	Yes	43	47.8	54	44.6	15	46.9	4	50
	No	47	52.2	67	55.3	17	53.1	4	50
Leucocytosis	Yes	54	60	52	42.9	10	31.2	4	50
	No	36	40	69	57.1	22	68.8	4	50
Crp	Yes	29	32.2	44	36.3	14	43.8	4	50
	No	61	67.8	77	63.6	18	56.2	4	50

Table 4. Prevalence of radiologically confirmed pneumonia in different age group

Age	Pneumonia N(%)	Study population in each group
2months- 1year	71(78.88)	90
1-5 year	66(54.54)	121
6-10 year	11(34.37)	32
11-14 year	4(50)	8

Table 5. Association of clinical parameters with pneumonia

Clinical parameters		Pneumonia	No Pneumonia	P value
Fever	Yes	131	48	0.26
	No	21	51	
Vomiting	Yes	24	9	0.36
	No	128	90	

Wheeze	Yes	81	98	0.05
	No	71	1	
Refusal to feed	Yes	39	15	0.26
	No	113	84	
Temperature \geq 99.5 F	Yes	117	54	0.0019
	No	35	45	
Spo2 < 95%	Yes	22	10	0.31
	No	130	89	
Malnutrition	Yes	25	4	<0.001
	No	127	95	
Nasal flaring	Yes	59	6	0.038
	No	93	93	
Grunting	Yes	6	11	0.089
	No	146	88	
Retractions	Yes	121	64	<0.001
	No	31	53	
Crepitations	Yes	144	14	0.002
	No	8	85	
Anemia	Yes	73	43	0.05
	No	79	56	
Leukocytosis	Yes	91	29	<0.001
	No	61	70	
CRP	Yes	60	31	<0.001
	No	92	68	

Malnutrition was present in 11.6% patients and absent in 88.4% patients. Malnutrition was present maximum in the age group 2 month – 1 years with 15.6%.

Nasal Flaring was present in 25.9% of children. On examination of the respiratory system retractions and crepitations were present in 73.7% and 62.9% of children in the study population respectively. Grunting was present in 6.8% of children in the study population.

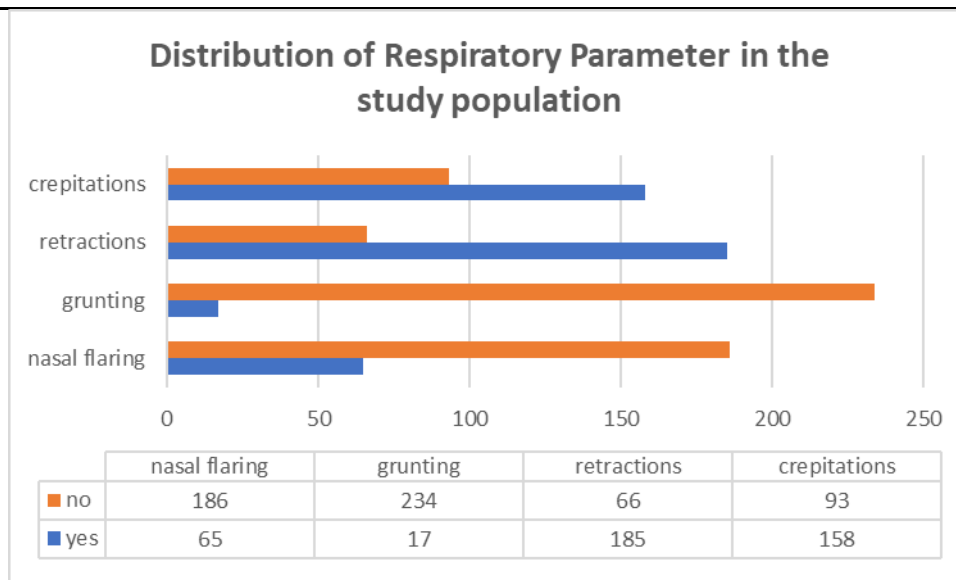


Figure 1. Distribution of Respiratory Parameter in the study population

Figure 1 depicts of all the laboratory investigations done, anaemia was present in 46.2% of children in the study population. Leucocytosis was present in 47.8% and absent in 52.2% of children in the study population. CRP was positive in 36.2% of children in the study population.

Chest X-ray suggesting Pneumonia was present more in age group 2 month – 1 years (46.7%), followed by age group 1 year – 5 year (43.42%).

History of fever and refusal to feed were significantly associated with confirmed Pneumonia with P values of 0.001 and 0.047 respectively. But vomiting was not significantly associated with confirmed Pneumonia with p value found 0.124. History of wheeze was significantly associated with confirmed Pneumonia with p value 0.001.

Temperature was found significantly associated in present study with P value of 0.00194 and oxygen saturation was not significantly associated with confirmed Pneumonia with p value 0.31.

Presence of malnutrition was significantly associated with confirmed Pneumonia with P value of 0.0026.

Crepitation was found in 94.7% radiographically confirmed Pneumonia cases. Nasal flaring, grunting, retractions, and crepitation were significantly associated with confirmed Pneumonia with P value of <0.05.

Leucocytosis is significantly associated with confirmed Pneumonia with p value 0.001. Anaemia and CRP was found in 48 % and 39.5% of the confirmed Pneumonia patients, it was found to be not significantly associated with confirmed Pneumonia with P value of 0.47 and 0.18.

Presence of history of fever, refusal of feed, oxygen saturation < 95%, wheeze, presence of nasal flaring, chest retractions, crepitation, presence of malnutrition, presence of leucocytosis and CRP having sensitivity of 86.19%, 25.7%, 14.5%, 53.3%, 38.8%, 79.6%, 94.7%, 16.4%, 59.9%, and 39.5% respectively in predicting Pneumonia.

Presence of history of fever, refusal of feed, oxygen saturation < 95%, wheeze, presence of nasal flaring, chest retractions, crepitation, presence of malnutrition, presence of leucocytosis, CRP and anaemia having positive predictive value of 73.2%, 72.2%, 68.8%, 45.3%, 90.8%, 65.4%, 65.4%, 86.2%, 75.8%, 65.9% and 62.9% respectively in predicting Pneumonia.

The variables having both high sensitivity and high positive predictive value for predicting presence or absence of Pneumonia were presence of history of fever, refusal to feed, crepitation and chest retractions.

The Present study concluded that there is strong association between clinical parameters like fever, refusal to feed, grunting crepitation, wheeze, retraction with radiographically confirmed Pneumonia cases. The present study observed that there is strong association between laboratory parameter like leucocytosis, anaemia, CRP with radiographically confirmed Pneumonia cases

Discussion

The present study aimed to examine the clinical and laboratory profiles of 251 children with cough and fast breathing, focusing on various parameters such as age distribution, associated symptoms, vital signs, malnutrition, radiographic findings, and laboratory investigations. The results provide valuable insights into the characteristics of children presenting with respiratory symptoms and their association with confirmed pneumonia.

Age distribution played a significant role in this study, with most affected children falling within the 1-5 years age group (48.2%). This finding aligns with previous research highlighting the vulnerability of young children to respiratory infections (9). Additionally, malnutrition was observed in 11.6% of patients, with the highest prevalence found in the age group of 2 months to 1 year (15.6%). Malnutrition has been recognized as a risk factor for respiratory illnesses in children, compromising their immune system and respiratory function (10).

The study identified several associated symptoms commonly observed in children with cough and fast breathing. Fever was the most prevalent symptom, affecting most patients, followed by wheezing, refusal to feed, and vomiting. These findings are consistent with previous studies highlighting the presence of fever and respiratory distress symptoms in children with pneumonia [11-13]. Moreover, the study demonstrated a significant association between a history of fever and refusal to feed with confirmed pneumonia ($p < 0.05$).

Vital signs, such as temperature and oxygen saturation, were crucial indicators of the severity of respiratory distress in the study population. A temperature above 37.5 degrees Celsius was observed in 68.1% of children, reinforcing the presence of an active infection similar to other studies [14, 15]. Although oxygen saturation levels below 95% were found in 12.7% of children, the association with confirmed pneumonia was not significant ($p > 0.05$). However, it is important to note that decreased oxygen saturation levels can still indicate respiratory compromise and the need for close monitoring and intervention [16].

Radiographic findings, particularly chest X-rays, played a vital role in confirming pneumonia cases. The study revealed that pneumonia was most prevalent in the age group of 2 months to 1 year, followed closely by the age group of 1-5 years. This finding is consistent with previous researches highlighting the susceptibility of young children to pneumonia [17, 18]. Another study done by Goel et al reported only 45.20% radiologically confirmed pneumonia cases. [19]

Furthermore, the presence of crepitations was strongly associated with confirmed pneumonia ($p < 0.05$), emphasizing its importance as a clinical sign of respiratory infection.

Laboratory investigations provided additional insights into the association between laboratory parameters and confirmed pneumonia. Anemia was observed in 46.2% of children, and leucocytosis was present in 47.8% of cases. While the presence of leucocytosis was significantly associated with confirmed pneumonia ($p < 0.001$), anemia did not show a significant association ($p > 0.05$). C-reactive protein (CRP) was positive in 36.2% of children, suggesting the presence of inflammation, but its association with pneumonia was not statistically significant ($p > 0.05$). In Ramakrishnan K study, [20] Anaemia was not significantly associated with Pneumonia with P value of 0.05. In koster study,[21] Leucocytosis was significant association with Pneumonia with p value < 0.001 and CRP were significantly associated with Pneumonia with p value 0.001. The significant parameters in Al-Najjar study, presence of history of fever, wheeze, refusal of feed, chest retractions, crepitations, had got sensitivity of 86.8%, %, 93.4%, 80.1%, 87.2% and got specificity of 61%, 2.9%, 88.3%, 15.6% and positive predictive value of 62.3%, 41.5%, 83.4%, 41.5% respectively in predicting pneumonia in children. [22] The significant parameters in Gupta et al study, presence of history

of fever, refusal of feed, vomiting, wheeze, chest retractions, crepitations, had got sensitivity of 72%, 15%, 16%, 9%, 62%, 81% and got specificity of 64%, 100%, 83%, 99%, 98%, 99% and positive predictive value of 39%, 100%, 22%, 92%, 92%, 97% respectively in predicting pneumonia in children. [23]

Conclusion

In conclusion, this study provided valuable information regarding the clinical and laboratory profiles of children with cough and fast breathing. The findings highlighted the association of various symptoms, vital signs, radiographic findings, and laboratory parameters with confirmed pneumonia cases. Fever, refusal to feed, crepitations, and chest retractions were identified as parameters with both high sensitivity and high positive predictive value in predicting pneumonia. This study contributes to our understanding of the clinical characteristics and associations in children presenting with respiratory symptoms, which can aid healthcare professionals in diagnosing and managing pneumonia effectively.

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