ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 02 | February - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

CLINICAL AND DIAGNOSTIC FEATURES OF PNEUMONIA IN CHILDREN : A COMPARISON OF CASES WITH AND WITHOUT CHEST INDRAWING

Paediatrics

Dr. C. Uthra Selvi* Assistant Professor, Department of Paediatrics, Government Theni Medical College & Hospital, Theni, Tamilnadu, India. *Corresponding Author

Dr. M. Krithiga Assistant Professor, Department of Paediatrics, Government Theni Medical College & Hospital, Theni, Tamilnadu, India.

Dr. R. Selva Kumar Professor, Department of Paediatrics, Government Theni Medical College & Hospital, Theni, Tamilnadu, India.

Dr. V. Lakshmana Kumar Nodal Officer, Multi-Disciplinary Research Unit (MDRU), Associate Professor, Department of Microbiology, Government Theni Medical College & Hospital, Theni, Tamilnadu, India.

Dr. P. Jeyaprakash Scientist 'B', Multi-Disciplinary Research Unit (MDRU), Government Theni Medical College & Hospital, Theni, Tamilnadu, India.

Dr. P. Vijayabaskar Scientist 'C', Multi-Disciplinary Research Unit (MDRU), Government Theni Medical College & Hospital, Theni, Tamilnadu, India.

ABSTRACT

Background: Chest indrawing is a key sign in the WHOs revised classification of childhood pneumonia, but its predictive value for radiographic confirmation and clinical severity requires further investigation. This study compared the clinical, diagnostic and therapeutic profiles of children with pneumonia presenting with and without this sign. **Methods:** An observational study was conducted from September 2018 to August 2019, enrolling 250 children aged 2 month to 5 years admitted with signs and symptoms of pneumonia with and without chest indrawing at Pediatrics Ward, Government Theni Medical College and Hospital. Participants were classified into two groups based on the presence (n=113) or absence (n=137) of chest indrawing, following WHO guidelines. Clinical parameters, biochemical investigations, chest X-ray findings and treatment outcomes were compared between the groups. **Results:** Children with chest indrawing had significantly higher respiratory rates, lower oxygen saturation and lower weight and hemoglobin levels. While chest X-ray confirmed pneumonia in only 30% of children with indrawing, this group had a 1.71 times higher risk of requiring intravenous antibiotics compared to those without indrawing (31% vs. 13.9%) $p<0.001$. The most common reason for switching to intravenous therapy was failure to respond to oral antibiotics. The sensitivity of chest indrawing for predicting radiologically confirmed pneumonia was low (30.4%), though it demonstrated utility as a marker for disease severity necessitating escalated care. **Conclusion:** Although a poor predictor of positive chest X-ray findings, chest indrawing is a significant clinical marker of severity, identifying children who are more likely to fail oral therapy and require intravenous antibiotics thus guiding crucial management decisions in resource limited settings.

KEYWORDS

Childhood Pneumonia; Chest X-ray; Antibiotics

INTRODUCTION

"Stop pneumonia, every breath counts", the theme for world pneumonia day 2020 starts with stop pneumonia as the impact of the disease especially on the under five children of middle and lower income countries has been immense causing high mortalities and responsible for other morbidities like malnutrition and reduced performance. An acute respiratory infection commonly caused by viruses or bacteria, namely pneumonia has been responsible for 15% of all deaths in under 5 age children amounting to more than 808000 in the year 2017. The impact of pneumonia can be understood on comparison with other diseases like AIDS, malaria and measles combined wherein pneumonia kills more children. Pneumonia results in death of more than 2 million children under 5 every year, accounting for almost one in five under 5 deaths worldwide (1). This has made pneumonia being rightly called as the "biggest killer" of under five children worldwide. Despite several safe, affordable and effective interventions being implemented towards reduction of pneumonia mortality, there has been a steady decline from 4 million deaths in 1981 (2) to just over one million in 2013 (3) "reduce by two-thirds, between 1990 and 2015, the under-five mortality rate". The Millennium Development Goal (MDG) four of reducing child mortality has generated interests throughout the world in the development of accurate methods of quantification of the cause specific mortality rates due to acute respiratory infections (ARIs) in children aged less than 5 years (4). In addition, the extent of coverage of the interventions to control these deaths has to be monitored on a timely basis if MDG 4 is to be achieved (5).

The United Nations in 2015 adopted "The Sustainable Development Goals (SDGs)" to promote healthy lives and well-being for all children. The SDG Goal 3.2.1 is to end preventable deaths of newborns and under 5 children by 2030 with other major public-health diseases like HIV/AIDS, malaria, and tuberculosis seeing an up rise. The attention of the world has shifted from acute respiratory infections to these diseases. More than half of under 5 child deaths are due to diseases that are preventable and treatable through simple, affordable interventions. The leading causes of death in young children over 28 days of age remain pneumonia, diarrhea, birth defects and malaria. In children from low income countries though the rates of death from all conditions are higher, they are 100 times more likely to die from infectious diseases than those in high-income countries (6).

The need for prompt, effective diagnostic and treatment measures required for pneumonia creates a significant strain on the medical front line services. In this context the first priority should be the avoidance of complicated techniques or delay in diagnosis and management of pneumonia and a more effective means of disease control through application of simplified and standardized procedures. There is an immense need for scaling up and targeting of interventions with a view to reach every child in order to prevent and control ARI's. Coordinated child health and related programs involving parents, communities, community health workers and the private sector will play an important role in achieving the targets of SDGs.

Aim of the Study

Primary Objective:
To define the role of retractions in prediction of chest X ray changes in pneumonia.

Secondary Objective:
To analyze the clinical profile, derangements in biochemical parameters and pathological indices, and blood culture positivity among children admitted for pneumonia with chest indrawing and pneumonia without chest indrawing.

MATERIALS AND METHODS

Study Design: Observational study

PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

Study Area: Pediatric Ward, Government Theni Medical College and Hospital, Theni, Taminadu.
Study Duration: September 2018 to August 2019.
Study Population: Children aged 2 months to 5 years admitted with signs and symptoms of pneumonia with and without chest indrawing at Theni Medical College and Hospital.

Inclusion Criteria: Children aged 2 months to 5 years (and) Signs and symptoms of pneumonia (and) Children with or without chest indrawing.
Exclusion Criteria: Congenital Heart Diseases, Congenital Lung Disorders, Metabolic Disorders, Tuberculosis, Children with danger signs of pneumonia (not able to drink, persistent vomiting, lethargy, convulsions and stridor) and Parents not willing to give consent.

Methodology
Institutional Ethics committee approval was obtained prior to the start of the study and all ethical principles were adhered to throughout the course of the study. The study participants were not entitled for any monetary support.

Study Tools
Demographic Data on the neonate is obtained using the proforma Name, time of birth, sex, IP number, Gestational age, birth weight History: Birth, immunization history, General examination Alertness levels Vitals, Systemic Examination Cardiovascular system Respiratory system Abdomen and Central Nervous System.

Investigations
Complete Blood Count, Random Blood Sugar, Renal Function Tests, Liver Function Tests, Serum Electrolytes, C Reactive Protein, Urine Routine, Chest X Ray, Antibiotics and Complications.

Outcome
Children aged 2 months to 5 years admitted with signs and symptoms of pneumonia with and without chest indrawing at Pediatrics Ward, Theni Medical College and Hospital who fulfil the inclusion and exclusion criteria were selected for the study. Written informed consent was obtained from either of the parents before the start of the study.

Children are classified into pneumonia with and without chest indrawing based on the "Revised WHO classification and treatment of childhood pneumonia at health facilities" (7) and monitored for clinical outcomes. Chest X ray findings are used to scale the severity of pneumonia and are compared with clinical parameters like tachypnea. Antibiotics are prescribed as per the treatment guidelines.

Case Definition
Chest Indrawing : The WHO IMCI guidelines defines chest indrawing as the abnormal inward inspiratory movement of the tissue inferior to the costal cartilage adjoining the lower anterior chest wall (subcostal area) and often occurs in children during respiratory diseases with poorly compliant lungs (8).

Lobar Pneumonia : Also known as non-segmental pneumonia, involves diffuse consolidation which involves the entire lobe of the lung and is characterized by 4 stages namely congestion, red hepatization, grey hepatization and resolution. In plain radiograph, there is homogenous opacification which follows a lobar pattern and the opacification can be sharply defined at fissures. Appearance of air bronchograms result from non-opacified bronchus within a consolidated lobe (9).

Diffuse Broncho Pneumonia : Bronchopneumonia is characterized on plain radiograph by multiple small nodular or reticulonodular opacities which tend to be patchy and/or confluent with patches of inflammation separated by normal lung parenchyma (10).

Data Analysis
Data was collected using the proforma and was entered in Microsoft Excel. Results were analyzed using Statistical Package for Social Sciences software 16.0. Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented as Mean ± SD and results on categorical measurements are presented in frequencies (%). Differences in the quantitative variables between groups were assessed by means of paired t test. Comparison between groups was made by non-parametric Mann-Whitney test. Chi square test was used to analyze categorical variables and multivariate analysis was done to test dependent variables. p value of < 0.05 using a two tailed test was taken as statistically significant.

RESULTS AND DISCUSSION
250 children participated in the study. The mean age of the study participants was 21.07 months with a standard deviation of 11.097 months. The minimum age was 4 months while the oldest child was 54 months. 134 (53.6%) were female children while 116 (46.4%) were male children with a male to female ratio of 0.86:1 (Table 1).

Table 1. Frequency Distribution of Parameters Across Study Participants, Types of Pneumonia Among Study Participants on X ray and Organisms Isolated Through Bacteria Culture.

Parameter	Frequency	Percentage	Parameter	Frequency	Percentage
Age Group			Chest indrawing		
Less than 12 months	43	17.2	Yes	113	45.2
12-24 months	150	60.0	No	137	54.8
25-36 months	41	16.4	Auscultatory findings		
37-48 months	13	5.2	Normal	179	71.6
< 48 months	3	1.2	Wheeze	16	6.4
Male	116	53.6	Rhonchi	32	12.8
Female	134	46.4	Crepitations	4	1.6
Informant			Decreased breath sounds	19	7.6
Mother	226	90.4	Types of pneumonia among study participants on X ray		
Father	18	7.2	Unilateral Lobar pneumonia	30	40
Grand Mother	6	2.4	Bilateral Lobar pneumonia	2	2.7
Type of delivery			Unilateral diffuse pneumonia	14	18.7
Normal	198	79.2	Bilateral diffuse pneumonia	10	13.3
LSCS	52	20.8	Unilateral Multifocal pneumonia	12	14.7
Maturity during delivery			Bilateral Multifocal pneumonia	8	10.6
Term	196	78.4	Total	76	100
Preterm	54	21.6	Organisms isolated through Bacteria culture		
Bottle feed	Klebsiella sp.	8	36.36		
Yes	203	81.2	Gram (-) ve rods (Non AF)	5	22.72
Cough	200	80	Acinetobacter sp.	2	9.09
			Pseudomonas sp.	5	22.72
			Staphylococcus aureus	2	9.09

The cohort was predominantly composed of toddlers, with the majority (60.0%) aged 12-24 months. The gender distribution was nearly equal. Most children were born at term (78.4%) via normal vaginal delivery (79.2%). A significant risk factor, bottle-feeding, was reported in 81.2% of the participants (Table. 1). Distribution of gender among different age groups among different age groups. Most of the children are in the 12-24 month group followed by the 25-36 month group. However, in the under 1 year age group, there was a female predominance while in the 25-36 months age group there was a male predominance (Figure. 1).

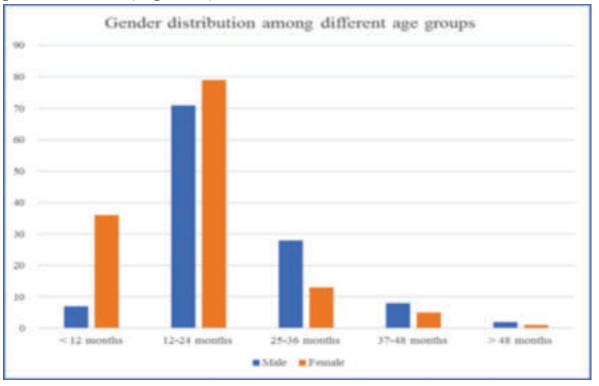

Figure 1. Distribution of Gender Among Different Age Groups of Study Participants

Distribution of various parameters of study participants, Children less than 2 years were the majority group contributing to more than 70% of the study participants. Informants were mothers for most children with fathers and grandmothers contributing to information in some children. Most of the children were delivered normally and were bottle fed. Prematurity was seen among 21.6% of study participants. All children presented with fever and tachypnoea. Most of the children had normal chest X ray findings (54%) while the most common abnormality noted in the X ray was pneumonic consolidation (either unilateral/ bilateral/ lobar/ bronchopneumonia) (Table.1).

Table. 1 showed gram negative bacteria were the primary pathogens isolated from samples. Klebsiella sp. was the most common (36.36%), followed by Pseudomonas sp. (22.72%) and Acinetobacter sp. (9.09%). Staphylococcus aureus was the only Gram positive bacterium isolated (9.09%).

Bacterial culture among children with pneumonia, Bacterial cultures were positive in only 16% of the study participants reflecting the mixed aetiology of pneumonia. Among culture isolates, the most common bacterial isolate among all children is Klebsiella (36.36%) followed by Pseudomonas and Gram-negative Rods. However, the clinical usefulness of blood culture remains controversial as most of the children are already on oral amoxycillin and reports of blood culture does not delay initiation of empirical antibiotic therapy (Table. 1). This culture positivity was similar to a study by Waterer and Wunderink (11). Wherein the most common bacterial isolate was Pseudomonas and Acinetobacter. However in a study by Falade et al., (12) Streptococcus pneumoniae was the most common isolate followed by Haemophillus infuenzae but the isolates were from lung aspirates, pleural fluid aspirates and blood culture. This could possibly explain the higher positivity rate among children with pneumonia in this study as compared to the lower rates in our study which employed only blood culture.

Table. 2 showed data reveal a mean height of 82.12±10.31 and a mean weight of 10.59±2.34, indicating a cohort of young children. Clinically, the mean pulse rate was 83.20±7.72 bpm and the mean respiratory rate was 50.15±6.77 breath/min. The mean oxygen saturation (SpO_2) was 95.52%, with values ranging from 92% to 99%. The average body temperature was 37.54°C. Laboratory findings show a mean haemoglobin level of 11.63±0.66 g/dL and a mean total leukocyte count of 12,386.21±2610.73 cells/µL.

Table 2. Descriptive Statistics Among Study Population.

Parameter	Min	Max	Mean	SD
Height (cm)	61	104	82.12	10.311
Weight (kg)	6.00	16.50	10.59	2.340
Pulse Rate (bpm)	70	104	83.20	7.718
Respiratory Rate (breath/min)	40	72	50.15	6.772
SpO2 (%)	92	99	95.52	1.626
Temperature (oC)	36	39	37.54	0.883
Haemoglobin (g/dL)	10	14	11.63	0.660
Total count (cells/µL)	7320	19542	12386.21	2610.734

Figure. 2 illustrate the spectrum of chest X ray findings among the study patients. The radiological review identified both normal results and a range of pathological patterns consistent with pneumonia. The key findings were categorized as Lobar Pneumonia, Diffuse Bronchopneumonia, and Multifocal Bronchopneumonia. A portion of the X-rays were reported as Normal despite the clinical diagnosis of pneumonia.

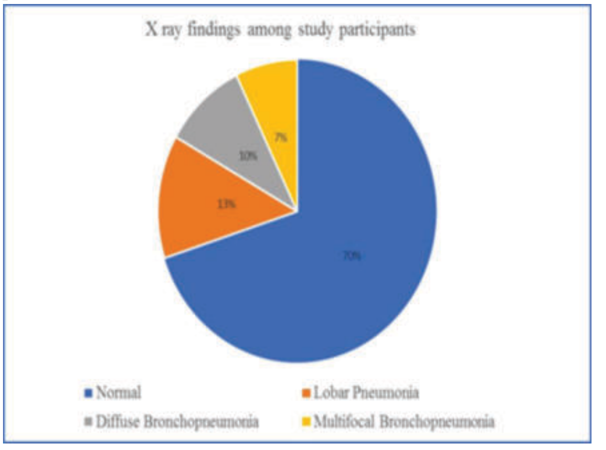

Figure 2. X Ray Findings Among Study Participants

Auscultatory findings and pneumonia, in our study among all children, auscultatory findings were normal in 71.6%, decreased breath sounds were seen in 7.6%, Ronchi in 12.8%, Wheeze in 6.4% and crepitations among 1.6% of children. However, among children with chest indrawing, breath sounds were normal in 79%, ronchi in 10.6%, decreased breath sounds in 10.6%, crepitations in 1.8%. Though wheeze was relatively a finding in upper airway disease, reports of wheeze occurring with decreased frequency especially among children with non-severe pneumonia have been reported elsewhere (Table. 3 and Figure. 3). In children with non-severe and severe pneumonia, wheeze is an occasional accompaniment and is usually seen in a large proportion of children having lower chest indrawing or fast breathing (13, 14).

Table 3. Descriptive Data of Parameters Among Two Groups of Children and Frequency Distribution of Parameters Among Parameters Among Two Groups of Children.

Parameter	Children with chest indrawing (no. 113)	Children without chest indrawing (no. 137)	p value
Height	79.62 ± 10.43	84.01 ± 9.83	0.001
Weight	10.01 ± 2.38	11.045 ± 2.21	<0.000
Pulse Rate	82.37 ±7.36	83.82 ± 7.94	0.141
Respiratory rate	53.54 ±7.05	48.35 ± 5.35	<0.000
SpO2	95.02 ± 1.35	95.91 ± 1.71	<0.000
Temperature	38.47 ± 0.29	38.47 ± 0.29	0.889
Haemoglobin	11.49 ± 0.62	11.75 ±0.69	0.003
Total count	12115.69 ±2445.9	12591.96 ± 2719.89	0.153
Male	40 (35.4)	76 (55.5)	
Female	73 (64.6)	61 (44.5)	0.002
Informant			
Mother	103 (91.2)	123 (89.8)	
Father	6 (5.3)	12 (8.8)	
Grand Mother	4 (3.5)	2 (1.5)	
Normal	85 (75.2)	115 (82.5)	
LSCS	28 (24.8)	24 (17.5)	0.163
Term	90 (79.6)	106 (77.4)	
Preterm	23 (20.4)	31 (22.6)	0.758
Bottle feed	24 (21.2)	23 (16.79)	
Cough	23 (21.3)	27 (19.0)	
Auscultatory findings			
Normal	82 (72.6)	97 (70.8)	
Decreased breath sounds	13 (11.5)	6 (4.4)	
Rhonchi	12 (10.6)	20 (14.6)	
Wheeze	4 (3.5)	12 (8.8)	
Crepitations	2 (1.8)	2 (1.5)	
IV antibiotics	35 (30.97)	19 (13.87)	

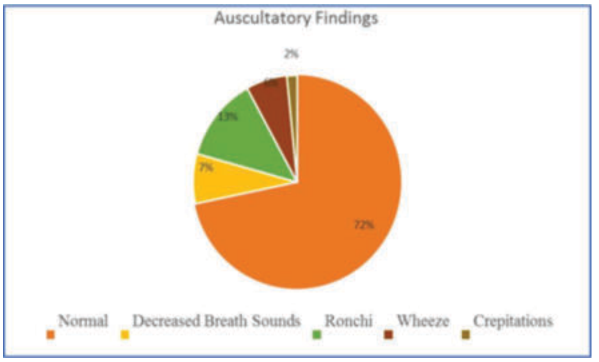

Figure 3. Auscultatory Findings Among Study Participants

Table. 4 showed Significant differences were observed the older group being taller 84.49±5.15cm and weight 12.31±1.18kg. Clinically, the most prominent differences were in respiratory status. The younger group (2-12 months) presented with a significantly higher respiratory rate (54.22±5.04 breaths/min) and lower oxygen saturation (94.59±1.08%) compared to the older group. Laboratory parameters showed a marginally higher total leukocyte count in the older group and a higher haemoglobin level 11.98±0.63g/dL. Pulse rate and temperature were similar across both groups.

Table 4. Descriptive Statistics Among Age Groups Based on Classification of Pneumonia

Parameter	2 - 12 months (mean ± SD)	12 - 5 years (mean ± SD)
Height	71.05 ± 4.61	84.49 ± 5.15
Weight	8.04 ± 0.79	12.31 ± 1.18
Pulse Rate	83.26 ± 7.41	83.15 ± 7.94
Respiratory rate	54.22 ± 5.04	48.17 ± 6.50
SpO2	94.59 ± 1.08	96.15 ± 1.63
Temperature	38.47 ± 0.29	38.42 ± 0.29
Haemoglobin	11.12 ± 0.33	11.98 ± 0.63
Total count	12113.08 ± 2484.27	12568 ± 2684.46

One of the most common pediatric problems of airway, namely pneumonia faces a fundamental problem due to the lack of widely accepted, commonly used definition (s) and poor classification of heterogeneous pathologies and clinical phenotypes. This lack of clarity in classification results in difficulty with clinical diagnosis and often responsible for research work which is poorly formulated (15). The severity of this problem is most evident in unnecessary necessitating empiric antibiotic therapy due to the lacunae in identifying the infectious organism responsible for lung infection. The advantages of making a specific diagnosis is that specific therapy could be provided whose efficacy would be similar to providing empiric wide spectrum therapy for prolonged duration (16).

Reasons for starting intravenous antibiotics, In the current study, the most common reason for start of intravenous antibiotics was failure to respond to oral antibiotics in the form of persistence of fever, tachypnea and chest indrawing. This was seen in 51% of children (Figure 4). The other reasons for change of oral to intravenous antibiotics include culture sensitivity and antibiogram patterns, development of empyema and effusion. Studies by Friis et al., (17) recommend usage of intravenous antibiotics even in case of viral pneumonia due to strong association between respiratory syncitial virus and Haemophillus influenza type B among children less than 1 year.

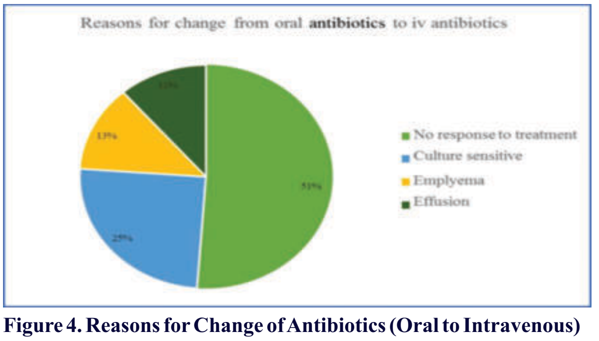

Figure 4. Reasons for Change of Antibiotics (Oral to Intravenous)

Pneumonia Types among children with and without chest indrawing, Lobar pneumonia was the most common type of pneumonia among all children (42.7%) while multifocal bronchopneumonia was the least (25.4%). When stratified age wise, less than 12 months age group had more of lobar pneumonia, 12-24 months age group had lobar pneumonia while broncho pneumonia was seen only in children less than 3 years (Figure 5). Children less than 3 years have higher rates of pneumonia in surveys undertaken in UK. The reasons behind this may be because of their chances to have severe disease with the result they get hospitalized compared to older children (18).

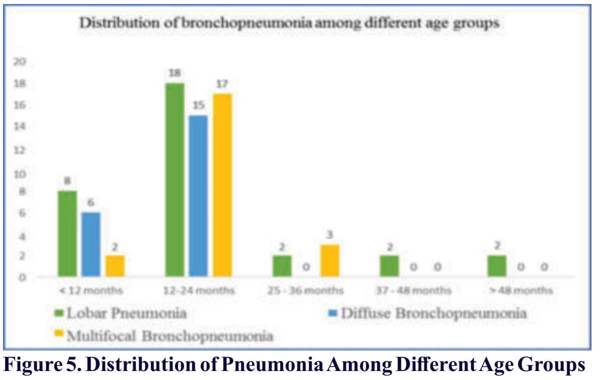

Figure 5. Distribution of Pneumonia Among Different Age Groups

Routine intravenous antibiotic treatment of acute lower respiratory infections especially in infants and small children admitted to hospital, for non-severe is not indicated. In case of a secondary rise of temperature or prolonged fever lasting more than one week or occurrence of chest indrawing, a bacterial super infection should be suspected and appropriate intravenous antibiotics started. Respiratory signs alone are not an indication for antibiotic treatment.

Intravenous antibiotics and chest indrawing pneumonia, in this study 35 (31.0) participants among children with chest indrawing pneumonia received IV antibiotics while among the children without chest indrawing pneumonia only 19 (13.9) participants received intravenous antibiotics. This difference was statistically significant ($p < 0.001$). Children with chest indrawing pneumonia had a 1.711 times risk of being administered iv antibiotics in comparison to children without chest indrawing and this association is statistically significant (Table. 5).

Table 5. Association Between Chest Indrawing and Intravenous Antibiotics and Association of Chest Indrawing with chest X Ray

Association between chest indrawing and intravenous antibiotics					
Parameter	Children with chest indrawing (no. 113)	Children without chest indrawing (no. 137)	OR	CI	p value
IV Antibiotics					
Yes	35 (31.0)	19 (13.9)	1.711	1.073 – 3.293	0.001
No	78 (69.0)	118 (86.1)			
Association of chest indrawing with chest X Ray					
Parameter		Sensitivity	Specificity	+ LR	- LR
Overall		0.41	0.50	0.81	1.19
Pneumonia		0.304	0.612	0.78	1.14

The primary clinical indications for initiating intravenous antibiotic therapy. The most common reason for switching to intravenous antibiotics was no response to oral antibiotics, which was markedly more frequent in children with chest indrawing (22) compared to those without (6). The presence of complications such as empyema 3 and 4 with and without indrawing respectively (Figure. 6).

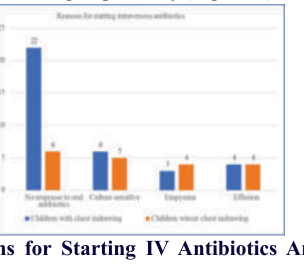

Figure 6. Reasons for Starting IV Antibiotics Among the two Groups of Children

In our study the risk of failure with oral antibiotics among children with chest indrawing was associated with resistance to antibiotics, development of empyema and effusion and the risk was -0.4%, -0.6% and -0.4% respectively. The risk of failure estimated in this study was lower than in other studies which may be explained on the fact that lower number of subjects recruited under the chest indrawing category required antibiotics. A higher sample size would have been a solution to this issue. The difficulties arising in identification of bacterial and viral pneumonias on clinical grounds and coexistence of both the etiological agents have resulted in WHO recommending oral antibiotics to all children especially from developing countries who have clinical signs based on guidelines for pneumonia (19).

Among oral antibiotics, amoxicillin in a dose 30-40 mg/kg/day for 3-5 days is a suitable drug that can be used for non-severe pneumonia by the practicing physician in outpatient setting. The advantage of amoxicillin is that shortening the duration of therapy to 3 days is possible. The equivalent efficacy of a shorter course of amoxicillin in comparison to the standard five-day regimen has been demonstrated by a meta-analysis of three randomized controlled trials from developing countries, including India (20, 21, 22).

Among children with chest indrawing 81 (71.68%) children had normal X-Ray and among children without chest indrawing Chest X-Ray was normal in 94 (68.61%). This was similar in pattern to a study conducted by Bhavneet and Ladbans, (23) among children in Shimla which showed normal X ray findings in 71.6% among children with chest indrawing. The diagnostic role of chest indrawing alone compared with X Ray findings was also demonstrated by Julio and Maria (24) that among the various parameters used in the diagnosis of Pneumonia, chest indrawing despite having a low sensitivity, it was the most powerful item to pneumonia diagnosis in discriminant analysis.

In our study though chest indrawing was able to classify the children with pneumonia, chest X ray was a better tool and confirmatory investigation for diagnosis of pneumonia. The sensitivity of chest indrawing to diagnose pneumonia when compared with X ray was only 30.4% and specificity was 61.2%. The positive predictive value was 0.90 and negative predictive value was 1.04. The predictive accuracy was 50.4% In view of this though chest indrawing could be used as a screening tool especially in community management of pneumonia, its role in definitive management of pneumonia faces setbacks due to lack of sensitivity in comparison to chest X Ray.

CONCLUSION

The revision in the definition and classification of pneumonia by WHO is a good initiative against the background of usage of multiple terms in multiple fields of medical practice and research. The inclusion of only two categories as pneumonia with and without chest indrawing helps to eliminate the dangers of poor classification of pneumonia such as unnecessary empiric antibiotic therapy and formation of heterogeneous groups in research, thereby influencing research studies and clinical management. As a result, these outcomes help to overcome the problem of antibiotic resistance and early referral of pediatric patients with chest indrawing to tertiary care centers for initiation of intravenous antibiotic therapy. In the interim, to determine the etiology of pneumonia, better ways need to be sought and researchers should consider the benefits of using the revised methods of classification by WHO to provide more homogeneous groups thereby generating studies which could provide clearer answers to research questions.

Limitations: Absence of a control group and lack of culture sensitivity for all children could not be employed. Follow up of patients could throw some light on long term aspects of pneumonia.

Acknowledgments

This study was supported by the Department of Health Research, Ministry of Health and Family Welfare, (Grant No: V.25011/85/2015-HR). Government of India under the scheme of Multi-Disciplinary Research Unit (MDRU), Government Theni Medical College, Theni, Tamilnadu.

REFERENCES

1. Wardlaw T, Salama P, Johansson EW, Mason E. (2006). Pneumonia: the leading killer of children. The Lancet. 368(9541): 1048-1050.
2. Leowski J. (1986). Mortality from acute respiratory infections in children under 5 years of age: global estimates. World Health Statistics Q. 39(2): 138-144.
3. Graeme Wilson Fell, Lucia Hug, Yang Liu, Wanli Nie, David Sharrow, Danzhen You (United Nations Children's Fund). (2024). Report 2024 - Levels and Trends in Child Mortality. Copyright © United Nations Children's Fund (UNICEF), 2025 ISBN: 978-92-806-5636-7. 1-104. https://data.unicef.org/resources/levels-and-trends-in-child-mortality-2024/.
4. United Nations Millennium Development Goals (Internet). (2020). United Nations. Available from: ttps://www.un.org/millenniumgoals/childhealth.shtml.
5. Igor Rudan, Cynthia Boschi-Pinto, Zrinka Biloglav, Kim Mulholland, Harry Campbell. (2008). Epidemiology and etiology of childhood pneumonia. Bulletin of the World Health Organization. 86(5): 408-416.
6. World Health Organization (2019). World health statistics 2019: Monitoring health for the SDGs : Sustainable development goals. Geneva, Switzerland. ISBN: 9789241565707. 1-132.
7. World Health Organization (2014). Revised WHO Classification and Treatment of Pneumonia in Children at Health Facilities: Evidence Summaries. ISBN 978-92-4-150781-3. 1-34.
8. McCollum ED, Ginsburg AS. (2017). Outpatient Management of Children with World Health Organization Chest Indrawing Pneumonia: Implementation Risks and Proposed Solutions. Clinical Infectious Diseases. 65(9): 1560-1564.
9. Vilar J, Domingo ML, Soto C, Cogollos J. (2004). Radiology of bacterial pneumonia. European Journal of Radiology. 51(2): 102-113.
10. Paks M, Elfeky M, Murphy A. (2014). Bronchopneumonia. Reference article, Radiopaedia.org (Accessed on 22 Apr 2025) https://doi.org/10.53347/rID-27561.
11. Waterer GW, Wunderink RG. (2001). The influence of the severity of community-acquired pneumonia on the usefulness of blood cultures. Respiratory Medicine. 95(1): 78-82.
12. Falade AG, Mulholland EK, Adegbola RA, Greenwood BM. (1997). Bacterial isolates from blood and lung aspirate cultures in Gambian children with lobar pneumonia. Annals of Tropical Paediatrics. 17(4): 315-319.
13. William Morrant Baker, William Senhouse Kirkes, Vincent Dormer Harris. (2016). Handbook of Physiology, Volume 1. ISBN-13: 978-1357567675. 1-398.
14. Mathews B, Shah S, Cleveland RH, Lee EY, Bachur RG, Neuman MI. (2009). Clinical Predictors of Pneumonia among Children with Wheezing. Pediatrics. 124(1): e29–36.
15. Mackenzie G. (2016). The definition and classification of pneumonia. BMC Pneumonia. 8(14): 1-5.
16. Van der Eerden M M, F Vlaspolder, C S de Graaff, T Groot, W Bronsveld, H M Jansen, W G Boersma. (2005). Comparison between pathogen directed antibiotic treatment and empirical broad spectrum antibiotic treatment in patients with community acquired pneumonia: a prospective randomised study. Thorax. 60(8): 672-678.
17. Friis B, Andersen P, Brenoe E, Hornsleth A, Jensen A, Knudsen FU. (1984). Antibiotic treatment of pneumonia and bronchiolitis. A prospective randomised study. Archives of Disease in Childhood. 59(11): 1038-1045.
18. Clark JE, Hammal D, Hampton F, Spencer D, Parker L. (2007). Epidemiology of community-acquired pneumonia in children seen in hospital. Epidemiol Infect. 135(2): 262-269.
19. Rakesh Lodha, Sushil K Kabra, Ravindra M Pandey. (2013). Antibiotics for community-acquired pneumonia in children. Cochrane Database Syst Rev. CD004874. 1-136.
20. Haider BA, Lassi ZS, Bhutta ZA. (2008). Short-course versus long-course antibiotic therapy for non-severe community-acquired pneumonia in children aged 2 months to 59 months. Cochrane Database of Systematic Reviews. 16:(2): CD005976.
21. Rojas-Reyes MX, Granados Rugeles C. (2006). Oral antibiotics versus parenteral antibiotics for severe pneumonia in children. Cochrane Database of Systematic Reviews. 19(2): CD004979.
22. Lorgelly PK, Atkinson M, Lakhanpaul M, Smyth AR, Vyas H, Weston V. (2010). Oral versus i.v. antibiotics for community-acquired pneumonia in children: a cost-minimisation analysis. European Respiratory Journal. 35(4): 858-864.
23. Bhavneet Bharati, Ladbans Kaur. (2008). Role of Chest X Ray in predicting outcome of acute severe pneumonia. Indian Pediatrics. 45: 893-898.
24. Julio Pereira and Maria Escuder. (1998). The importance of clinical symptoms and signs in the diagnosis of community-acquired pneumonia. Journal of Tropical Pediatrics. 44(1): 18-24.