Original Research Article

CLINICO-AETIOLOGICAL STUDY OF PNEUMONIA IN TWO MONTHS TO FIVE YEARS CHILDREN ADMITTED TO A MEDICAL COLLEGE IN A DISTRICT OF WEST BENGAL

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Abstract

Background: To study clinico-aetiological findings of cases admitted with children in Pneumonia. **Materials and Methods:** A cross-sectional study was conducted in the Paediatrics department of Malda Medical College and Hospital, involving a total of 90 children of both sexes aged two months to five years who were randomly selected and admitted with pneumonia between March 2021 to February 2022. Written informed consent was obtained from the parents through face-to-face interviews, following which all relevant medical history was collected. The study included a thorough clinical examination, including general survey, anthropometry, and systemic examination, as well as radiological and blood investigations. The study population was evaluated and treated for their present illness at the same time. **Result:** The study population consisted of 90 children with pneumonia. Most cases (71.1%) were in the age group of 2 months to 24 months, and 67.8% were male. The most common symptoms at presentation were fever, cough, respiratory distress, trachypnea, and underweight. Bacterial pneumonia was the most common cause (48.9%), followed by unknown cause (11.1%), and RSV was the most common viral cause (7 cases, 58.3%). Staphylococcus aureus was the most commonly isolated bacteria (63.6% of culture-positive cases). Most patients (58.8%) had undernutrition. **Conclusion:** Our study also revealed that children with very severe pneumonia who had underlying issues such as undernutrition, lack of immunization, lower socioeconomic status, and non-exclusive breastfeeding were more likely to die. Therefore, early referral of such patients is crucial in preventing disease progression and reducing mortality rates.
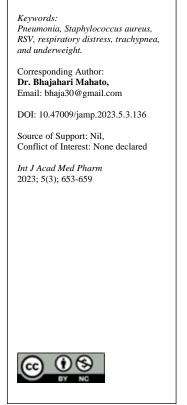
INTRODUCTION

Globally pneumonia is responsible for high morbidity and mortality among children under 5 years of age. The World Health Organization (WHO) has estimated an incidence of 0.37 episodes per child per year for clinical pneumonia, India accounts for 36% of the total WHO South East Asia regional burden.[1] Approximately 10 to 20% of these episodes tend to be severe.[2] In the most recent estimate of Acute Lower Respiratory Infections associated mortality in India(2014), pneumonia was held responsible for 369,000 deaths (28% of all deaths), making it the single most important killer in this age group.[3] The national level surveys of India reported the prevalence of ARI only, which was found to be 2.4–8.9% .[4]

The etiology of pneumonia in the pediatric population can be classified by age-specific versus pathogen-specific organisms.[5] Neonates are at risk for bacterial pathogens present in the birth canal, and this includes organisms such as group B streptococci, Klebsiella, Escherichia coli, and Listeria monocytogenes.[6]Streptococcuspneumoniae,Streptococcuspyogenes,andStaphylococcus aureuscan be identified in late-onset neonatal pneumonia.[6]Viruses are the main cause of pneumonia in older infants and toddlers between 30 days and 2 years old.[7]In children 2 to 5 years old, respiratory viruses are also the most common.[8]The rise of cases related to S. pneumoniaeand H. influenzaetype Bis observed in this age group.[9] Children with chronic diseases are also at risk for specific pathogens. In cystic fibrosis, pneumonia secondary toS. aureusandPseudomonas aeruginosa is ubiquitous.[10]Patients with sickle cell disease are at risk of infection from encapsulated

organisms.[11]Children who are immune-compromised shouldbeevaluated for Pneumocystis jirovecii, cytomegalovirus, and fungal species if no other organism is identified.[12]Unvaccinated children are at risk for vaccine-preventable pathogens.

Thereby, the study was conducted with the aim of clinico-aetiological study of pneumonia in two months to five years children admitted to a medical college in a district of West Bengal.

MATERIALS AND METHODS

A cross-sectional study was conducted in the Paediatrics department of Malda Medical College and Hospital, involving a total of 90 children of both sexes aged two months to five years who were randomly selected and admitted with pneumonia between March 2021 to February 2022. Written informed consent was obtained from the parents through face-to-face interviews, following which all relevant medical history was collected. The study included a thorough clinical examination, including general survey, anthropometry, and systemic examination, as well as radiological and blood investigations. The study population was evaluated and treated for their present illness at the same time.

Inclusion Criteria

1. Age two months to five years of both sex.
2. Admitted in children ward.
3. Children with clinically &radiologically identified Pneumonia.

Exclusion Criteria

1. Parents not willing to be enrolled in the study.
2. Patients with pre-existing heart disease.

Study Variables: Risk factors-Age on presentation, sex, built and nutrition, family size, socio-economic status, asthma, heart disease.

General Examination Finding, Severity Scores.

Etiology: Etiological profile of children with pneumonia was analysed.

X ray Findings

Normal, Hyperinflation, pulmonary opacities, Consolidation, Collapse, effusion.

Other Investigation Findings

Hemogram, blood culture, C - reactive protein, Echocardiography.

Outcome

Successfully discharged (Left against Medical Advice), Expired, Referred out.

Data Collection

After taking written informed consent from the parents through face to face interview, all relevant history was obtained from the parents or other caregiver. Proper clinical examination comprising of general survey, anthropometry and systemic examination was performed. Radiological and blood investigations was done. The data was captured in pre-structured proforma. All the study population

was properly evaluated and treated for the present illness at the same time.

Radiological Investigation

Digital Chest X-Ray, HRCT, USG chest, Echocardiography if required.

General Examination

Fever
Cough
Respiratory distress
Tachypnea
Underweight
Cyanosis
Pallor
Wheezing
Inability to take food
Chest in drawing

Laboratory Investigation

Blood for Hb%, TLC, DLC, Platelet count. ESR.

Procedures

90 children were randomly selected admitted with Pneumonia. Detailed history was documented and general examination of children was performed to determine the severity of illness. All children participating in this study was undergoing digital chest x-ray. Final diagnosis and outcome was confirmed during discharge of the baby.

Statistical Analysis

All recorded data was analyzed with suitable diagrams, figures, tables and findings were discussed in details to draw appropriate conclusions using standard statistical analysis. Data were analyzed using Statistical Package for the Social Sciences (SPSS) Version 21.0. Categorical variables were expressed as number and percentages. Fisher's exact test, Chi-square test was used for categorical data as appropriate. A p value < 0.05 was considered.

RESULTS

Age distribution among study population we have found maximum number of the cases was present in 2 – 24 months children. Out of 90cases, 71.1 %(64) cases were in the age group of 2 months to 24 months and rest 28.9 %(26) were in the age group of 25 months to 60 months. Among total 90 cases, 67.8 %(61) were male and 32.2 %(29) were female. At the time of presentation most of the children had fever, cough, respiratory distress, trachypnea, and underweight, i.e. 62.2%, 56.7%, 54.4%, 53.3%, 57.8%, Other complaints at the time presentation were Cyanosis 20%, Pallor 17.8%, wheezing 13.3% and Inability to take food 24.4%, Chest in drawing 17.8% respectively. Radiological finding of chest x-ray out of 90 cases consolidation was present 34.4%, Infiltration was present 18.9%, Haziness observed 15.6%, plural Effusion present 6.7% and fibrosis was found 2.2% children respectively.

Table 1: Demographic characteristics among study population

Age in Months	No of Cases	Percentage
2 – 24 months	64	71.1
25 – 60 months	26	28.9
Sex		
Male	61	67.8
Female	29	32.2
Clinical parameters		
Fever	56	62.2
Cough	51	56.7
Respiratory distress	49	54.4
Tachypnea	48	53.3
Underweight	52	57.8
Cyanosis	18	20.0
Pallor	16	17.8
Wheezing	12	13.3
Inability to take food	22	24.4
Chest in drawing	16	17.8
Radiological findings		
Consolidation present	31	34.4
Infiltration present	17	18.9
Haziness observed	14	15.6
Plural Effusion seen	06	6.7
Fibrosis present	02	2.2

Table 2: Etiological profile of children with pneumonia (n=90)

Underlying causes	No of cases	Percentage
Bacterial	44	48.9
Viral	12	13.3
Aspiration syndromes	5	5.6
Pulmonary tuberculosis	2	2.2
Congenital heart disease	9	10.0
Bronchiectasis	5	5.6
Immunodeficiency (HIV)	3	3.3
Idiopathic/ unknown cause	10	11.1
Total	90	100.0

Bacterial pneumonia was the most common causes of pneumonia i.e. 48.9% followed by viral causes were 13.3%, Aspiration syndromes were found in 5.6% children, Pulmonary tuberculosis had 2.2%, Congenital heart disease was found 10.0%, Bronchiectasis had 5.6%, Immunodeficiency (HIV) cases had 3.3%, and Idiopathic/ unknown cause was 11.1% respectively.

Table 3: Isolation of bacteria & Virus

Variables	Isolation of bacteria	No of Cases	Percentage
Bacteria (n= 44)	Staphylococcus aureus	28	63.6
	Streptococcus pneumoniae	10	22.8
	Haemophilus influenza	6	13.6
Virus (n=12)	RSV (respiratory syncytial virus),	7	58.3
	COVID-19	5	41.7

In the present study, culture was positive in 44 cases out of which Staphylococcus aureus was 28 (63.6%) cases, Streptococcus pneumoniae in 10 (22.8%) cases and Haemophilus influenzae in 6(13.6%) cases. There were 12 occurrences of pneumonia, and of them, 7 (58.3%) were caused by RSV (respiratory syncytial virus) and 5 (41.7%) were caused by COVID-19.

Table 4: Table: Risk factors (n=90)

Characteristics	Variables	No of cases	Percentage
Nutritional status	Under Nutrition	53	58.9
	Normal	37	41.1
Immunisation status	Immunized	84	93.3
	Non-Immunized	06	6.7
Socio-economic Status	Upper	08	8.9
	Upper middle	14	15.5
	Lower middle	12	13.3
	Upper lower	22	24.4
	Lower	34	37.8
Feeding practice	EBF	32	35.6

	Non EBF	58	64.4
Exposure to smoke	Exposed	31	34.4
	Not exposed	59	65.6

Risk factors of pneumonia among study population we found Most of the patients 53 (58.8%) included in the study had under nutration. About 84(93.3%) patients were completely immunized according to their age. 34 (37.8%) patients were from lower socio-economic status. 31 (34.4%) patients did not have any history of exposure to smoke.

Table 5: Severity of pneumonia (n=90)

Severity of pneumonia	No of Cases	Percentage
Pneumonia	66	73.3
Severe pneumonia	14	15.6
Very severe pneumonia	10	11.1
Total	90	100.0

Among 90 cases, 73.3 %(66) were pneumonia, 15.6% (14) were severe pneumonia and 11.1 %(10) were very severe pneumonia.

Table 6: Hospital Stay (n=90)

Hospital Stay (Days)	No of Cases	Percentage
1-5	22	24.5
5-10	57	63.3
>10	11	12.2
Total	90	100.0

Maximum number of cases was stay in hospital up to 5-10 days. Total 24.5 %(22) cases had hospital stay of 1-5 days , 63.3%(57) cases had hospital stay of 5-10 days and 12.2%(11) cases had hospital stay of >10 days.

Table 7: Final outcome (n=90)

Final outcome	No of Cases	Percentage
Survive	84	93.3
Death	06	6.7
Total	90	100.0

The final outcome found 93.3 %(84) patients had survived, 6.7 %(06) patients had died.

Table 8: Correlation with age & Isolation of Bacteria

Underlying causes	Total No of cases (n=44)	2 – 24 months (n=64)		25 – 60 months (n=26)	
		No	%	No	%
Staphylococcus aureus	28(63.6%)	23	82.1	5	17.9
Streptococcus pneumoniae	10(22.8%)	9	90.0	1	10.0
Haemophilus influenza	6(13.6%)	6	100.0	0	0.0
Statistical Inference	Chi- square- 3.96676 P Value- 0.137				

Staphylococcus aureus was found in 28 cases, of those, 23 (82.1%) were from children ages 2 to 24 months, and 5 (17.9%) were from children ages 25 to 60 months. Streptococcus pneumoniae was found in 10 cases, of those, 9(90%) from children ages 2 to 24 and 10% from 25 to 60 months. And only 6 cases were Haemophilus influenza out of them 100% cases from 2 – 24 months of children.

Table 9: Correlation with age & Isolation of Virus

Underlying causes	Total No of cases (n=12)	2 – 24 months (n=64)		25 – 60 months (n=26)	
		No	%	No	%
RSV (respiratory syncytial virus),	7(58.3%)	5	71.4	2	28.6
COVID-19	5(41.7%)	4	80.0	1	20.0
Statistical Inference	Chi- square- 3.0857 P Value- 0.07				

RSV (respiratory syncytial virus) was found in 7 cases. Of those 7 cases, 5 (71.4%) were from children ages 2 to 24 months, and 2 (28.6%) were from children ages 25 to 60 months. COVID-19 was found in 5 cases. Of those, 1 (20%) involved a child between the ages of 25 to 60 months, and 4 (80%) involved children between the ages of 2 to 24 months.

Table 10: Correlation with age & Risk factors

Characteristics	Variables	No of cases	2 – 24 months (n=64)	25 – 60 months (n=26)	p Value
Nutritional status	Under Nutrition	53(58.8%)	36(53.1%)	16(69.2%)	0.178
	Normal	38(42.2%)	28(46.8%)	10(30.8%)	
Immunisation status	Immunized	84(93.3%)	60(93.7%)	24(92.3%)	0.803
	Non-Immunized	06(6.7%)	4(6.3%)	2(7.7%)	
Socio-economic Status	Upper	08(8.9%)	5(10.9%)	3(3.8%)	0.559
	Upper middle	14(15.5%)	12(17.2%)	2(11.5%)	
	Lower middle	12(13.3%)	7(14.1%)	5(11.5%)	
	Upper lower	22(24.4%)	19(25.0%)	3(11.5%)	
	Lower	34(37.8%)	21(32.8%)	13(50.0%)	
Feeding practice	EBF	32(35.6%)	21(32.8%)	11(42.3%)	0.545
	Non EBF	58(64.4%)	40(62.5%)	18(69.2%)	
Exposure to smoke	Exposed	31(34.4%)	23(25.0%)	8(34.6%)	0.355
	Not exposed	59(65.6%)	41(75.0%)	18(69.2%)	

Among 90 cases, 73.3 %(66) were pneumonia, 15.6% (14) were severe pneumonia and 11.1%(10) were very severe pneumonia.

Table 11: Correlation with age & outcome

Outcome	Total No of cases (n=90)	2 – 24 months (n=64)		25 – 60 months (n=26)	
		No	%	No	%
Survive	84(93.3%)	60	93.8	24	92.3
Death	6(6.7%)	4	6.2	2	7.7
Statistical Inference	Chi- square- 0.0618 P Value- 0.803				

We have not found significant different between age and outcome, chi-square value- 0.0618 and p value was 0.803.

DISCUSSION

Study was conducted in the Department of paediatrics, Malda Medical College and Hospital. It was prospective observational study, in our hospital the prevalence rate of pneumonia is almost 6 %. We have taken 90 patients presenting with symptoms like nasal flare, cough and cold, tachypnoea, crepts, wheeze, difficulty in breathing, chest indrawing, grunting with or without fever and radiological finding suggestive of pneumonia was evaluated on the basis of their platelet count.

Age distribution among study population we have found maximum number of the cases was present in 2 – 24 months children. Out of 90 cases, 71.1 %(64) cases were in the age group of 2 months to 24 months and rest 28.9 %(26) were in the age group of 25 months to 60 months. Among total 90 cases, 67.8%(61) were male and 32.2%(29) were female .Correlation with Sex & severity of pneumonia 70% were male, 30% were female. Out of 14 cases of severe pneumonia, 71.4% were male and 28.6% were female. Out of 66 cases of pneumonia, 66.7% were male and 33.3% were female.

We have also found very severe pneumonia was present in 10 patients, out of which 80% were in between 2-24 months, 20% were between 25-60

months. Severe pneumonia was present in 14 patients out of which 42.8% were in between 2-24 months, 57.2% were in between 25-60 months. Pneumonia was present in 66 patients out of which 75.8% were in between 2-24 months, 24.2% were in between 25-60 months. There is significant increase in severity of pneumonia in younger age group

Another study of Choudhury J & Rath D,[12] found total of 230 children, admitted with lower respiratory tract infection in the under study hospital, were included in the study out of which 170 (73.9%) were within the age range of 2 to 12 months and 60 (26.1%) within the age range of 12 to 60 months.

In our study, among 90 cases ,73.3%(66) were pneumonia, 15.6% (14) were severe pneumonia and 11.1%(10) were very severe pneumonia, similar study of Choudhury J & Rath D,[101] found Out of 170 infants, 80 had very severe pneumonia, 52 had severe pneumonia, and 38 developed pneumonia. Out of 60 children in the age group of 12 to 60 months, 32 had pneumonia, 16 had severe pneumonia, and 12 had very severe pneumonia. This clearly depicted that the severity of pneumonia was more marked in infants than older children.

At the time of presentation most of the children had fever, cough, respiratory distress, trachypnea, and underweight, i.e. 62.2%, 56.7%, 54.4%, 53.3%,

57.8%, Other complaints at the time presentation were Cyanosis 20%, Pallor 17.8%, wheezing 13.3% and Inability to take food 24.4%, Chest in drawing 17.8% respectively.

Yaguo Ide LE et al,[13] reported cough in 75.9%, fever in 70.7%, fast breathing in 53%, respiratory distress in 83.6% of pneumonia cases. Ahmad Al Najjar S et al.,[14] reported fever in 87.4%, tachypnea in 73.5%, cough in 98% and retraction in 80% cases of pneumonia which is almost tallying with our reports.

In our study, Radiological finding of chest x-ray out of 90 cases consolidation was present 34.4%, Infiltration was present 18.9%, Haziness observed 15.6%, plural Effusion present 6.7% and fibrosis was found 2.2% children respectively.

Kumar et al, investigated 41 children to determine the underlying cause of persistent pneumonia and discovered that 29.3% of the children with persistent pneumonia had aspiration syndrome. GERD and oil instillation in the nose were the leading causes of aspiration. 19.2% had lung TB, 7.3% had immunodeficiency, 4.9% had CHD, and 2.4% had a foreign object.[15]

Lodha et al, assessed 19 infants with chronic pneumonia and identified pulmonary tuberculosis as the underlying aetiology in 31.5% of cases. This relatively high frequency of pulmonary tuberculosis in our community should alert doctors and health officials, prompting them to intensify their efforts to prevent and control this illness.[16]

In this study, Risk factors of pneumonia among study population we found Most of the patients 53 (58.8%) included in the study had under nutration. About 84(93.3%) patients were completely immunized according to their age. 34 (37.8%) patients were from lower socio-economic status. 31 (34.4%) patients did not have any history of exposure to smoke.

In our research, 84 (93.3%) patients were inoculated according to the National Immunisation Schedule (NIS) and only 6 (6.7%) were not. Debnath D. et al,[17] reported that 23.8% of individuals had full vaccination according to the NIS, but 51.2% of cases had incomplete immunisation according to age. This difference may be a result of greater vaccination coverage (as measured by the NIS) in our research location and increased parental knowledge. As a frequent consequence of both pertussis and measles, immunisation plays a significant role in avoiding pneumonia.

In our research, the majority of cases (51 (37.8%) and 24.4%) belonged to the lower and higher lower classes, whereas 14 (15.5%) cases were from the upper middle (II) class. In a research conducted in Karnataka, Kumar AMK et al. identified a 76.5% incidence of pneumonia among those of lower socioeconomic level (class III-V). Thorn LK et al,[18] similarly showed an inverse connection between pneumonia cases and socioeconomic status. In our research, 35.6% of the patients were exclusively breastfed whereas 64.4% were not

exclusively breastfed. In a comparable research conducted in Karnataka, India, Divyarani DC et al,[19] observed that 94.6% of patients were exclusively breastfed. This low rate of exclusive breast feeding in our study population may be a result of mothers' lack of understanding about the advantages of exclusive breast feeding.

In the present research, 34.4% of patients were exposed to cooking with firewood, while 65.6% of cases were not exposed to smoking. The literature indicates that parental smoking has a direct effect on paediatric clinical pneumonia in underdeveloped countries.[20]

Vlacha V et al,[21] reported Thrombocytosis was identified in approximately one-third of the studied pediatric CAP patients, which is consistent with the previously reported percentage (9-48%) of thrombocytosis in patients with respiratory tract infections. Thrombocytopenia in adult severe CAP has already been studied.[22] However, few studies have explored the impact of thrombocytopenia on the severity of pneumonia in pediatric patients. In the present study, it was demonstrated that thrombocytopenia is an independent predictor of severe Pneumonia in pediatric patients.

We have found, Maximum number of cases were stay in hospital up to 5-10 days. Total 24.5%(22) cases had hospital stay of 1-5 days , 63.3%(57) cases had hospital stay of 5-10 days and 12.2%(11) cases had hospital stay of >10 days. The final outcome in our study 93.3%(84) patients had survived , 6.7%(06) patients had died. Kumar AMK et al, [23] in their study observed mortality of 3%. The higher mortality rate observed in our study could be due to more number of very severe pneumonia cases in contrast to their study population.

In children hospitalized with pneumonia in the developing world, age <6 months was the strongest factor associated with enteral treatment failure among children 3–59 months,[24] age <4 months was associated with mortality (relative risk [RR], 3.5; 95% CI, 3.0–4.2) among children <24 months,[25] and age <6 months was associated with mortality (OR, 2.2; 95% CI, 1.1–4.2) among children <15 years.[26] We have not found significant different between age and mortality, chi-square value- 0.0618 and p value was 0.803.

CONCLUSION

Our study focused on the prevalence of pneumonia, with a total of 90 patients included. Among these patients, 66 were diagnosed with pneumonia, 14 with severe pneumonia, and 10 with very severe pneumonia. We found that the most common underlying causes of pneumonia in children were bacterial and viral infections, followed by aspiration syndromes, pulmonary tuberculosis, congenital heart disease, bronchiectasis, and immune-deficiency.

Our study also revealed that children with very severe pneumonia who had underlying issues such as undernutrition, lack of immunization, lower socioeconomic status, and non-exclusive breastfeeding were more likely to die. Therefore, early referral of such patients is crucial in preventing disease progression and reducing mortality rates.

REFERENCES

1. Mathew JL, Patwari AK, Gupta P, Shah D, Gera T, Gogia S, et al. Acute respiratory infection and pneumonia in India: a systematic review of literature for advocacy and action: UNICEF-PHFI series on newborn and child health, India. Indian Pediatr [Internet]. 2011 [cited 2017 Nov 20];48(3):191–218.

2. Ghimire M, Bhattacharya SK, Narain JP. Pneumonia in South-East Asia region: a public health perspective. Indian J Med Res [Internet]. 2012;135(4):459–68.

3. Krishnan A, Amarchand R, Gupta V, Lafond KE, Suliankatchi RA, Saha S, et al. Epidemiology of acute respiratory infections in children - preliminary results of a cohort in a rural north Indian community. BMC Infect Dis [Internet]. 2015;15(1):462.

4. International Institute for Population Sciences . District Level Household and Facility Survey −4 State Fact Sheet maharashtra. 2014.

5. Rudan I, O'Brien KL, Nair H, Liu L, Theodoratou E, Qazi S, Lukšić I, Fischer Walker CL, Black RE, Campbell H., 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.

6. Arif F. Updated Recommendations Of Rcog On Prevention Of Early Onset Neonatal Group B Streptococcus Infection. J Ayub Med Coll Abbottabad. 2018 Jul-Sep;30(3):490.

7. Verhoeven D. Influence of Immunological Maturity on Respiratory Syncytial Virus-Induced Morbidity in Young Children. Viral Immunol. 2019 Mar;32(2):76-83.

8. GBD 2016 Lower Respiratory Infections Collaborators. Estimates of the global, regional, and national morbidity, mortality, and aetiologies of lower respiratory infections in 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Infect Dis. 2018 Nov;18(11):1191-1210.

9. Gessner BD, Sutanto A, Linehan M, Djelantik IG, Fletcher T, Gerudug IK, Ingerani, Mercer D, Moniaga V, Moulton LH, Moulton LH, Mulholland K, Nelson C, Soemohardjo S, Steinhoff M, Widjaya A, Stoeckel P, Maynard J, Arjoso S. Incidences of vaccine-preventable Haemophilus influenzae type b pneumonia and meningitis in Indonesian children: hamlet-randomised vaccine-probe trial. Lancet. 2005 Jan 1-7;365(9453):43-52.

10. Dryahina K, Sovová K, Nemec A, Španěl P. Differentiation of pulmonary bacterial pathogens in cystic fibrosis by volatile metabolites emitted by their in vitro cultures: Pseudomonas aeruginosa, Staphylococcus aureus, Stenotrophomonas maltophilia and the Burkholderiacepacia complex. J Breath Res. 2016 Aug 10;10(3):037102.

11. Martí-Carvajal AJ, Conterno LO. Antibiotics for treating community-acquired pneumonia in people with sickle cell disease. Cochrane Database Syst Rev. 2016 Nov 14;11:CD005598.

12. Choudhury J, Rath D. Thrombocytosis in Under-Five Children with Lower Respiratory Tract Infection, Arch Pediatr Infect Dis.2018 6(1): e61605

13. Yaguo-Ide LE, Nte AR. Childhood pneumonia and under-five morbidity and mortality at the University of Port Harcourt Teaching Hospital- a situational analysis. The Nigerian Health Journal. 2011;11(3):93-96.

14. Ahmad Al Najjar S, Al Rabbaty A, Al Hatam I. Analysis of chest x-ray and clinical finding in children with pneumonia. Zanco Journal of Medical Sciences. 2013;17(2):477-81.

15. Kumar M, Biswal N, Bhuvaneswari V, Srinivasan S. Persistent Pneumonia: Underlying Cause and Outcome. Indian J Pediatr. 2009; 76:1223–226.

16. Lodha R, Puranik M, Chandra U, Natchu M, Kabra SK. Persistent pneumonia in children. Indian Pediatr. 2003; 40:67–70.

17. Debnath D, Wanjpe A, Kakrani V, Singru S. Clinical and epidemiological study of acute respiratory infection cases in children below twelve years of age in a tertiary care teaching hospital in Pune, India. Medical Journal of Dr D Y Patil University, 2012;5(2):125-28.

18. Thorn LK, Minamisava R, Nouer SS, Ribeiro LH, Andrade AL. Pneumonia and poverty: a prospective population-based study among children in Brazil. BMC Infect Dis. 2011;11:180.

19. Divyarani DC, Goudappa R Patil, K Ramesh. Profile on risk factors of pneumonia among Under-five age group at a Tertiary care hospital, International Journal of Current Microbiology and Applied Sciences. 2014;3(6):750-54.

20. Prina E, Ferrer M, Ranzani OT, Polverino E, Cilloniz C, Moreno E, et al. Thrombocytosis is a marker of poor outcome in community-acquired pneumonia. Chest. 2013;143(3):767-75.

21. Vlacha V, Feketea G: Thrombocytosis in pediatric patients is associated with severe lower respiratory tract inflammation. Arch Med Res 2006, 37(6):755-759.

22. Feldman C, Kallenbach JM, Levy H, Reinach SG, Hurwitz MD, Thorburn JR, Koornhof HJ: Communityacquired pneumonia of diverse aetiology: prognostic features in patients admitted to an intensive care unit and a "severity of illness" core. Intensive Care Med 1989, 15(5):302-307.

23. Kumar AMK, Badakali AV, Mirji G, Vanaki RN, Pol R. Clinical profile and outcome of acute lower respiratory tract infection in children aged between 2 months to 5 years. International Journal of Contemporary Pediatrics. 2017;4(1):105-09.

24. Mamtani M, Patel A, Hibberd PL, et al.. A clinical tool to predict failed response to therapy in children with severe pneumonia. PediatrPulmonol 2009; 44:379–86.

25. Djelantik IG, Gessner BD, Sutanto A, et al.. Case fatality proportions and predictive factors for mortality among children hospitalized with severe pneumonia in a rural developing country setting. J Trop Pediatr 2003; 49:327–32.

26. Araya S, Lovera D, Zarate C, et al.. Application of a prognostic scale to estimate the mortality of children hospitalized with community-acquired pneumonia. Pediatr Infect Dis J 2016; 35:369–73.