**Original article:**

**Relationship between severity of anemia and outcome in children younger than 5 years with pneumonia**

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**ABSTRACT**

**Background**: Acute lower respiratory tract infections are the leading cause of death in children under five years of age. The aim of this study was to assess the degree of anemia in patients with pneumonia and to correlate the severity of anemia with outcome in patients with pneumonia.

**Material & Method**: Present prospective comparative study was conducted among the Children less than 5 years of age diagnosed as community acquired pneumonia (CAP) admitted in wards and ICUs of hospitals affiliated to JJM Medical College, Davangere. Informed consent was taken from parents of all children to be enrolled in the study with written consent in the language understood by parents. Detailed history and physical examination findings were recorded. Hb level less than 11 g/dl were considered as anaemia in the study. The study group included 80 cases of CAP with anaemia and 80 cases of CAP without anaemia. The data were entered in excel sheet and analysed using SPSS v21.0 operating on windows 10. A p-value of <0.05 was considered statistically significant.

**Result**: A total of 160 participants with comparable mean age and gender between the groups. On assessment of type of anemia, 55% of the patients with microcytic hypochromic anemia, 25% with normocytic normochromic anemia, 13.8% with macrocytic anemia and 6.2% with microcytic normochromic anemia. There was significant lower mean hemoglobin among the patients with mortality compared to the patients recovered. (p<0.05) On correlation of the hemoglobin level with the hospital stay, there was linear inverse relation, patients with lower hemoglobin showed longer hospital stay (r=-0.546, p<0.05).

**Conclusion**: There is a significant association of the magnitude of pneumonia with the presence of anemia. Also, anemia among the patients with pneumonia had higher incidence of requirement of mechanical ventilation, longer hospital stay and higher incidence of mortality.

**Keywords**: Anemia, Pneumonia, Mortality, Community acquired pneumonia.

**Introduction**

In children under the age of five, acute lower respiratory tract infections are the main cause of mortality. Croup syndromes, bronchitis, bronchiolitis, and pneumonia are examples.1–3 Lower respiratory tract infections associated with anemia occur more commonly in children.4 Globally, pneumonia is the leading cause of death with age standardized mortality rates of 38.9/100000 children.5 In developing countries, more than 4 million children under 5 years of age die each year from acute respiratory tract infections(ARI), particularly pneumonia.5 The mortality due to Pneumonia may be avoided in children by using basic treatments, and it can be treated with low-cost, low-tech medicine and care.6–8

Anemia in children under 5 years of age, defined by the World Health Organization as a hemoglobin concentration < 11 g/dL, is a global public health problem.9 Anemia increases the risk of pneumonia and is associated with worst outcomes in children suffering from pneumonia.10 More than 75% of children with CAP progresses to severe disease. Identifying the risk factors allows timely institution of appropriate treatment and reduce the risk of death/complications.5 Low Hb level as a risk factor for LRTI is not fully evaluated.4 There is a need to evaluate anemia as a risk factor for worsening the outcome of pneumonia.11 This can be done by correlating the prevalence of anemia with the clinical outcome of pneumonia.

Present study aimed to assess the magnitude of anemia in children under 5 years and correlating the outcome of pneumonia in children under 5 years with anemia and those without anemia.

**Material & Method**

Present prospective comparative study was conducted among the Children less than 5 years of age diagnosed as community acquired pneumonia (CAP) admitted in wards and ICUs of hospitals affiliated to JJM medical college, Davangere. Patients with CAP diagnosed using WHO recommendations, with presence of fever, cough, fast breathing and crepitations, decreased breathing sounds on auscultation were included in study. The patients with recurrent pneumonia, cystic fibrosis, congenital heart disease, malignancy, immunodeficiency, hematological disorders, hemodynamic instability, recurrent wheezing and recurrent aspiration were excluded from the study.

Informed consent was taken from parents of all children to be enrolled in the study with written consent in the language understood by parents. Detailed history and physical examination findings was recorded. Hb level less than 11 g/dl were considered as anaemia in the study. The study group included 80 cases of CAP with anaemia and 80 cases of CAP without anaemia. Statistical analysis: The data were entered in excel sheet and analysed using SPSS v21.0 operating on windows 10. A p-value of <0.05 was considered statistically significant.

**Result:**

Eighty patients with mean age of 31.96±13.56months, and 40 patients each were divided inot the children with anemia and without anemia. There is no significant difference between the mean age in two groups.

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| Table 1: Demographic details between two groups | | | | | | |
|  | | **Anemia** | | **Non-Anemic** | | **p-value** |
| **Mean** | **SD** | **Mean** | **SD** |
| Age | in months | 31.8 | 13.1 | 32.3 | 13.6 | 0.96 |
| Gender | Female | 33 | 41.3% | 31 | 38.8% | 0.747 |
| Male | 47 | 58.8% | 49 | 61.3% |
| Hemoglobin g/dl | | 8.3 | 0.9 | 12.2 | 0.8 | 0.01\* |
| Duration of stay | | 9.0 | 4.4 | 6.2 | 3.1 | 0.01\* |
| Outcome | Death | 3 | 3.8% | 1 | 1.3% | 0.311 |
| Recovered | 77 | 96.3% | 79 | 98.8% |
| Need for | Ward care | 33 | 41.3% | 57 | 71.3% | 0.01\* |
| Oxygen therapy | 30 | 37.5% | 17 | 21.3% |  |
| Mechanical Ventilation | 17 | 21.3% | 6 | 7.5% |  |

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| Table 2: Hemoglobin concentration compared with outcome among Anemic patients | | | | | |
|  | **Death** | | **Recovered** | | **p-value** |
| **Mean** | **SD** | **Mean** | **SD** |
| Hemoglobin g/dl | 7.1 | 0.4 | 8.3 | 0.9 | 0.01\* |

On assessment of severity of anemia, 17.6% of patients had mild anemia, 76.2% had moderate grade of anemia and 6.2% with severe anemia.

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| Table 3: Comparison of the severity of anemia with outcome of patients | | | | | | | | |
|  | | **Anemia** | | | | | | **Chi-square**  **(p-value)** |
| **Mild Anemia** | | **Moderate Anemia** | | **Severe Anemia** | |
| N | N % | N | N % | N | N % |
| **Need for** | **Ward care** | 4 | 80.0% | 12 | 19.7% | 1 | 7.1% | 12.90 (0.12)\* |
| **Oxygen therapy** | 1 | 20.0% | 24 | 39.3% | 5 | 35.7% |
| **Mechanical Ventilation** | 0 | 0.0% | 25 | 41.0% | 8 | 57.1% |
| **Outcome** | **Death** | 0 | 0.0% | 1 | 1.6% | 2 | 40.0% | 19.502 (0.01)\* |
|  | **Recovered** | 14 | 100.0% | 60 | 98.4% | 3 | 60.0% |  |

On comparison of the need for type of treatment with severity of the anemia, there was significant higher incidence of the patient’s mechanical ventilation was seen in 57.1% with severe anemia, 41% in moderate anemia. (p<0.05) 80% of the patients with mild anemia required the ward care and 19.7% with moderate anemia and 7.1% with severe anemia needed ward care

Figure 1: Comparison of the anemia severity with duration of hospital stay

Figure 2: Association of the duration of stay with hemoglobin levels among participants

On correlation of the hemoglobin level with the hospital stay, there was linear inverse relation, patients with lower hemoglobin showed longer hospital stay (r=-0.546, p<0.05)

**Discussion**

In developing countries, more than 4 million children under 5 years of age die each year from acute respiratory tract infections (ARI), particularly pneumonia.5Anemia in children under 5 years of age, defined by the World Health Organization as a hemoglobin concentration < 11 g/dL, is a global public health problem.9 In children under the age of five, accounting for 14% of all fatalities in children under the age of five but 22% of all deaths in children aged one to five.12,13

In present study on assessment of type of anemia, 55% of the patients with MHA, 25% with NNA, 13.8% with MA and 6.2% with MNA. Mean hemoglobin level in the anemic and non anemic groups were 8.30.9g/dl and 12.2±0.8g/dl, respectively, with significant P-value of 0.01. Similar to our study, no significant difference in the mean age and gender distribution was found in the study by Mourad S et al., also the mean haemoglobin level in the anaemic and non-anemic groups was 9.99 ±0.62 g/dl and 11.99 0.92 g/dl, respectively, with a significant P-value of 0.001. 14 In another study by Garrido D et al., anemia was found in 21.25%. Prevalence of anemia in children under 36 months was significantly higher than those with over 3 years age. It was concluded that anemia is a frequent condition in pediatric pneumonia particularly during the first 3 years of life.15 Reade MC et al., One in three (33.9%) individuals had at least mild anaemia upon presentation, three in five (62.1%) were anaemic at some time during their hospital stay, and one in two (54.5%) survivors were released anaemic.16

On comparison of the mean hemoglobin level with the outcome among the patients, there was significant lower mean hemoglobin among the patients with mortality (7.1±0.4) compared to the patients recovered (8.3±0.9).(p<0.05) On correlation of the hemoglobin level with the hospital stay, there was linear inverse relation, patients with lower hemoglobin showed longer hospital stay (r=-0.546, p<0.05) However the patients on mechanical ventilator required longer days of hospital stay compared to the patients treated in ward or in PICU.(p<0.05) On assessment of days of hospital stay, there is significant longer hospital stay among the patients with anemia compared to the patients without anemia group.(p<0.05) Concordance to present study, Banajeh SM et al., documented that the patients with severe anemia showed the higher incidence of death compared to the patients with less severe anemia. Study showed that Hb less than 10g/dl was a significant risk factor for death from severe pneumonia.17 In line to our study, Mourad S et al., documented that the lower hemoglobin level shown as a risk factor for lower respiratory tract infection. Anemic children were twice as likely as the control group to get a lower respiratory tract infection, with iron deficiency anaemia predominating.14 It was concluded in study by Rani N etal., that anemia is generally neglected while treating pediatric pneumonia so pediatricians must check Hb levels on routine basis among this targeted population.18

Chisti MJ et al., documented that using multivariable logistic regression analysis, anaemia was found to be independently associated with fatal outcome after adjusting for potential confounders such as female sex, lack of immunisation, abnormal mental status, severe acute malnutrition, dehydration, hypoxemia, severe sepsis, and bacteremia (OR = 1.88, 95% CI 1.23-2.89, p = 0.004).19 Another study by Chang IF et al., documented that Anemia is a biomarker linked to poor outcomes in paediatric CAP, and individuals with IDA or normocytic anaemia should be closely evaluated and handled since they may have a more severe condition.20 The finding that the prevalence of anaemia is inversely related to increasing age in children under the age of five who are hospitalised for pneumonia/severe pneumonia is quite noteworthy. This might be because newborns have a greater frequency of severe diseases, such as severe acute malnutrition21,22 and severe sepsis,23 than older children, and these severe illnesses have been linked to anaemia.

**Conclusion**

There is a significant association of the magnitude of pneumonia with the presence of anemia. Also, anemia among the patients with pneumonia had higher incidence of requirement of mechanical ventilation, longer hospital stay and higher incidence of mortality. The study also documented a direct relation of the severity of anemia with longer hospital stay and worst outcome as mortality. Hence the study strengthen the findings that the pneumonia patients with anemia should be treated with additional care and intervention at the appropriately to reduce the worst outcome in them.

**Reference:**

1. Suwanjutha S, Chantarojanasiri T, Watthana-kasetr S, Sirinavin S, Ruangkanchanasetr S, Hotrakitya S, et al. A study of nonbacterial agents of acute lower respiratory tract infection in Thai children. Rev Infect Dis. 1990;12(8):S923–8.

2. Denny FW, Clyde Jr WA. Acute lower respiratory tract infections in nonhospitalized children. J Pediatr. 1986;108(5):635–46.

3. Sheikh Quyoom Hussain MA, Wani JG, Ahmed J. Low hemoglobin level a risk factor for acute lower respiratory tract infections (ALRTI) in children. J Clin diagnostic Res JCDR. 2014;8(4):PC01.

4. Ramakrishnan K, Harish PS. Hemoglobin level as a risk factor for lower respiratory tract infections. Indian J Pediatr. 2006;73(10):881–3.

5. Koh JWJC, Wong JJ, Sultana R, Wong PPC, Mok YH, Lee JH. Risk factors for mortality in children with pneumonia admitted to the pediatric intensive care unit. Pediatr Pulmonol. 2017;52(8):1076–84.

6. Scrivani P V, Thompson MS, Dykes NL, Holmes NL, Southard TL, Gerdin JA, et al. Relationships among subgross anatomy, computed tomography, and histologic findings in dogs with disease localized to the pulmonary acini. Vet Radiol Ultrasound. 2012;53(1):1–10.

7. Stahl J, Sage MR. Radiological–pathological correlation: Alveolar pattern. Australas Radiol. 2001;45(1):74–97.

8. Andrews GA, Kennedy GA. Respiratory diagnostic pathology. Vet Clin North Am Food Anim Pract. 1997;13(3):515–47.

9. Menon MP, Yoon SS, Group UMISTW. Prevalence and factors associated with anemia among children under 5 years of age—Uganda, 2009. Am J Trop Med Hyg. 2015;93(3):521.

10. Jakhar SK, Pandey M, Shah D, Ramachandran VG, Saha R, Gupta N, et al. Etiology and risk factors determining poor outcome of severe pneumonia in under–five children. Indian J Pediatr. 2018;85(1):20–4.

11. Reddy KRA, Yadav A, Muruga S. Hemoglobinopathies Pattern Among High Suspicion Anemic Patients attending Tertiary Care Hospital in Telangana. J Cardiovasc Dis Res. 2022;13(7):16–26.

12. Organization WH. Revised WHO classification and treatment of pneumonia in children at health facilities: evidence summaries. 2014;

13. Shann F. The management of pneumonia in children in developing countries. Clin Infect Dis. 1995;21(Supplement\_3):S218–25.

14. Mourad S, Rajab M, Alameddine A, Fares M, Ziade F, Abou Merhi B. Hemoglobin level as a risk factor for lower respiratory tract infections in Lebanese children. N Am J Med Sci. 2010;2(10):461.

15. Garrido D, Fuseau M, Garrido S, Vivas G, Gutiérrez M. Prevalence of anaemia in children diagnosed with pneumonia in a tertiary hospital in Quito, Ecuador. J Nepal Paediatr Soc. 2018;38(2):102–9.

16. Reade MC, Weissfeld L, Angus DC, Kellum JA, Milbrandt EB. The prevalence of anemia and its association with 90-day mortality in hospitalized community-acquired pneumonia. BMC Pulm Med. 2010;10(1):1–10.

17. Banajeh SM, Al-Sunbali NN, Al-Sanahani SH. Clinical characteristics and outcome of children aged under 5 years hospitalized with severe pneumonia in Yemen. Ann Trop Paediatr. 1997;17(4):321–6.

18. Rani N, ZUBAIR N, ATTA HI. Frequency Of Anemia In Children Suffering From Pneumonia At A Tertiary Care Hospital. J Med Physiol Biophys. 2018;41:53–7.

19. Chisti MJ, Kawser CA, Rahman ASMMH, Shahid ASMS Bin, Afroze F, Shahunja KM, et al. Prevalence and outcome of anemia among children hospitalized for pneumonia and their risk of mortality in a developing country. Sci Rep. 2022;12(1):10741–9.

20. Chang I, Shih W, Liu Y, Ho T, Yen T, Chang H, et al. The association of anemia with the clinical outcomes of community‐acquired pneumonia in children. Pediatr Pulmonol. 2022;57(6):1–11.

21. Ahmed T, Ali M, Ullah MM, Choudhury IA, Haque ME, Salam MA, et al. Mortality in severely malnourished children with diarrhoea and use of a standardised management protocol. Lancet. 1999;353(9168):1919–22.

22. Chisti MJ, Hossain MI, Malek MA, Faruque ASG, Ahmed T, Salam MA. Characteristics of severely malnourished under‐five children hospitalized with diarrhoea, and their policy implications. Acta Paediatr. 2007;96(5):693–6.

23. Chisti MJ, Salam MA, Smith JH, Ahmed T, Pietroni MAC, Shahunja KM, et al. Bubble continuous positive airway pressure for children with severe pneumonia and hypoxaemia in Bangladesh: an open, randomised controlled trial. Lancet. 2015;386(9998):1057–65.