

**HAEMOGLOBIN LEVEL AS A RISK FACTOR FOR LOWER RESPIRATORY TRACT INFECTIONS**Harishchandra Venkata Yanamandala<sup>1</sup>, Bonela Sai Kumar<sup>2</sup><sup>1</sup>Associate Professor, Department of Paediatrics, Gitam Institute of Medical Sciences and Research, Andhra Pradesh.<sup>2</sup>Assistant Professor, Department of Paediatrics, Gitam Institute of Medical Sciences and Research, Andhra Pradesh.**ABSTRACT****BACKGROUND**

Lower Respiratory Tract Infection (LRTI) is an inflammation of the airways, pulmonary tissue below the larynx level. Children who are below 5 years of age suffer about 5-6 episodes of LRTI per year on an average.<sup>1,2</sup> The largest cause of death in children worldwide is pneumonia. If the haemoglobin level is below 11 g/dL<sup>3</sup>, then the child is considered as anaemic. In children, LRTIs associated with anaemia occur more commonly than in adults. Pneumonia kills about an estimated 1.1 million children under the age of 5 years old worldwide. It is more prevalent in South East Asia and Africa.<sup>3,4,5</sup> Anaemia is a condition in which the number of RBCs is very low to meet the body's physiologic needs. The most common cause of anaemia is deficiency of iron. In both developing and developed countries, anaemia is a common health problem. This study is a prospective study, which was conducted to assess the low haemoglobin level as a risk factor for developing LRTI in children.

**MATERIALS AND METHODS**

This is a prospective study, which was conducted in 75 children who attended the outpatient unit of Department of Paediatrics, Gitam Institute of Medical Sciences and Research. It was conducted during the period between December 2015 to December 2016. By the symptoms and signs, pneumonia was diagnosed.

Exclusion Criteria- Children who had congenital malformations of chest wall, severe systemic illness and protein malfunction. All children's height and weight were recorded to assess the nutritional status.

**RESULTS**

C-Reactive Protein Estimation (CRP) was more than 6 mg/L in 34 (45.3%) patients in the study group, 11 (14.7%) in the control group. Mantoux test was positive for 17 (22.6%) among study group and none in the control group. Pneumonia as per radiological evidence was present in 49 (65.3%) and hyperinflation of lungs in 26 (34.7%) among the study group. X-ray reports were normal in 8 cases (10.7%). Age was not found to be a significant factor, which affects the results in both the groups ( $p=0.32$ ,  $0.41$  in the study group and control group). 53 children (70.6%) in the study group and 23 children (30.6%) were anaemic. 57% had Iron Deficiency Anaemia (IDA), 9% had Anaemia of Chronic Infection(ACI) and 4.6% had haemolytic anaemia. 25% among the control group had IDA, 4% had ACI and 1.6% had HA. 60% had a wheezing history in the study group and 38% had asthma history in their family.

**CONCLUSION**

In LRTI children, iron deficiency anaemia was significantly found. The anaemic patients were found to be 4 times more susceptible to LRTI. To reduce LRTI, early diagnosis and treatment of anaemia is important.

**KEYWORDS**

Anaemia, Chronic Infection, LRTI.

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haemoglobin level is below 11 g/dL<sup>3</sup>, then the child is considered as anaemic. In children, LRTIs associated with anaemia occur more commonly than in adults. Pneumonia kills about an estimated 1.1 million children under the age of 5 years old worldwide. It is more prevalent in South East Asia and Africa.<sup>3,4,5</sup> Anaemia is a condition in which the number of RBCs is very low to meet the body's physiologic needs. The most common cause of anaemia is deficiency of iron. In both developing and developed countries, anaemia is a common health problem. This study is a prospective study, which was conducted to assess the low haemoglobin level as a risk factor for developing LRTI in children.

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**Exclusion Criteria**

Children who had congenital malformations of chest wall, severe systemic illness and protein malfunction. All children's height and weight were recorded to assess the nutritional status. The following investigations were done namely Complete Blood Count (CBC), C-Reactive Protein Estimation (CRP), Mantoux test and x-ray chest. In all anaemic children, peripheral smear, serum iron-binding capacity and serum ferritin tests were done. For children who had other complaints of illness other than LRTI were randomly selected as control. The variables in numbers were reported in mean and standard deviation. The variables which were categorical were reported in numbers and percentages. The categorical variables were assessed by Chi-square test. In

univariate analysis, variables showing statistically significant with  $p=0.25$  were considered as risk factor. Logistic regression technique was used to find the risk factor in multivariate reanalysis. P value less than 0.05 was considered to be statistically significant.

**RESULTS**

Variables	Study Cases (n=75)	Control Cases (n=75)	95% CI	P-value
<b>Age</b>				
<6 years	48 (64%)	45 (60%)		
6-14 years	24 (32%)	30 (40%)		
>14 years	3 (4%)	0 (0%)		
<b>Sex</b>				
Male	45 (60%)	40 (53.3%)	0.57-2.31	0.39
Female	30 (40%)	35 (46.7%)		

**Table 1. Shows that Age Group of Children Varied from 10 Months to 15 Years**

Variables	Study Cases (n=75)	Control Cases (n=75)	95% CI	P-value	
Anaemia	Yes	53 (70.6%)	23 (30.6%)	0.000	
	No	22 (29.4%)	52 (69.4%)	3.0-11.10	
PEM	Yes	10 (13.3%)	3 (4%)	0.85-7.80	0.05
	No	65 (86.7%)	72 (96%)		
ANC	Highest thru 7.51	11	10	0.50-2.60	0.60 (NS)
	Normal	72	80		
AEC	Lowest thru 0.04	10	3	1.30-21.80	0.0025 (Sig.)
	Normal	30	55		
AEC	Highest thru 0.4	50	25	1.61-5.89	0.000 (Sig.)
	Normal	22	62		

**Table 2. Shows Relationship between the Patient Characteristics and LRTIs**

Protein Energy Malnutrition-PEM, Absolute Neutrophil Count-ANC, Absolute Oeosinophil Count-AEC, Confidence Interval-CI.

C-Reactive Protein estimation (CRP) was more than 6 mg/L in 34 (45.3%) patients in the study group, 11 (14.7%) in the control group. Mantoux test was positive for 17 (22.6%) among study group and none in the control group. Pneumonia as per radiological evidence was present in 49 (65.3%) and hyperinflation of lungs in 26 (34.7%) among the study group. X-ray reports were normal in 8 cases (10.7%). Age was not found to be a significant factor, which affects the results in both the groups ( $p=0.32$ , 0.41 in the study group and control group). 53 children (70.6%) in the study group and 23 children (30.6%) were anaemic. 57% had Iron-Deficiency Anaemia (IDA), 9% had Anaemia of Chronic Infection (ACI) and 4.6% had haemolytic anaemia. 25% among the control group had IDA, 4% had ACI and 1.6% had HA. 60% had a wheezing history in the study group and 38% had asthma history in their family.

**DISCUSSION**

In different studies from literature survey, several risk factors for developing LRTI had been reported. K. Ramakrishnan et al<sup>6</sup> conducted a prospective study to evaluate the role of haemoglobin level as a risk factor for Lower Respiratory Tract Infections in children (LRTI). 100 children who came to the outpatient department for LRTI

were included in the study. Age and sex-matched 100 children not having any respiratory illness were taken as control. They were subjected to Complete Blood Count (CBC), C-Reactive Protein estimation (CRP), Mantoux test and x-ray chest. Peripheral smear, serum ferritin and serum iron-binding capacity were done for all anaemic children.

Radiological evidence of pneumonia was present in 63 children (63%). Hyperinflated lungs were seen in 27 (27%). Mantoux was positive in 22 children (22%) of study group and none among control group. CRP >6 mg/L was noted in 45 children (45%) of study group and 14 (14%) of control group. Seventy four of study group (74%) and 33 of control group (33%) had anaemia. Of the anaemic children, 60 (60%) had iron deficiency, 10 (10%) chronic inflammation and 4 (4%) had haemolytic anaemia. These values were 30 (30%), 2 (2%) and 1 (1%) respectively for control group. Low haemoglobin level due to whatever aetiology was a risk factor ( $p=0.000$ ). Anaemic children were 5.75 times more susceptible to LRTI compared to the control group. Prevention of anaemia due to whatever aetiology will reduce the incidence of LRTI. Sheikh Quyoom Hussain et al<sup>7</sup> analysed whether a low haemoglobin level is a risk factor for Acute Lower Respiratory Tract Infections (ALRTI) in children. Prospective case control study on 220 children (110 cases and controls each) was carried out in our children's hospital (G.B. Pant Hospital), an associated hospital of Government Medical College, Srinagar, of Kashmir Northern

India. All patients between the age of 1 month to 5 years of age who fulfilled the inclusion criteria were included. We used WHO criteria to diagnose ALRTI among the cases and age and sex matched patients who did not have respiratory complaints were kept as controls. Patients who had congenital heart diseases, tuberculosis, malignancies or dysmorphic features were excluded from the study. All patients were subjected to detailed history and through clinical examination followed by investigations like Complete Blood Count (CBC), Peripheral Blood Film (PBF) smear, blood culture and sensitivity test, x-ray chest, serum iron and iron-binding capacity were done in all cases. Our study had slightly male preponderance 57.3% in study group and 59.1% in control group. Maximum number of children were between 3 months and 23 months both in the study (80.9%) as well as in the control (81.8%) group. In this study, haemoglobin level <11 gm/dL was considered low. Mean Hb level was 8.8 gm/dL in the study group and 11.6 gm/dL in the control group. Anaemia was found in 71 (64.5%) cases in the study group and in 31 (28.2%) cases in the control group. Anaemic patients were found to be 4.6 times more susceptible to ALRTI in our study (Odds ratio was 4.63), p-value <0.01. Iron deficiency was found in 78.9% of total anaemic cases in the study group, p-value <0.01. In the study group, the mean serum iron level was 35.3 mcg/dL in the anaemic cases and 57.1 mcg/dL in the non-anaemic cases. While in the control group, these values were 52.4 mcg/dL and 62.6% mcg/dL, respectively, (p value <0.01). Anaemia, predominantly, iron-deficiency anaemia was significantly found in ALRTI patients and these patients were found to be 4.6 times more susceptible to ALRTI. Early and accurate diagnosis of anaemia in children suffering from various ailments in particular to ALRTI will serve the mankind in a better way. Yogesh Avhad et al<sup>8</sup> had done a prospective study, which was carried out over a one-year period in Paediatric Outpatient Department ward and Paediatric Intensive Care Unit of a tertiary care centre in Mumbai. The study included 110 diagnosed cases of lower respiratory tract infections as per WHO criteria. 110 age and sex matched patients who did not have respiratory complaints or chronic illness were enrolled as controls. Appropriate history was taken and detailed clinical examination was carried out in all patients followed by routine investigations like CBC, peripheral smear and chest x-ray. On studying the age distribution, maximum children were in the age group of 9 months to 3 years. Male preponderance was found with male:female ratio being 1.3:1.67% of the cases and 36% of the controls in the study were found anaemic. Anaemia was found to be a significant risk factor for LRTI (p value <0.001) with odds ratio of 3.59. Most of the anaemic patients had hypochromic microcytic anaemia suggestive of iron-deficiency anaemia. Anaemia was significantly found in patients with lower respiratory tract infections and these patients were found to be 3.59 times more susceptible to lower respiratory tract infections. Prevention of anaemia, due to whatever aetiology, early diagnosis and treatment is important to reduce the incidence of lower respiratory tract infections in children. Koch A et al<sup>9</sup>

have conducted a study in which acute respiratory infections cause considerable morbidity among Inuit children, but there is very little information on the risk factors for these infections in this population. To identify such factors, the authors performed a prospective community-based study of acute respiratory infections in an open cohort of 288 children aged 0-2 years in the town of Sisimiut, Greenland. Between July 1996 and August 1998, children were monitored weekly and episodes of upper and lower respiratory tract infections were registered. Risk factor analyses were carried out using a multivariate Poisson regression model adjusted for age. Risk factors for upper respiratory tract infections included attending a childcare centre (relative risk = 1.7 compared with home care) and sharing a bedroom with adults (relative risk = 2.5 for one adult and 3.1 for two adults). Risk factors for lower respiratory tract infections included being a boy (relative risk = 1.5), attending a childcare centre (relative risk = 3.3), exposure to passive smoking (relative risk = 2.1) and sharing a bedroom with children aged 0-5 years (relative risk = 2.0 for two other children). Breastfeeding tended to be protective for lower respiratory tract infections. The population-attributable risk of lower respiratory tract infections associated with passive smoking and childcare centres was 47% and 48%, respectively. The incidence of acute respiratory infections among Inuit children may be reduced substantially through public health measures. Sawsan Mourad et al<sup>10</sup> conducted a study to determine the relationship between anaemia and lower respiratory tract infection as a risk factor in Lebanese children. A total number of two hundred infants and children aged nine months to twelve years were included; one hundred cases were hospitalised for lower respiratory tract infection in Department of Paediatrics, Makassed General Hospital; and one hundred healthy, age and sex matched controls were selected from outpatient department. Complete blood count, iron level, ferritin level and total iron-binding capacity were taken if haemoglobin level less than 11 g/dL. In addition, peripheral blood smear, chest radiograph and C-reactive protein were done to hospitalised cases. Definition of iron deficiency anaemia and normal laboratory values were predetermined. Anaemia was found in 32% of hospitalised cases and 16% of healthy controls. Mean haemoglobin level was  $9.99 \pm 0.62$  grams per decilitre and  $11.99 \pm 0.92$  grams per decilitre in anaemic and non-anaemic group, respectively with a significant P-value of 0.001. C-reactive protein levels and number hospitalisation days were similar among the anaemic and non-anaemic group. History of recurrent chest infections was significantly higher in both anaemic group and hospitalised cases compared to non-anaemic group and healthy controls. Low haemoglobin level was a risk factor for lower respiratory tract infection with a P-value of 0.008. Anaemic children were two times more susceptible to lower respiratory tract infection compared to the control group and iron-deficiency anaemia was predominating. Accurate diagnosis and prevention of anaemia, whatever its aetiology, is essential.

**CONCLUSION**

In LRTI children, iron-deficiency anaemia was significantly found. The anaemic patients were found to be 4 times more susceptible to LRTI. To reduce LRTI, early diagnosis and treatment of anaemia is important.

**REFERENCES**

- [1] WHO. Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia. Vitamin and mineral nutrition information system. Geneva: World Health Organization. 2008 (WHO/NMH/NHD/MNM/11) (<http://www.who.int/vmnis/prevalence/anaemia.pdf>).
- [2] WHO. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and mineral nutrition information system. Geneva: World Health Organization 2011. (WHO/NMH/NHD/MNM/11.1) (<http://www.who.int/vmnis/indicators/hemoglobin.pdf>).
- [3] Kotecka PV. Nutritional anaemia in young children with focus on Asia and India. *Indian J Community Med* 2011;36(1):8-16.
- [4] Azab SF, Sherief LM, Saleh SH, et al. Impact of the socioeconomic status on the severity and outcome of community-acquired pneumonia among Egyptian children: a cohort study. *Infect Dis Poverty* 2014;3:14.
- [5] Biswas A, Biswas R, Manna B, et al. Risk factors of acute respiratory infections in under-fives of urban slum community. *Indian J Public Health* 1999;43(2):73-75.
- [6] Ramakrishnan K, Harish PS. Haemoglobin Level as a risk factor for lower respiratory tract infections. *Indian J Pediatr* 2006;73(10):881-883.
- [7] Hussain SQ, Ashraf M, Wani JG, et al. Low hemoglobin level a risk factor for acute lower respiratory tract infections (ALRTI) in children. *J Clin Diagn Res* 2014;8(4):PC01-PC03.
- [8] Avhad Y, Wade P, Ghildiyal RG. Anaemia as a risk factor for lower respiratory tract infections (LRTI) in children. *International Journal of Contemporary Medical Research* 2016;3(12):3512-3514.
- [9] Koch A, Molbak K, Sorenson P, et al. Risk factors for acute respiratory tract infections in young Greenlandic children. *Am J Epidemiol* 2003;158(4):374-384.
- [10] Mourad S, Rajab M, Alameddine A, et al. Hemoglobin level as a risk factor for lower respiratory tract infections in Lebanese children. *N Am J Med Sci* 2010;2(10):461-466.