DOI: 10.7860/JCDR/2014/8387.4268

Original Article

Paediatrics Section

Low Hemoglobin Level a Risk Factor for Acute Lower Respiratory Tract Infections (ALRTI) in Children

SHEIKH QUYOOM HUSSAIN[1], MOHD ASHRAF [2], JUVERIA GULL WANI[3], JAVID AHMED[4]

ABSTRACT

Background: Acute lower respiratory tract infection is a major cause of death in under five years of age, and anemia is the commonest co-factor in pediatric patients seeking medical advice especially in developing countries.

Aim: To analyze whether a low hemoglobin level is a risk factor for acute lower respiratory tract infections (ALRTI) in children.

Materials and Methods: 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 thorough 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.

Results: 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 hemoglobin 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. Anemia was found in 71 (64.5%) cases in the study group and in 31 (28.2%) cases in the control group. Anemic patients were found to be 4.6 times more susceptible to ALRTI in our study (Odds Ratio was 4.63), p-value <0.001. Iron deficiency was found in 78.9% of total anemic cases in the study group, p-value <0.001. In the study group, the mean serum iron level was 35.3 mcg/dL in the anemic cases and 57.1 mcg/dL in the non-anemic cases. while in the control group, these values were 52.4 mcg/dL and 62.6% mcg/dL respectively, (p-value <0.01).

Conclusion: Anemia, predominantly iron deficiency anemia, 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 anemia in children suffering from various ailments in particular to ALRTI will serve the mankind in a better way.

Keywords: ALRTI, Anemia, Children, Iron deficiency, Pneumonia

INTRODUCTION

Hemoglobin (Hb) level is the most reliable indicator of anemia among all individuals. Anemia is a major public health problem that can occur at any stage of the life cycle, but is more prevalent in pregnant women and young children having iron deficiency [1]. Approximately over 75% of children between the age of 1-3 years are anemic in India [2], and are at risk of developing various consequences of anemia including infections. Lower Respiratory Tract Infections (LRTI) includes all infections of the lungs and the airways below the larynx [3]. and includes croup syndromes, bronchitis, bronchiolitis and pneumonia [4]. Acute lower respiratory tract infections (pneumonia) is the biggest single cause of childhood death under the age of 5 years in developing countries [5]. Approximately 150 million episodes of childhood pneumonia are reported every year from the world and there are about 3 million deaths, less than 5 years of age, each year due to pneumonia, of these deaths 90-95% are in the developing countries [6].

Various risk factors have been proposed to increase the chances of development of lower respiratory infections some of them are definite some are likely and few are possible [7]. Since infections of the lower respiratory tract are the major morbidity and mortality indicators among the children, gaining control over the risk factors will have a promising effect on the wholesome growth and development of children. Our study was conducted with the objective to know the association of low Hb levels among the children with LRTI.

MATERIALS AND METHODS

The present study was a hospital based prospective study conducted over a period of one year from March 2011 to February 2012, in the Department of Paediatrics, G.B Pant Hospital, which is an associated tertiary care hospital of Government Medical College Srinagar. For a 68%, and 21% prevalence of anemia among the cases and controls, and at a power of 90% with 95% confidence interval, the sample size for current study was 90 cases in each group, however, we took 110 cases in each group for convenience and more accuracy. We selected the LRTI patients using the WHO criteria i.e. patients having fever, cough, fast respiratory rate for age, chest in-drawing, and ronchi or crepitations on auscultation. All other patients who were suffering from other systemic illnesses like congenital heart diseases, tuberculosis (any evidence plus Montaux test positive cases), protein Energy Malnutrition (PEM > Grade III as per Indian Academy of Paediatrics (IAP) Classification), children who already received antibiotic from outside were excluded from the study. Hemoglobin level <11gm% was considered low in this study. Investigations like complete blood count (CBC), peripheral blood smear (PBF), blood culture and sensitivity test, X-ray chest, serum iron and iron binding capacity were done in all cases. Blood sample were taken from anti-cubital vein of each child by a trained phlebotomist. Sterile, disposable syringes and needles, and proper tubes were used. Hemoglobin level was estimated in the blood samples using cyanmeth method by automatic blood cell analyser.

Iron level and TIBC were measured by using the Ferrozine method without deprotienization.

STATISTICAL ANALYSIS

Data was described as mean ± SD/SE and percentages. Least significant difference for intergroup variance was measured at 95% confidence interval. The metric data was analysed by student's t-test whereas Mann-Whitney U-test and Fisher's exact test were used for non-parametric data. P-value was expressed up to three decimal places. SPSS version 19.0 and Excel software were used for data analysis.

RESULTS

Observations of our study are depicted in tables as under [Table/Fig-1,2]:

	Study (110)		Control (110)		p-value
	n	%	n	%	
AGE (month)					
≤ 2	13	11.8	10	9.1	0.435
3 to 23	89	80.9	90	81.8	
24 to 59	8	7.3	10	9.1	
Gender					
Male	63	57.3	65	59.1	0.785
Female	47	42.7	45	40.9	
Clinical Features					
Fever	104	94.5	91	82.7	0.006
Cough	110	100.0	8	7.3	0.000
Fast Respiratory Rate	74	67.3	0	0.0	0.000
Chest in-drawing	92	83.6	0	0.0	0.000
Ronchi/Crepitations	64	58.2	0	0.0	0.000
Vomiting	23	20.9	56	50.9	
Diarrhea	6	5.5	38	34.5	
Pain Abdomen	3	2.7	32	29.1	
Dehydration	6	5.5	30	27.3	
Convulsions	9	8.2	28	25.5	
Poor Feeding/sore throat	60	54.5	66	60.0	

[Table/Fig-1]: Age, Gender and Clinical Profile Distribution of the Studied Subjects

	Study (110)		Control (110)		Odds Ratio	p-value
	n	%	n	%		
Anemic	71	64.5	31	28.2	4.63	0.001
Non-Anemic	39	35.5	79	71.8	1	
PBF Smear						
(Hypochromic Microcytic)	56	78.9	10	32.3	7.86	0.001
Normocytic Normochromic	15	21.1	21	67.7	1	
Serum Iron Levels in Micrograms (mcg/dL)						
Anemic LRTI	35.3 ± 14.4		57.1 ± 13.8 (34, 81)			0.000
Non-Anemic LRTI	52.4 ± 15.1		62.6 ±16.7 (35, 95)			0.004

[Table/Fig-2]: Anemia in the studied sujects

DISCUSSION

Anemia is the commonest ailment affecting human's health, socio-economic development and overall betterment of the mankind. Most common cause for anemia is nutritional deprivation in particular, iron deficiency [8]. In Southeast Asia, the proportion of anemic population is the highest in the world, with 616 million people at risk [9]. In children, major health consequences include impaired cognitive and physical development and increased mortality and morbidity related to occurrence of infections [10]. Balanced and adequate nutritional supplementation to the growing children is of immense importance for development and maturity of immunity, consequently development of resistance against the infections. So nutritional inadequacy including the iron deficiency forms an indirect risk factor for the contracting acute lower respiratory tract Infection (ALRTI) [11]. Most common affected age group was 3 months to 23 months, which is quite comparable with the study conducted by Malla T et al., [12]. The common involvement of this age group could be because, supplementary and complementary feeding practices that might be inadequate and inappropriate, are practiced and advocated widely in this age, due to which Hb could touch the nadir.

As shown in [Table/Fig-1] there is no gender significance of having ALRTI among various studied populations [12-14] which is quite comparable to our study. Hemoglobin level less than 11 gm% was considered anemia in our study subjects. Out of the 220 children, 102 were anemic giving us a proportion of 46.36% a rate lower than the average national rate of our country [2], which could be because most people in Kashmir region possess the habit of taking biologically more feasible form of nutritional iron (meat). Anemia was found in 71 (64.5%) cases in the study group and in 31 (28.2%) cases in the control group which is comparable to other studies [12-14], as shown in the [Table/Fig-2 & 3].

Mean serum iron level was 35.3 mcg/dL in the anemic and 52.41 mcg/dL in the non-anemic ALRTI cases (p-value <0.01), while in control group, the mean serum iron level was 57.1 mcg/dL in the anemic and 62.6 mcg/dL in the non-anemic subjects, (p-value <0.01), pointing an association of low serum iron in ALRTI, a hypothesis needs consolidation of the previously held research [15, 16]. Although the early prospective interventional studies conducted, derived the support from the value of iron supplements in reducing rates of respiratory infections in infants [17,18]. In our study anemic patients had 4.63 OR for developing ALRTI, while as it was 5.6 [12], 5.76 [13] and 2.08 [14] in previous studies, as shown in [Table/Fig-3]. A result that is showing consistent strength of association of anemia and ALRTI.

It seems noteworthy that oxygen (O_2) and carbon-dioxide (CO_2) transport is primarily facilitated by Hb, besides Hb acts as buffer for nitric oxide (NO) and other body derangements [19]. Therefore quantitative and/or qualitative reduction in Hb, may adversely affect the normal functions. Alveolar macrophages obtain iron primarily from the RBC metabolism and plasma pool, and their function may be hampered in iron deficient states [20], and hence could be possible explanation for association of ALRTI and deficient iron state and consequently iron deficiency anemia.

REFERENCES

[1] Bruno de Benoist, Erin McLean, Ines Egli and Mary Cogswell. Worldwide prevalence of anaemia 1993–2005 : WHO global database on anaemia. World Health Organization 2008//: [accessed on 25/10/2013].

[2] Pasricha SR, Black J, Muthayya S, Shet A, Bhat V, Nagaraj S, et al. Determinants of Anemia Among Young Children in Rural India. *Paediatrics*.2010; 126: e140-9.

[3] Thomas P Green, Susanna A. McColley. Disorders of the lungs and lower airways. In: Richard E. Behrman, Robert Kleigman, Hal B. Jenson, ed. Nelson Text Book of Paediatrics. 17th ed. Philadelphia: Saunders 2004: 1401.

[4] Kabra SK. Disorders of repiratory system. In: Paul VK, Bagga A (Eds) Ghai Essential Paediatrics, CBS Publishers and Distributors Pvt. Ltd. New Delhi 2013; pp 371-95.

[5] Graham SM, English M, Hazir T, Enarson P. Challenges to improving case management of childhood pneumonia at health facilities in resource-limited setting. *Bull WHO.* 2008; 86: 349-55.

[6] Bryce J, Boschi-Pinto C, Shibuya K. WHO estimates of the causes of death in children. *Lancet*. 2005; 365: 1147-52.

[7] Jackson S, Mathews KH, Pulani D, Falconer R, Rudanl, Campbel H, et al. Risk factors for severe acute lower respiratory infections in children – a systematic review and meta-analysis. *Croat Med J*. 2013; 54: 110-21.

[8] Kotecka PV. Nutritional Anemia in Young Children with Focus on Asia and India. *Indian J Community Med*. 2011; 36: 8–16.

[9] Latham M. Human Nutrition in the Developing World. Food and Agricultural. Available at: http://www.fao.org/ DOCREP/W0073e/w0073e00.htm. [accessed

	Present Study		Malla T et al.,		Mourad S et al.,		Ramakrishanan et al.,	
	Cases (%)	Control (%)	Cases (%)	Control(%)	Cases(%)	Control(%)	Cases(%)	Control(%)
Sex								
Males	57	60	71	67	51	52	63	58
Females	43	40	29	33	49	48	37	42
p-value	NS	NS	NS	NS				
Anemia								
Present	64.5	28.2	68.6	38.6	68	84	74	33
Absent	35.5	71.8	31.4	61.4	32	16	26	67
p-value	0.001 (S)		<0.001 (S)		0.008 (S)		0.000 (S)	
OR	4.63		5.6		2.08 (Adjusted OR)		5.76	

[Table/Fig-3]: Comparison of present study with other studies showing association of LRTI with gender and anemia
NS: Non-significant; OR: Odds Ratio

on Dec.15,2013].
[10] WHO, 2001. Iron Deficiency Anaemia: Assessment, Prevention and Control. A1. Guide for Programme Managers. Available at: tp://www.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/WHO_NHD_01.3/en/index.htm [accessed on on Dec.15,2013].
[11] Koch A, Molbak K, Homoe P, Sorensen P, Hjuler T, Olesen ME, et al. Pedersen FK, Olsen OR, Melbye M: Risk factors for acute respiratory tract infections in young Greenlandic children. *Am J Epidemiol*. 2003; 158: 374-84.
[12] Malla T, Pathak OK, Malla KK. Is low haemoglobin level a risk factor for lower respiratory tract infection. *Indian J Pediatr*. 2006; 73: 881-3.
[13] Ramakrishnan K, Harish PS. Hemoglobin level as a risk factor for lower respiratory tract infections. *Indian J Pediatr.* 2006; 73: 881-3.
[14] Mourad S, Rajab M, Alameddine A, Fares M, Ziade F, Abou Merhi B. Hemoglobin level as a risk factor for lower respiratory infections in Lebanese children. *North Am J Med Sci*. 2010; 2: 461-6.
[15] De-Silva A, Atukorola S, Weevasighel. Iron supplementation improves iron status and reduces morbidity in children with or without URTI. *Am J Clin Nutr*. 2003;77: 234-41.
[16] Oppenheimer SJ. Iron and Its Relation to Immunity and Infectious Disease. *J. Nutr*. 2001; 131: 616S-35.
[17] Canonne-Hergaux F, Gruenheid S, Govoni, G. Gros, P. The NRAMP protein and its role in resistance to infection and macrophage function. *Proc. Assoc. Am. Physicians*. 1999; 111:283-9.
[18] Cantwell, RJ. Iron deficiency anemia of infancy. Some clinical principles illustrated by the response of Maori infants to neonatal parenteral iron administration. *Clin. Pediatr*. 1972; II: 443-9.
[19] Ganong WF. Gas transport between the lungs and the tissues. Review of Medical Physiology: 22nd ed. New York; Mc Graw-Hill, 2005; 666-9.
[20] Mateos F, Brock JH, Perez-Arellanoa JL. Iron metabolism in the lower respiratory tract. *Thorax*.1998; 53: 594-600.

PARTICULARS OF CONTRIBUTORS:
1. Registrar, Department of Paediatrics, GB Pant Hospital, Government Medical College Srinagar, India.
2. Lecturer Pediatric Nephrology, Department of Paediatrics, GB Pant Hospital, Government Medical College Srinagar, India.
3. Registrar, Department of Gynecology and Obstetrics, L. D. Hospital Srinagar, India.
4. Assistant Professor, Department of Community Medicine, Shere-i-Kashmir Institute of Medical Sciences Soura Srinagar, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Sheikh Quyoom Hussain,
Noor Abad Colony, Jamia Masjid Lane, Hyderpora, Srinagar, J & K-190014, India.
Phone: 09858828356, E-mail: drquyoom34@rediffmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Jan 06, 2014**
Date of Peer Review: **Feb 06, 2014**
Date of Acceptance: **Feb 10, 2014**
Date of Publishing: **Apr 15, 2014**