

# Prevalence of microcytic hypochromic anemia in children with LRTI in the age group of 3 months to 5year: Is iron deficiency anemia a risk factor for LRTI?

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## Abstract

**Introduction:** Lower respiratory tract infection (LRTI) include all infections of the lungs and the large airways below the larynx and includes croup syndromes, bronchitis, bronchiolitis and pneumonia. 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. **Methods:** Objective: To evaluate prevalence of microcytic hypochromic anemia in children with LRTI in the age group of 3 months to 5year: Is iron deficiency anemia a risk factor for LRTI. Design: Cross sectional study. Setting: A tertiary care center Karnataka, india (SIMS, shivamogga) Participants: 50 children who admitted for LRTI were included in the study group. Age and sex-matched 50 children, not having any respiratory illness, were taken as control group. Main outcome measures: They were subjected to complete blood count (CBC) mainly for hemoglobin, hematocrite, RBC indices and RDW in those children. **Result:** 35 out of 50 children of study group (70%) and 5 out of 50 children of control group (10%) had anemia. Out of 35 anemic children in study group 21(60%) and out of 5 anemic children in control group 4(80%) had peripheral blood picture showing microcytic hypochromic anemia. And out of 35 anemic children in study group 28(80%) and out of 5 anemic children in control group 2(40%) had low ferritin. **Conclusion:** these value shows anemia is more prevalent in children with LRTI and most of those anemic have microcytic hypochromic anemia with high RDW indicating iron deficiency is the cause for anemia and probably iron deficiency is a risk factor for LRTI.

**Keyword:** LRTI, Anemia, Hemoglobin, Serum Ferritin, Hematocrit

## Introduction

Lower respiratory tract infection (LRTI) include all infections of the lungs and the large airways below the larynx and includes croup syndromes, bronchitis, bronchiolitis and pneumonia [1]. On an average, children below 5 years of age suffer about 5-6 episodes of LRTI per year [2]. 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 [3].

Approximately over 75% of children between the age of 1-3 years are anemic in India [4]. Iron deficiency anemia in children occurs most frequently between the age of 6 months and 3 years, the same period of age when repeated infections occur[5].

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Lower respiratory tract infections associated with anemia occur more commonly in children than in adults. But prevalence of anemia in LRTI and iron deficiency per se as a risk factor for LRTI not evaluated.

And there were only studies on hemoglobin level in respiratory infection.

Hence this cross sectional study was conducted for assessing prevalence of microcytic hypochromic anemia, and iron deficiency as a risk factor for developing LRTI in children in the age group of 3months to 5 years.

**Aim and objective of study-**To study the Prevalence of microcytic hypochromic anemia in children with LRTI in the age group of 3 months to 5year: Is iron deficiency anemia a risk factor for LRTI?

## Material and Methods

This cross sectional comparative study was conducted in Department of Pediatrics in SIMS, shivamogga between March 2013 to August 2013. A total of 100 children aging between 3 months and 5 years were selected; study group included 50 cases hospitalized for lower respiratory tract infection (LRTI) as per criteria of WHO, and 50 healthy children without any respiratory problems, age and sex matched, attending Out Patient Department were included in control group. A written consent was taken from parents or guardians before they were subjected to investigations. The following laboratory test were done in all children: complete blood count mainly considering hemoglobin, hematocrit, RBC indices, serum ferritin. And other tests like blood culture, CXR were done as per respiratory tract infection investigation protocol.

**Blood Screening-** A trained phlebotomist drew blood from the antecubital vein of each child. Sterile, disposable syringes and needles, and proper tubes were used. The blood samples were analyzed at SIMS, Shivamogga clinical laboratory for complete blood count. Hemoglobin level was estimated in the blood samples using an automatic blood cell counter. The cutoff point for low hemoglobin (Hb) level, low RBC indices, low hematocrit and low ferritin were taken from table 1[6,7].

**Table-1: Cut of values for anemia**

Age group	3m to 5 month	6m to 5years
Hemoglobin (g/dl)	<9.5	<11
Hematocrit (%)	<35	<33
MCV	<95	<78
MCH	<25	<24
MCHC	<28	<33
Serum FERRITIN	<24mg/dl	

Anemia is defined if patient had value of hemoglobin and hematocrit below the cut of value for age according to WHO standard as defined in above table and RBC indices and serum ferritin will be correlated.

**Inclusion Criteria-** We included in the study all hospitalized children aged between 3 months and 5 years with a diagnosis of LRTI; fever, cough, tachypnea, chest retractions, and ronchi or crackles up on chest auscultation, as per WHO criteria [2,8,9]. Weight and height were recorded to all children in order to assess the nutritional status.

**Exclusion Criteria-**Exclusion criteria included children with prematurity, congenital chest wall malformations, severe systemic illness (congenital heart disease, tuberculosis, etc), chronic diseases (diabetes, hepatitis, liver failure, etc), intake of iron supplements, and previous history of infection in the control group.

**Statistical Analysis-** Data analysis was performed using statistical package of social science (SPSS) version 16.0 for windows. Numerical variables were reported in terms of mean and standard deviation. Categorical variables were reported in terms of numbers and percentages.

Association of each of the categorical variable with response variable was assessed by Chi-square test. In multivariate analysis, variables showing P-value less than 0.05 were considered to be statistically significant. The sample size, 50 in each group, was found to be capable to define the expected result.

## Results

Study population was taken between 3m to 5years of age. 50 children with LRTI admitted in department were take in study group as per definition of WHO and 50 healthy children attending pediatric OPD were taken in control group.

**Table-2: Age distribution of children were as in below Table 2**

	Cases	Control	P value
3m – 5m	11	10	0.06
6m –5year	39	40	

As we can see from table 2 p value is  $>0.05$ . So in both groups, age was not found as a significant factor affecting the result.

**Table-3: Sex distribution of children were as in below Table 3**

	Cases	Control	P vale
male	18	20	0.17
female	32	30	

As we can see p value  $>0.05$ , sex distribution in both groups is not a significant factor affecting result.

**Table-4: Shows the mean hemoglobin, hematocrit (HCT), RBC indices and serum ferritin in cases and control**

	3m – 5m		6m – 5year	
	Cases	Control	Cases	Control
HB	8.7 $\pm$ 1.05	9.6 $\pm$ 1.1	10.4 $\pm$ 1.2	11.3 $\pm$ 1.4
HCT	29.0 $\pm$ 3.4	35.2 $\pm$ 4.2	32.2 $\pm$ 2.6	33.6 $\pm$ 3.2
MCV	71.03 $\pm$ 9.6	91.1 $\pm$ 10.4	73.5 $\pm$ 7.1	77.4 $\pm$ 8.2
MCH	23.54 $\pm$ 2.4	25.2 $\pm$ 2.8	23.7 $\pm$ 2.8	24.6 $\pm$ 2.4
MCHC	31.26 $\pm$ 1.7	32.4 $\pm$ 1.4	31.9 $\pm$ 1.5	33.5 $\pm$ 1.8
S. FERRATIN	16.79 $\pm$ 1.9	23.8 $\pm$ 1.3	17.04 $\pm$ 2.6	23.2 $\pm$ 1.8

**Table-5: Shows number of children who had anemia in study group and control group according to WHO cutoff for age group**

	3m – 5m		6m -5year		Total	
	Case	Control	Case	Control	Case	Control
Anemic	7	1	28	4	35(70%)	5(10%)
Normal	4	9	11	36	15(30%)	45(90%)
P value	0.014		$<0.01$		$<0.01$	

From **table 5** it seen that there are 70% (35 out of 50) of study group children (with LRTI) had anemia and only 10% (5 out of 50) of controls (healthy children) had anemia with a significant p value  $<0.01$ .

**Table-6: Shows incidence of microcytic hypochrmic anemia in cases and control**

	Total	
	Case	Control
Microcytic hypochromic	21	4
normal	29	46
P value	$<0.01$	

In study group 35 children who had anemia according to WHO cut off, 21(60%) children were having microcytic hypochromic blood picture in peripheral smear and in control out of 5 anemic patients 4 (80%) were having microcytic hypochromic blood picture.

**Table-7: Shows low and normal ferritine value in anemic cases and controls**

	Cases	Control
Low ferritin	28	2
Normal ferritin	7	3
P value	0.05	

In study group 80% children (28 out of 35) and in control group 40% children (2 out of 5) low serum ferritin indicting probably iron deficiency is the cause for anemia.

## Discussion

The prevalence of anemia varies between developed and developing countries. Reaching up to 50% of preschool children in some developing countries, and is principally caused by iron deficiency. As many as 20% of children in the United States and 80% of children in developing countries will be anemic at some point by the age of 18 years old. As per studies published in AAP full-term healthy babies receive enough iron from their mothers in the third trimester of pregnancy to last for the first four months of life. However, human milk contains little iron, so infants who are exclusively breastfed are at increased risk of iron deficiency after 4 months of age and studies recommend iron supplementation in full term from 4 months onwards. AAP also recommends iron supplementation in preterm from 2 weeks of age.

Age distribution of our study is comparable to Sheikh Quyoom Hussain et al in which he studied 220 children from age group of 2m to 5year. And he mentions in his study that nutritional inadequacy including the iron deficiency forms an indirect risk factor for the contracting acute lower respiratory tract Infection (ALRTI). Most common affected age group was 3 months to 23 months, which is quite comparable with the study conducted by Malla T et al. 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.

Several risk factors for developing LRTI had been reported in different studies. Baskaran *et al* in a study of 43 children between 3-5 years had found 83 % with pneumonia had hemoglobin less than 11 g/dL [10]. In another study of iron deficiency anemia and respiratory infection by De-Silva A *et al*, an overall prevalence of anemia was found in 52.6% [11]. He concluded that iron treatment significantly reduced the morbidity of even children with URTI. In our study 70% study group and 10% control group had anemia which is similar to result of Ramakrishnan et al in 2006 found, in a study of 200 infants and children between 9 months to 16 years, that 74% of cases and 33 % of controls were anemic (with 80% and 82 % IDA, respectively). In our study mean hemoglobin and hematocrit in study group in the age group of 3m – 5m was 8.7±1.05mg/dl and 29.0±3.4% respectively and in the age group of 6m – 5year was 10.4±1.2mg/dl and 32.2±2.6% respectively. Attending a day care center was reported as the most important risk factor for respiratory tract infections in children aged 2-5 years [12]. In a community based study of 288 children, risk factors for LRTI noted were being a boy, attending a child care center, exposing to passive smoking and sharing a bed room with children aged 0-5 years [13]. Few reports are available in literature regarding the role of low hemoglobin level per se, as a risk factor for developing LRTI. We have found that anemia more prevalent and most probably cause for anemia being iron deficiency and iron deficiency is a significant risk factor for developing LRTI.

It is feasible to recollect the normal functions of Hb. It facilitates oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) transport. It carries and inactivates nitric oxide (NO) and also play the role of a buffer [14]. Tissue ‘oxygen buffer’ function is very important one of buffering system. Hemoglobin in the blood is mainly responsible for stabilizing the oxygen pressure in the tissues [15]. Quantitative and/or qualitative reduction in Hb, may adversely affect the normal functions. Probably it may be the reason for low hemoglobin level found to be as a serious risk factor for developing LRTI.

**Table-8: Comparison of present study with other studies showing association of LRTI with gender and anemia**

	Present study		Sheikh et al[16]		Malla T et al[17].		Mourad S et al[18].		Ramakrishnan et al[19].	
	Cases (%)	Control (%)	Cases (%)	Control (%)	Cases (%)	Control (%)	Cases (%)	Control (%)	Cases (%)	Control (%)
<b>Sex</b>										
Male	36	40	57	60	71	67	51	52	63	58
Female	64	60	43	40	29	33	49	48	37	42
P value	NS	NS	NS	NS	NS	NS				
<b>anemia</b>										
Present	70	10	64.5	28.2	68.6	38.6	68	84	74	33
Absent	30	90	35.5	71.8	31.4	61.4	32	16	26	67
P value	<0.01	<0.01	0.001	<0.001	0.008	<0.001				

NS: Non-significant

## Research Article

In our study we found in study group 80% of anemic children had low ferritin. And we all know iron deficiency is the one of the main cause for anemia and even Iron metabolism is of crucial importance in the biology and pathophysiology of the lower respiratory tract. As with many other factors involved in inflammation, it is very important that an appropriate iron balance is maintained. Local deficiency could impair growth and proliferation of cells responsible for the inflammatory response and tissue repair (lymphocytes and fibroblasts) and the synthesis of mediators (for example, arachidonic acid derivatives)[16].

## Conclusion

In conclusion prevalence of anemia is more in children with LRTI and most of those anemic cases will have blood picture of microcytic hypochromic anemia with low serum ferritin indicating probably iron deficiency is the cause for anemia and probably iron deficiency is the risk factor for LRTI. Further studies with iron profile needed to confirm this hypothesis.

## Recommendations

### So we recommend:

- Screen for anemia in pediatric age group on a regular bases.
- From the age of 4 months supplement iron according RDA as recommended by AAP.
- In Indian children most common cause of iron deficiency anemia is worm infestation. So antihelminthic prophylaxis should be offered to all children above the age of 1 year, every 6 months and if possible to implement this in immunization schedule like vitaminA as recommended by NRHM assam in a article named "Guidelines for Deworming of Young Children - GiveWell"[20].
- Antenatal supplementation of iron should be uniformed through national programs as anemia in mother leads to anemia in infants.

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