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## RESEARCH ARTICLE

# IRON DEFICIENCY ANEMIA AS A RISK FACTOR FOR PNEUMONIA IN CHILDREN: A HOSPITAL BEASED STUDY

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**ABSTRACT**

**Background:** Pneumonia is the most common single cause of death among children under 5 years of age in the developing countries, Pneumonia accounts for 16% of all deaths of children under that age, killing 920136 children in 2015. Anemia prevalence in young children continues to remain over 70% in most parts of India and Asia despite a policy being in place and a program that has been initiated for a long time. The major health consequences of anemia include physical and cognitive impairment, as well as increased morbidity and mortality related to infection.

**Aims and objectives**

- To assess Iron deficiency anemia (IDA) as a risk factor for pneumonia.
- To know the association between IDA and pneumonia in children.

**Methods:** This case control study was conducted in Department of Pediatrics in Silchar Medical College and Hospital, Silchar during the period of one year from July 2016 to June 2017. A total of 100 children aging between 6 months-60 months were selected and grouped into 50 cases which were hospitalized for pneumonia (28 (56%) male and 22 (44%) female) and 50 healthy controls (29 (58%) male and 21 (42%) female) without any respiratory problems, attended Out Patient Department. After taking an informed verbal consent from the parents, children were subjected to medical history taking, clinical examination and complete blood count was done, Serum Iron, serum ferritin, and total iron biding capacity were done among children with hemoglobin less than 11 g/dl. Chest radiography was also done for hospitalized cases for pneumonia. **Results:** Anemia, particularly IDA, was significantly more frequent among cases than controls groups ($p<0.001$). Hemoglobin level was significantly lower in the IDA patients than in the IDA controls ($P=0.02$), Anemia was a risk factor for childhood pneumonia ($P<0.001$, odds ratio 6.8, and confidence interval 2.73-17.09) and recurrent chest infection ($P<0.001$, odds ratio 10.48, and confidence interval 3.59-30.56). **Conclusions:** Anemia, particularly IDA in children associated with pneumonia was significant. Prevention, early and accurate diagnosis and prompt treatment of anemia are necessary for a better outcome.



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## INTRODUCTION

Pneumonia is the most common single cause of death among children under 5 years of age in the developing countries. Pneumonia accounts for 16% of all deaths of children under that age, killing 920136 children in 2015 (WHO, 2014) An abnormally low hemoglobin level due to pathological conditions (s) is defined as anemia. Iron deficiency is one of the most common, but not there only cause of anemia. Other causes of anemia include chronic infections, particularly malaria, hereditary hemoglobinopathies and folic acid deficiency. Anemia prevalence in young children continue to remain over 70% in most parts of India and Asia despite a policy being in place and a program that has been initiated for a long time.

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Anemia is the most common ailment affecting human health, socioeconomic development, and the overall betterment of mankind. Nutritional deficiency, particularly iron deprivation, is the most common cause of anemia (Country Representative, 2011) Globally, anemia affects 1.62 billion people (confidence interval (CI) 1.50-1.74), representing 24.8% of the population (CI 22.9-26.7%). It affects 305 million school age children, with a prevalence of 25.4% (CI 19.9-30.9) (De Benoist, 2008) The major health consequences of anemia include physical and cognitive impairment, as well as increased morbidity and mortality related to liability to infection. Adequate and balanced nutrition is important for the immune system development and maturity with the consequent development of resistance against infections. Thus, it has been stated that malnutrition including iron deficiency forms and indirect risk factor for contracting acute lower respiratory tract infection (Hussain *et al*., 2014).

Various risk factors have been proposed to increase the chances of developing pneumonia, some of them are definite, some are likely, and a few are possible (Jackson *et al*., 2013). As a infections of the lower respiratory tract are the major causes f morbidity and mortality among children, gaining control over their risk factors will have a promising effect on the growth and development of children (Hussain *et al*., 2014)

## MATERIALS AND METHODS

This case control study was conducted in Department of Pediatrics in Silchar Medical College and Hospital, Silchar during the period of one year from July 2016 to June 2017. A total of 100 children aging between 6 months – 60 months were selected by using of simple random sampling and grouped into 50 cases which were hospitalized for pneumonia (28 (56%) male and 22 (44%) female) and 50 healthy controls (29 (58%) male and 21 (42%) female) without any respiratory problems, attended Out Patient Department. They were divided into two groups.

### CASE

Included 50 patients hospitalized for pneumonia, with median age of 24 months (range 6-60 months): 25 (56%) male and 22 (44%) female patients.

### CONTROL

Included 50 clinically healthy controls with a median age of 30 months (range 6-60 months) attending the outpatient clinic of the same hospital: 29 (58%) male and21 (42%) female patients.

**Inclusion criteria:** All hospitalized children between 6 months and 60 months with a diagnosis of pneumonia according to the WHO (1) criteria- namely, cough and/or difficult breathing with or without fever, fast breathing, or lower chest wall in drawing where their chest moves in or retracts during inhalation (in a healthy person, the chest expands during inhalation). Diagnosis was confirmed by the presence of bronchial breathing, crackles, and bronchophony on auscultation, as well as consolidation in chest radiography. Informed consent was taken from the parents of children before being included in the study.

### Exclusion criteria

- Congenital chest anomalies.
- Intake of iron supplements
- Other diseases such as congenital heart disease, tuberculosis, diabetes, liver cell failure, etc.

### The Children were subjected to the following

- Medical history taking, including age, sex, residence, cough, fever, difficult breathing, grunting, past history of recurrent chest infection, and vaccination.
- Clinical examination, including weight and height recording to assess the nutritional status, as well as chest, cardiac, and abdominal examination.
- Complete blood count: For children with hemoglobin level below 11 g/dl, serum iron, serum ferritin, and total iron binding capacity (TIBC) were detected.
- Chest radiography was performed and C-reactive protein was evaluated for the hospitalized patients.

**Sampling:** Blood samples (5 ml) were obtained by means of vein-puncture. Each sample was divided into two parts: one part was put in a EDTA tube for complete blood count and the other part was put in a plain vacationer for serum iron, TIBC, serum ferritin, and C-reactive protein evaluation.

**Serum iron and binding capacity:** Stanbio iron and TIBC procedure no. 0370 (Stanbio Laboratory Anekf Diagnostics Copany, Boerne City in Texas, USA) was used. Reference ranges for serum iron were 40-100 ug/dl for infants and 50-120 g/dl for children. For TIBC, they were 100-140 µg/dl for infants and 250-400 µg/dl for children (Burtis, 2006). Serum ferritin was detected using Accu Bind ELISA Micro wells (Monobind Inc., LaForest, California, USA). The cutoff value for diagnosing iron-deficiency anemia (IDA) is serum ferritin less than 10 ng/ml (McPherson, 2007). The Mentzer index was calculated using the following formula: Mantzer index= mean corpuscular volume/red blood cell count, and transferring saturation was calculated using the following formula: transferring saturation= iron level/TIBx100 (normal value = 20-45%) (McPherson, 2007). C-reactive protein more than 0.3 mg/dl was considered positive. In the control group, IDA was diagnosed when serum ferritin was less than 10 ng/ml, [7] or when serum iron was lower than 50 µg/dl serum TIBC was higher than 400 µg/dl (Burtis, 2006). Considering the fact that infection can affect iron panel studies by increasing serum ferritin level (usually by more than 50 µg/l if no iron deficiency) and decreasing serum iron level and TIBC. The diagnosis of IDA in pneumonic patients was made when at least three of the below parameters were present:

- Hypochromic and microcytosis seen in blood smear (Sipahi, 2004)
- Low mean corpuscular volume (MCV) (specificity around 96%) (not affected by infections)
- Red cell distribution width greater than 14.5 (sensitivity of 92.1% and specificity of 90.9%)
- Mentzer index greater than 13.5 (with around 85% specificity and sensitivity).
- Transferrin saturation less than 10% (with a specificity of 85% if below 15% and sensitivity around 80%).

## STATISTICAL METHODOLOGY

The collected data were tabulated and analyzed using the suitable statistical methods. The 'SPSS' computer program was used (IBM, Endicott, Broome Country, New York, United States). Two types of statistics were performed: descriptive statistics including percentage (%), mean, and SD, and analytic statistics, which includes the x 2-test, Fischer exact test, Student's t-test, CI, and the odds ratio (OR).

## RESULTS

Out of our 100 infants and children, 41 (82%) cases and 20 (40%) controls were anemic, with a mean Hb level of 8.9±1.6 mg/dl in cases and 10.1±1.1 mg/dl in controls. IDA was found in 32 (64%) case and 12 (24%) controls. Compared with anemic controls, anemic cases had significantly lower hemoglobin (P = 0.001). Serum iron (P=0.001), and transferring saturation (P = 0.001), but higher serum ferritin (P = 0.01).

**Table 1. Frequency of Anemia among Case and Control**

| Study Subjects | Cases (n=50) (n) (%) | Controls (n=50) (n) (%) | X 2 –Test | p-value | OR | CI (Lower-Upper) |
|---|---|---|---|---|---|---|
| Nonanemic | 9 (18%) | 30(60%) | 12.57 | 0.0001 | 6.8 | 2.73-17.1 |
| Anemic | 41(82%) | 20(40%) | | | | |

**Table 2. Types of Anemia in the Case and Control Groups**

| Type of Anemia | Cases(n=50)(n(%) | Controls(n=50)(n (%)] | $X^2$-Test | p-value |
|---|---|---|---|---|
| Nonanemic | 9(18%) | 30(60%) | | |
| Iron-deficiency anemia | 32(64%) | 12(24%) | 11.89 | 0.0001* |
| Non-iron deficiency Anemia | 9(18%) | 8(16%) | | |

*Significant difference

**Table 3. Mean Hemoglobin Level in Anemic Case and Anemic Control**

| HemoglobiParameters Hb (gm/dl) | Cases | Controls | t-Test | p-value |
|---|---|---|---|---|
| Mean ±SD | 8.9±1.6 | 10.1±1.1 | 3.1 | 0.001* |
| Median | 8.9 | 10.1 | | |
| Range | 6.5-10.9 | 9-11 | | |

**Table 4. Iron Profile in Iron Deficiency Anemic Cases and Iron Deficiency Anemic Controls**

| Iron Profile | IDA cse | IDA control | T-Test | p-Value |
|---|---|---|---|---|
| Serum iron (µg/dl)Mean ±SD | 27±11.13 | 38±13.06 | 3.37 | 0.001* |
| Serum ferritin (µg/1)Mean ±SD | 18.8±14.9 | 9.2±5.3 | 3.87 | 0.001* |
| Serum ferritin (µg/I)Mean ±SD | 18.8±14.9 | 9.2±5.3 | 3.87 | 0.001* |
| TIBC (µg/dl)Mean±SD | 511.7±99.4 | 487±94.3 | 0.67 | 0.91 |
| Transferrin saturation (%)Mean±SD | 6.6±4.73 | 7.9±2.6 | 2.89 | 0.01* |

IDA, iron-deficiency anemia; TIBC, total iron binding capacity, * Significant difference; a

**Table 5. History of Recurrent Chest Infection amongst Anemic and Non-Anemic Children**

| History of Recurrent Chest Infection | Anemic Children n = 61(%) | Non-Anemic Children N= 39(%) | $X^2$-Test | p-value | OR | CL |
|---|---|---|---|---|---|---|
| Positive | 37(60.6) | 5(13.1) | 29.7 | <0.001* | 10.48 | 3.59-30.59 |
| Negative | 24 (39.3) | 34 (89.7) | | | | |

However, there was no significant difference as regards the TIBC. Anemia was found to be a risk factor for pneumonia, with an OR of 6.8, CI of 12.73-17.1 and P=value of 0.0001. This means that anemic children were about four times more susceptible to develop pneumonia compared with nonanemic children. History of recurrent chest infection was significantly more common in anemic than in nonanemic children, with a p-value less than 0.001, OR of 10.48 and CI of 3.59-30.59 (Tables 1-5)

## DISCUSSION

The current study shows that anemia, especially IDA, is still a community problem in Indian children. In addition, it provides a statistically significant positive association between anemia, predominantly IDA, and chest infection, particularly pneumonia. We found that the prevalence of anemia was significantly higher among patients than among controls, with 41 (82%) cases and 20 (40%) controls being anemic. Moreover, anemia was found to be a risk factor for chest infections in general (OR 10.48; CL 3.59-30.59; and P<0.001) and pneumonia in particular (OR 2.8; CI 2.73-17.7; and P=0.0001). Thus, anemic children were about four times more susceptible to develop pneumonia compared with nonanemic children. WHO (WHO, 2006) reported that, in 2005, 6 of the Egyptian children from 6 months to 8.2 years of age had hemoglobin levels less than 11 g/dl. El-Sakka *et al*. (2014) stated that low hemoglobin level is a risk factor for acute lower respiratory infections as it was detected in 62.5% of pneumonic patients, 56.25% bronchiolitis cases, and 42.71% of the control groups, with a P=value of 0.044. Moreover, among Indian children, Hussain *et al*. (2014) reported that 64.5% of their hospitalized patients and 28.2% of the healthy controls were anemic and that the anemic children were 4.6 times more susceptible to lower respiratory tract infection. The mean hemoglobin level of our patients was 9.9±1.5 g/dl, which is significantly lower than that of the controls (11.6±0.2 g/dl) (P=0.001). Moreover, the mean hemoglobin level of the anemic patients was 8.9±1.6 g/dl, which is significantly lower than that of the anemic controls (10.1±1.1 g/dl) (p=0.001). These result are in agreement with those of Zamzam *et al*. (2013) who fund a significant difference between patients and controls as regards the hemoglobin level, with means of 9.5±0.76 and 11.3±0.55 mg/dl, respectively (p>0.001). In our children, IDA was the predominant type of anemia. It was detected in 32 (78%) anemic cases and 12 (60%) anemic controls. Hussain *et al*. (2014) reported that iron deficiency was found in 78.9% of anemic patients, with a P-value less than 0.01. Mourad *et al*. (2010) also found that the percentage of IDA in anemic patients (48) was 75% and that in anemic controls (22) was 68.75%). Compared with anemic controls, anemic patients had significantly lower serum iron (p=0.001) and transferrin saturation (P=0.001), but a higher serum ferritin (p=0.01) we found no significant difference as regards the TIBC. This can be explained by the fact that infection can affect iron panel studies by increasing the ferritin level as an acute phase

reactant and decreasing the iron level and TIBC. (Sipahi, 2004) Our results are in agreement with those of Hussain *et al*. (2014). Who found that serum iron of the anemic cases (35.3±14.4 mg/dl) was significantly lower than that of the anemic controls (57.1±13.8 mg/dl), with a P-value of 0.0001.

**Conclusion**

From the previous results, it can be concluded that anemia, predominantly IDA, is still a considerable community problem in Indian children. Moreover, anemia is a risk factor for chest infections, particularly pneumonia, with anemic children being about four times more susceptible to have pneumonia compared with the nonanemic children. Prevention, early diagnosis, and prompt treatment of anemia, particularly IDA, in all children, with special emphasis on those suffering from lower respiratory infections, including pneumonia, are necessary.

## REFERENCES


Burtis CA, Edward RA. 2006. Principles of colorimetric determination of unsaturated iron binding capacity in serum, In: Burtis CA, Edward RA, David EB, editors. Tietz textbook of clinical chemistry, 4th ed. Philadelphia, Pennsylvania, USA: Elsevier Saunders, 2195-2197.

Country Representative, AZZ, the USAID Micronutrient Project, Academy for Education Development and Ex/ Professor and Head, Department of PSM, Government Medical College Vadodara, Gujarat, India. Nutritional Anemia in Young Children with Focus on Asia and India, Indian Journal of Community Medicine/Vol 36/Issue 1/January 2011.

De Benoist B., McLean E., Egli I., Cogswell M. 2008. Worldwide prevalence of anaemia 1993-2005. WHO Global Database on Anaemia, Geneva: *World Health Organisation*, Available at:

El-Sakka AS., Imam SS., Amer HA., Moustafa SA. 2014. Vitamin D deficiency and low hemoglobin level as risk factors for severity of acute lower respiratory tract infections in Egyptian children: a case-control study, Egyptian Pediatric Association Gazettee.

http://whqlibdoc.who.int/publications/2008/9789241596657_eng.pdf.

http://www.who.int/mediacentre/factsheets/fs331/en/#(Last accessed on 2015 Apr 10)

Hussain SQ, Ashraf M, M, Wani JG, Ahmed J. Low hemoglobin level a risk factor for acute lower respiratory tract infections (ALRTI) in children J. ClinDiagn Res 2014; 8:PC01-PC03.

Jackson S., Mathews KH., Pulanic D., Falcner R., Rudan I., Campbell H. *et al*., 2013. Risk factors for severe acute lower respiratory infections in children: a systematic review and meta-analysis *Croat Med J.,* 54: 110-121.

McPherson RA., Pincus MR. 2007. Iron deficiency anemia: diagnosis ad management. In: McPherson RA, PncusMR, editors. Henry's clinical diagnosis and management laboratory methods, 21st ed. Philadelphia, PA: WB Saunders 455-482.

Mourad S., Rajab M., Alameddine A., Fares M., Ziade F., Merhi BA. 2010. Hemoglobin level as a risk factor for lower respiratory tract infections in Lebanese children. N. *Am J Med Sci.,* 2:461-466.

Sipahi T., Koksal T., Tavil B., Akbar N. 2004. The effects of acute infection on hematological parameters. *Pediatr Hematol Oncol*., 21:513-520.

WHO. 2014. Pneumonia; fact sheet no. 331. Available at:

WHO. Vitamin and Mineral Nutrition Information System (VMIS). Egypt: WHO Global Database on Anaemia; 2006. Available at: http://who.int/vmnis/anaemia/ data/database/ countries/egy_ida.pdf.

Zamzam WE., Ramadan IA., EL-Sharkawy AR. et at., 2013. Molecular diagnostic value of Pneumococcal pneumonia among Egyptian children (MSc thesis). Egypt: Benha University.


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