e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(9); 221-225

Original Research Article

A Study Assessing the Association of Anemia with Acute Lower Respiratory Tract Infection in Pediatric Age Group of 6 Months to 5 Years: A Case Control Study

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Received: 10-3-2023 Revised: 20-04-2023 / Accepted: 25-05-2023

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Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to assess the association between anaemia and lower respiratory tract infection among the under five-year-old children.

Methods: This observational case-control study was performed in children in the age group of 6 months-5 years who attended the out-patient and in-patient unit of the Department of Paediatrics for the period of 18 months. 200 subjects were selected in the study.

Results: Majority of the patients belonged to 7-24 months age group in case and controls respectively. In the present study, there was male predominance. Except for a few non-specific symptoms like poor feeding, vomiting which were not significantly different between the cases and controls, the major respiratory symptoms like cough, fast breathing, chest in-drawings, crepitations were significantly associated only with the LRTI group. There was no significant difference in the presence of Anemia between males and females. There was a significant difference in magnitude of anemia among various age groups. The highest level of anemia was recorded among those with LRTI in the 25-42 months age group which was significantly ($p<0.001$) higher than their normal counterparts. The mean hemoglobin level was much lower among the children with LRTI compared to those who did not manifest LRTI. The other blood indices like mean MCV, Mean MCHC, Red cell distribution width, serum iron, mean ferritin, TIBC were all significantly different between the cases and controls.

Conclusion: The study clearly proved that anemia is an important risk factor for lower respiratory tract infection among children aged 6 months to 5 years. The early detection of anemia in children and treatment of the same or prevention of anemia using improved dietary iron intake and deworming can be ideal interventions in preventing the important risk factor converting healthy children to victims of LRTI.

Keywords: Anemia, Iron Deficiency, Lower Respiratory Tract Infection, Respiratory Infection.

Introduction

Anemia is characterized by a decreased quantity of red blood cells, often accompanied by diminished hemoglobin levels or altered red blood cell morphology. [1] It is a major global nutritional problem of immense public health significance, affecting people of all ages, sex and economic group. [2] Among various nutritional deficiency anemias, iron deficiency anemia (IDA) is the commonest. [3] Lower respiratory tract infection (LRTI) includes all infections of the lungs and the large airways below the larynx. [4] Acute lower respiratory tract infections (ALRTIs) are responsible for 19% of all deaths in children less than 5 years of age and 8.2% of all disabilities and premature mortality as measured by disability-adjusted life years. [5] In ALRTI, pneumonia is the biggest cause of death under the age of 5 years. Every year approximately 150 million episodes of childhood pneumonia and about 3 million deaths due to pneumonia are reported worldwide in children less than 5 years of age. [6]

Various risk factors have been proposed for development of lower respiratory infections like low birth weight, malnutrition, vitamin A deficiency, lack of breastfeeding, passive smoking, poor socioeconomic status, large family size, family history of bronchitis, advanced birth order, crowding, young age and air pollution. [7] Anemia is a major global nutritional problem of immense public health significance, affecting people of all ages, sex and economic group of both developing and developed countries. Global prevalence of anemia in preschool children is around 47%. Anemia in children occurs most frequently between 6 months to 3 years, the period of age when repeated respiratory tract infections occur.

Lower respiratory tract infection (LRTI) includes all infections of the lungs and the large airways below the larynx. On average, children below 5 years of age suffer about 5 to 6 episodes of LRTI per year, and still a burden until 12 years of age and more. [8] Pneumonia is the biggest single cause of childhood death under the age of 5 years in developing countries. [9]Globally there are about three million deaths, less than 5 years of age, each year due to pneumonia. Of these deaths, 90 to 95% are in the developing countries. [10] LRTI associated with anemia occurs more commonly in children than in adults, with anemia affecting approximately 30% of children all over the world. [11,12] 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.

The aim of the present study was to assess the association between anaemia and lower respiratory tract infection among the under five year old children.

Materials and Methods

This observational case-control study was performed in children in the age group of 6 months-5 years who attended the out-patient and in-patient unit of the Department of Paediatrics of Nalanda Medical College and Hospital, Patna, Bihar, India for the period of 18 months. 200 subjects were selected in the study.

Inclusion Criteria

A total of 200 cases aged 6 months to 5 years with LRTI defined by a history of cough and/or difficult breathing, with or without fever, fast breathing [according to the age of the child] or lower chest wall in-drawing or at least one other danger sign)], and 200 controls attending the paediatric OPD or hospitalized with complaints of illness other than ALRTI were age and gender matched.

Exclusion Criteria

Children having congenital malformations of chest wall, having severe systemic illness, protein energy malnutrition grade III, case of tuberculosis congenital cardiac/lung parenchymal lesions/chest wall malformations, bronchial asthma, immunodeficiency disorders, taking iron supplements were excluded from the study.

A pretested, semi-structured questionnaire which included the social and environmental history, anthropometric measurements was used for the study. The investigations which were done in all children included a Complete blood count, CRP, Peripheral blood smear, chest X-ray. According to WHO the criteria for Acute lower respiratory tract infection is presence of fever, cough with fast breathing of >60/min in <2 months and >50/min in 2-12 month of age and >40/min in 12 month-5 years of age, the duration of illness being <30 days. Pneumonia was classified as pneumonia and severe pneumonia.

Blood was drawn from anti- cubital vein of each child by trained phlebotomist. Sterile disposable needles and syringes and tubes were used. Automatic blood cell counter was used to estimate blood Hb level. Hemoglobin level <11g% was considered as low cut-off point in this study. Serum iron, serum ferritin and total iron binding capacity (TIBC) were done if hemoglobin level is below 11g%.

Statistical Analysis

The collected data was analyzed by using SPSS (Statistical Package for Social Sciences) version 19.0 for windows. The continuous variables expressed in terms of proportions or percentages. Chi-square test will be carried out to test the differences between proportions. A p-value less than 0.05 will considered as statistically significant.

Results

Table 1: Socio-demographic, clinical signs and symptoms associated with cases and controls

Clinicalfeatures	Cases (%)n=200	Controls (%)n=200	p-value
Age categories			
7-24 months	130	110	
25- 42 months	50	60	0.512
43- 60 months	20	30	
Gender			
Male	112	108	
Female	88	92	0.72

Symptoms			
Cough	200	20	<0.001
Fever	180	160	0.02
Fast breathing	148	15	<0.001
Poor feeding	108	98	0.54
Noisy breathing	38	2	<0.001
Convulsions	8	22	0.02
Vomiting	35	25	0.316
Loose stools	5	30	0.003
Sore throat	2	28	0.004
Signs			
Cyanosis	15	0	<0.001
Chest in-drawings	136	0	<0.001
Rhonchi	72	0	<0.001
Crepitations	110	0	<0.001
Dehydration	15	52	0.0002

Majority of the patients belonged to 7-24 months age group in case and controls respectively. In the present study, there was male predominance. Except for a few non-specific symptoms like poor feeding, vomiting which were not significantly different between the cases and controls, the major respiratory symptoms like cough, fast breathing, chest in-drawings, crepitations were significantly associated only with the LRTI group.

Table 2: Magnitude of anemia and its distribution in various age and gender categories

Clinical features	Cases n=200	Controls n=200	p-value
Age categories			
7-24 months	75	36	
25- 42 months	25	16	<0.001
43- 60 months	40	8	
Gender			
Male	75	35	
Female	65	25	0.25
Total	140	60	0.002

There was no significant difference in the presence of Anemia between males and females. There was a significant difference in magnitude of anemia among various age groups. The highest level of anemia was recorded among those with LRTI in the 25-42 months age group which was significantly ($p<0.001$) higher than their normal counterparts.

Table 3: Laboratory parameters related to anemia among cases and controls

Hematologicalparameters	Cases (%)	Controls	p- value
Mean hemoglobin(g%)	10.5±0.8	11.9±1.1	<0.001
Mean MCV (fL)	64.26±2.4	78.2±3.7	<0.001
Mean MCH (pg)	18.2±1.3	24.6±3.4	<0.001
Mean MCHC (g/dL)	30.52±3.4	32.48±6.2	<0.001
RDW (%)	16.4±3.4	14.6±5.8	<0.001
Serum iron (µg/dL)	42±7.3	74±12.1	<0.001
Mean serum ferritin (ng/mL)	38.12±5.6	80.1±10.1	<0.001
Mean TIBC (µg/dL)	390±35.5	336±40.6	<0.001

The mean hemoglobin level was much lower among the children with LRTI compared to those who did not manifest LRTI. The other blood indices like mean MCV, Mean MCHC, Red cell distribution width, serum iron, mean ferritin, TIBC were all significantly different between the cases and controls.

Discussion

Global prevalence of anemia is in increase throughout and currently being 29% in pregnant women, 38% in non- pregnant women and 43% in children. [13] The effects of anemia range from reduction in the working capacity and efficiency at mild to moderate levels to chest pain and dyspnoea as severity progresses in adults. Under-five are more prone to lower respiratory tract infections like croup syndromes, bronchitis, bronchiolitis and pneumonia. [14] Pneumonia is major cause of morbidity and mortality in children under the age of five in developing countries. [15] Around 150 million episodes of childhood pneumonia are reported every year from the world, 3 million deaths and of these deaths 90-95% is in the developing countries. [16]

Majority of the patients belonged to 7-24 months age group in case and controls respectively. In the present study, there was male predominance. In the study by Ahmad et al, 72% of ALRTI cases and 34% of non-ALRTI controls had hemoglobin level below 11g% which was comparable to present study. [17] Similar results were documented in the studies conducted by Malla et al[2] and Sheikh et al. [18] The present study showed that there was no significant difference in proportion of anemia between the cases and controls which was also implicated in the previous study.[17] Except for a few non-specific symptoms like poor feeding, vomiting which were not significantly different between the cases and controls, the major respiratory symptoms like cough, fast breathing, chest in-drawings, crepitations were significantly associated only with the LRTI group. There was no significant difference in the presence of Anemia between males and females. There was a significant difference in magnitude of anemia among various age groups. The highest level of anemia was recorded among those with LRTI in the 25-42 months age group which was significantly ($p<0.001$) higher than their normal counterparts. The mean hemoglobin level was much lower among the children with LRTI compared to those who did not manifest LRTI. The other blood indices like mean MCV, Mean MCHC, Red cell distribution width, serum iron, mean ferritin, TIBC were all significantly different between the cases and controls. Hemoglobin being a superior oxygen transport vehicle after the gaseous exchange at lungs, when there is a deficiency, can lead to a hypoxic environment leading to infections. This opens scope for a hypothesis for future research on the role of hematinics on the prevention or treatment of LRTI. The symptoms of LRTI associated only in those with anemia brands anemia as an important risk factor for LRTI. Similar study done by Savitha et al [19] declared anemia to be one of the risk factors of LRTI. In contrary, Broor et al, found that anemia was not associated strongly with LRTI. [7]

Among preschool children living in underprivileged communities in developing countries, infectious diseases such as LRTI and IDA are often coexistent. [20] Researchers have argued that any inadequate supply of iron to body tissues is detrimental to immunity. [21] The effects of IDA on immune function, and increase in susceptibility to infections are well established. Changes in iron status during commonly occurring acute infections in children are not well understood. [20] The sputum and lavage of patients with pneumonia will demonstrate sideromacrophages, which reflect elevated iron concentrations in the lower respiratory tract. With infection, the host iron status can be critical; that's why the issue of whether altered iron homeostasis functions as a primary pathogenic mechanism in lung injury is raised. However, decreasing available iron through either nutritional depletion or use of chelators directly impacts such injury. [22-24]

Conclusion

The study clearly proved that anemia is an important risk factor for lower respiratory tract infection among children aged 6 months to 5 years. The early detection of anemia in children and treatment of the same or prevention of anemia using improved dietary iron intake and deworming can be ideal interventions in preventing the important risk factor converting healthy children to victims of LRTI.

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