

Original Research Article

Association between anemia and acute lower respiratory tract infection in under-five children at Puducherry, India: a case control study

Gobinaath¹, Arun Daniel J.^{2*}

¹Department of Paediatrics, Sri Venkateshwaraa Medical College, Research centre and Hospital, Pondicherry, India

²Department of Community Medicine, Aarupadai Veedu Medical College and Hospital, Pondicherry, India

Received: 25 December 2019

Revised: 17 January 2020

Accepted: 28 January 2020

*Correspondence:

Dr. Arun Daniel J.,

E-mail: drdanfi@yahoo.co.in

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Anemia has been widely studied as an important factor in the immunity composition of under five children. The incidence of infections in children can be attributed to some extent to the prevalence of anemia among them. Hence this study aimed at exploring the association between anemia and lower respiratory tract infection (LRTI) among the 6 months to 5 years old children as an effort to establish anemia as an independent risk factor for LRTI.

Methods: A case-control study was conducted among 200 children in the age group of 6 months–5 years who attended the out-patient and in-patient unit of the department of paediatrics during July to September 2019. Accordingly 100 cases of LRTI and 100 normal controls were age and gender matched and their parents were interviewed using a semi-structured questionnaire. Blood investigations were done and documented in a proforma. The association between anemia and LRTI was studied statistically.

Results: Anemia was associated strongly with LRTI [odds ratio=4.96 (2.72, 9.1)] with 68% of the cases with LRTI manifesting anemia. The highest level of anemia was recorded among those with LRTI in the 25-42 months age group (80.8%) which was significantly ($p<0.001$) higher than controls. The mean hemoglobin level was 9.6 ± 0.8 gm% among the cases which was significantly lower ($p<0.001$) than that of the controls (11.7 ± 1.1 gm%). The mean iron level was 40 ± 7.3 $\mu\text{g/dL}$ among cases and 72 ± 12.1 $\mu\text{g/dL}$ among the non-LRTI group ($p<0.001$).

Conclusions: Anemia was significantly associated with LRTI group compared to the control group proving it to be an independent risk factor for LRTI.

Keywords: Anemia, Iron deficiency, Lower respiratory tract infection, Respiratory infection

INTRODUCTION

Global prevalence of anemia is in increase throughout and currently being 29% in pregnant women, 38% in non-pregnant women and 43% in children.¹ 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.² Pneumonia is major cause of morbidity and mortality in children under the age of five in developing countries.³ 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.⁴

Anemia by providing a hypoxic environment in the respiratory circulation can be one major contributor to lower respiratory tract infections in the under five age group. Hence an observational study was conducted to see the association between anaemia and LRTI among the under five children at Puducherry, India.

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 Sri Venkateswara Medical College Hospital and Research Center, Ariyur, Puducherry, India, during July 2019 to September 2019 (3 months).

The study was conducted after getting the approval of the ethical committee of the institution, and written consent was taken from parents or guardians before enrolment of the child in the study.

Inclusion criteria

A total of 100 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 100 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.

The sample size 100 in each group were calculated considering a prevalence of 52% and absolute precision taken as 10%.⁵

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 be considered as statistically significant.

RESULTS

The study sample comprised of a total of 200 children (100 cases and 100 controls) aged 6 months to 5 years among which majority were males (60%) and others were females (40%). The clinical features associated with the cases and controls are summarized in Table 1.

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

Clinical features	Cases (%) n=100	Controls (%) n=100	p-value
Age categories			
7-24 months	64	57	0.539
25- 42 months	26	29	
43- 60 months	10	14	
Gender			
Male	54	56	0.78
Female	46	44	
Symptoms			
Cough	100	8	<0.001
Fever	90	78	0.02
Fast breathing	72	8	<0.001
Poor feeding	52	48	0.57
Noisy breathing	18	1	<0.001
Convulsions	3	11	0.02
Vomiting	17	12	0.315
Loose stools	3	15	0.003
Sore throat	1	14	0.004
Signs			
Cyanosis	7	0	<0.001
Chest in-drawings	68	0	<0.001
Rhonchi	35	0	<0.001
Crepitations	54	0	<0.001
Dehydration	7	26	0.0002

Except for a few non specific symptoms like poor feeding (48%), vomiting (12%) which were not significantly different between the cases and controls, the major

respiratory symptoms like cough (100%), fast breathing (72%), chest in-drawings (68%), crepitations (54%) 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=100	Controls (%) n=100	p-value
Age categories			
7-24 months	42 (65.6)	14 (24.6)	<0.001
25- 42 months	21 (80.8)	10 (34.5)	
43- 60 months	5 (50)	6 (42.9)	
Gender			
Male	35 (64.8)	19 (33.9)	0.27
Female	33 (71.7)	11 (25)	
Total	68 (100)	30 (100)	0.002

Figures in () indicate column percentages.

Odds ratio=4.96 (95% confidence interval: 2.72, 9.1).

Table 2 shows 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 (80.8%) which was significantly ($p<0.001$) higher than their normal counterparts.

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

Hematological parameters	Cases (%) n=100	Controls (%) n=100	p-value
Mean hemoglobin (g%)	9.6±0.8	11.7±1.1	<0.001
Mean MCV (fL)	62.28±2.1	79.5±3.8	<0.001
Mean MCH (pg)	19.3±1.3	24.9±3.4	<0.001
Mean MCHC (g/dL)	30.59±3.4	32.48±6.2	<0.001
RDW (%)	17.4±3.1	13.6±5.8	<0.001
Serum iron (µg/dL)	40±7.3	72±12.1	<0.001
Mean serum ferritin (ng/mL)	39.12±5.6	80.1±10.1	<0.001
Mean TIBC (µg/dL)	392±35.9	333±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 as shown in Table 3.

DISCUSSION

The study included 100 cases and 100 controls with their age and gender distribution not significantly different and comparable as per Table 1. The magnitude of anemia was 68% among the cases and 30% among the controls in the present study. The prevalence of anemia was 44-74% in children in developing countries.⁷ 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.⁸ Similar results were documented in the studies conducted by Malla et al and Sheikh et al.^{9,10} 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.⁸

The mean hemoglobin level was 9.6±0.8 gm% among the cases which was significantly lower ($p<0.001$) than that of the controls (11.7±1.1 gm%). In the earlier study by Ahmad et al, the mean hemoglobin level was 9.2g% for study group and 11.4g% for control group which was similar in lines with present study results.⁸ The mean iron level was 40±7.3µg/dL in the LRTI group and it was significantly lower ($p<0.01$) when compared to the non-LRTI group (72±12.1µg/dL). Similar findings were reported by Malla et al in which the mean serum iron level was 36µg/dL in the anemic and 71µg/dL in the non-anemic ALRTI cases ($p<0.01$).⁹ 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 declared anemia to be one of the risk factors of LRTI.¹¹ In contrary, Broor et al, found that anemia was not associated strongly with LRTI.¹² Further exploratory studies are needed to establish the causal association of anemia in leading to LRTI.

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 at Puducherry. 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.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. World Health Organization. The Global Prevalence of anaemia in 2011. WHO Library Cataloguing-in-Publication Data. 2015. Available at: www.who.int. Cited 9 Dec 2019.
2. Kabra SK. Disorders of respiratory system. In: Paul VK, Bagga A, eds. Ghai essential paediatrics. CBS

- Publishers and Distributors Pvt. Ltd. New Delhi; 2013:371-395.
3. 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.
 4. Bryce J, Boschi-Pinto C, Shibuya K. WHO estimates of the causes of death in children. *Lancet.* 2005;365:1147-52.
 5. Kumar SG, Majumdar A, Kumar V, Naik BN, Selvaraj K, Balajee K. Prevalence of acute respiratory infection among under-five children in urban and rural areas of Puducherry, India. *J Nat Sci Biol Med.* 2015;6(1):3-6.
 6. WHO, UNICEF, UNU. Iron deficiency anaemia: assessment, prevention and control, a guide for programme managers. Geneva: World Health Organization; 2001. Available at: http://www.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/WHO_NHD_01.3/en/index.html
 7. Mourad S, Rajab M, Alameddine A, Fares M, Ziade F, Merhi BA. Hemoglobin level as a risk factor for lower respiratory tract infections in Lebanese children. *N Am J Med Sci.* 2010;2(10):461-6.
 8. Ahmad S, Banu F, Kanodia P, Bora R, Ranhotra AS. Assessment of iron deficiency anemia as a risk factor for acute lower respiratory tract infections in nepalese children- a cross-sectional study. *Ann Int Med Dent Res.* 2016;2(6):149-53.
 9. Malla T, Pathak OK, Malla KK. Is low hemoglobin level a risk factor for acute lower respiratory tract infections? *J Nepal Pediatric Soci.* 2010;30(1):1-7.
 10. Sheikh HQ, Ashraf M, Wani JG, Ahmed J. Low hemoglobin level a risk factor for acute lower respiratory tract infections (ALRTI) in Children. *J Clin Diagn Res.* 2014;8(4):1-3.
 11. Savitha MR, Nandeeshwara SB, Kumar PMJ, Haque F, Raju CK. Modifiable risk factors for acute lower respiratory tract infections. *Indian J Pediatr.* 2007;74(5):477-82.
 12. Broor S, Pandey RM, Ghosh M, Maitreyi RS, Lodha R, Singhal T, et al. Risk factors for severe acute lower respiratory tract infection in under-five children. *Indian Pediatr.* 2001;38(12):1361-9.

Cite this article as: Gobinaath, Daniel AJ. Association between anemia and acute lower respiratory tract infection in under-five children at Puducherry, India: a case control study. *Int J Contemp Pediatr* 2020;7:679-82.