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**Original Research Article**

# Prevalence of anaemia among the hospitalized children in a rural tertiary care teaching hospital

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## ABSTRACT

**Background:** The most important nutritional deficiency (micronutrient deficiency) among children in the present world is iron deficiency. The objective of this study was to evaluate the prevalence of nutritional anemia (iron deficiency anemia) among the hospitalized children in the tertiary care rural hospital. To evaluate the distribution of anemia among various age groups, sex and its association with various systemic illness.
**Methods:** Retrospective (record based) cross sectional study carried out in a tertiary care teaching hospital. Information regarding age, gender, chief complaints, laboratory investigations carried out like total WBC count, haemoglobin was collected. Final diagnosis with system of involvement was documented. These factors were analysed.
**Results:** Data collected from 905 patients were analysed for the study purpose. Out of 270 children in the age group of less than 2 years 72% of children were anemic. In the age group of 2-5 years55.7% of children were anemic. Nearly 2/3 of children in less than 5 years of hospitalized children were anemic. Overall 50% of children between1 month to 12 years were anemic. System wise analysis have shown 57% of respiratory cases, 47 % of gastrointestinal cases and 48% of infectious disease cases were anaemic.
**Conclusions:** Nutritonal anemia is a major health burden in young children in developing countries. Iron deficiency in early life during the period of brain maturation is extensively studied by various research groups. Changes in brain were also reported in animal studies. Understanding the impacts of iron deficiency in terms of its role in cognitive development, intellectual development, motor development, immune function, school performance and physical development this is considered as an important and urgent public health problem in our country.

**Keywords:** Anemia, Iron deficiency, Prevalence

## INTRODUCTION

The most important nutritional deficiency (micronutrient deficiency) among children in the present world is iron deficiency.[1] Nutritional anemia is used not only as a health indicator but also, a socio-economic indicator for any nation. The terms anemia, iron deficiency and iron deficiency anemia are used interchangeably.[1] Prevalence of anaemia more than 40 percent in any country is considered as a public health threat as per WHO criteria.[2] The recent report NFHS-4 (national family health survey-4, 2015-2016) shows, it is still high in India.

During early infancy, there will be a progressive decline in Hb level in first few weeks. This is known as physiological anemia of infancy. Infants with low reserve of iron or the subsequent supply of iron through dietary source is insufficient, they manifest as iron deficiency

anemia. This is commonly seen in the age group of 9-24 months.[1] Iron deficiency anemia can cause pica as well as loss of appetite. Pallor is an important clinical finding in children with anemia. But clinically visible pallor appears in children when the Hb level falls below 7-8 gms.[3]

Even before the appearance of anemia, iron deficiency can cause decreased school performance in children.[4] Prevention of nutritional anemia (iron deficiency anemia) has to be considered as a national concern considering the consequences of physical and mental development of children.[5] T-cell immunity is slightly impaired in iron deficiency and the resultant subtle changes can be corrected with oral iron replacement.[6]

Children with long term iron deficiency anemia are at risk of developmental disadvantage and cognitive function.[7,8] Iron deficiency in early life may affect visual and auditory function thereby contributing to long-lasting changes in cognitive and behavioural functions in children.[9] Clinical trials have shown the association of the developmental delay with iron deficiency in early life.[10,11] Persistent neurophysiolgical changes as well as cognitive, motor and social-emotional functions have been observed, in children with iron deficiency. The mechanism is attributed to changes in neurometabolism, myelination and neurotransmitter function in children with iron deficiency during infancy.[12] In infancy impairment of cognitive function, physical capacity and thermoregulation are seen in children even with subclinical form of iron deficiency (without anemia).[12-14]

Excellent progress has been made since 1990 to prevent iodine deficiency and vitamin A deficiency with the implementation of national programme. but still we have a long way to eliminate iron deficiency in children.[15] To have healthy nation with healthy children and to become a developed country we need to discuss this issue as public health importance.

## METHODS

Retrospective study with cross sectional analysis.

### *Inclusion criteria*

Children with the age group of 1 month to 12 years admitted in pediatric tertiary care institute and undergone baseline investigations like complete haemogram and peripheral smear study (showing hypochromic microcytic anemia) were included in this study. The data was collected during the period, January 2015 to December 2015, from the case sheets after the ethical committee clearance.

### *Exclusion criteria*

- Children who were readmitted or discontinued the treatment
- Those children who were not investigated with complete haemogram
- Children with hypochromic microcytic anema other than nutritional cause (haemoglobinopathies) as a final diagnosis were excluded from the study
- Children with documented other micronutrient deficiencies like vitamin A, vitamin C and zinc were excluded from our study.

The present study was a retrospective (record based) cross- sectional study carried out in a tertiary care teaching hospital situated at the rural part of the Pondicherry state. The case records of pediatric inpatients maintained at the hospital medical records department were used to collect the study variables. The study was approved by the institute research and ethical committee.

The sample size was calculated to be 900 based on the prevalence of anemia among paediatric inpatients from the previous study as 72% with 3% absolute precision using the formula 4 $pq/d^2$ where p is the prevalence, q is 100-p and d the absolute precision. On an average 200 patients get admission per month in Pediatric department of the college. In order to collect complete required data fulfilling the sample size, it was decided to collect data from all patients admitted on alternate days of every month during the study period. Totally 1024 records were assessed. Of these 905 were eligible to enrol in the study. Records of children who were not tested for haemoglobin and without peripheral smear finding, who were readmitted, with pre-existing chronic illness, children who discharged against medical advice and records with incomplete data were excluded. Children diagnosed to have other causes of anemia, (haemoglobinopathies) other than nutritional cause as final diagnosis was also excluded. Haemoglobin estimation WBC count was carried out using Auto analyser, Horida Medical (ABX Pentra DF 120 L) which was calibrated every year. WHO criteria was used to classify various stages of nutritional anemia among study subjects.

Structured proforma was created and was pilot tested before initiating the data collection process. Trained medical workers posted at the Paediatric department were used to extract information from case records. To ensure the quality of the data collected, the extracted information was checked and verified by the investigators regularly. Information regarding age, gender, chief complaints, laboratory investigations carried out like total WBC count, haemoglobin was collected.

Data were entered in EpiData version 3.1 (The EpiData Association, Odense, Denmark) and analysed using SPSS version 24.0 (SPSS Inc., Chicago). Description of study parameters were given in frequency and percentages. Chi-square test was used to find the association between grades of anemia and various study parameters. Tests were two tailed and p value less than 0.05 were considered as statistically significant.

## RESULTS

1,024 case records were assessed for eligibility, of these 905 cases fulfilled all the criteria to get enrolled in the study. Of the 119 cases excluded 2 cases were diagnosed to have acute lymohoblastic leukemia and 3 cases as haemolytic anemia with microcytic picture and other records were excluded as per exclusion criteria. Table 1 describes the study participant's details on demography, laboratory parameters and clinical profile. 335, (37%) of the study subjects were more than 5 years of age, 270, (29.8%) of them were less than 2 years old. Majority (55.6%) of them were males. 402 (44.4%) were female children. 587(64.9%) of them had their white blood cell count within normal range. The major system of illness was ascertained based on the final diagnosis written on the records. Majority of the children admitted had respiratory complaints followed by infectious diseases and gastro-intestinal illness. 331 (36.6%) of them had respiratory illness namely bronchiolitis, bronch-opneumonia, exacerbation of bronchial asthma and others. 158 (17.5%) of them had one or other gastro-intestinal cause of admission. 238 (26.3%) of them had infectious reason of illness which were not categorized into either respiratory or gastro-intestinal system. 70 (7.7%), 31 (3.4%) and 25 (2.8%) of them had central-nervous system, cardiovascular and renal causes of illness respectively (Table 1).

**Table 1: Description of study subjects based on their age, gender, total WBC count, anaemia grade, and system of illness (N = 905).**

| Characteristics | Frequency | Percentage |
|---|---|---|
| **Age category in years** | | |
| < 2 | 270 | 29.8 |
| 2 - 5 | 300 | 33.1 |
| > 5 | 335 | 37.0 |
| **Gender** | | |
| Female | 402 | 44.4 |
| Male | 503 | 55.6 |
| **Total WBC count** | | |
| Normal | 587 | 64.9 |
| Abnormal | 318 | 35.1 |
| **Haemoglobin status** | | |
| Normal | 452 | 49.9 |
| Mild anemia | 219 | 24.2 |
| Moderate anemia | 219 | 24.2 |
| Severe anemia | 15 | 1.7 |
| **System of illness** | | |
| Respiratory | 331 | 36.6 |
| Gastro-intestinal | 158 | 17.5 |
| Infectious diseases | 238 | 26.3 |
| Central nervous system | 70 | 7.7 |
| Cardio-vascular | 31 | 3.4 |
| Renal | 25 | 2.8 |
| Others | 52 | 5.7 |
| **Total** | **905** | **100** |

452 (49.9%) of the children haemoglobin level was normal. 453 (50.1 %) of the children admitted had nutritional anemia. Of these children, 219 (24.2%) were mildly anemic, another 219 (24.2%) were moderately anemic and 15 (1.7%) of them were severely anemic as per WHO criteria as expressed in Table 1.

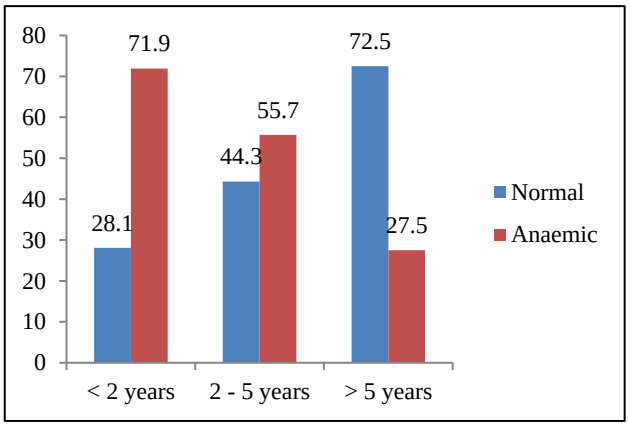


**Figure 1: Distribution of anaemia based on age.**

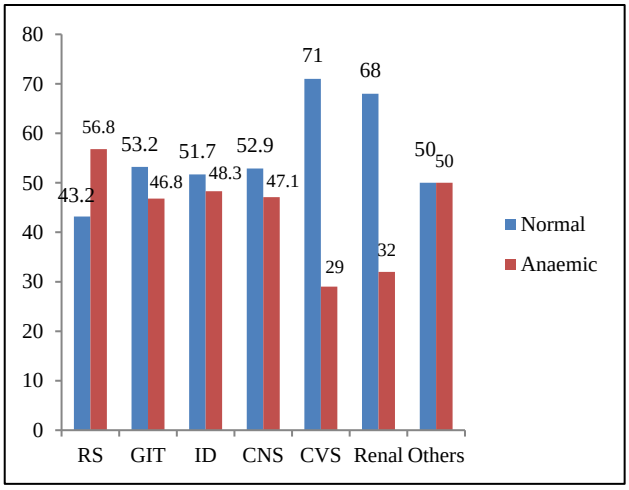


**Figure 2: Distribution of anemia and system of illness.**

Age of the children, WBC count and system of illness were statistically associated 9p vale < 0.05) with various grades of anemia, as seen in table-2. Children with any grades of anemia were more (71.9%) in the age group of less than 2 years and less (27.5%) in the age group of more than 5 years as shown in Figure 1. Nearly two thirds (63.3%), in the age group of less than 5 years of hospitalised children were anemic. Among children in the age group of less than 2 years, 37.4% were moderately anemic and 31.5% were mildly anemic. Percentage of mild, moderate and severe anemia was lesser among children who were more than 5 years of age and greater among children less than 2 years of age. This association is statistically significant, ($p < 0.001$). There was no statistical difference in the percentage of various grades of anemia between male and female children, ($p = 0.55$). Overall anemia and various grades of anemia were more among children whose WBC count was abnormal and

this difference was statistically significant, (p = 0.02). Analysis of prevalence of nutritional anemia as per the system of illness showed that children with respiratory illness were maximally anemic (56.8%) than with any other system of illness. This association was again statistically significant, (p< 0.001) (Tables 1, 2 and Figure 1, 2).

**Table 2: Association between grades of anaemia and other variables.**

| Characteristics | Grade of anaemia@ | | | | Chi-square vale, df | p value@ |
|---|---|---|---|---|---|---|
| | Normal N (%)# | Mild N (%)# | Moderate N (%)# | Severe N (%)# | | |
| **Age category in years** | | | | | | |
| < 2 | 76 (28.1) | 85 (31.5) | 101 (37.4) | 8 (3.0) | 131.5, 6 | <0.001* |
| 2 - 5 | 133 (44.3) | 78 (26.0) | 86 (28.7) | 3 (1.0) | | |
| > 5 | 243 (72.5) | 56 (16.7) | 32 (9.6) | 4 (1.2) | | |
| **Gender** | | | | | | |
| Female | 190 (47.3) | 102(25.4) | 103 (25.6) | 7 (1.7) | 2.08, 3 | 0.55 |
| Male | 262 (52.1) | 117(23.3) | 116 (23.1) | 8 (1.6) | | |
| **Total WBC count** | | | | | | |
| Normal | 314 (53.5) | 133(22.7) | 133 (22.7) | 7 (1.2) | 9.67, 3 | 0.02* |
| Abnormal | 138 (43.4) | 86 (27.0) | 86 (27.0) | 8 (2.5) | | |
| **System of illness** | | | | | | |
| Respiratory | 143 (43.2) | 89 (26.9) | 98 (29.6) | 1 (0.3) | 70.2, 18 | <0.001* |
| Gastro-intestinal | 84 (53.2) | 46 (29.1) | 28 (17.7) | 0 | | |
| Infectious diseases | 123 (51.7) | 53 (22.3) | 57 (23.9) | 5 (2.1) | | |
| Central nervous system | 37 (52.9) | 15 (21.4) | 17 (24.3) | 1 (1.4) | | |
| Cardio-vascular | 22 (71) | 2 (6.5) | 7 (22.6) | 0 | | |
| Renal | 17 (68) | 4 (16) | 2 (8) | 2 (8) | | |
| Others | 26 (50) | 10 (19.2) | 10 (19.2) | 6 (11.5) | | |

Note: @ p value based on Chi-square test; df- degrees of freedom; * Statistically significant; # row percentage.

**Table 3: Features of children with respiratory illness (N = 331).**

| Characteristics | Frequency | Percentage |
|---|---|---|
| **Age category in years** | | |
| < 2 | 147 | 44.4 |
| 2 - 5 | 103 | 31.1 |
| > 5 | 81 | 24.5 |
| **Gender** | | |
| Female | 146 | 44.1 |
| Male | 185 | 55.9 |
| **Total WBC count** | | |
| Normal | 172 | 52 |
| Abnormal | 159 | 48 |
| **Haemoglobin status** | | |
| Normal | 143 | 43.2 |
| Mild anemia | 89 | 26.9 |
| Moderate anemia | 98 | 29.6 |
| Severe anemia | 1 | 0.3 |

As the main cause of illness for getting admission was respiratory system involvement. These subsets of children were further analysed. The result was presented in Table 3. It showed that the majority of them were less than 2 years (44.4%) and were males (55.9%), with 48 % of them having abnormal WBC count and 56.8 % having nutritional anemia. Among the children admitted with gastro-intestinal disorders, infectious diseases and central nervous system disorders,46.8%, 48.3% and47.1% were anemic respectively.

## DISCUSSION

There are many studies with prevalence of anemia in the community, but there are few studies conducted to explore the prevalence of anemia among the hospitalized children. The institution where this study was carried out is located in rural area and serving the people from lower socioeconomic group. In our study out of 905 cases, 63% (570) of cases belong to the age group of less than 5 years. In our study 194 (71.9%) out of 270 children in the age group of less than 2 years were anemic. In the age group of less than 5 years 63.3%were anemic. This is about the proportion of anemia in this age group. There will be a fall in iron stores as well as it takes time to develop anemia in iron deficiency. The true incidence of iron deficiency will be much higher.[1] The true percentage

of iron deficiency will be about 100%when the prevalence of anemia is about 70%in the age group of less than 2 years.[1] To evaluate the prevalence of iron deficiency we need to evaluate the serum iron level and document if it is less than 12 micrograms. Because of affordability constraints in rural settings serum iron was done only when indicated. In a study done by Rosemary Ferraria dos Santos et al in Brazil reported the prevalence of anemia of 71% in children in the age group of 6-12 months and 36.2 % in the age group of 36months and above.[16] This is similar to our study.

In a study done by Reha et al in Tanzania the overall prevalence rate of anemia in the under 5 age group was 77.2%.The proportion of mild, moderate and severe anemia in this study was 16.5%, 33% and 27.7% respectively.[17] In this study the prevalence of severe anemia was significantly high (27.7%) and it was attributed to the prevalence of environmental factors, like the prevalence of malaria parasite apart from basic nutritional and socioeconomic factors.[17] In our study the proportion of mild, moderate and severe anemia was 24.2%, 24.2% and 1.7% respectively. In our study the prevalence of severe anemia was significantly low. The incidence of documented malarial parasites was seen only in 3 cases of our study group with infectious diseases during the year 2016. In a study by Ughasoro et al the prevalence of moderate and severe anemia was 43.4% and 5.8% respectively.[18] There was no direct relationship with moderate and severe anemia with nutritional status.[18] In a study done in a tertiary care hospital Nigeria the overall prevalence of malaria and anemia in the age group of less than 5 years among hospitalized children were 75.77% and 87.32% respectively. This incidence is significantly higher among the developing countries.[19]

In a study done in a tertiary care centre in Bangalore the incidence of anemia among the hospitalized children were 72.9% in the age group of 6months to 12 years and the majority belong to (98%) nonhemoglobinopathies.[20] When compared to our study (50.1%) the overall incidence in Bangalore study group, it was higher by 20%. The above study was done during the year 2011 and our study was done during the year 2015. It depends on the socioeconomic status, environmental factors as well as awareness about the balanced diet. In a study by Sahan KS et al in Mangalore reported the prevalence of anemia among the infants in the age group between 6-12 months of age was 56% with mean age group of 9.6 months and two third of their children were admitted for the respiratory symptoms. Iron deficiency was attributed to the cause of anemia in their study.[21] Out of 331 cases admitted with respiratory illness 58.6% of cases were anemic in our study and among the systemic infectious disease (238 cases) 48.3% were anemic. In a study done by Herbert J et al concluded that T-cell immunity is slightly impaired in iron deficiency and these changes can be corrected by oral iron supplementation.[6,22]

Various studies have shown that moderate anemia in infancy have less I.Q when compared to children without anemia among the school going children. Animal studies also indicate that iron is an important trace element seen in the brain tissues.[1] Anemia is seen with high incidence in developing countries and alarmingly more in lower socioeconomic countries.[23] Maternal anemia is also associated with childhood anemia.[23] Global estimates of the prevalence of anemia in infants and children in the age group 6 to 60 months of age group during 2011 in India was 59% with the blood haemoglobin level less than 11 gms%. The level of public health significance belong to severe category.[3] It is based on the WHO criteria that the country where the prevalence is more than 40 percent is considered as severe category of public health importance. Whereas in many developed countries like Australia, Canada and most of the European countries the incidence is less than 15%. The incidence is alarmingly high in some African countries with more than 70%.[3]

The WHO statistics have shown that the prevalence of anemia in children less than 5 years in India, has decreased from 75 percent to 59 percent over the past two decades (1990 to 2011), but still we have long way to go.[24] The prevalence of serum iron deficiency may be much higher and this is one of the significant and urgent public health problem. A presumptive diagnosis of iron-deficiency anemia is most often made by a complete blood count demonstrating a microcytic anemia with a high red cell distribution width, reduced red blood cell count,normal white blood cell count, and normal or elevated platelet count.[3]

Anemia is classified based on mean corpuscular volume into microcytic, normocytic and macrocytic. Mild microcytic anemia can be treated presumptively with oral iron therapy in children below 3 years of age provided there are no other features suggestive of haemolysis.[25] An increase in hemoglobin ≥1 g/dL after a month of iron therapy is usually the most practical means to establish the diagnosis of iron deficiency anemia.[3] If the anemia is refractory to oral iron therapy then the patient must be evaluated for gastro intestinal blood loss. Based on the clinical features and baseline investigations one can further investigate for other forms of hypochromic microcytic anemia.[20] Other investigations such as reduced serum ferritin, reduced serum iron, increased total iron-binding capacity, are not usually necessary unless there is severe anemia or the anemia does not respond to iron therapy and other clinical factors are present.[1] Iron deficiency anemia is common in the age group of 9-24 months of age. Nutritional anemia is also seen in adolescent age during the phase of rapid growth. Iron deficiency has various impacts in children. Iron deficiency per se even before the development of anemia can cause intellectual impairment as well as affect the motor functions in infants and adolescents. When subsequently treated with iron supplement these changes may be irreversible.[1]

Anemia and infectious diseases are the major health burden in developing countries in young children. In infectious diseases, the protein factor Hepcidin which is synthesized and released interferes with the bioavailabity of iron.[26-28] In our study nearly 26% of cases were admitted due to systemic infections like enteric fever, scrub typhus and various systemic viral infections. When the prevalence of respiratory and gastrointestinal infections are added nearly 2/3 of the cases of our hospital admissions in pediatric ward is mainly due to one or other forms of infections. Global anemia prevalence statistics shows that the incidence is higher in developing countries and significantly high in poor socieo-economic countries.[29] In a study by Balarajan Y et al reports that anemia in children and mothers are disproportionately high in low-income and middle-income countries.[23] In various studies done in developing countries socioeconomic inequality with macro and micro nutrient deficiency as well as maternal nutrition status are considered as the major cause of anemia in children.[30]

There is rapid growth and maturation of brain in early part of life especially in the first two years. In our study the prevalence of anemia in less than two years is significantly (72%) high. If we consider iron deficiency in this age group it will be definitely higher. Various studies have highlighted the importance of iron in early brain development and its impact on the outcome.[10,31-34]

## CONCLUSION

To become a developed country as a healthy nation we need to have healthy children. Nutritional anemia due to iron deficiency is the leading trace element deficiency seen in children. This is treatable as well as preventable problem in children. We need to ensure antenatal iron supplementation. Weaning food items should contain good sources of iron. Screening for anemia can be done by 1 year. Creating awareness among the parents regarding iron sources in diet, incorporation of iron rich food items in the mid-day meal program makes the children to get balanced diet and will prevent iron deficiency anemia to a greater extent.

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## REFERENCES

1. Iron deficiency anaemia. Assessment, prevention, and control. A guide for programme managers. Available at http://www.who. int/nutrition /publications/en/ida_assessment_prevention_control .pdf. Accessed on 21 December 2016.
2. Global estimates of the prevalence of anaemia in infants and children aged 6-59 months, 2011. Available at http://www.who.int /nutrition/ publications/micronutrients/global_prevalence_anaemia_2011_maps.pdf. Accessed on 17 December 2016.
3. The global prevalence of anaemia in, 2011. Available at http://apps.who.int /iris/bitstream/ 10665/177094/1/9789241564960eng.pdf?ua=1. Accessed on 17 December 2016.
4. Halterman JS, Kaczorowski JM, Aligne CA, Auinger P, Szilagyi PG. Iron deficiency and cognitive achievement among school-aged children and adolescents in the United States. Pediatr. 2001;107(6):1381-6.
5. Villalpando S, Shamah-Levy T, Ramírez-Silva CI, Mejía-Rodríguez F, Rivera JA. Prevalence of anemia in children 1 to 12 years of age. Results from a nationwide probabilistic survey in Mexico. Salud Publica Mex. 2003;45 Suppl 4:S490-498.
6. Krantman HJ, Young SR, Ank BJ, O'Donnell CM, Rachelefsky GS, Stiehm ER. Immune function in pure iron deficiency. Am J Dis Child. 1960;1982 Sep;136(9):840-4.
7. Lozoff B, De Andraca I, Castillo M, Smith JB, Walter T, Pino P. Behavioral and developmental effects of preventing iron-deficiency anemia in healthy full-term infants. Pediatrics. 2003;112(4):846-54.
8. Lozoff B, Jimenez E, Wolf AW. Long-term developmental outcome of infants with iron deficiency. N Engl J Med. 1991;325(10):687-94.
9. Algarín C, Peirano P, Garrido M, Pizarro F, Lozoff B. Iron deficiency anemia in infancy: long-lasting effects on auditory and visual system functioning. Pediatr Res. 2003;53(2):217-23.
10. Beard JL, Connor JR. Iron status and neural functioning. Annu Rev Nutr. 2003;23:41-58.
11. Black MM, Baqui AH, Zaman K, Ake Persson L, El Arifeen S, Le K, et al. Iron and zinc supplementation promote motor development and exploratory behavior among Bangladeshi infants. Am J Clin Nutr. 2004;80(4):903-10.
12. Lozoff B, Beard J, Connor J, Barbara F, Georgieff M, Schallert T. Long-lasting neural and behavioral effects of iron deficiency in infancy. Nutr Rev. 2006;64(5 Pt 2):S34-43-91.
13. Moffatt ME, Longstaffe S, Besant J, Dureski C. Prevention of iron deficiency and psychomotor decline in high-risk infants through use of iron-fortified infant formula: a randomized clinical trial. J Pediatr. 1994;125(4):527-34.
14. Enwonwu CO. Functional significance of iron deficiency. Annual nutrition workshop series. Available at http://eric.ed.gov/?id=ED337422. Accessed on 17 December 2016.
15. Indian Pediatrics - Editorial. Available at http://www.indianpediatrics.net/apr2003/apr-293-295.htm. Accessed on 17 December 2016.
16. dos Santos RF, Gonzalez ESC, de Albuquerque EC, de Arruda IKG, Diniz A da S, Figueroa JN, et al. Prevalence of anemia in under five-year-old children in a children's hospital in Recife, Brazil. Rev Bras Hematol E Hemoter. 2011;33(2):100-4.

17. Simbauranga RH, Kamugisha E, Hokororo A, Kidenya BR, Makani J. Prevalence and factors associated with severe anaemia amongst under-five children hospitalized at Bugando Medical Centre, Mwanza, Tanzania. BMC Hematol. 2015;15:13.
18. Ughasoro MD, Emodi IJ, Okafor HU, Ibe BC. Prevalence of moderate and severe anaemia in children under 5 in university of Nigeria teaching hospital Enugu, Southeast Nigeria. Pediatr Res. 2011;70(S5):489-9.
19. Oladeinde BH, Omoregie R, Olley M, Anunibe JA, Onifade AA, Oladeinde OB. Malaria and anemia among children in a low resource setting in Nigeria. Iran J Parasitol. 2012;7(3):31-7.
20. Saba F, Poornima S, Balaji PAR, Varne SRR, Jayashree K. Anemia among hospitalized children at a multispecialty hospital, Bangalore,Karnataka, India. J Fam Med Prim Care. 2014;3(1):48-53.
21. A study of anemia in hospitalised infants at a tertiary care hospital, 2015. Available at http://www.njcmindia.org/uploads/6-2_155-160.pdf.
22. Ekiz C, Agaoglu L, Karakas Z, Gurel N, Yalcin I. The effect of iron deficiency anemia on the function of the immune system. Research Gate. 2005;5(7):579-83.
23. Balarajan Y, Ramakrishnan U, Ozaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet Lond Engl. 2011;378(9809):2123-35.
24. Prevalence of anemia among children (% of children under 5) Available at http://data. worldbank.org/indicator/SH.ANM.CHLD.ZS. Accessed on 19 December 2016.
25. Janus J, Moerschel SK. Evaluation of anemia in children. Am Fam Physician. 2010;81(12):1462-71.
26. Shaw JG, Friedman JF. Iron deficiency anemia: focus on infectious diseases in lesser developed countries. Anemia. Available at https://www.hindawi.com/journals/anemia/2011/260380/abs/. Accessed on 15 May 2011.
27. Anemia and infection: a complex relationship. Available at http://www.scielo.br/ pdf/rbhh/ v33n2/v33n2a02.pdf. Accessed on 28 December 2016.
28. Kim YJ, Park SK, Lim HJ, Lee H. Gastrointestinal disease in children with iron deficiency anemia. Korean J Pediatr. 1999;42(5):697-703.
29. Tolentino K, Friedman JF. An update on anemia in less developed countries. Am J Trop Med Hyg. 2007;77(1):44-51.
30. Tatala S, Svanberg U, Mduma B. Low dietary iron availability is a major cause of anemia: a nutrition survey in the Lindi District of Tanzania. Am J Clin Nutr. 1998;68(1):171-8.
31. Grantham-McGregor S, Ani C. A review of studies on the effect of iron deficiency on cognitive development in children. J Nutr. 2001;131(2S–2):649S-666S.
32. Pollitt E. Iron deficiency and cognitive function. Annu Rev Nutr. 1993;13(1):521-37.
33. Walter T, De Andraca I, Chadud P, Perales CG. Iron deficiency anemia: adverse effects on infant psychomotor development. Pediatr. 1989;84(1):7-17.
34. Kariger PK, Stoltzfus RJ, Olney D, Sazawal S, Black R, Tielsch JM, et al. Iron deficiency and physical growth predict attainment of walking but not crawling in poorly nourished Zanzibari infants. J Nutr. 2005;135(4):814-9.

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