

Original Research Article

A cross-sectional study of anaemia in children under 15 years of age attending a community health centre in Punjab

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ABSTRACT

Background: Anaemia is the common nutritional problem in the world having a detrimental effect on the growth and development of the child. The objective of the study was to estimate the prevalence of anaemia in the region and its correlation with iron deficiency, serum ferritin, vitamin B12 and folate deficiency.

Methods: A hospital based observational cross-sectional study was carried out in the outpatient paediatrics department of a Community Health Centre in Punjab. Study subjects included 52 anaemic children aged under 15 years of age. They were evaluated by obtaining a detailed history, physical examination and haemoglobin, serum iron, serum ferritin, serum vitamin B12 and folate levels.

Results: Among 52 anaemic children, iron deficiency was found in 62% cases (32 children) with 48% of cases showing low ferritin levels and 25% having elevated TIBC. Isolated vitamin B12 deficiency was present in 25% cases (13 children) and folic acid deficiency in 8% cases (4 children). Vitamin D deficiency <15 ng/ml was seen in 29% anaemic children (15 children) and vitamin D insufficiency in 31% cases (16 children). Significant associations were found between low hemoglobin and low serum iron ($p=0.031$) and ferritin ($p=0.001$).

Conclusions: Iron deficiency anaemia, vitamin B12 and folate deficiency contributes significantly to the prevalence of anaemia. The National Family Health Survey-5 has reported an increase in the prevalence of anaemia in the under-five age group from 59% to 67.1% over the last five years. Hence, there is a need to develop guidelines for the diagnosis, treatment and prevention of anaemia.

Keywords: Anaemia, Iron deficiency, Serum ferritin, Vitamin B12 deficiency

INTRODUCTION

Anaemia is an important entity encountered in our daily clinical practice. A child is said to be anaemic when the hemoglobin and/or hematocrit is two standard deviations below the mean for that particular age and sex.¹ Nutritional anaemia develops when the hematopoietic nutrients required for hemoglobin synthesis and/or maintenance are insufficient to meet the demands of a child. The vast majority of anemias are due to the deficiency of iron, vitamin B12 and/or folic acid.² In addition, the role of other nutrients like vitamin D, vitamin C, pyridoxine and proteins in erythropoiesis is being recognised.³ The statistics from the National family

health survey (NFHS-5, 2019-21) have raised a red flag highlighting the rising prevalence of anaemia across all ages.⁴ The highest spike in anaemia was reported among children (6-59 months) with a rise to 67.1% (NFHS-5) from 58.6% (NFHS-4) followed by girls aged 15-19 years.⁵ The Comprehensive National Nutrition Survey (CNNS) conducted in 2016-2018 revealed that 41% of preschoolers (1-4 years), 24% school-age children (5-9 years) and 28% of adolescents (10-19 years) in India have anaemia.⁶ The etiology of anaemia was nutritional in 68.6%, 50.9% and 65.1% in children aged 1-4 years, 5-9 years and 10-19 years respectively.⁶ Iron deficiency was common in under-five children, while folate and vitamin B12 deficiency was higher among school going

and adolescent age groups. Folate or vitamin B12 deficiency anaemia accounted for more than a third of anaemia in these three age groups and 10-18% of children and adolescents with anaemia had combined iron and folate or vitamin B12 deficiency.

Deficiency of hematopoietic micronutrients not only results in anaemia but also leads to impairment in cognitive performance, behavioural and motor development, coordination, language development and scholastic achievements. Unfortunately, these changes may be irreversible in younger children emphasizing the need for timely prevention, diagnosis and treatment. Additionally, nutritional anemias have a deleterious impact on the physical strength of the individuals as well as decreased productivity and economic loss to the country.^{7,8}

In Punjab, an increase in childhood anaemia from 56.6% to 71.1% in children aged 6-59 months has been reported in NFHS-5. This indicates a significant public health concern in the state, with nearly two-thirds of young children affected by anaemia that requires attention and targeted interventions. The objective of the study was to estimate the prevalence of anaemia in the region and its correlation with iron deficiency, serum ferritin, vitamin B12 and folate deficiency.

METHODS

A hospital based observational cross-sectional study was carried out. The study was conducted in the paediatrics department of Community Health Centre, Fatehgarh Churian, Punjab to determine the prevalence of iron, folate and vitamin B12 deficiency in anaemic children aged 0-15 years. It was a cross-sectional study in which a total of 52 children visiting the outpatient department were enrolled. Institutional ethics committee approval was obtained for the study. Parents and caregivers were counselled regarding the study and informed consent was taken prior to blood sampling.

Inclusion criteria

Anaemic children in the age group 0-15 years were included in the study.

Exclusion criteria

Children having recent illness within 7 days prior to hospital visit were excluded because serum ferritin level is falsely raised in infection. Also, children with haemolytic anaemia, bleeding disorders, malignancy and chronic systemic illness that contributes to anaemia were excluded.

A detailed history was taken from the parents or caregivers and thorough physical examination was carried on each patient on enrolment to the study. Blood samples were collected for haemoglobin, serum iron

along with serum ferritin and total iron binding capacity (TIBC), serum vitamin B12 and serum folate levels, serum vitamin D and serum calcium levels. A haemoglobin level of less than 11gm% according to WHO criteria was used to diagnose anaemia in these children. Anaemia was further classified into mild (10-10.9 gm%), moderate (7-9.9 gm %) and severe (<7 gm%) based on the WHO criteria.⁹ The acceptable biological reference value for serum iron was considered to be between 65-175 ug/dl and that of serum ferritin and TIBC were 20-322 ng/ml and 250-400 ug/dl respectively. Serum vitamin B12 levels between 200-835 pg/ml were reviewed as normal. Serum folate levels of less than 3.37 ng/dl and vitamin d levels of less than 15 ng/dl were reviewed as deficient.

The results were analysed for various parameters and subjected to standard statistical analysis by SSPS 18.0 using chi-square test.

RESULTS

Among 52 anaemic children in the study group, 24 (46.1%) children had moderate anaemia, 28 (53.9%) had severe anaemia and none had mild anaemia. The mean haemoglobin level of children with anaemia in this study was 6.66±1.48 g/dl.

In the study group, moderate anaemia was more prevalent in the age group <5 years i.e., 11 children (46%) followed by 8 children (33%) in the 5-10 age group. Similarly, severe anaemia was more commonly observed in <5 age group i.e., 18 cases (64%) and each 5 children in both 5-10 and 10-15 age groups as shown in Table 1.

There was overall male preponderance in the study group. Male children constituted 65.4% (34 children) of the study population and female children made 34.6% (18 children) of the population. There was no statistically significant correlation of gender with hemoglobin levels ($p=0.562$). Severe anaemia was seen in 11 females (39%) and 17 males (61%) while moderate anaemia was present in 7 females (29%) and 17 males (71%) as shown in Table 2.

Among the 52 children with anaemia, the majority 61.5% (32 children) have iron deficiency. Severe anaemia was prevalent in 21 children (65.6%) with iron deficiency while 11 children (34.4%) with iron deficiency had moderate anaemia as shown in table 3. 13 children (25%) were found to be vitamin B12 deficient followed by 4 cases of folate deficiency. 8 children with vitamin B12 deficiency were found to be severely anaemic while moderate anaemia was detected in 5 vitamin B12 deficient cases. Vitamin B12 was found to be in normal biological reference range in 36 cases while it is found to be high in 3 children. Mean serum iron and vitamin B12 levels were 61.40±38.68 ug/dl and 390.87±235.14 pg/dl respectively. Out of 12 cases of combined deficiency, the maximum number of cases, 9 (17%) were of iron and

vitamin B12 deficiency followed by 2 cases (4%) of iron and Folate deficiency and 1 child (2%) with vitamin B12 and folate deficiency. 9 children (75%) had severe anaemia and only 3 cases (25%) had moderate anaemia. Serum ferritin was observed to be low (<12 ng/ml) in 25 children (48% cases) which was found to be statistically significant. Additionally, severe anaemia was associated with 80% cases (20 children) with low serum ferritin levels while 20% cases (5 children) were found to be moderately anaemic as shown in table 4. TIBC was elevated in 13 cases (25%), 9 children with severe

anaemia and 4 children with moderate anaemia. Vitamin D was found to be deficient in 15 children (29%) and insufficient in 16 cases (31%). Severe anaemia was observed in 6 children (21%) with vitamin D deficiency and 7 cases (25%) with vitamin D insufficiency while moderate anaemia was found to be present in 9 children (38%) with vitamin D deficiency. Serum calcium levels were found to be low in 15 children (54%) with severe anaemia and 11 children (46%) with moderate anaemia. Mean vitamin D and serum calcium levels were 23.12±18.23 ng/ml and 8.53±1.04 mg/dl respectively.

Table 1: Age and haemoglobin levels of children in the study population.

Age (in years)	Haemoglobin level (gm/dl)		Number of children	P value
	Severe (<7 gm/dl)	Moderate (7-9.9 gm/dl)		
≤5	18	11	29	0.352
5-10.0	5	8	13	
>10	5	5	10	
Total	28	24	52	

Table 2: Haemoglobin levels and gender distribution in the study population.

Gender	Haemoglobin level (gm/dl)		Number of children	P value
	Severe (<7 gm/dl)	Moderate (7-9.9 gm/dl)		
Female	11	7	18	0.562
Male	17	17	34	

Table 3: Distribution of haemoglobin and serum iron levels in children in the study population.

Serum iron levels (ug/dl)	Haemoglobin level (gm/dl)		Number of children	P value
	Severe (<7 gm/dl)	Moderate (7-9.9 gm/dl)		
Low (<65 ug/dl)	21	11	32	0.031
Normal	7	13	20	

Table 4: Distribution of haemoglobin and ferritin levels in children in the study population.

Ferritin levels (ng/dl)	Severe anaemia (Hb<7 gm/dl)	Moderate Anaemia (Hb 7-9.9 gm/dl)	Number of children	P value
Low (<20)	20	5	25	0.001
Normal	8	19	27	

DISCUSSION

Anaemia is a major and long-standing public health problem in India with its prevalence remaining high in children over the past thirty years despite several measures to tackle this health problem.¹⁰ There are wide differences in the prevalence rates within the country, as evident from the data from the NFHS surveys over the years. Studies from different parts of India since 2010 have reported varying prevalence of anaemia ranging from 48.5% to 95.7%. The wide inter-regional differences in prevalence of anaemia and its severity can be attributed to the multifactorial aetiology of anaemia and other factors potentiating it including genetic, nutritional, environmental, socioeconomic and cultural

factors which differ from region to region and between different communities. In the study, 28 children had severe anaemia, 24 children had moderate anaemia while none had mild anaemia. Kanchana et al and John et al, has reported a prevalence of 26.6%, 46.8% and 3.6% and 51.2%, 43.9% and 4.9% respectively for mild, moderate and severe anaemia in their studies.^{11,12} Jose et al, reported 25.5% children had mild anaemia, 15.7% had moderate anaemia and none had severe anaemia in under five children in their study in Kerala.¹³ Rahman et al, conducted a study of prevalence of anaemia among 5-9 years old Indian children which revealed a higher proportion of moderate anaemia i.e., 46.8% with 26.6% of children with mild anaemia and 3.6% had severe anaemia.¹⁴ Another study by Raja et al, in Tamil Nadu studied prevalence of anaemia in school children in the

age group 8 to 14 years and observed that the majority of children had mild anaemia (64.39%) followed by moderate 28.03% and severe anaemia 7.58%.¹⁵ The majority (56%) of cases of anaemia were found in children below 5 years of age. Globally, it's estimated that 40% of children aged 6-59 months are affected by anaemia. Dutta et al, concluded that anaemia is more prevalent among children aged 6-59 months in India i.e., about 59% which is a severe public health problem.¹⁶ A higher proportion of severely anaemic children 28 (53.9%) can be attributed to the hospital-based nature of the study.

In the present study, 32 children out of 52 had iron deficiency anaemia which was found to be statistically significant. A systematic review and meta-analysis by Gedfie et al, revealed that the global pooled prevalence of iron deficiency anaemia among under five children was 16.42% ($p < 0.01$).¹⁷ Other studies by John et al, Ray et al, Pasricha et al, Santokh et al and Jose et al, have reported prevalence of iron deficiency anaemia of 25.6%, 56%, 61.9%, 69.5% and 33.3% respectively.^{12,13,18-20} The single most common cause of anaemia in children is iron deficiency anaemia. Apart from iron deficiency anaemia, various other nutritional deficiencies like folic acid, vitamin B12, riboflavin, vit A, C, E, acute and chronic infections, haemoglobinopathies etc may cause anaemia. 25 children (48%) with anaemia had low levels of ferritin which was statistically significant ($p < 0.001$).

Chanpura et al, observed that 78 patients out of 111 patients (72.07%) had low serum ferritin levels. Low levels of serum ferritin were found in patients with mild anaemia and these results were statistically significant.²¹ Another study was carried out by Aggarwal et al, in Department of Paediatrics at University College of Medical Sciences and Guru Teg Bahadur Hospital, Delhi on iron status of children aged 9-36 months in an urban slum under Integrated Child Development Services project, Delhi. It concluded that 87% of children (sub sample study) were iron deficient as determined by low serum ferritin levels.²²

In the clinical study 13 out of 52 children had vitamin B12 deficiency and 4 children had folate deficiency. Combined deficiency was found in 13 children. Chhabra A et al, observed vitamin B12 deficiency (44%) to be more common than folate deficiency (11%).²³ Sanket K Mahajan et al, observed a higher prevalence of folate deficiency (26%) as compared to vitamin B12 deficiency (6%).²⁴ Vitamin B12 was deficient in 29% cases with severe anaemia and 21% cases with moderate anaemia. Thomas et al, also has observed that Vitamin B12 levels were deficient in 68.2% cases with severe anaemia and 45.2% cases with mild-moderate anaemia.²⁵ Similarly, combined deficiency was mostly associated with severe anaemia (9 cases) followed by 3 cases with moderate anaemia. Arora et al, also observed combined deficiency was mostly associated with severe anaemia (90%) followed by 1 case (10%) with moderate anaemia.²⁶

Vitamin D was found to be deficient in 9 cases (38%) with moderate anaemia and 6 cases (21%) of severe anaemia. Atkinson et al, evaluated the relationship between 25(OH)D deficiency and anaemia in a cohort of otherwise healthy children aged 1-12 years.²⁷ The study found that prevalence of anaemia was significantly higher (62%) in patients with vitamin D deficiency when compared with normal vitamin D levels. In a study conducted in South Korea, Jin et al, investigated the relationship between iron status and serum vitamin D levels in infants 3-24 months of age.²⁸

The major finding was the presence of vit D deficiency in a greater percentage of infants with iron deficiency anaemia and established a significant correlation between hemoglobin and 25 (OH)D levels. In our study, serum calcium was found to be low in 15 cases (54%) with severe anaemia and 11 cases (46%) of moderate anaemia. Calcium deficiency can interfere with the iron absorption and potentially can worsen or contribute to iron deficiency anaemia. Alfihili et al, reported that total serum calcium was found to be significantly low in anaemic population compared to non-anaemic subjects and this pattern was observed across all age groups in both genders.²⁹

Anaemia, primarily caused by iron deficiency, continues to be a significant public health concern among children in Punjab. The National Family Health Survey (NFHS-4) reported that more than 50% of children aged 6-59 months in Punjab are anaemic. In the majority of children with nutritional anaemia, diagnosis is straightforward and can be established with minimum diagnostic workup. Serum ferritin assay is strongly recommended for the confirmation of the diagnosis of IDA by Pediatric and Adolescent Nutrition Society of the Indian Academy of Pediatrics. Most cases of IDA can be managed with oral iron therapy using 2-3 mg/kg elemental iron daily.³⁰ Vitamin B12 should preferably be started 10-14 days ahead of oral folic acid to avoid precipitating neurological symptoms.

After completing therapy for nutritional anaemia, all infants and children should be advised to continue prophylactic iron-folic acid (IFA) supplementation as prescribed under Anemia Mukh Bharat guidelines. For prevention of anaemia, additional measures to control anaemia in preschool children include earlier IFA supplementation in low birthweight infants, delayed cord clamping at birth, development of local innovative iron and nutrient rich complementary feeds in infant and child nutrition, periodic de worming, enhancers of iron absorption in diet, treatment of common infections etc. Further research is required to evaluate aetiology, test feasibility of additional interventions and implementation issues of existing programs. Complete blood count for MCV, MCH, MCHC etc and peripheral blood smear was not done because of financial constraints. A detailed dietetic evaluation of children with calculation of specific nutrient intake could not be taken.

CONCLUSION

The prevalence of anaemia and iron deficiency anaemia was high in under 15 children. There were significant associations between haemoglobin levels and serum iron levels and serum ferritin levels of the children in the study. Anaemia remains a significant health concern for children in Punjab and addressing this issue requires a multi-pronged approach that includes improving dietary habits, promoting iron supplementation and raising awareness about the causes and consequences of anaemia.

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

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