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## PREVALENCE OF IRON DEFICIENCY ANAEMIA AMONG 5-12YEAR AGED RURAL SCHOOL CHILDREN

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### ABSTRACT

**Background:** Anaemia is one of the most common and intractable nutritional problems in the world today. It has consequences on human, social and economic development, and associated with increased risk of morbidity and mortality, especially in young children. The World Health Organization (WHO) estimates that approximately two billion people are anaemic based on haemoglobin concentrations below recommended thresholds<sup>1</sup>. **Objectives:** The present study was conducted to evaluate the prevalence of iron-deficiency anaemia among 5-12y old rural school children of low socio-economic status. **Methods:** School based cross sectional study was done in remote villages of Jagalur, Davangere. A total of 484 children from three government schools were selected over a period of one year. Children of both sexes were included in the study. Anaemia was diagnosed by Complete Blood Count (CBC) and Serum Ferritin was estimated by Enzyme Linked Immunosorbent Assay (ELISA). **Results:** Prevalence of anaemia was 30.4% as per WHO recommendations. Among these girls were highest (57.8%) when compared to boys (42.2%). Iron deficiency was the commonest cause occurring in 50.3% of children. **Conclusion:** Childhood anaemia continues to be a significant public health problem in school children aged 5-12y and iron deficiency is the commonest cause of anaemia.

**Keywords:** Anaemia, Iron-deficiency, Serum Ferritin, Prevalence, Rural children, Low socio-economic status.

### INTRODUCTION

Anaemia is one of the most widespread public health problems, especially in developing countries, and has important health and welfare, social and economic consequences. These include impaired cognitive development, reduced physical work capacity, and in severe cases increased risk of mortality<sup>2</sup>.

Nutritional anaemia is a recognized public health problem throughout the world. An estimated 30% of the world's population is anaemic, with the global prevalence of

anaemia among 6-12y old children to be 36% and 77% in developing regions respectively<sup>3</sup>. In earlier studies prevalence of anaemia among 5-14y old urban and rural Indian children was found to be in the range of 66.7 to 77%<sup>4</sup>.

Infants and young children are at particular risk of under-nutrition because of high demands for energy and essential nutrients at this stage of rapid growth<sup>5</sup>. Growing children are usually very active and so have nutritional needs. Inadequate intake of micronutrients is recognised as an important contributor to the global burden of disease and disability such as mental impairment<sup>6</sup>.

Iron deficiency was defined by Yip and Lynch<sup>7</sup> as functional tissue iron deficiency and the absence of iron stores with or without

anaemia. The prevalence of iron deficiency, is estimated to be from 2.0 to 2.5 times the overall prevalence of anaemia. Iron deficiency anaemia is the most severe degree of iron deficiency and occurs if the haemoglobin (Hb) concentration falls below a threshold level<sup>8</sup>.

Recent studies on prevalence of anaemia have been on preschoolers only<sup>9,10</sup>. The present study was undertaken to determine the prevalence of anaemia among school children aged 5-12y from rural areas and an attempt is also made to define the etiology of anaemia among this vulnerable group of children. In view of the deleterious effects of iron deficiency anaemia, this study is undertaken to find the prevalence of iron deficiency anaemia among 5-12y aged rural children in Jagalur, Davangere with a view to proffering suggestions for improvement and intervention.

#### MATERIALS AND METHODS

**Ethical clearance:** Ethical clearance was obtained from the Bharathiar University, R & D centre. Informed written consent was taken from all students and their guardians for interview and sample collection.

**Type of study:** A school based cross-sectional study, deals with investigation of the prevalence of anaemia and iron deficiency in children between the ages 5-12 years.

**Study area:** Three schools from three different villages of Jagalur taluk, Davangere district, Karnataka were selected.

**Background information:** The people of the area are involved in a lot of agricultural activities. Farm produce such as rice, jowar, maize, sugarcane, cotton and different vegetables are produced in Jagalur. Some residents/people are involved in growing flowers like marigold and jasmine. Livestock such as goats, sheep and cows are reared in the area, for consumption as well as for cash.

**Period of study:** June 2009 –July 2010.

**Sample size:** A school based cross-sectional study was conducted through a pretested, semi structured interview schedule in rural areas of

Davangere. A total of 484 samples between the age group of 5-12y participated in the study.

**Selection of the study subjects:** Only those schools who gave us permission to carry out this study were included.

**Inclusion and Exclusion criteria:** The rural school cater to low socio-economic group of population. None of these individuals had any gastrointestinal symptoms during the period of sample collection. The age of children was ascertained by questioning them and later confirmed from school registers in case of any discrepancy between the two, the date in the school register was taken as accurate. Age in completed years was taken for analysis.

**Anthropometry:** Height, weight and Mid-Upper Arm Circumference (MUAC) of all children were measured. Height was taken in cm using a wooden board fixed with a plastic tape to the nearest 1cm. weight was measured by using electronic bathroom scale (UNISCALE) to the nearest 100g. TALK-MUAC tape was used to measure MUAC to the nearest 1mm.

**Collection of blood sample:** The skin was cleaned with a 70% alcohol swab and allowed to dry before being punctured. 2.5ml of blood was drawn from the antecubital vein by means of a vacutainer and vacutte needle attached to plain vacutte tube for serum ferritin estimation and 2.5 ml in Ethylene Diamine Tetra Acetic acid (EDTA) tube for Complete Blood Count (CBC).

**Complete Blood Count (CBC):** A complete haemogram was estimated using automated haematology Beckman Coulter Counter, USA. Grading of anaemia was diagnosed as per WHO recommendations<sup>1</sup>.

**Estimation of Serum Ferritin by ELISA:** In all anaemic children iron studies were done by ELISA (Recommendations for measurement of serum iron in human blood, 1978). The ferritin was estimated in batches of samples by indirect solid phase enzyme linked immunometric assay [Elitech Ferritin

(France)]. A concentration of serum ferritin (SF), <12mg/l is indicative of depleted iron stores.

## RESULT

Out of 484 subjects in the study population, >90% of the children belonged to families with lower income group.

**Demographic characteristics:** Age wise distribution of the children is depicted in Table 1. Children were categorized into four groups based on the age group. 112 children from 5-6y, 121 from 7-8y, 125 from 9-10y and 126 from 11-12y children. Participation of boys was 48.8%, and that of girls were 51.2%.

**Anthropometric measurements:** Among 236 boys, 15 were underweight, 3 obese and 218 were normal, whereas among 248 girls, 34 were underweight, 11 obese and 203 girls were normal. The BMI of boys and girls are depicted in Table 2.

**Prevalence of Anaemia:** Of the 484 children, 30.4% were found to be anaemic and 69.6% were non-anaemic. Among these, mild anaemia was found in 42.2%, moderate anaemia in 36.1% and 21.8% were severely anaemic (Table 3).

**Prevalence of anaemia based on age group:** The prevalence of anaemia was found to be more in 5-6y age group (36.7%) followed by 7-8y (29.2%), 9-10y (19.7%) and lowest in 11-12y (14.3%) age group (Table 3).

**Prevalence of anaemia based on gender:** The prevalence of anaemia was found to be highest in girls (57.8%) when compared to boys (42.2%). Mild anaemia was seen in 45.2% boys and 54.8% girls, moderate anaemia was found in 39.6% boys and 60.4% girls, whereas severe anaemic cases were seen in 20.9% boys and 59.4% girls (Table 3).

**Prevalence of Iron-Deficiency:** 49.7% of the children studied had normal iron levels and 50.3% were iron deficient. Among non-anaemic children 5% had depleted iron stores. There was no difference in anaemia between the boys and girls. There was no marked

difference in the age grades. The least affected was the 7-8y (17.4%) and 11-12y (17.4%) followed by 9-10y (19.2%). The 5-6y children had highest prevalence of iron deficiency anaemia (21.4%) (Table 4).

## DISCUSSION

The etiology of anaemia is complex and often a combination of factors. Socio-economic status is known to be a major associated factor expressing itself through diet, parasitic infestations and chronic infections. Deficiencies of one or more nutrients including iron, folic acid, vitamin B<sub>12</sub> and vitamin A are proposed as important dietary causes of anaemia. Among these, iron deficiency is suggested to give the highest attributable proportion<sup>12</sup> and little is known about the relative importance of other nutrients.

The major causes of iron deficiency include insufficient iron-rich foods and poor bioavailability of consumed iron. Poor bioavailability has been reported as the major cause of iron deficiency in a population whose diet is predominantly cereal-based.

Apart from the form of iron present in the diet (heme and non-heme), factors inhibiting (for example, phytate, calcium) or enhancing (for example, ascorbic acid) its absorption are also important<sup>13</sup>. In addition, increased need of iron may also occur through blood loss that may be pathologic, e.g., hookworm infestation or physiologic.

Other causes of anaemia not linked to dietary deficiency include chronic infections, malaria, abnormal formation of haemoglobin, and sickle-cell disease<sup>14</sup>.

The prevalence of anaemia in rural school children aged 5-12y was found to be 30.4% in the present study. Among these 42.2% had mild anaemia, 36.1% were moderately anaemic and 21.8% were severely anaemic. DeMaeyer *et al.*,<sup>15</sup> reported the prevalence of anaemia in 5-12y old children to be 36%, while study<sup>16</sup> among 5-15y old urban school

children of Punjab anaemia was 77%. The prevalence was high as 93% in children from Varanasi<sup>17</sup>. The recent National family Health Survey-2 (NFHS-2)<sup>18</sup> estimated prevalence of anaemia among children of Delhi to be 69%.

The variations in the prevalence of anaemia in other studies could be explained on the basis of heterogeneity of the studied population, dietary habits, different nutritional status and incidence of worm infestation in a defined geographical area. In the present study iron-deficiency was mainly due to the low socio-economic status.

The prevalence of anaemia was more in the age group 5-6y (36.7%) followed by 7-8y (29.2%), 9-10y (19.7%) and least in the children aged 11-12y (14.3%). This is because young children are among the vulnerable groups. They have accelerated need for nutrients at this critical period, especially micronutrients.

In the present study, 49.7% of the children studied had normal iron levels and 50.3% were iron deficient. The prevalence of iron deficiency without anaemia were 5%. This result is in agreement with the result of others<sup>19</sup>. They observed that 5% of the anaemic children were iron deficient. Hashizume *et al.*,<sup>20</sup> too found that high iron intake was significantly associated with decrease prevalence of anaemia.

In developing countries, low standards of living, low socio-economic conditions, restricted access to food and lack of knowledge for good dietary practices and personal hygiene contribute even more to a high occurrence of iron-deficiency and hence anaemia<sup>21</sup>.

The study provides an indication to initiate the anaemia prophylaxis measures for children in India including nutrition education in school.

To conclude, childhood anaemia continues to be a significant public health problem in school children and iron deficiency either alone or in combination is the commonest nutritional cause of anaemia in school children aged 5-12y in the community. Improvement in knowledge and life style can be enhanced through educational programs, the curriculum and through the media.

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**Table 1: Age wise distribution of Rural School Children (5-12y)**

Age Group	Number (n)
5-6y	112
7-8y	121
9-10y	125
11-12y	126
Total	484

**Table 2: Body Mass Index of 5-12y Boys and Girls**

Age	BMI of Boys			Total	BMI of Girls			Total
	Under weight	Normal	Obese		Under weight	Normal	Obese	
5-6y	8	44	-	52	12	48	-	60
7-8y	5	49	-	54	09	57	1	67
9-10y	2	62	2	66	08	47	4	59
11-12y	-	63	1	64	05	51	6	62
Total	15	218	3	236	34	203	11	248

$\chi^2 = 18.0, P < 0.001$  HS

**Table 3: AGE AND SEX WISE PREVALENCE OF ANAEMIA**

Age	Non-anaemia			Anaemia												Total
				Mild anaemia			Moderate anaemia			Severe anaemia			Total			
	Boys n (%)	Girls n (%)	Total n (%)	Boys n (%)	Girls n (%)	Total n (%)	Boys n (%)	Girls n (%)	Total n (%)	Boys n (%)	Girls n (%)	Total n (%)	Boys n (%)	Girls n (%)	Total n (%)	
5-6	31 (17.8)	27 (16.6)	58 (17.2)	10 (35.7)	14 (41.2)	24 (38.7)	06 (28.6)	12 (37.5)	18 (34.0)	05 (38.5)	07 (36.8)	12 (37.5)	21 (33.9)	33 (38.8)	54 (36.7)	112
7-8	33 (19.0)	45 (27.6)	78 (23.1)	12 (42.9)	08 (23.5)	20 (32.3)	05 (23.8)	09 (28.1)	14 (26.4)	04 (30.8)	05 (26.3)	09 (28.1)	21 (33.9)	22 (25.9)	43 (29.2)	121
9-10	54 (31.0)	42 (25.8)	96 (28.5)	03 (10.7)	07 (20.6)	10 (16.1)	06 (28.6)	05 (15.6)	11 (20.8)	03 (23.1)	05 (26.3)	08 (2.5)	12 (19.4)	17 (20.0)	29 (19.7)	125
11-12	56 (32.2)	49 (30.1)	105 (31.2)	03 (10.7)	05 (14.7)	08 (12.9)	04 (19.0)	06 (18.8)	10 (18.9)	01 (7.7)	02 (10.5)	03 (9.4)	08 (12.9)	13 (15.3)	21 (14.3)	126
Total	174 (51.6)	163 (48.4)	337 (69.6)	28 (45.2)	34 (54.8)	62 (42.2)	21 (39.6)	32 (60.4)	53 (36.1)	13 (40.6)	19 (59.4)	32 (21.8)	62 (42.2)	85 (57.8)	147 (30.4)	484

Anaemic status w.r.t i) sex:  $X^2 = 3.85$ ,  $P = 0.27$  NS, ii) age:  $P < 0.001$  HS

**Table 4: Prevalence of Iron Deficiency (SF)**

Age Group	Serum Ferritin (SF) (ng/ml)				Total (n=484)
	5-6y (n=112)	7-8y (n=121)	9-10y (n=125)	11-12y (n=126)	
Non-anaemic(n=337)	2 (11.8%)	3 (17.6%)	5 (29.4%)	7 (41.2%)	17(5%)
Anaemic (n=147)	22 (29.7%)	18 (24.3%)	19 (25.7%)	15 (20.3%)	74 (50.3%)
Mild anaemic (n=62)	4 (21.1%)	2 (10.5%)	7 (36.8%)	6 (31.6%)	19 (30.6%)
Moderate anaemic (n=53)	8 (24.2%)	11 (33.3%)	7 (21.2)	7 (21.2%)	33 (62.2%)
Severe anaemic (n=32)	10 (45.5)	5 (22.7%)	5 (22.7%)	2 (9.1%)	22 (68.8%)
Total	24 (26.4%)	21 (23.0%)	24 (26.4%)	22 (24.2%)	91 (18.8%)

$\chi^2 = 1.23, P = 0.74$  NS

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