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Iron Status of Adolescent Girls (10-15 years) Attending a Government School in Jaipur City, Rajasthan, India

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ABSTRACT

Iron deficiency anaemia is widely prevalent amongst women and children in India. The present work was designed to be an intervention study with nutrient fortified biscuits to ameliorate the micronutrient status of adolescent girls from a low socio-economic background. The baseline data on iron status of 109 adolescent girls (10-15 years) studying in a government school in Jaipur city, India are presented here. The iron status of adolescent girls was determined through haemoglobin, serum iron and serum ferritin levels. The results revealed that 96.3% of the adolescent girls suffered from anaemia, 31.2% of whom had mild deficiency and 65.1% had moderate deficiency. Anaemia was more prevalent in the older age groups. About 31% of the subjects had normal levels while the rest (69%) had low levels of serum iron. Similarly, about 75% of the subjects had low serum ferritin levels. Conclusively, anaemia was highly prevalent in the studied population and the adolescent girls had low haemoglobin, serum iron and serum ferritin levels. It is recommended that the school system be used for micronutrient supplementation to improve their nutritional status as the students are more regimented here for distribution of nutrient fortified food products.

Keywords: Adolescent girls, haemoglobin, iron status, serum ferritin, serum iron

INTRODUCTION

Nutritional anaemia is widely prevalent in many parts of the world, particularly in developing countries. Although many nutrients and co-factors are involved in the maintenance of a normal haemoglobin concentration, the most common nutrient deficiency in nutritional anaemia, from the public health point of view, is iron deficiency. Iron requirements of children are closely related to growth and increase during periods of rapid growth, both in pre-school and school age children. In girls, there is a further increase in iron requirements at the onset of menstruation (INACG, 1977).

In Rajasthan, India, according to the NFHS–3 report, about 53.9% women in the age group of 15-19 years had anaemia (Hb <12.0 g / dl) including 36.8% who were mildly anaemic (Hb 10.0–11.9 g / dl), 14% who were moderately anaemic (Hb 7.0–9.9 g / dl) and 3.1% who were severely anaemic (Hb <7.0 g / dl). About 58% of women (15–49 years) within the lowest wealth index were found to be anaemic (NFHS, 2008).

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The most deprived urban populations live in slums. Some of the worst slums in the world can undoubtedly be found in Indian cities. Jaipur city is no exception. The two most vulnerable groups who are the most adversely affected in the slums are women and children. The women, adolescents and children are mostly malnourished and suffer from many nutritional deficiencies.

Adolescent girls are a marginalised group in any society more so when they belong to the low socio-economic group and come from slums. Designed as an intervention study, biscuits fortified with nutrients such as vitamin A, iron, folic acid, iodine and ascorbic acid were used to supplement the diet of adolescent girls attending a government school. The current paper presents baseline data on the iron status of adolescent girls attending a government school located in a slum in Jaipur city, India.

METHODOLOGY

Ten government schools in Jaipur city were visited. The willingness of the Principal of the school to participate in the study, adequate number of female students in a separate section in higher classes and the school being close to the University campus were the factors considered in the selection of the school. All adolescent girls (n=148, 10-16 years) studying in classes VI to VIII, attending a government school fulfilling all criteria, and residing in a slum where the school was situated comprised the sample for the study. After collecting personal, anthropometry and nutrient intake data, baseline levels for haemoglobin (Hb), serum iron and serum ferritin were determined for 109 adolescent girls (10-15 years) as a few students were absent on the day of blood collection and in some cases blood / serum was not adequate for analysis. The second author carried out the blood collection in Jaipur and analysed the blood samples for various iron parameters at AIIMS, New Delhi. The data were collected from July 2004 to December 2004. The study was approved by the Departmental Ethics Committee and written consent for participation in the study was obtained from the parents of the adolescent girls.

Blood was collected in labeled plain and EDTA vials. Serum was separated from blood in plain vials and transferred to labeled vials for transport to New Delhi for analysis packed with dry ice in thermocole boxes. Haemoglobin was determined by cyanmethaemoglobin method using Hemocor-D kit of Crest Biosystems, Goa. Serum iron was assayed by Spinreact kit, SA, Spain. Serum ferritin was determined by immuno-enzymatic assay by Dia Metra kit of Segrate (MI) Italy.

Anaemia is present in a population when haemoglobin (Hb) concentration is less than 12g / dl for children between 12-14 years (WHO, 2001). The classification of anaemia into different grades has been given by WHO (1989). The same criterion for grading anaemia has been used in the NFHS (2008) report. The deficient criteria has been stated as <60 mcg / dl (<11 microM / L) for serum iron (INACG, 1985) and as <15 mcg / L (<15 ng / ml) for serum ferritin (WHO, 2001).

RESULTS

Haemoglobin

The mean haemoglobin level of adolescent girls (10-15 years) was 9.43 ± 1.365g / dl implying that a majority of the subjects suffered from a moderate degree of anaemia (7-9.9g / dl). Of the 109 subjects, 4 (3.7%) had normal levels of haemoglobin, 34 (31.2%) suffered from mild deficiency and 71 (65.1%) suffered from moderate deficiency (Table 1). Hence, about 96% of the subjects suffered from mild and moderate iron deficiencies taking the cut-off point of haemoglobin as < 12g / dl.

Considering the data age-wise, high percentages of subjects suffering from mild anemia were from the younger age groups of 10^+ and 11^+ years. High percentages of

Table 1. Haemoglobin and serum iron levels of adolescent girls

	Haemoglobin				*Serum iron*		
	Hb (g/dl)	*Normal (>12g/dl)*	*Mild (10-<11.9g/dl)*	*Moderate (7-<9.9g/dl)*	*Iron (microM/L)*	*Normal (>11microM/L)*	*Deficient (<11microM/L)*
Total sample	(n=109) 9.43 ±1.365	4(3.7)	34(31.2)	71(65.1)	(n=109) 10.84 ±3.682	34(31.2)	75(68.8)
10+ years	(n=15) 9.67 ±1.406	0	8(53.3)	7(46.7)	(n=15) 10.74 ±3.429	5(33.3)	10(66.7)
11+ years	(n=18) 10.19 ±1.424	2(11.1)	9(50.0)	7(38.9)	(n=18) 12.84 ±4.709	9(50.0)	9(50.0)
12+ years	(n=28) 9.54 ±1.202	0	8(28.6)	20(71.4)	(n=28) 11.40 ±3.775	10(35.7)	18(64.3)
13+ years	(n=30) 9.18 ±1.345	1(3.3)	8(26.7)	21(70.0)	(n=30) 10.35 ±3.151	9(30.0)	21(70.0)
14+ years	(n=8) 8.34 ±0.826	0	0	8(100.0)	(n=8) 8.40 ±0.695	0	8(100.0)
15+ years	(n=10) 9.02 ±1.418	1(10.0)	1(10.0)	8(80.0)	(n=10) 9.75 ±3.542	1(10.0)	9(90.0)

Mean ± SD.
Figures in parentheses denote percentages.

subjects suffering from moderate deficiency anemia were from the older age groups of 12^+ to 15^+ years. Consequently, the mean haemoglobin levels were the lowest for the older age groups. This can be attributed to the onset of menstruation after 12^+ years of age which further deteriorated the already existing low iron status in adolescent girls. However, in each age category, the mean haemoglobin level was below the cut-off point of 12g / dl.

Serum iron

The mean serum iron of the subjects was 10.84 ± 3.682 micro M / l which was less than 11 micro M / l taken as the deficiency criteria (INACG, 1985). About 31% of the subjects had normal levels while the rest (69%) had low levels of serum iron (Table 1).

When the data were analysed age-wise, the mean serum iron levels of the younger age groups were higher than those of the older age groups. Here, too the picture was quite similar to the haemoglobin profile. Low mean serum iron concentrations were observed for adolescent girls of 14^+ and 15^+ years.

Data on haemoglobin and serum iron levels revealed that anaemia was prevalent in the school girls and that it was highest in the older age groups. This could be due to onset of menstruation in girls of higher ages and hence a lowering of their iron status.

Table 2. Frequency distribution of adolescent girls according to serum ferritin levels

	Serum Ferritin ng/ml	
	Normal (>15ng/ml)	*Deficient (<15ng/ml)*
Total sample	(n=100) 25(25.0)	75(75.0)
10+ years	(n=11) 1(9.1)	10(90.9)
11+ years	(n=18) 5(27.8)	13(72.2)
12+ years	(n=26) 7(26.9)	19(73.1)
13+ years	(n=27) 8 (29.6)	19(70.4)
14+ years	(n=7) 0	7(100.0)
15+ years	(n=11) 4(36.4)	7(63.6)

Figures in parentheses denote percentages

Serum ferritin

The serum ferritin level is the most specific biochemical test that correlates with relative total body iron stores. Considering the cut-off level of <15 mcg/l, about 75% of the subjects had low while 25% had serum ferritin levels in the normal range (Table 2). The percentage of adolescent girls with low serum ferritin levels ranged from 64 to 100% in all the ages. Looking at the serum iron figures, 69% of the subjects had low serum iron levels, too. Hence, these adolescent girls suffered from an added disadvantage of low iron stores, too.

DISCUSSION

Socio-economic status has a bearing on the prevalence of anaemia in poor communities. In the present study, a very high percentage of adolescent girls from a low socio-economic background were found to suffer from anaemia when the cut-off point was taken as <12g/dl for haemoglobin. Sharma, Prasad & Rao(2000) had reported that 61.9% of adolescent girls of poor communities in the urban areas of Delhi and 85.4% in the rural parts of Bharatpur (Rajasthan) were anaemic. In an urban slum in Delhi, the prevalence of anaemia, as judged by WHO recommended 'cut off' value of haemoglobin <11g/dl was found to be 76% amongst pre-school children (Gomber *et al.*, 1998). Later, Gomber *et al*. (2003) had stated that pure or mixed iron deficiency anaemia was the commonest type of anaemia in 68.42% of schoolchildren from the urban slums of Delhi. Bentley & Griffiths (2003) had noted that poor urban women of Andhra Pradesh had the highest rates and odds of being anaemic. Hence, adolescent girls and women from disadvantaged sections of our society have higher chances of developing nutritional deficiencies.

The National Nutrition Monitoring Bureau has reported prevalence of anemia as 90.1% in 12-14 year old girls (n=435) and 87.6% in 15-17 year old girls (n=437) from West Bengal (NNMB, 2003). Toteja *et al.* (2006) had assessed the prevalence of anaemia among adolescent girls in 16 districts of India. Their results revealed that among adolescent girls (n=4,337) from 16 districts, the overall prevalence of anaemia (defined as haemoglobin <12g / dl) was 90.1% with 7.1% having severe anaemia (Hb <7 g / dl). The findings of the present study support those of Toteja *et al.* (2006) in reiterating that in some sections of the Indian population, the prevalence of anaemia could be quite high.

The prevalence of anaemia in 406 school-going children of age group 5-10.9 years from the urban slums of Delhi, India was 41.8% as judged by WHO recommended cut-off values for haemoglobin (Gomber *et al.*, 2003). Bentley & Griffiths (2003) investigated the prevalence of anaemia among 4,032 ever - married women aged 15-49 years from 3,872 households in Andhra Pradesh, India. In all, 32.4% had mild anaemia (10-10.9g / dl for pregnant women, 10-11.9g / dl for non-pregnant women), 14.2% had moderate (7-9.9g / dl) and 2.2% had severe (<7g / dl) anaemia. In the present study, the prevalence of anaemia in adolescent girls (10 to 15 years) from a low socio-economic background was found to be quite high.

Kanani & Poojara (2000) had reported that the mean initial haemoglobin levels of the experimental group of adolescent girls (10-14 years, n=75) of low socio-economic communities of Vadodara, India was 10.80±1.2g / dl and that of the control group of adolescent girls (10-14 years, n=78) was 10.93±1.3g / dl. In the present study, the mean haemoglobin concentration was found to be 9.43±1.365 g / dl, which was lower than that reported by Kanani & Poojara (2000).

Pathak *et al.* (2004) had determined the status of serum ferritin and folate levels amongst young married non-pregnant women aged 18 years or more from six randomly selected villages in the district of Faridabad, Haryana, India. Serum ferritin and folate levels less than 15.0 and 3ng / ml were considered as indicators of poor iron and folic acid stores, respectively. Almost 63.8 and 27.7% of the women had poor serum ferritin and folate levels. This was attributed by the authors to poor dietary intake of food and thereby, of iron and folic acid. Bains & Mann (2000) had found that the haemoglobin levels of college students from Ludhiana, India, were below the normal value. The values of serum iron, transferrin saturation (TS) and unsaturated iron binding capacity (UIBC) were in the normal range but near the lower margin. The TIBC was above the normal range. The serum ferritin values showed very poor iron stores. The scenario on the iron status of young adolescent girls in the present study was also not satisfactory.

Foo *et al.* (2004a; 2004b) determined the iron status of 199 apparently healthy male and female adolescents aged 12-19 years living in a fishing community in Sabah, Malaysia. The mean haemoglobin value for the females was 12.4±1.6g / dl with 28.6% of adolescents having haemoglobin values less than 12 g / dl. The mean serum ferritin level for female adolescents was 15.4mcg / l with 49.5% of the females having deficient levels of ferritin. In the present study, 96.4% of the adolescent girls had anaemia taking the cut-off point for haemoglobin as 12g / dl and 69.0% had low levels of serum ferritin. This difference can be attributed to the Malaysian adolescents coming from a fishing community.

It can, therefore, be concluded that anaemia is widely prevalent amongst adolescent girls. This is supported by the findings of the present study where 96% of the adolescent girls had anemia taking the cut-off point for haemoglobin as <12g / dl.

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