IRON DEFICIENCY IN ADOLESCENTS

Pages with reference to book, From 3 To 5

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ABSTRACT

Two hundred and seventy school children between 13 to 20 years were investigated for iron deficiency. Overall iron deficiency (assessed by serum ferritin assay) was 39% in adolescents; 30% boys and 54% girls were iron depleted, anemia was found in 17% boys (Hb 13g/dl) and in 18% girls (Hb 12g/dl). Iron deficiency was more frequent than anemia in adolescent girls than boys. Iron deficient children had significantly lower mean Hb levels (p 0.001) compared to children with adequate iron stores. A significant correlation was found between serum ferritin concentration and Hb levels in iron deficient children (r=0.49, p 0.001). A high prevalence of iron deficiency in adolescents reported here reflects the limited availability of dietary iron in children belonging to lower socio-economic group and the importance of screening for iron deficiency and the treatment of these children with iron preparation. Iron status in this age group warrants further evaluation and research (JPMA 42: 3, 1992).

INTRODUCTION

There has recently been a considerable speculation about iron deficiency in young people and the need for community based surveys to assess the size of the problem[1]. Iron deficiency anemia most frequently occurs in adolescence because accelerated physical growth both in boys and girls and menstruation and dieting for fear of obesity in female teenagers[2]. This is the problem of both poor and socially advanced countries. In the British Isles, a high prevalence of iron depletion has been reported among Irish adolescents[3] and in young children in hospitals or areas with a large proportion of Asian families[4]. As little is known about iron deficiency in adolescents in Pakistan, this study aimed to assess its prevalence in young school children in Islamabad and compare the results with other reported series.

SUBJECTS AND METHODS

The subjects were 270 school children (age group 13 to 20 years) from the four Federal Government schools located in the suburbs of Islamabad city. Age, sex, family income, previous history of any serious illness, worm infestations, blood donation or blood transfusion and history of abnormal bleeding were recorded. They were examined and features like pale conjuctive, smooth tongue and koilonychia were noted. Blood for haemoglobin was taken in bottles containing EDTA and for serum ferritin in plain tubes. Serum was separated and frozen at -20°C until the serum ferntin assay. Haemoglobin was estimated on the same day by cyanmethemoglobin method. Serum ferritin concentration was measured by radioimmunoassay (RIA) technique using ferritin RIA kits (Amersham International Limited, UK). The kit provides a sensitive and convenient assay for the measurement of ferritin in serum over the approximate range of 0 to 1000 ng/ml. A set of quality control sera (Amersham, UK) were also analysed with each assay. Each assay was performed in duplicate serum samples and radioactivity was counted in multidetector computerized IBM P.C., gamma counter. The results were analysed on IBM compatible computer and correlation coefficient “r” value was calculated by Karl Pearson’s formula.

RESULTS

Of 270 children, 170 were boys and 100 girls. Their ages ranged from 13 to 20 years and 13 to 19 years respectively. The mean age in boys was 15.2 (SE 0.15) and girls 14.6 (SE 0.13) years. Majority of the children belonged to low income families, 52% had monthly family income less than Rs.1,500, 30% between Rs.1,500 to 2,500 and 18% between Rs.2,600 to 3,500. The family size ranged from 4 to 18 with a mean of 8.6. In 86% families the earning member was only father, in 12% brother was also working while in 2% families only mother was the earning member. Few families kept cows and goats as the only source of income. All children were residing in more than 20 villages located near the schools. The main presenting signs and symptoms were pale conjuctive in 22%, koilonychia in 20% and tongue smoothness in 4.8%. Forty six (17%) children complained of weakness, tiredness and giddiness. Twelve (4.4%) children had worms, while 92 (34%) gave the previous history of worms manifestations. Seven (2.6%) children had fungal infection on the face. Excessive menstrual blood loss was noted in 15% girls. No reliable history of medication especially of iron was available in these children. The mean haemoglobin concentration was 13.9 g/dl. In boys the mean haemoglobin was 14.2 ± SE 0.13 (range 6.0 - 18.7 g/dl) and in girls 13.2 ± SE 0.13 (range 8.8 - 15.8 g/dl). The difference in mean haemoglobin levels between the two sexes was significant ($p < 0.001$). Of the total 170 boys, 30(17.6%) had haemoglobin levels less than 13 g/dl while 18 (18%) girls had haemoglobin levels below 12 g/dl. Very low haemoglobin levels below 10 g/dl were found in 5 (3%) boys and 4(4%) girls. The overall mean ferritin concentration was 27.4 (SE 1.5) ng/ml, 30.3 (SE 2.0) ng/ml in boys (range 1-160 ng/ml) and 22.4 (SE 2.1) ng/ml in girls (range 1 - 122 ng/ml). There was a significant difference (p 0.01) in mean ferritin levels between the two sexes. The criteria for iron deficiency by the method used in present study was serum ferritin levels below 16 ng/ml. Using this crite na 30% (51/170) of boys and 54% (54/100) of girls were found to be iron deficient. Of the total 270 children, 105 (38.8%) were iron depleted. When children were grouped according to the criteria of iron deficiency (Table I),

TABLE I. Means (± SE) Hb levels in children with ferritin levels ≤ 16 ng/ml and those with > 16 ng/ml.

Serum ferritin (ng/ml)	Haemoglobin (g/dl) Mean ± SE (No.)	Range
Boys		
≤ 16 ng/ml	*13.4 ± 0.26 (51)	8.4 - 17.2
> 16 ng/ml	14.6 ± 0.16 (119)	8.8 - 18.7
Girls		
≤ 16 ng/ml	*12.9 ± 0.20 (54)	8.8 - 15.8
> 16 ng/ml	13.6 ± 0.16 (46)	11.0 - 15.8

*p < 0.001

significant difference was found in the mean Hb levels. Iron deficient children had significantly lower mean Hb levels ($p < 0.001$) compared to children with adequate iron stores.

TABLE II. Mean (± SE) Ferritin levels in anemic boys (Hb < 13 g/dl) and girls (Hb < 12 g/dl) and those with normal Hb levels.

Haemoglobin (g/dl)	Serum ferritin (ng/ml) Mean ± SE (No.)	Range
Boys		
Hb < 13 g/dl	*16.2 ± 2.8 (30)	1 - 65
Hb ≥ 13 g/dl	33.4 ± 2.3 (140)	1 - 160
Girls		
Hb < 12 g/dl	14.3 ± 5.1 (18)	1 - 72
Hb ≥ 12 g/dl	24.2 ± 2.2 (82)	1 - 122

*p < 0.001

Table II shows that boys with Hb levels < 13 g/dl have signifi cantly ($p < 0.001$) low mean serum ferritin levels as compared to those with Hb levels < 13 g/dl. In girls with Hb levels < 12 g/dl, though the mean serum ferritin levels were lower than the mean levels in those with Hb levels > 12 g/dl but the

difference was not statistically significant. A significant correlation was found between serum ferritin concentration and Hb levels in iron deficient children ($r = 0.49$, $p < 0.001$). All the 12 children who had worms were found to be iron deficient and of the 15% girls with excessive menstrual blood loss, 10% had depleted iron stores.

DISCUSSION

Iron deficiency remains the most common single nutrient deficiency world wide and a cause of much morbidity[5]. A high prevalence of iron deficiency, anemia has been reported in infants and young children due to their rapid growth and often inadequate diet during weaning[4-6] and in adolescents, in whom a marked growth spurt occurs and iron requirements may outstrip absorption[3,7-9]. The prevalence of iron deficiency observed in this study was in general agreement with previous surveys; Iron deficiency (as sessed by serum ferritin assay) has. been reported in 40% of the adolescents in the British Isles[3] which is an unexpectedly high proportion, while the number of adolescents diagnosed as anemic were 13% of the boys and 7% of the girls (using Hb concentration at the recommended cut off points of 13 g/dl for adolescent boys and 12 g/dl for girls). In the present study, 39% of the adolescents were iron depleted while anemia was found in 17% boys and 18% girls. Iron deficiency found in adolescents in present study is higher than that reported from Japan[9] where adolescent iron deficiency anemia increased as the age. advanced, being 1.5% in the senior high school boys and 10% in senior high school girls. In a survey in United States 12% of the adolescent boys and 24% of girls were found iron deficient. These studies and present study indicate that the prevalence of iron deficiency is higher than that of anemia. This can partly be due to an overlap between the Hb concentration of normal and anemic individuals. The Hb concentrations of the adolescents with low ferritin concentrations in this study indicate the low sensitivity when Hb concentration is used as the criteria for iron deficiency. Low serum ferritin concentration in non-anemic ado lescents may be due to the presence of sufficient iron for cry thropoiesis but no store surplus. Iron deficiency has been reported much more common in adolescent girls than boys[3,9]. Fifty four percent adolescent girls and 30% of boys were iron deficient in this study. Such young women have a limited capacity to regulate body iron and compensate for any additional iron losses. They would therefore require iron therapy in pregnancy if iron deficiency anemia is to be avoided and would not be able to donate blood without developing anemia. This borderline state of iron balance in adolescent girls reflects the limited availability of dietary iron and the losses of iron due to menstruation[9]. The incidence of iron deficiency anemia in large population groups is inversely proportional to economic status. In present study the much higher prevalence of iron deficiency in adoles cents belonging to low socioeconomic group is likely to be due to a low intake of expensive iron containing foods especially meat, fish and poultry. All the children with worms infestations were iron deficient. They lived in villages with improper toilet facilities, unhygienic living conditions and lack of basic health education which play a major role in causation of worms infestation. Further studies are needed to assess the iron status in children and adolescents of higher socio-economic group and strategies for management of these cases through health education and organized school health services.

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