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Prevalence of Anemia Among School Going Adolescents of Chandigarh

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This study was conducted to assess the prevalence of anemia and determine serum ferritin status among 1120 apparently healthy adolescents (12 to 18 years) sampled from 11 city and 2 rural schools in Chandigarh. All the boys and the girls were subjected to anthropometric examination and hemoglobin estimation. The estimation of hemoglobin was done by cyanmethemoglobin method. Serum ferritin was estimated by ELISA (UB1 Magiwel enzyme immuno assay) method in 183 students. The overall prevalence of anemia calculated as per WHO Guidelines was significantly higher among girls (23.9%) as compared to boys (odds ratio –3.75, 95% CI –2.59 to 5.43, P <0.01). Anemia was observed more in rural (25.4%) as compared to urban (14.2%) adolescents (OR - 0.49, 95% CI - 0.34 to 0.70, P < 0.01). Iron stores estimated by serum ferritin in 183 subjects were deficient in 81.7% and 41.6%of the adolescent girls and boys, respectively.

Key words : *Adolescents, Anemia, Prevalence, Serum ferritin.*

NUTRITIONAL anemia is prevalent all over the world, with an estimated one billion people being iron deficient (1). Recent data from the District Nutrition Project (Indian Council of Medical Research) in 16 districts of 11 states, on prevalence of anemia in non pregnant adolescent girls (11-18 years) showed rates as high as 90.1% with severe anemia (Hb <7 g/dL) in 7.1%(2). In a study by Kapoor and Aneja(3) from public and government schools in Delhi, anemia among adolescent girls was as high as 50.8%. Compared to the vast amount of work done in pregnant mothers and young children, there are relatively few published studies on the prevalence of anemia in adolescents and

probably none in boys, and none from the city of Chandigarh.

The present study was designed to assess the prevalence of anemia and determine serum ferritin status among apparently healthy urban and rural school going children of Chandigarh in the age group of 12 to 18 years.

Subjects and methods

This cross sectional study was conducted from August 2002 to November 2002 in the urban and rural areas of Chandigarh. A total of 1180 students from thirteen schools between the age group of 12 to 18 years participated in the study. The selected urban schools were within the 5 km radius of our hospital and only those schools who gave us the permission to carry out this study were included. The two rural schools selected were registered in the adolescent health project of our department and come under rural health center of Department of Social and Preventive Medicine of our Medical College.

The rural schools cater to low socioeconomic group of population. The schools in urban areas included government and private schools catering to middle and high socioeconomic group. Considering the significance of variation in urban and rural samples, the samples size was calculated taking the level of significance at 5% and the power to 80%, which was found to be 195 in each group. 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.

A social demographic profile including parents' education, family structure and diet consumed (vegetarian, non-vegetarian) was noted. A detailed general physical examination was done to look for pallor, icterus, edema, hyperpigmentation, lymphadenopathy, bleeding spots and signs of vitamin deficiency and was noted on a predesigned proforma. Physical examination was done to rule out any systemic abnormality. The anthropometric measurements (weight and height) were made by single observer eliminating inter observer variability and errors. Nutritional status was evaluated using World health organization (WHO)(4) recommended age specific cut-off points of body mass index (BMI) based on the National Health and Nutrition Examination Survey (NHANES) percentile values(5).The body mass index (weight/height^2) less than 5th percentile for that particular age was the criteria used for classifying undernutrition. The study was carried out after obtaining free and informed verbal consent of the students and their parents. All the adolescents who were apparently healthy on general physical examination were included in the study. Those adolescents with chronic illness or receiving long-term drugs and needing hospitalization in the last two weeks before the study were excluded. Finally, 1120 students were included in the study and sixty students were excluded based on above exclusion criteria and those who did not volunteer to give blood for examination.

Samples were collected for estimation of hemoglobin by cyanmethemoglobin method and serum ferritin by ELISA (UB 1 Magiwel enzyme immunoassay) method. For hemoglobin estimation, 20 µL capillary blood was collected by finger prick into 5 mL Drabkins solution from all the participating students and measured on the same day. Samples for serum ferritin was collected from 183 students, for which 3 ml of venous blood was collected in test tubes, left to stand at room temperature for half an hour, centrifuged at 3500 r.p.m. for 10 minutes, and the separated serum was

transfused to fresh vials and stored at –30ºC,and the kit was calibrated against the WHO standards. Amongst girls, every fourth girl's sample was taken. In boys, since they were reluctant to give samples for serum ferritin, samples were collected from those whosoever volunteered. The hemoglobin and ferritin were estimated under strict quality control in the hematology laboratory of our medical college which is enrolled with External Quality Assurance program conducted by All India Institute of Medical Sciences, New Delhi (supported by National Accreditation Board for Testing and Caliberation Laboratories).

The criteria for detecting anemia was diagnosed as per WHO guidelines, (values less than 12 g/dL for girls from 12 to 18yrs and boys less than 14 years and less than 13 g/dL for boys from 15 to 18 yrs of age)(6). Iron deficiency was determined by taking the value of serum ferritin less than 15 ng/mL(7) .

Statistical analysis was done by SPSS software and Chi square test was used to calculate statistical significance.

Results

The study population comprised of 911 students from urban and 209 from rural area respectively. There were 590 girls and 530 boys. The overall prevalence of anemia among adolescents was 16.25% (182/1120). The hemoglobin values ranged from 6.5 to 18.2 (median 13.5; mean 13.35 $\pm$ 1.54; SE 0.05; 95% C). Prevalence of anemia was significantly higher (P <0.01)amongst girls (23.9%,141/590) as compared to the boys (7.7%, 41/530).

Anemia was significantly less among the urban school going children as compared to rural school going ones (14.16% *vs* 25.4%; P <0.01). Both girls 34.23% (38/111) and boys 15.3% (15/98) of the rural group were significantly more anemic than girls 21.5% (103/479) and boys 6% (26/482) of the urban group (P < 0.05 and < 0.01, respectively).

Serum ferritin level was estimated in 183 adolescents of which 86.8% (159/183) were girls and 13.2% (24/183) were boys. The serum ferritin level in girls below 15 ngm/mL was seen in 81.8% (130/159) as compared to boys (41.7%; P <0.01).

Iron deficiency anemia *i.e.,* hemoglobin level below the cut off for the age and serum ferritin level less than 15 ng/mL was noted in 11.4% of the girls and none of the boys, but the total number of boys tested for serum ferritin was small. It was also noted that in 73.2% (134/183) students despite being non anemic (normal hemoglobin), the serum ferritin was reduced (<15 ng/mL) and on the other hand there were six cases who were anemic but with serum ferritin level more than 15 ng/mL.

14.3% (84/590) girls and 14.2%(76/530) boys were undernourished (BMI <5th centile). Prevalence of anemia in girls whose weight was more than 5th centile was 21.9% as compared to 35.7% in those whose BMI was less than 5th centile (P <0.001). Similarly, in boys 6.7% were anemic in well-nourished group as compared to 14.4% in undernourished group (P <0.05). Associated micronutrient deficiencies included xeropthalmia in 18 and knuckle hyperpigmentation in two adoles-cents and all of them were anemic. None of adolescents had icterus, lymphadenopathy, edema or bleeding spots.

Discussion

Nutritional anemia though global in occurrence, is more of a concern in the developing countries because of the high prevalence in these regions. In spite of its high prevalence in children, studies on prevalence in adolescents specially boys are relatively few from developing countries. Adolescence

Key Message

- The prevalence of anemia in Chandigarh was 23.9% and 7.7% in adolescent girls and boys respectively and was related to nutritional status.

is a period of rapid growth and with inadequate and improper dietary habits, one is vulnerable to all kind of nutritional morbidities. Malnutrition, and worm infestation further aggravate the problem.

In a recent study conducted in semi urban Nepal, the prevalence of anemia in adolescent girls aged 11-18 years was found to be about 68.8%(8). In some of the less developed countries like Peru, Indonesia and Bangladesh, the prevalence of anemia in girls has been found to be around 25-30%(9).

Aggarwal, *et al*.(10) in a government school based study from middle socio-economic group of North East Delhi reported a prevalence of anemia as 45%. Similarly, studies on prevalence of anemia from different states of rural India, reported a prevalence of anemia from 46% to 98% (11-13).

In our study, prevalence of anemia in rural area, where majority were from lower or middle income group, was 34.2%. Whereas, in urban girls, who were from middle and high income group the prevalence was 23.9%. These findings are similar to those described by Vasanthi, *et al.* (14) where anemia and iron deficiency was of higher order in the rural girls as compared to the urban slum adolescent girls (28% to 24%). Similarly, Jondhale, *et al.* reported a prevalence of anemia as 14% in adolescent girls where the household income was more than Rs. 5000 per month and 26% where the household income was less than Rs. 5000 per month(15).

There are hardly any studies on the prevalence of anemia in boys. In our study, the overall prevalence of anemia in boys was 8% similar to one from a developed county like Norway(7). In rural area, the prevalence of anemia in the boys was 15.3%. Since the overall prevalence of anemia in the girls from rural population in our study is relatively low as compared to national standards, we speculate that if more studies are conducted in boys from low socio-economic group or rural or slum area, the prevalence of anemia in boys will be much higher nation wide.

Various studies confirm that serum ferritin is one of the most sensitive method for assessment of iron stores and for the detection of mild iron depletion(16). Its levels are directly related to bone marrow iron in all disease groups except those involving chronic inflammatory stage, malignancy and increased red cell turnover(17). However, the students enrolled for this study were healthy students and did not have any apparent clinical disorder. Overall majority of adolescent girls in our study were in pre-latent phase of iron deficiency anemia ie 81.8% of them showing depleted iron stores and 11.4% showed iron deficiency anemia (Serum ferritin <15 ng/mL and Hemoglobin <12 g/dL). Agarwal, *et al*.(10) in their study on adolescents girls of northeast Delhi noted 85% girls to be iron deficient and out of which 49.3% were anemic.

The present study reveals that most of the adolescent girls are in the pre-latent phase of iron deficiency anemia(depleted iron stores but normal hemoglobin levels), hence the

diagnosis of anemia is of particular importance in the adolescent girls because they enter the reproductive cycle soon after menarche. Further studies on the prevalence of anemia in the adolescent boys from low socioeconomic status, specially rural and urban slum areas are needed to find out the magnitude of the problem so that timely community based intervention can be instituted.

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