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Research Article

IMPACT OF NUTRITION EDUCATION IN REDUCING IRON DEFICIENCY ANEMIA IN ADOLESCENT GIRLS

***Manjeet Kaur[1], Roopam Bassi[2] and Saurab Sharma[3]**
Dept. of Physiology, Sri Guru Ram Das Institute of Medical Sciences & Research, Amritsar, India
**Author for Correspondence*

ABSTRACT
Iron deficiency is the commonest cause of anemia in the world, and continues to be the most prevalent nutritional anemia in developing countries. High prevalence of anemia among adolescent girls is a matter of great concern as they enter reproductive life soon after attainment of menarche. Thus, worldwide attention over iron deficiency anemia in pregnancy has shifted recently from providing nutritional supplements during pregnancy to attempting to ensure that women especially adolescent girls have adequate iron stores prior to conception. The present study was undertaken to assess serum iron status of fifty medical girl students and improvement if any, in their iron status with medical education. Various hematological tests measuring serum iron levels, hemoglobin concentration, hematocrit and RBC counts were done to assess their iron status at baseline, and follow up study after 12months. It was found that 62% of girl students had mild anemia (Hb>12gm/dl), and 14% of them had anemia of moderate degree (Hb>12gm/dl) at baseline which was significantly improved by nutrition education intervention in the follow up study after 12months.Hence from the study it was concluded that nutrition education is one of the appropriate, effective and sustainable approach to combat iron deficiency anemia.

Key Words*: Adolescent Girls, Iron Deficiency Anemia, Nutrition Education.*

INTRODUCTION
Iron deficiency anemia is a serious public health concern in most developing countries. In India, the prevalence of anemia among adolescent girls is 90%.(Toteja GS et al,2006).Variations in the prevalence rates of anemia are seen within the country with the lowest prevalence of 33% being reported from Andhra Pradesh to highest of 98% in Rajasthan. (Seshadri S,1997)
Adolescence is a time of intense physical, psychological and cognitive development (Jill S et al,2001). The iron needs are the highest in the adolescent girls because of increased requirements for expansion of blood volume associated with growth spurts and onset of menstruation (Dallman PR,1992)(Beard JL,2000) Thus growth spurts, menarche, poor diet and no added iron supplementation puts them into the high risk category of iron deficiency anemia. When these adolescent girls after marriage subjected to the added demands for iron during pregnancy, it may be too late to address the problem of anemia during pregnancy. Therefore adolescent girls who are potential mothers need to have better status of hemoglobin.
Regulation of iron balance occurs mainly in the gastrointestinal tract through absorption.(Beard J et al,1996) Iron in diet is present in heme and non heme forms. These two forms are absorbed differently. Heme form is present in meat, chicken and fish, and is absorbed two to three times faster than the non heme form which is found in plant based foods and iron fortified foods(Mangels R,2000)(Hallberg L,1981) .Enhancers of iron absorption are heme iron and vitamin C; Inhibitors of iron absorption include polyphenols, tannin, phytates and calcium. (Siengenberg D et al,1991).
The minimum daily dietary iron requirement during adolescence is 12 to 15mg/day which is increased up to threefold by the end of pregnancy.(Hallberg L and Hulten L,1996). Therefore improvement of the body iron stores should be emphasized before child bearing. (Kurz KM and Galloway R,2000)This can be achieved by programs for prevention of anemia among adolescent girls through nutrition, education and supplementation. (Chaudhary SM and Dhage VR,2008)(Zlotin S,2003)

MATERIALS AND METHODS
The study was conducted on 50 girl medical girl students, 17-19 years of age in the department of Physiology, Government Medical College, Amritsar. Selection of the girls was random. A detailed but

relevant history of each case was taken and every case was thoroughly examined. Blood samples were taken from anterior cubital vein and following tests were done after taking the consent of the subjects on prescribed proforma.

1.Haemoglobin estimation was done by Sahli's method.
2.Haematocrit: PCV was done by Wintrobe's method.
3.RBC Count was done using Hayem's diluting fluid.
4.Serum Iron estimation was done by Ramsay's Di-piridyl method.

The above investigations were carried out at baseline and labeled as Group 1. Repeat investigation after 12 months of same study cases was done and labeled as Group II. Various hematological indices like MCV, MCH and MCHC were calculated from above investigations. Lectures on Nutrition and good eating habits were organized for these girls .The girls were also advised to increase the number of daily meals with vitamin c rich foods in combination with iron rich foods daily.

The mean values & standard deviation along with 'p' values were calculated for all the parameters and tabulated. Statistical analysis using paired t' test was done to compare and see whether significant change present as indicated by 'p' values between the Groups.

RESULTS

A detailed and relevant history of 50 study cases revealed that 28(56%) girl students were vegetarian and 22(44%) were non vegetarians as shown in Table I along with bar diagram.

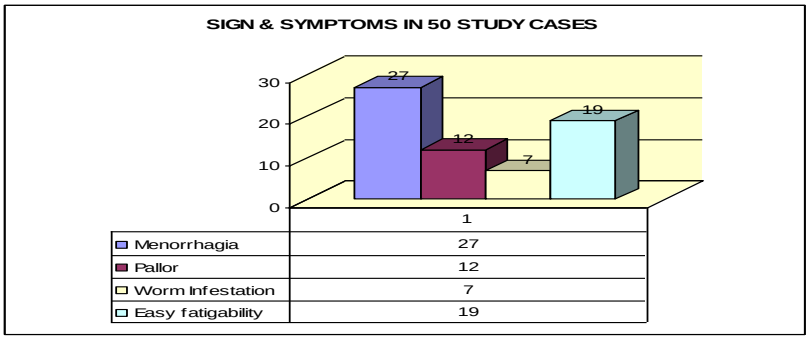
Table 1: Dietary History of 50 Study Cases in Group I

Sr .No	Factor	No .of Cases	Percentage
I	Vegetarian	28	56%
II	Non Vegetarian	22	44%

In our present study 27(54%) of girls students had complaints of Menorrhagia , 19(38%) presented with easy fatigability, 12(24%) had pallor and 7(14%) had history of worm infestations. The prevalence of anemia showed significant association with vegetarian diet, history of excessive menstrual bleeding and worm infestation, as shown in Table II with bar diagram.

Table 2: Sign & Symptoms Of Anaemia In 50 Study Cases In Group I

Sign & Symptoms	50 Study Cases	Percentage
Menorrhagia	27	54%
Pallor	12	24%
Worm Infestation	7	14%
Easy fatigability	19	38%



Hematological Parameters

1.Serum Iron –(Normal serum Iron levels 50-150 µg/dl).Serum iron levels of medical girl students in Group I was 101.52± 4.95 µg/dl, and repeat levels in Group II was 103.06± 4.0 µg/dl as shown in Table III. There was no significant change in serum iron levels in comparison between Group I and Group II study cases. The percentage change in serum iron levels from Group I and Group II was 1.56±1.73,as shown in Table IV.

2.Hemoglobin estimation- (Normal mean hemoglobin levels are 14.0 gm/dl ± 2.0) .The mean values of hemoglobin concentration in girl students in Group I was 11.20±1.18 and in Group II was 11.75±0.82 as shown in Table III. There was significant rise in hemoglobin levels in comparison between Group I and Group II study cases, with percentage change of 5.36±4.78,as shown in Table IV.

Lectures on Nutrition and good eating habits were organized for these girls .The girls were also advised to increase the number of daily meals with vitamin c rich foods in combination with iron rich foods daily.

3. RBC (Red Blood Cell) Count-(Normal RBC count is 4.5 million/cubic mm.) Our study data showed RBC count in Group I as 3.93±0.42 million /cubic mm and in Group II as 4.1. ± 0.38 million/cubic mm.as shown inTable III. There was significant increase ($p < 0.05$) in the mean values with percentage change in RBC count by 6.23±11.22 from Group I to Group II, as shown in Table IV.

*4 .Hematocrit or PCV(Packed Cell Volume)-(*Normal Mean values is 36-45%.)The mean values obtained in Group I was 34.94±3.9 % and in Group II was 36.66±2.37%.as shown in Table III. Our data showed significant increase($p < 0.05$) in the values in Group II from Group I with percentage change of about 5.32±6.15 as shown in Table III & IV .

Table 3: Comparison of Haematological Parameters In 50 Study Cases

Sr .No.	Parameters	Baseline Group I		Follow up Group II		"p" value	Significance
		Mean	SD	Mean	SD		
1	Serum Iron(µg/dl)	101.52	4.95	103.06	4.43	>0.05	NS
2	Hemoglobin(gm/dl)	11.20	1.18	11.75	0.82	<0.05	S
3	RBC Count(million/mm3)	3.93	0.42	4.14	0.38	<0.05	S
4	PCV(%)	34.94	3.19	36.66	2.37	<0.05	S
5	MCV(µmm³)	89.46	7.97	89.01	8.19	>0.05	NS
6	MCH(picogm)	28.66	2.91	28.53	2.84	>0.05	NS
7	MCHC(%)	32.03	1.40	32.05	0.95	>0.05	NS

"p" value >0.05 NS (Not Significant)
"p" value <0.05 S (Significant)

Table 4: Comparison of Percentage Change in 50 Study Cases from Baseline to Follow up Study after 12 Months

Parameters	Percentage Change	
	Mean	SD
Serum Iron	1.56	1.73
Hemoglobin	5.36	4.78
RBC Count	6.23	11.22
PCV	5.32	6.15
MCV	0.11	11.23
MCH	0.18	10.80
MCHC	0.23	5.08

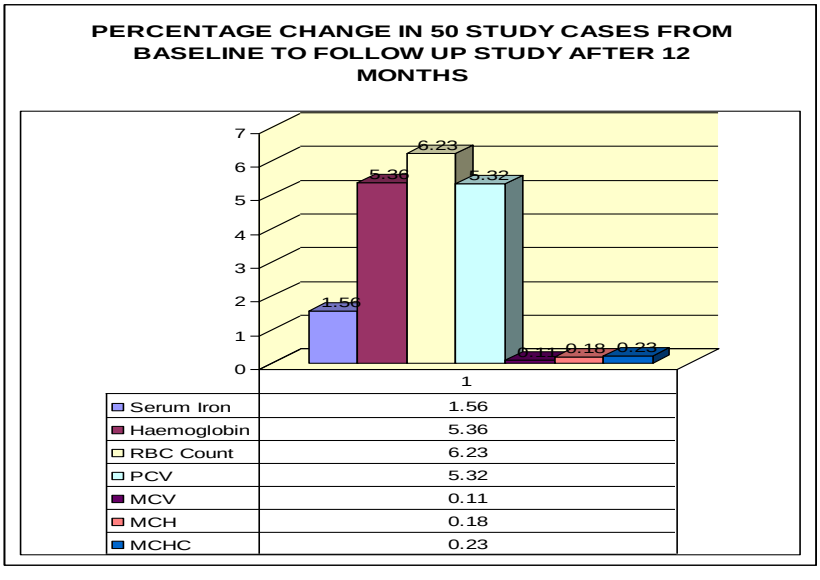
MCV: Mean Corpuscular volume- (Normal value of Mean Corpuscular volume is 80-100µcumm.) MCV in Group I was 89.46±7.97 µcu mm while in Group II was 89.01±8.19 µcu mm. There was insignificant change in values in Group I and Group II with percentage change of only 0.11±11.23,as shown in Table III & IV.

MCH: Mean Corpuscular Hemoglobin-(Normal values of Mean Corpuscular Hemoglobin is 27-32 pico grams.)The mean values for MCH in Group I was 28.66±2.91 pico grams while in Group II was 28.53±2.24 pico grams with percentage change of 0.18±10.80,as shown in Table III & IV.

MCHC: Mean Corpuscular Hemoglobin Concentration-(Normal values of Mean Corpuscular Hemoglobin Concentration is 30-34%.)The mean values of MCHC in Group I was 32.03±1.40% and in Group II was 32.05+_0.95% with percentage change of 0.23±5.08,as shown in Table III &IV.

DISCUSSION

The incidence of iron deficiency amongst adolescents is rising. The awareness regarding anemia and appropriate diet is extremely poor in adolescents. (Kanani S,1995)Estimates suggest that over one-third of world population suffers from anemia, mostly iron deficiency anemia. The National Family Health Survey (NHFS-3) conducted in 2005-2006 presents the statistics that 56% of adolescents are anemic.A recent study in adolescent girls of rural Wardha, India (Kaur S et al,2006) found prevalence of anemia to be 59.8% with significant association of low iron intake vegetarian diet, and excessive menstrual bleeding, similar to our study. Despite the magnitude of the problem few strategies exist in Indian public health programs to tackle iron deficiency anemia in adolescent girls. A multipronged 12 +12 initiative has been launched by WHO in the country The initiative is targeted at all adolescents across the country with aim for achieving hemoglobin level of 12gm% by age of 12 years by 2012.Thus to combat anemia, present study was done in which serum iron status of 50 medical girl students was observed by measuring their serum iron levels hemoglobin estimation, hematocrit, and RBC count. Red cell indices i.e MCV, MCH,& MCHC were calculated from above values. Repeat assessment was done after 12 months follow up from baseline study.



Serum Iron : It was observed that serum iron levels were with in normal range of 50-150g/L. In Group 1 the mean serum iron levels were 101.52±4.95 as compared to 103.06±4 in Group II indicating no significant change ($p>0.05$) after 12 months follow up study. Thus above results do not indicate iron deficiency anemia but, at same time iron deficiency cannot be ruled out, as serum iron directly measures the amount of iron in the blood and not reflects body iron stores. Serum ferritin measures body iron

stores, which is not done in our study, therefore according to Lozof's iron deficiency stages, it could be stage of iron-depletion.(Lozoff B,1988)

Hemoglobin: Normal hemoglobin levels are 14gm/dl+2 in women. Mean values of hemoglobin in Group 1 were 11.20±1.18 gm/dl and in Group II were 11.75±0.82 gm /dl. It was observed that 62% of girls had mild anemia (10-12 gm/dl) and 14% had moderate anemia (<10gm/dl) in Group I baseline study. There was significant($p<0.05$) rise in hemoglobin levels with percentage change of 5.36±4.78 as compared to baseline with 12 month follow up study as shown in table-3. The impact of Adolescent Girls Anemia Prevention program in Maharashtra (2000-2003) showed hemoglobin level rise from 5.8 to 9.5gm/dl in severely anemic girls and from 8.9 to 11.2gm/dl in moderately anemic girls by changing dietary behavior (Pande R et al,2005).Another similar community-based randomized behavioral and dietary intervention trial was conducted in adolescent girls of Lima, Peru. Their results showed improvement in dietary intake of iron and iron status due to change in knowledge (Creed-Knashiro HM et al,2000).In our research also, iron status of girl students improved by getting medical knowledge which is in accordance with the above studies.

RBC count : Our data showed RBC count in Group I was 3.93±0.42 million/cu mm while in Group II was 4.14±0.38 million/cu mm. Mild anemia (<4.5m/cumm) was seen in 80% of girl students while 12% of girls had moderate anemia(<3.5m/cumm) in Group I. There was significant rise ($p<0.05$) in RBC count as compared from Group I to Group II showing %age change of 6.23±11.22.

PCV or Hematocrit : Mean values obtained in Group I was 34.94±3.19 and in Group II was 36.66±2.37 as shown in table III. PCV count in 52% of girl students was below 35% indicating anemia in Group I. There is significant rise ($p>0.05$) in PCV counts in comparison between Group I to Group II, with %age change of 5.32±6.15 as shown in table IV. Anemia is a collective name for reduction of erythrocytes, hemoglobin or hematocrit, although all three conditions may be present. On the basis of above parameters our study signified that majority of girls had mild anemia and few of them had moderate anemia. There was significant increase ($p<0.05$) in hemoglobin,RBC count and hematocrit after 12months of medical education. Similar study in Southern Benin was conducted where multidietary strategy improved iron status of adolescent girls (Aloafe H et al,2009).

RED CELL INDICES: The degree of change in the red cell indices is related to the duration and the severity of anemia.

MCV: In 86% of girl students MCV was within normal range of 80-100cumm. Only 2% of cases showed microcytosis (<80 cu mm) and 12% of cases showed macrocytosis (<100 cu mm) in Group I baseline study.

MCH: In 72% of girl students MCH was within normal range of 27-32pg, 18% of girls showed hypochromia (<27pg) in Group I baseline study.

MCHC: In 90% of girls MCHC was within normal range of 30-34%.Only 8% of girls showed percentage saturation of hemoglobin less than 30% in Group I study cases.
The MCV and MCH are reduced in usually acute patients, while MCHC is reduced in long standing or severe cases. In mild cases of iron deficiency of short duration the indices are normal. Combined deficiency of folate and iron may give rise to macrocytic and microcytic hypochromic anemias which could yield normal indices .In early iron deficiency anemia the red cells are normocytic and normochromic.(Fairbanks VF et al,1971)In later stages microcytosis develop.
In our study, majority of cases showed normocytic normochromic anemia followed by few cases of macrocytic and microcytic hypochromic anemia indicating combined folate and iron deficiency could be the cause. Iron and folic acid supplementation reduces prevalence of anemia by 21.5%(Kotecha PV et al,2009) But consumption of these tablets have several side effects of gastrointestinal tract therefore by

educating adolescents to improve their diet containing good sources of iron and other micronutrients have equally good impact on their iron status.(Mathur B et al,2004)Various other studies also show that Nutrition education intervention resulted in improvement of nutritional knowledge as well as increase in consumption of nutrition rich foods.(Saibaba A et al,2002)(Sajjan JT,2008).

Conclusion

We conclude that adolescent girls have tendency to consume junk food and not enough food rich in iron sources .Growth spurts and menarche increases iron requirements with poor diet and no added iron supplementation puts them into the high risk category for iron deficiencies. Thus increasing awareness and knowledge among adolescent girls will improve anemia in long run .and potential of applying this experience(study) through schools ,colleges and other organisations reaching adolescent girls provides an exciting and feasible opportunity. Hence Nutrition Education and supplementation should be a part of Education System to improve iron status of adolescents, so that after marriage they can enter pregnancy with no serious iron-deficiency handicaps.

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