
IRON INTERVENTION FOR IMPROVEMENT OF IRON STATUS IN ADULT FEMALE

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ABSTRACT:

The importance of micronutrient deficiencies to the health and development of nation is universally recognized. Anemia both in terms of prevalence as well as in its ill effects has been recognized as one of the most important micronutrient deficiency. It is the major public health problem today. Iron deficiency anemia affect more than 3.5 billion people in the developing world. Therefore, prevention and control of iron deficiency anemia is imperative for improving quality of life. A total of 120 unmarried college going adult females aged 18-25 years were selected for the study on the basis of their hemoglobin level. 90 anemic females were divided into three groups (30 in each group) on the basis of type of intervention i.e. food based powder group (FBPG), synthetic iron group (SIG), and dietary improvement group (DIG). Anthropometric measurements and hematological status were assessed before and after intervention to evaluate the effects of intervention. Data on anthropometric measurements revealed that weight, skinfold thickness at subscapular and suprailiac site, waist hip circumference of anemic subjects were significantly low as compared to reference group. Similarly other body indices weight for age, weight for height and BMI of the anemic subjects were significantly low than the value of reference group. Results showed that anthropometric measurements, body indices and body composition were not affected and changed by iron intervention. Hematological status of anemic adult females revealed that mean hemoglobin level of subjects was 9.85g/dl before intervention, which increased significantly to 11.59g/dl after intervention. Data showed that there was no significant difference among the three groups with respect to hemoglobin level before intervention as well as after intervention and all three methods of intervention were equally effective to improve iron status. Iron intervention also had positive effect on other hematological status i.e. RBC count, hematocrit, MCV, MCH and MCHC. These results clearly depicts that iron intervention had positive impact on iron status.

Keywords:

Anemia;

Adult female;

Iron intervention.

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1. INTRODUCTION:

The element iron was first recognized as a constituent of body tissue in 1713. Iron is the most abundant element on earth. In the earth's crust it is second among metals only to aluminum. It represents about 0.004% of the body weight, an amount varies from 3 to 5 g depending on age, sex, size, nutritional status, general health and size of iron stores. Iron is essential for the completion of numerous important biological functions; including electron transfer reaction, gene regulation, binding and transport of oxygen, regulation of cell growth and differentiation. Nutritional anemia is a major public health problem in the world today. It affects all age groups, both sexes and has developmental and health consequences. Iron deficiency causes a reduction in number of RBC or the amount of circulating hemoglobin. Multiple factors are responsible for iron deficiency anemia (IDA), the immediate cause is inadequate bioavailability of iron in the diet. Along with this, the diets are poor in ascorbic acid and protein, a situation which would lead to poor absorption of dietary iron and thus explain, the wide spread iron deficiency in spite of seemingly high intake of iron. Parasitic infestations, malaria, chronic infections and genetic factors may also cause anemia. Globally the most affected groups are pregnant women (48%) and 5-14 years old children (39%). Predictably, the prevalence of anemia in developing countries is 3 to 4 times higher than in industrialized countries [1]. Estimates suggest that about 25-50 per cent girls became anemic by the time, they reach menarche. Both rural and urban girls are equally affected from iron deficiency [2]. With increasing age, the prevalence rates decline in male, while such reduction was not observed in females [3], women are 10 times more likely to be iron deficient than men. IDA in women of child bearing age increases the hazards associated with the complication of pregnancy, premature birth, low birth weight and causes infant to enter life with suboptimal iron reserves. Therefore, prevention and control of iron deficiency anemia is imperative for improving quality of life. The management of anemia involves use of iron preparation commercially available in the form of tablets, capsules and syrup. However, a nutritionist advocates the prevention and treatment of anemic condition by dietary management. Dietary management is required not only to increase the intake but also to increase bioavailability of iron from the predominantly cereal based diet of the vast majority of Indian population. In this regard the present study was conducted to evaluate the effect of iron intervention through medicine, indigenous foods and nutrition education.

OBJECTIVE:

The study was conducted to find out effects of iron intervention on iron status.

2. RESEARCH METHOD:

The present study was conducted on adult females of Udaipur city, Rajasthan. A total of 120 Unmarried adult females aged 18-25 years studying in different colleges of Udaipur were selected on the basis of their hemoglobin level. 90 anemic adult females were identified (hemoglobin level $<12\text{g/dl}$). Along with this a group of 30 normal adult females considering normal hemoglobin level ($\geq 12\text{g/dl}$) was also selected as a reference group. An interview schedule was developed and pretested before collection of data. The background information about the family and the subject was recorded for each adult female. Three approaches of iron intervention were used to improve hemoglobin level i.e. Food Based Powder Group (FBPG), Synthetic Iron Group (SIG), and Dietary Improvement Group (DIG). The selected 90 females were divided into 3 groups i.e. 30 in each group. For group I i.e. FBPG, iron rich tablets were developed by mixing iron rich powder of lotus stem and rice bran with lemon juice. For this purpose the methods of iron rich powder developed by Jain and Sharma [4] from lotus stem and Jain and Mathur [5] from rice bran were used. Subjects of group II i.e. SIG were given commercial iron tablets. In III group i.e. Dietary Improvement Group, dietary improvement done by personal discussion. Pre and Posttest design was used for intervention and it was carried out for 60 days. The nutritional status of adult females was assessed using anthropometric measurements i.e. weight, height, waist and hip circumferences and skinfold thickness at four sites using standardized techniques. From these measurements BMI, weight for height, waist hip ratio and body composition were also calculated. Hematological examination i.e. hemoglobin, RBC count, hematocrit, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration of these females carried out by twin cell. It is microcomputer based hematological analyzer. Anthropometric and hematological examinations were carried out before and after intervention. Above mentioned measurements were also carried out on reference group once during the study.

3. RESULTS AND ANALYSIS:

Results revealed that majority of the families were Hindu (86%) and vegetarian(91%). Non vegetarian foods were consumed rarely by non-vegetarian families. Maximum number of adult female's i.e. 77% was from nuclear families. Information on family size depicted that maximum family i.e. 89.66 per cent had 4 to 6 member in their family. The mean total income of the family was Rs. 25510 per month.

3.1 Anthropometric measurements:

Weight, height, skinfold thickness at four sites, waist and hip circumference were taken for each of selected adult female before and after intervention and for reference group once during the study.

3.1.1 Weight:

No significant change in weight value was observed after intervention among anemic groups. The mean weight before and after intervention were 43.78 kg and 43.98 kg, respectively (Table 1). However, the weight of anemic group was significantly lower ($p < 0.01$) than the reference group before and after intervention. For reference group, weight value as percentage of standard was 89.31 and it was significantly higher than anemic group before and after intervention at 1 per cent level. This indicated that the weight was not affected by the intervention group. Prevalence of malnutrition assessed using McLaren classification [6] also did not show any changes with intervention.

3.1.2 Height:

Mean height of anemic (154.82 cm) and nonanemic (152.85 cm) group did not show any significant difference (Table 1). Although, the height percent to NCHS standard [7] for anemic group was higher (99.45%) than reference group (93.37%), but the difference was not statistically significant. Prevalence of malnutrition showed 20 percent non anemic women and 10 per cent anemic were short stature.

3.1.3 Weight for Height:

Mean weight for height per cent of anemic group before intervention was 101.23, it was increased to 101.68 after intervention. For reference group weight for height per cent was 119.02, it was statistically significant with anemic group before and after intervention which indicates no change in weight for height status after intervention (Table 2). Prevalence of malnutrition showed that 70 percent adult females were normal, 16.67 per cent were mal nourished and 13.33 per cent were over nourished. After intervention 3.33 per cent under nourished females were shifted to normal category but it was not statistically significant.

3.1.4 Body mass index:

Similar to other body measurements, body mass index was increased slightly after intervention i.e. from 18.38 to 18.46 kg/m², which was not statistically significant. Mean BMI value of reference group was 21.55 kg/m² (Table 2). This BMI value of reference group was significantly higher than anemic group before and after intervention at both 5 and 1 per cent level. McLaren classification evinced that 40 per cent women were normal before intervention which increased to 43.33 per cent after intervention. No change was observed in over weight category after intervention.

Table 1: Mean \pm SD values of body measurements of intervention group

Parameters	Refer ence group (30)	Anemic group							
		FBPG (30)		SIG (30)		DIG (30)		Total (90)	
		Before	After	Before	After	Before	After	Before	After
Age (yrs.)	19.13 \pm 1.46	19.56 \pm 1.35	-	18.78 \pm 0.89	-	19.76 \pm 1.45	-	19.37 \pm 1.32	
Weight (kg)	50.55 \pm 6.05	43.90 \pm 2.30	44.15 \pm 1.55	43.75 \pm 4.15	43.00 \pm 3.77	43.70 \pm 3.77	43.80 \pm 3.43	43.78 \pm 3.50	43.98 \pm 3.08
Height (cm)	152.8 \pm 5.04	154.7 \pm 4.82	-	157.80 \pm 4.50	-	151.95 \pm 7.08	-	154.82 \pm 6.08	-
Bicep (mm)	6.22 \pm 1.08	5.82 \pm 1.68	5.82 \pm 1.66	5.73 \pm 1.52	5.83 \pm 1.40	5.32 \pm 1.78	5.32 \pm 1.75	5.62 \pm 1.67	5.65 \pm 1.63
Tricep (mm)	11.82 \pm 2.22	10.62 \pm 2.84	10.64 \pm 2.79	9.4 \pm 1.59	9.42 \pm 1.71	10.86 \pm 2.6	10.92 \pm 2.62	10.29 \pm 2.49	10.32 \pm 2.51
Subscapular (mm)	16.52 \pm 2.76	12.62 \pm 4.45	12.78 \pm 4.16	11.04 \pm 1.6	11.12 \pm 1.55	12.84 \pm 3.87	12.96 \pm 3.44	12.17 \pm 3.62	12.29 \pm 3.44
Suprailiac (mm)	17.16 \pm 2.34	15.32 \pm 4.11	15.36 \pm 3.99	13.28 \pm 2.58	13.52 \pm 2.57	14.36 \pm 3.58	14.30 \pm 3.31	14.32 \pm 4.34	14.39 \pm 3.43
Waist circumference (cm)	73.7 \pm 3.16	69.80 \pm 5.60	69.85 \pm 5.13	69.4 \pm 5.44	69.7 \pm 4.87	68.7 \pm 5.25	69.05 \pm 5.16	69.30 \pm 5.45	69.53 \pm 5.07
Hip circumference (cm)	93.4 \pm 5.44	87.00 \pm 4 .07	87.20 \pm 3.52	87.20 \pm 3.52	87.35 \pm 3.32	86.70 \pm 3.82	86.85 \pm 3.90	87.10 \pm 3.61	87.13 \pm 3.59

3.1.5 Skinfold thickness:

Mean value of bicep skinfold before and after intervention was 5.62 and 5.65 mm respectively. For reference group mean bicep value was 6.22mm, which is slightly higher from anemic group before and after intervention (Table 1). The tricep skinfolds as percentage of standards was 62.38 and 62.59 indicating that there was no improvement in fat stores at Tricep also. There was no significant difference between reference group and anemic group (both before and after intervention). Difference between mean values of subscapular fat folds before (12.17) and after (12.29) intervention was non-significant. In contrast to bicep and tricep, mean values of subscapular and suprailiac fat folds of reference group were significantly higher from anemic group females at prior and after intervention.

3.1.6 Waist Hip Circumference

Over all waist circumference of adult females was 69.30 and 69.53 cm before and after intervention respectively and was not significant. However, the values were significantly different from reference group. Waist hip ratio did not improve after iron intervention. Results also implied that waist circumference of these group were in proportion to hip circumference.

3.1.7 Body composition:

Body fat per cent of reference group calculated by skinfold thickness was 25.82. It did not vary significantly with per cent body fat of anemic females before and after intervention. It was found that mean fat free mass of anemic group before and after intervention was 76.27 and 75.99 per cent respectively. Per cent fat free mass was slightly decreased after intervention because fat mass increased slightly. It was also observed that iron intervention had no effect on body composition.

It was observed iron intervention had no positive effect on anthropometric measurements and indices. On the contrary in Kenya, a positive effect on growth and appetite was significant in supplemented group (87 primary school children for 14 weeks) than that in children, who were receiving the placebo [8]. Similar study was also conducted in urban area of Vadodara, India to investigate the effect of IFA supplements, and found positive effect on growth [9].

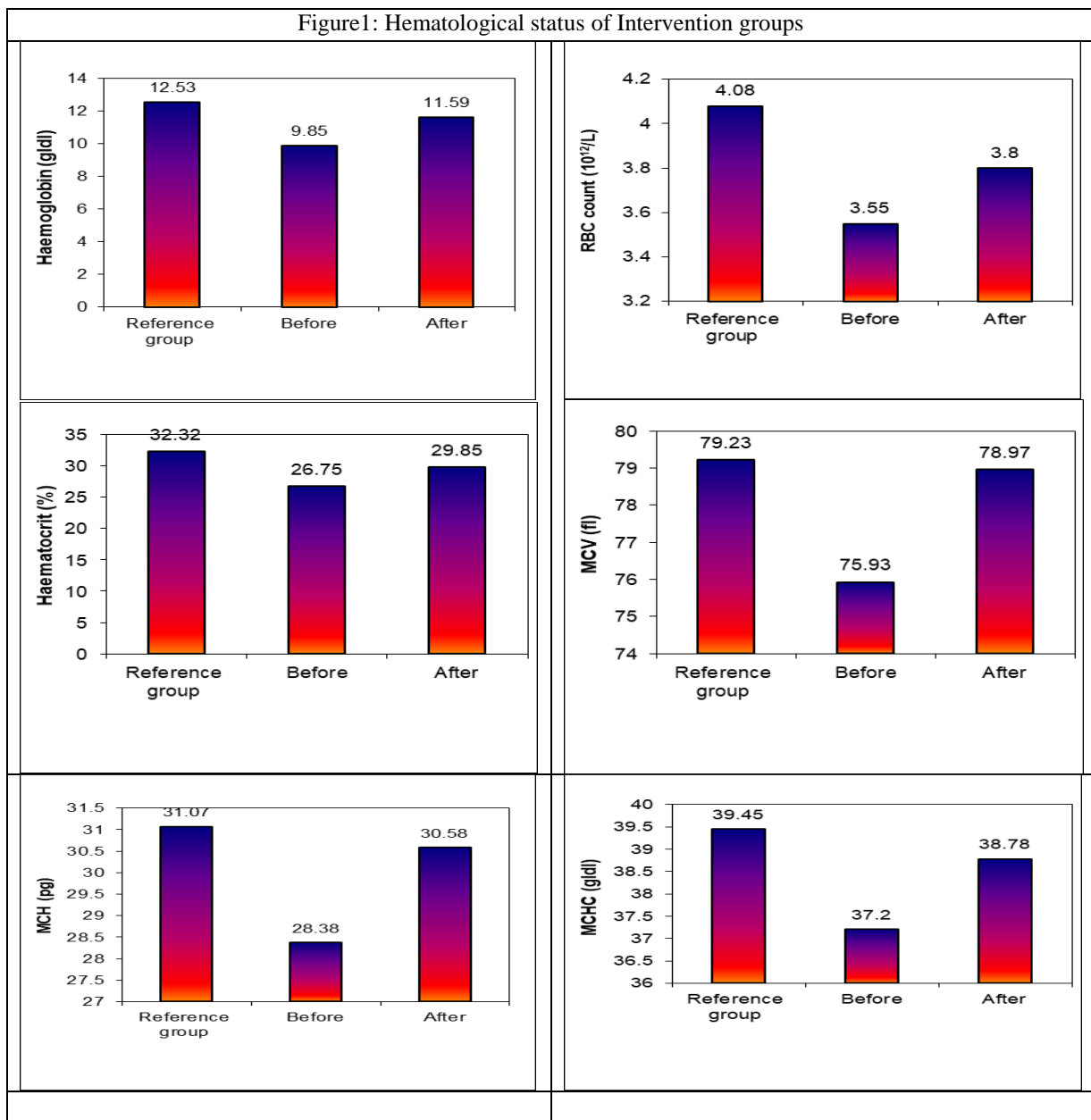
Table2: Mean +SD Values of body indices

Parameters	Reference group (30)	Anemic group (30)	
		Before	after
Weight/age (%)	89.3± 10.69	77.36± 6.18	77.71± 5.44
Height/age (%)	93.37± 3.33	99.45± 3.79	-
Weight/Height (%)	119.02± 5.73	101.23± 12.08	101.68± 15.36
BMI (Kg/m ²)	21.55± 1.28	18.38± 2.41	18.46± 2.30
Tricep (%)	71.64± 13.49	62.38± 15.06	62.59± 15.19
Waist Hip Ratio	0.79± 0.04	0.795± 0.049	0.797± 0.048

3.2 Hematological status:

3.2.1 Hemoglobin

Results revealed that mean hemoglobin level of subjects was 9.85 g/dl before intervention, which increased to 11.59 g/dl after intervention (figure1). This increment in hemoglobin due to intervention was highly significant ($p < 0.001$). Maximum increment in hemoglobin was observed in FBPG i.e. 1.98g/dl. In SIG and DIG increments in hemoglobin were 1.88 g/dl and 1.35 g/dl respectively (figure2). A significant increase ($p < 0.001$) in hemoglobin level was observed after intervention among all the groups indicating a positive effect of intervention.



Mean hemoglobin level of reference group was 12.53 g/dl and was statistically significant at 5, 1 and 0.1 per cent with hemoglobin level of anemic adult females before intervention. The degree of significance decreased to 5 and 1 per cent after intervention. This confirms the positive effect of intervention on hemoglobin level. These results were in close conformity with the findings of improved hemoglobin level in 30 children aged 7 to 12 years after supplementation of RTM (iron rich powder) [10]. Increased hemoglobin level in preschool children by supplementing nutrient rich mix prepared with indigenous foods was also reported [11]. Similar improvement in hemoglobin level after supplementation of medicinal iron in adult females has also been reported by [12], [13], [14] and [15]. After intervention, 30 per cent of anemic shifted to normal category and only 3.33 per cent remained in moderate category. Chi square values were highly significant indicating that intervention has positive effect on hemoglobin level. Similar findings have been reported in a pharmacological study to find out effect of tablets of lotus stem and seed with 40% sugar [16].

3.2.2 RBC Count:

A positive effect of intervention was also confirmed by a significant increase ($p < 0.05$) in the value of RBC count after intervention. It was interesting to note that the value of RBC count in anemic group prior to intervention was significantly lower with reference group, whereas this difference becomes non-significant after intervention. Results indicated that after intervention 20 per cent of anemic group had low RBC count shifted to normal category.

3.2.3 Hematocrit:

Figure 1 shows that mean hematocrit value of adult females was 26.75 per cent before intervention which increased significantly ($p < 0.001$) to 29.85 per cent after intervention. Mean hematocrit values of reference group differed significantly with the values of anemic group before and after intervention. But this difference was decreased and was significant only at 5 per cent level.

3.2.4 Mean corpuscular volume (MCV):

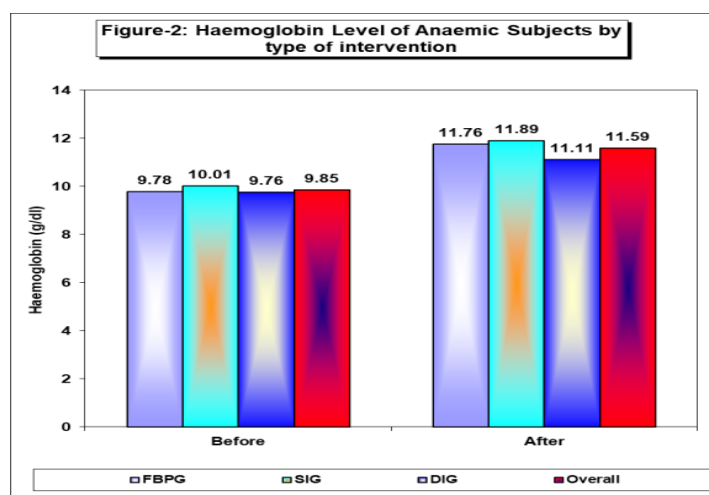
In contrast to above hematological measurements, MCV did not increase significantly after intervention implying that the increment in RBC count and hematocrit during intervention period was in proportion. In addition, MCV values of reference group and anemic group did not differ significantly.

3.2.5 Mean Concentration Hemoglobin (MCH):

MCH results were similar to MCV. It was also increased after intervention but the effect was not significant statistically. Difference between reference group and anemic group before and after intervention with respect to MCH were also not significant.

3.2.6 Mean Corpuscular Hemoglobin Concentration (MCHC):

MCHC value was increased significantly after intervention at 5 per cent level. Before intervention, it was 37.20 g/dl that is increased to 38.78 g/dl after intervention (figure 1). MCHC values before intervention differed significantly from reference group but after intervention it was not significant. It confirms the positive effect on intervention on hematological status. Chi square value showed that the difference was not significant but shift to subjects towards normal category was observed after intervention. Similar results were also observed in Indian girls of Southwest London [17], a study conducted on college students of India and reported that the anemic group had low level of iron, PCV, MCV, MCH AND MCHC [18]. Above results clearly reveal that intervention had positive effect on hematological status of anemic adult females.



4. Conclusion:

Results revealed that all 3 groups were similar with respect to anthropometric measurements and hematological status. Data on anthropometric measurements revealed that weight, skinfold thickness at subscapular and suprailiac sites, waist and hip circumference of anemic subjects were significantly low as compared to reference group. In the present study no change in anthropometric measurements after intervention can be attributed to the fact that the group was different and also due to the supplement given during intervention. In this study the intervention was mainly conducted through the iron concentrates. Hematological data in anemic groups showed improvement in all hematological parameters after intervention. Hemoglobin level of subjects was 9.85 g/dl before intervention, which increased to 11.59 g/dl after intervention. Hemoglobin, RBC count and MCH were found to increase significantly. No significant difference in hematological status of three groups of intervention before and after test design indicating that the improvement in iron status was almost similar in all three groups. It clearly suggests that food based and dietary counseling approaches can be used to replace the medicinal iron approach.

References:

- [1] ACC/SCN, Fourth report on the world nutrition situation: Nutrition during the life cycle, Geneva, 2000.
- [2] Vasanthi, G., Pawashi, A.B., Susie, H., Sujath, T. and Raman, L. Iron nutritional status of adolescent girls from rural area and urban slum. *Indian Pediatr.* 31 :127 , 1994.
- [3] Agrawal, D.K., Upadhyay, S.K., Tripathi, A.N. and Agrawal, k.N. Nutritional status, Physical work capacity and mental function in school children. New Delhi. Nutrition Foundation of India Scientific Report No.6 , 1987.
- [4] Jain, S. and Sharma, P., Unpublished data personal communication, Maharana Pratap University of agriculture and technology, Udaipur (Raj), 2001.
- [5] Jain, S. and Mathur, S., Unpublished data personal communication, Maharana Pratap University of agriculture and technology, Udaipur (Raj), 2001
- [6] McLaren, D. S. Nutritional Assessment. In: Text book of pediatrics nutrition. McLaren, D. S. and Burman, D. (Eds.) Churchill Livingstone, New York, 1976.
- [7] NCHS, Growth survey for children, birth to 18 years. Data from the National Health Survey, Vital Health Statistics, 11 (165): 28 (US Department of Health Education and Welfare), 1977.
- [8] Lawlers, J.W., Latham, M.C., Stephenson, L.S., Kinoti, S.N. and Pestet, A.M. Iron supplementation improves appetite and growth in anemic Kenyan primary school children. *J. Nutri.* 124 : 645. 1994.
- [9] Kanani, S.J. and Poojara, R.H., Supplementation with iron and folic acid enhances growth in adolescent Indian girls- Supplement. *J. Nutri.* 130 : 452S , 2000.
- [10] Sharma, P., Unpublished data personal communication, Maharana Pratap University of agriculture and technology, Udaipur (Raj), 2001.
- [11] Jain, S. and Trivedi, D., Unpublished data personal communication, Maharana Pratap University of agriculture and technology, Udaipur (Raj), 2001.
- [12] Gardner, G.W., Edgerton, V.R., Barnard, R.J. And Bernauer, E.M. Cardio respiratory, hematological and physical performance responses of anaemic subjects of iron treatment. *Am. J. Clin. Nutr.* 28 : 982, 1975.
- [13] Vijayalakshmi, P. and Jayanthi, N. Anemia and work output .*Ind. J. Nutr. Dietet*, 23:279, 1986.
- [14] Vijayalakshmi, P., Kupputhurai, U. and Uma Maheswari, V. Anemia and work output of farm women. *Ind. J. Nutr. Dietet*, 24 :233, 1987.
- [15] Li, R., Chen, X., Yan, H., Deurenberg, P., Garby, L. and Hautvast, J.G.A.J. Functional consequences of iron supplementation in iron deficient female cotton mill workers in Beijing China. *Am. J. Clin. Nutri.* 59 :908. 1994.

[16] Sharma, P., DravyaGunaVigyan, V.: Ayurveda series 3, ChaukhambhaBharti Academy, Varanasi, India: 713. 1993.

[17] Nelson, M., Bakaliou, F. and Trivedi, A. Iron deficiency anemia and physical performance in adolescent girls from different ethnic backgrounds. Br. J. Nutr. 72 : 427, 1994.

[18] Murthy, N. K., Srinivasan, S. and Rani, p. Anaemia and endurance capacity among children and women of 6-26 years. . Ind. J. Nutr.Dietet.26 : 319, 1989.