Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/4975
DOI URL: http://dx.doi.org/10.21474/IJAR01/4975
ISSN NO. 2320-5407

RESEARCH ARTICLE

EFFECT OF DIETARY IRON INTAKES ON PHYSICAL WORK CAPACITY OF ADOLESCENT GIRLS FROM DIFFERENT DEPRIVED COMMUNITIES.

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Manuscript Info

Manuscript History

Received: 27 May 2017
Final Accepted: 29 June 2017
Published: July 2017

Key words:-
Anemia, Public health, step test, resting pulse rate, low socio economic group.

Abstract

Anemia, primarily caused by a lack of dietary iron, is most commonly found in children from the lower socio economic groups. Nutritional anemia is a serious public health problem. The present investigation was undertaken with a major objective of assessing dietary iron intakes of female adolescent girls (10-18 years) residing in rural areas and urban slums of Chittoor Distirct. A group of age matched urban elite girls was also studied who acted as experimental control. The study sample of girls were selected by adopting multi stage sampling technique. The dietary survey of all the subjects was carried out to get food intake data for 3 alternated days in a week and by one day weighing method. Thus mean of 3 days intake was considered and mean of 3 days dietary iron intakes were compared with recommended allowances of ICMR. The physical work capacity of girls was assessed through step test. After recording pulse rate the subject was made to climb up and down a pair of 9" step stair case for a period of three minutes. Total number of steps taken during a three minute was counted immediately after stopping the activity post exercise pulse rates was counted. The time taken by the child to reach the basal pulse rate was noted as recover time in seconds. SPSS – 13 (statistical package for social sciences) was used for statistical analysis, student t- test and analysis of variance was done for comparison among 4 different communities for dietary iron intakes and physical work capacity. Results indicated that the mean iron intakes of rural and urban girls are significantly far below the RDA and the differences were significance at 1% level. Urban elite (UE) girls performed more number of steps than the other three groups of girls. The resting pulse rate, post exercise pulse rate and recovery time are significantly more for RSC (Rural Scheduled Caste) followed by USL (Urban Slum), RFC (Rural Forward caste) girls in comparison to UE (Urban Elite) girls.

Introduction:-

Anemia, primarily caused by a lack of dietary iron, is most commonly found in children from the lower socio economic groups. Of children in these groups, 10% to 21% have hemoglobin levels of less than 10g/dl of blood, indicative of iron deficiency. In addition to its consequences on physical and physiological functions, there is growing evidence of an adverse effect on behavioral and cognitive performance. The lack of dietary iron can result from parents' lack of knowledge about dietary sources of iron and the importance of iron in good nutrition, from the

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restrictive effect of poverty on the amount and variety of foods purchased, or from the difficulty of providing adequate dietary iron, even in favorable circumstances. In some children, infestation with intestinal parasites can worsen the problem. A few instances of anemia have been recorded as resulting from the use of cow's milk, which is low in iron and the exclusion of a wide variety of foods after the first year of life. Children with anemia are usually lethargic, easily tired, and highly susceptible to infections, and they may exhibit mental and motor impairments.
Childhood anemia is usually treated by giving iron salts that provide 30 to 100mg of iron per day, often in conjunction with vitamin C to enhance its absorption, until hemoglobin levels return to normal. The child should then adopt a diet that is high in iron-containing foods, such as meat, green leafy vegetables and iron fortified cereals. Nutrition health objectives for the nation for the year 2000 call for reducing the prevalence of childhood anemia and iron deficiency by 50%.

Nutrition anemia is a serious public health problem. Although anemia is widespread in the country, it especially affects women in the reproductive age group and young children. It is estimated that over 50 percent of pregnant women are anemic. Nutritional anemia, due to iron and folic acid deficiency, is directly or indirectly responsible for about 20% of maternal deaths. Anemia is also a major contributory cause of high incidence of premature births, low birth weight and prenatal mortality. Available research, including studies in Baroda, suggest that 65% to 75% of under privileged adolescent girls (10 to 18 yrs) in India are anemic. The poor iron intake from the diet (below 50% of recommended levels in our studies) and the known poor bioavailability of iron from typical cereal based diets, infections like malaria (which is endemic in our region) and blood loss through menstruation are the probable reasons.

Relatively little research has been done on the nutritional needs and problems of people from 2 to 10 years of age largely because few nutritional problems appear during this period. Although this is a crucial period of growth, children and adolescents are amazingly resilient in the face of short term nutrient deficiencies. There is little information on which to judge the long term consequences of specific eating patterns during childhood and adolescence but every reason to believe they are significant. Nutrient adequacy during childhood and adolescence definitely offers some protection against degenerative diseases associated with aging.

Materials and Methods:-

Diet surveys are an essential part of any complete study of the nutritional status of individuals or groups. They give useful information on nutrient intake levels, sources of nutrients, food habits and attitudes. The dietary survey of all the households/subjects was carried out to get food intake data for 3 alternate days in a week and by one day weighing method. A standard food weighing machine was used to measure actual food intake in terms of both cooked and raw food weights. Thus, a mean of 3 days intake was considered. Accordingly, nutritive values of the diets was calculated using food values book of ICMR, India (Gopalan et al., 1993). The mean values for all nutrient intakes of girls were compared with recommended dietary allowance of ICMR.

Physical work capacity and performance test:-

Physical work capacity is defined as the ability to perform maximal physical work. In the present investigation, the physical efficiency of the children was assessed through the two simple exercise tests, the Harward step test and running test. These two tests call for minimum equipment and minimal effort with respect to maintaince.

Determining Resting Pulse Rate (RPR):-

Nine inch Harward step test was conducted for each of the subjects in the sub sample to assess the physical stamina. The various steps in performing the nine-inch step test are as follows:

The pulse rate was counted for a minimum of one minute and it was repeated till duplicate values were obtained. After recording the pulse rate the subject was made to climb up and down a pair of 9” step stair case for a period of 3 minutes. The child was instructed to put both the feet one step and only then proceed to the nest. Total number of steps taken during a 3 minute period was counted. Time alarm was used to mark the point of stepping and stopping. Immediately after stopping the activity pulse rate was counted within the first 10 sec. for a period of atleast 30 seconds. The same is expressed as pulse rate beats/min to facilitate comparison between RPR and PEPR. Subsequent readings were made every minute. Each time for 30 seconds till the basal pulse rate had returned. The time taken by the child to reach the basal pulse rate was noted as recovery time in seconds.

SPSS – 13 (statistical package for social sciences) was used for statistical analysis. Student t-test was done to find out significant difference with standard values. One way analysis variance (ANOVA) was done for comparison among four different communities for iron intakes and physical endurance tests.

Results, Discussion and Conclusion:-

The data on mean iron intakes of rural and urban girls compared against RDA is presented in Table no. 1. The iron intakes of all the girls are significantly ($p<0.01$) far below the RDA and the differences were significant at 1% level. Urban elite girls recorded higher intakes when compared to other groups of girls. From the data, it is clear that RSC and USL girls are not consuming required amounts of iron rich foods. Hence, they are deficient in iron intakes than RDA as well as other counterparts. The RSC and USL girls are not able to meet the 50 percent of RDA.

The data based on NNMB (1972-92) summary also indicated the iron intakes observed for rural girls was much below the RDA and the bio-availability of iron in Indian diets in general is poor (3%). Anita Saxena (1996) also reported that 60 percent of girls and 30 percent of boys between and 15 years of age suffered from iron deficiency anemia. All the above observations made are in accordance with the results of the present study.

Kusuma (1996) recorded mean iron intakes of different age groups ranged from 13.82 to 15.91 mg. The mean iron intakes were far below the recommended dietary allowances. The percent deficits are 21 to 29 in 10 to 12 years and 48 to 51 in 13 to 15 years. Pavana (2001) also observed that the percent iron deficit ranged from 31 to 77.3 percent. Both rural and rural harizan girls are not even meeting 50 percent of RDA. Baby Depuru (2000) also stated that irrespective of age, all the two groups of rural and urban slum girls consuming required amount of iron rich foods. The rural scheduled caste and urban slum girls are not able to meet the 50 percent of RDA and are worst affected groups.

Table n. 1:- Mean Iron intake of rural and urban adolescent girls from different deprived communities. A Comparison with urban elite (control) and recommended dietary allowances (ICMR)

Age (years)	ICMR RDA K.Cal ($R_{1)}$	Mean Caloric intake (K.Cal) and related 't' values against R_1 and between groups								
		UE Mean	t value (R_1Vs UE)	USL Mean	T value (R_1 Vs USL)	RFC Mean	t Value (R_1 Vs RFC)	RSC Mean	t value (R_1 Vs RSC	$ F value (UE Vs USL RFC, RSC)
10+	20	12.68 ±3.36	17.806**	8.44 ±2.14	11.54**	10.23 ±3.61	12.14**	8.70 ±3.52	18.70**	2.15**
11+	20	13.36 ±3.78	10.81**	9.97 ±3.82	16.56**	10.82 ±4.10	17.43**	9.53 ±2.32	17.40**	27.68**
12+	20	14.57 ±2.25	16.51**	16.97 ±3.10	17.47**	11.62 ±3.17	12.83**	9.56 ±3.09	11.64**	71.4**
13+	20	15.29 ±9.15	10.65**	10.98 ±3.13	17.06**	12.79 ±2.23	10.21**	10.74 ±3.30	18.24**	14.36**
14+	20	16.40 ±5.29	14.53**	11.72 ±2.28	19.35**	13.04 ±2.17	19.91**	10.628 ±2.25	12.83**	73.24**
15+	20	17.57 ±6.24	11.19**	11.80 ±2.17	19.75**	14.06 ±2.02	19.86**	10.65 ±2.38	14.27**	10.01**
16+	20	17.72 ±5.15	10.90**	12.87 ±3.08	13.05**	15.73 ±3.31	12.49**	11.667 ±2.24	12.49**	18.38**
17+	20	18.49 ±4.22	14.75**	13.95 ±3.15	16.96**	16.90 ±4.21	12.68**	12.673 ±2.11	14.42**	12.28**
18+	20	19.20 ±3.21	18.56**	14.98 ±2.09	13.71**	17.69 ±3.22	17.69**	13.684 ±2.42	12.34**	

* P<0.05 **P<0.01

$ - 'F' value obtained from one way analysis of variance for comparison among the means due to the four groups

Foo et al., (2004) in their study on dietary iron intake of adolescents from a rural community in Sabah, Malaysia. Mean dietary iron intakes of the adolescents aged 12 to 19 years from all the selected fishing communities was 10.3 ± 2 and there was no significant difference between the male and female subjects. Iron intake was unsatisfactory, with almost all the subjects (98%) failing to meet the Malaysian RDA for iron. Only 17.6% had intakes between two thirds and 100% of the RDA. Iron intake among the female subjects was less adequate than that of the males. Almost all the female subjects (91.2%) had iron intakes below the two third level of the RDA compared with 67.7 % among the male adolescents. About three quarters of the dietary iron of the adolescents was derived from foods of plant origin such as rice and flour products (30%), nutrient - fortified beverages (14%), vegetables (10%), snacks (9%), cereals and tubers (9%), and fruits (5%). In contrast, only approximately 23% of the total iron intake was from animal origin products namely, fish and seafood (12%), meat and chicken (6%) and eggs (5%)

Nacioner et a\., (1005) reported that girls have inadequate iron and zinc intakes. Inadequate iron causes decreases in hemoglobin levels and potential for the iron deficiency anaemia in adolescent girls after menarche. The prevalence of iron deficiency anaemia of the adolescent population is estimated to be between 2% and 10%. NHANES III data show that the mean iron intakes of American adolescent girls is less than 12mg. Whereas 40% of American girls meet two thirds of the RDA for intake of iron, only 34% of Turkey girls meet this level. The low iron intake of subjects may be explained by the low consumption of meat, egg yolk, dry beans, green leafy vegetables and traditional grape, mulberry, or carob molasses, which are main sources of iron. Moreover, in contrast to adolescents living in developed countries, iron fortified cereals and breads are not consumed in that region. Therefore, Hb should be measured after menarche and iron replacement should be done if the Hb level is below 12g/dl. Zinc is also known to be essential for adolescent health. Effect of mild zinc deficiency caused by low intake may inversely affect growth and immune system and may lower appetite.

The iron content of the diet is especially important in the adolescent period because of the need for growth and to replace losses. (Samuelson et al.,1996). The mean iron intakes of male and female adolescents in this study (10.7 mg/dl) and (10mg/dl) are quite comparable with the findings of mean iron intakes of 12.2 mg among the males and 11.2mg for the female adolescents in peninsular Malaysia. The mean level of iron intake among the Malaysian adolescents is poor, especially among the female subjects plant based food sources contributed 77% of the total iron intake, which is similar to that reported among a group of adolescents in the Philippines. Such plant based diets generally have low iron availability and can therefore increase the risk of iron deficiency anemia.

It appears that the main reason for the poor iron status is the inadequate intake and bio-availability of dietary iron as well as poor intake of other nutrients. It is hoped that the findings from this study will be useful for the development of nutrition education and other intervention programmes, including micronutrient supplementation and dietary modification towards the eradication iron deficiency in adolescents for low income groups. It is therefore of importance to systematically conduct and document studies on the nutritional status of adolescents in all parts of India, including studies into the prevalence, severity and etiology of iron deficiency anaemia. Priority should, therefore, be given to female adolescents with regard to their iron intake.

Table no. 2:- Means values Hardward step performed by rural and urban adolescent girls

Age group (yrs)	Resting pulse rate				No.of steps taken (sec)				Post Exercise pulse rate				Recovery Times			
	UE	USL	RFC	RSC	UE	USL	RFC	RSC	UE	USL	RFC	RSC	UE	USL	RFC	RSC
10+	63 ± 2	85 ±2	81 ±4	912 ±2	86 ±2	70 ±2	74 ±1	69 ±3	111 ±2	131 ±4	121 ±4	136 ±6	139 ±5	200 ±7	171 ±4	204 ±5
11+	64 ±3	87 ±3	83 ±2	93± 3	84 ±3	69 ±3	75 ±3	67 ±2	93± 3	129 ±5	123 ±2	133 ±4	135 ±4	199 ±6	165 ±5	203 ±6
12+	67 ±2	88 ±2	84 ±2	89± 3	85 ±2	64 ±3	76 ±4	66 ±3	99± 2	133 ±4	124 ±4	131 ±2	133 ±3	197 ±5	166 ±3	202 ±2
13+	71 ±1	86 ±3	86 ±3	95± 2	87 ±2	65 ±2	72 ±3	65 ±2	101 ±2	134 ±5	122 ±3	133 ±5	134 ±5	185 ±4	164 ±7	205 ±5
14+	73 ±3	87 ±4	87 ±2	89± 3	89 ±3	67 ±3	71 ±3	64 ±4	102 ±5	132 ±3	119 ±3	134 ±3	129 ±6	191 ±6	165 ±8	195 ±7
15+	75 ±4	87 ±8	88 ±3	99± 3	84 ±2	66 ±2	74 ±4	65 ±5	103 ±2	129 ±5	120 ±4	135 ±3	130 ±4	192 ±7	167 ±5	195 ±2
16+	74 ±2	91 ±4	87 ±2	97± 2	85 ±3	68 ±2	73 ±3	61 ±3	104 ±3	128 ±3	118 ±4	137 ±4	131 ±3	193 ±5	164 ±3	189 ±5
17+	72 ±3	92 ±3	88 ±2	92± 3	83 ±2	69 ±3	72 ±1	62 ±2	110 ±5	130 ±4	117 ±3	129 ±6	132 ±4	201 ±7	171 ±5	190 ±6
18+	73 ±4	95 ±2	89 ±3	93± 4	82 ±1	67 ±2	71 ±2	64 ±3	109 ±6	129 ±5	115 ±2	130 ±4	133 ±5	202 ±6	172 ±4	192 ±5

Harward Step Test:- Harward step test in used to assess the cardio pulmonary compliance. It is evident from the Table no.2 that as the age increased, the number of steps taken per minute increased. Urban elite girls performed more number of steps than the other three groups of girls. The resting pulse rate, post exercise pulse rate and recovery time are significantly more for RSC followed by USL, RFC girls in comparison to UE girls.

From the above two tests, it is important to note that during short period of intense physical activity like time taken to run, number of steps taken, O_2 cannot be supplied at the require time, anaerobic metabolism takes place in the system to supply energy and oxygen debt is created. This debt slowly becomes normal during recovery.

An increase in pulse rate and blood pressure was also observed in the anemic when compared to normals which can be attributed to malnutrition and hypoxic conditions. Elevated level of O_2 consumption at rest was noticed in amemics (977.1±229.30), in contrast to normals (450.6±223.7). this might have been due to the elevated O_2being diverted to these muscles at the expense of non respiratory muscles. In the present study also, anemic groups (RSC, USL) recorded higher resting pulse rate, post exercise pulse rate and recovery time in contrast to control.

So, in view of these consequences the adolescent girls should be encouraged to consume more of iron and protein rich foods and nutrition education and can should be advocated because they are this future mothers. If their work capacity could be improved, the health and economic status of the country itself can be chaged. Government should take interest in supplementing this groups with low cost highly nutritious food for better work out put. Better

nutrition is definitely beneficial to the girls and increasing their food iron intakes can remarkably increase their work capacity.

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