

*RESULTS AND
DISCUSSION*

IV. RESULTS AND DISCUSSION

The result of the present study entitled “**Impact of Nutritious Supplement on Selected Anaemic Adolescents in Coimbatore city, Tamil Nadu**” is discussed under the following headings

- A. Background Information of the Selected Adolescents
- B. Details on the Nutritional Status of the Selected Adolescents
- C. Details on the Haemoglobin Levels of the Selected Underweight Anaemic Adolescents
- D. Impact of Nutritious Supplement on the Selected Underweight Anaemic Adolescents
- E. Impact of HOEP on the Selected Adolescents in Supplemented and Non Supplemented Group

A. BACKGROUND INFORMATION OF THE SELECTED ADOLESCENTS

1. Age and Sex Wise Distribution of the Selected Adolescents

Table VIII presents the age and sex wise distribution of the selected adolescents.

Table VIII

Age and Sex Wise Distribution of the Selected Adolescents

AGE (years)	BOYS (N=1823)		GIRLS (N=1343)		TOTAL (N=3166)	
	N	%	N	%	N	%
10-12	456	14	401	13	857	27
13-15	1,009	32	683	22	1,692	53
16-18	358	11	259	8	617	19

Among the selected 3166 adolescents, 32 percent of boys and 22 percent of girls were in the age group of 13 to 15 years, whereas 14 percent of boys followed by 13 percent of girls were in 10 to 12 years of age. Only 11 percent of boys and eight percent of girls belonged to the age group of 16 to 18 years.

2. Class Wise Distribution of the Selected Adolescents

Class wise distribution of the selected adolescents is presented in Table IX.

Table IX
Class Wise Distribution of the Selected Adolescents

CLASS	BOYS (N=1823)		GIRLS (N=1343)		TOTAL (N=3166)	
	N	%	N	%	N	%
6 to 8th std	909	29	658	21	1,567	49
9 to 10th std	665	21	437	14	1,102	35
11 to 12th std	249	8	248	8	497	16

Forty nine percent of the selected adolescents were from 6th to 8th standards, whereas 35 percent of the selected adolescents were studying 9th and 10th standards. Very few adolescents (8 % boys and girls respectively) were in the class of 11th and 12th standards.

3. Educational Status of the Parents of the Selected Adolescents

It was noted that among 3166 selected adolescents, 10 percent parents were illiterate, 40 percent parents had completed 12th standard and 50 percent parents had

college degree. Bhaskaran (2002) had concluded that the prevalence of malnutrition can be reduced by increasing the educational status of the parents and effort should be taken to raise women's awareness on the nutritional requirement of the children. An earlier study by Nutrition Foundation of India (2001) had also recognized that nutrition intervention would be effective when the education of both parents especially mothers were ensured up to middle or high school level.

4. Occupation of the Parents of the Selected Adolescents

The occupation of the parents of the selected adolescents is depicted in the following Table.

Table X
Occupational Status of the Parents of the Selected Adolescents

OCCUPATION	BOYS (N=1823)		GIRLS (N=1343)		TOTAL (N=3166)	
	N	%	N	%	N	%
Coolie Workers	748	24	728	23	1476	47
Private Companies	940	30	582	18	1522	48
Government Employees	46	1	12	0.37	58	2
Business	84	3	20	0.6	104	3
Agriculture	5	0.1	1	0.03	6	0.18

Majority (30 %) of boys' and 18 percent girls' parents were employed in private companies. Twenty four percent boys' and 23 percent girls' parents were coolie workers and they were employed on daily wages. Only less percentage of the parents were doing business and agriculture.

5. Economic Status of the Selected Adolescents

The income level of the selected adolescents is a good indicator of the socio economic, family back ground and life style pattern. The selected adolescents were classified into various income groups as suggested by HUDCO (2002). This is set out in Table XI and Figure 3.

Table XI
Total Monthly Income of the Family

INCOME LEVEL	BOYS (N=1823)		GIRLS (N=1343)		TOTAL (N=3166)	
	N	%	N	%	N	%
Low Income (Rs 2100- 4500)	1,227	39	654	20	1,881	59
Middle Income (Rs 4501-7500)	449	14	467	15	916	29
High Income (Rs >7500)	147	5	222	7	369	12

It was understood from Table XI and Figure 3 that among the selected 3166 adolescents, 39 percent boys and 21 percent girls belong to low income group (Rs 2100-4500). Fourteen percent boys and 15 percent girls come from middle income families (Rs 4501-7500). The present findings tune with Devi and Amirthagowri (2007) that higher percentage of selected adolescents from Coimbatore, Tamil Nadu were from low income group followed by middle socioeconomic status. The effect of income on health can be illustrated through quality of living conditions and accessibility to health care facilities.

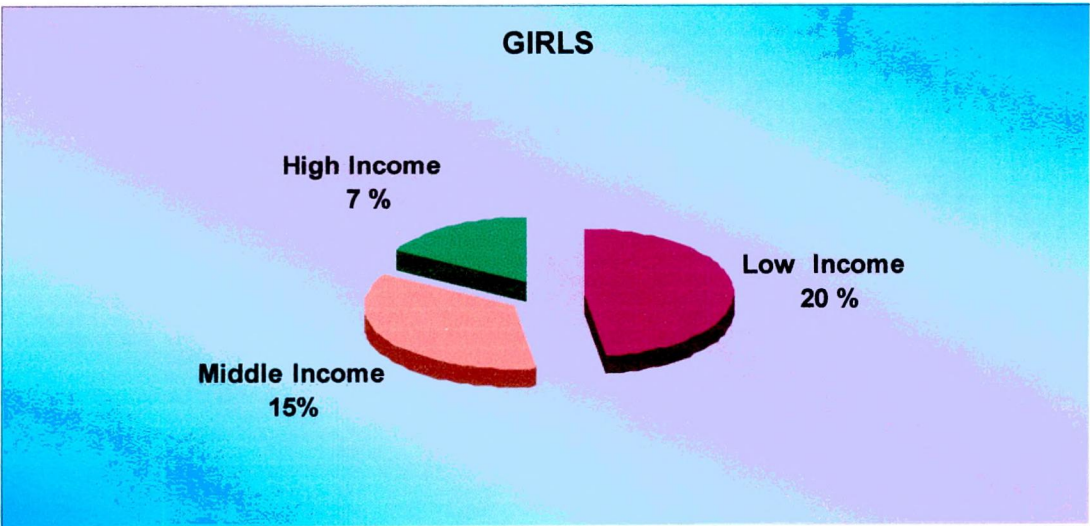
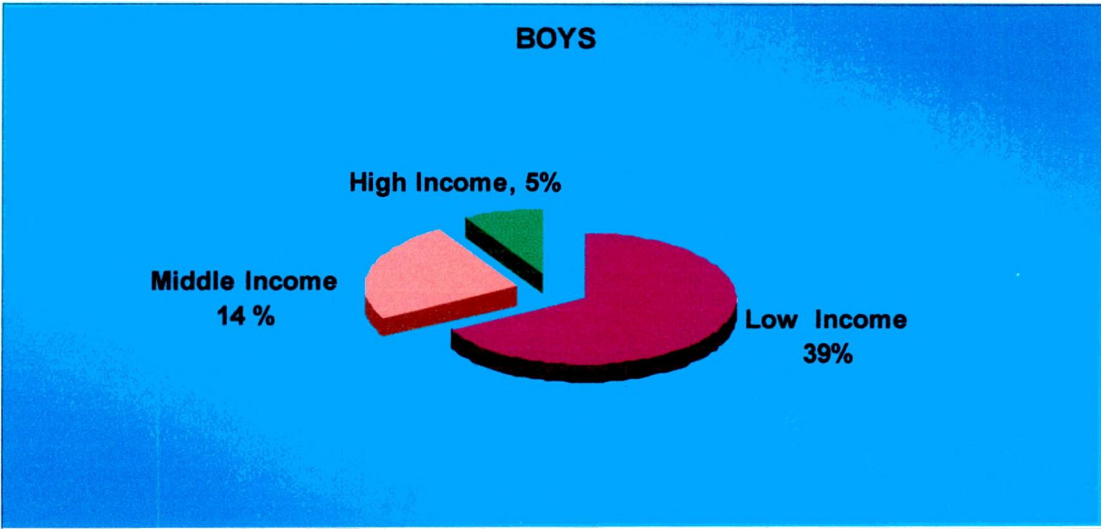


Figure 3

TOTAL MONTHLY INCOME OF THE FAMILY

6. Distribution of the Selected Adolescents by Type and Size of the Family

Nuclear families were the most predominant among the families surveyed in the areas of Coimbatore city. Among the 3166 adolescents interviewed, 47 percent of boys and 36 percent of girls were in nuclear family system. The present study is in line with the study conducted by LIC of India Census (India year book, 2004) which pointed out that 10 to 15 percent of the population live in age old family system and others move on to the nuclear family system.

The family size is one of the factors which affect the nutritional status of an individual, entire family and society. In the present investigation it was observed that majority of adolescent families have five members in their family. According to NIN (2005) the average family size of the urban areas of Tamilnadu is 4.9. The present finding is in tune with this statement.

B. DETAILS ON THE NUTRITIONAL STATUS OF THE SELECTED ADOLESCENTS

1. Body Mass Index of the Selected Adolescents

Distribution of the selected adolescents based on Body Mass Index is furnished in Tables XII a, XII b and Figure 4.

**Table XII a
BMI Wise Distribution of the Selected Adolescents Based on Percentile**

BMI Classification (NHANES I)	BOYS (N=1823)						GIRLS (N=1343)					
	AGE (years)											
	10-12		13-15		16-18		10-12		13-15		16-18	
	N	%	N	%	N	%	N	%	N	%	N	%
<5 th centile	211	7	484	15	124	4	176	6	256	8	80	3
5 th to 15 th centile	71	2	194	6	43	1	87	3	121	4	53	2
15 th to 85 th centile	153	5	302	10	176	6	126	4	281	9	120	4
85 th to 95 th centile	17	1	18	1	13	0.04	8	0.25	17	1	5	0.15
>95 th centile	4	0.12	11	0.3	2	0.06	4	0.12	8	0.25	1	0.03

Normal BMI - 15th to 85th percentile (NHANES I, 2004)

**Table XII b
BMI Classification of the Selected Adolescents for the Study**

BMI Classification (NHANES I)	BOYS (N=1823)		GIRLS (N=1343)		TOTAL (N=3166)	
	N	%	N	%	N	%
Underweight	819	26	512	16	1331	42
Risk of Underweight	308	10	261	8	569	18
Normal	631	20	527	17	1158	37
Overweight	48	1.5	30	0.9	78	2
Obesity	17	0.5	13	0.3	30	1

The above tables show that out of 1331 underweight adolescents, 15 percent boys and eight percent girls were in the age group of 13 to 15 years. The present finding is supported by Gianine (1999) that more boys are underweight cross 13 to 18 years. The present study is on par with Ravi (2002) which shows high prevalence of under weight (36.5%) among Chennai adolescents with BMI less than 5th percentile.

Among the 569 risk of underweight adolescents, 10 percent and eight percent were boys and girls respectively. In the case of selected 1158 normal weight adolescents, 20 percent were boys and 17 percent were girls. Only two percent of the selected adolescents were overweight and one percent of the selected adolescents were obese. The findings also line with Piechulek (2000) nutritional deficiency was significantly influenced by size of family, education, occupation of parents and family income.

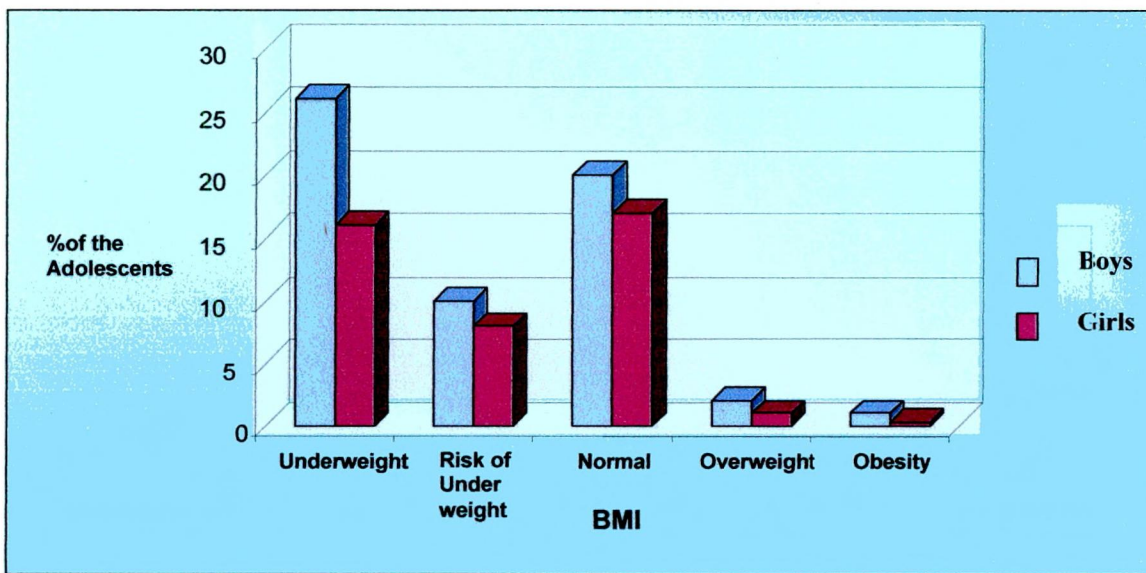


Figure 4

DISTRIBUTION OF THE SELECTED ADOLESCENTS ACCORDING TO BODY MASS INDEX CLASSIFICATION

2. Life Style Habits of the Selected Adolescents

a. Physical Activity of the Selected Adolescents

The investigator observed that all the selected adolescents indulge in playing at school at least for 45 minutes to one hour per week. About 24 percent boys and 15 percent girls performed yoga in school. Twenty three percent boys and 14 percent girls reported that cycling is the mode of transport to school.

Apart from the school timings very few play at home and they indulge in indoor games. The result is also in tune with Kapur and Sethi (2003) that 58 percent of the adolescents had preference for indoor activities.

b. Leisure Time Activity of the Selected Adolescents

All the selected adolescents had the habit of watching television when ever they have free time. Seventy three percent of the selected girls listen to songs atleast 30 minutes to one hour. Only 12 percent of the selected adolescents have the habit of reading magazines. Eight percent of the selected adolescents involved in other hobbies like drawing, painting, dancing and playing indoor games and they spent at least one hour per week.

The present results were in tune with the findings of Heelan et al., (2005) that increase in leisure time activity becoming more sedentary with watching television and video games to pass time is becoming most popular.

c. Impact of Television on Food Choices

The impact of television on food preferences of the selected adolescents was also assessed. Majority of the adolescents in the entire group reported that food advertisements on television influenced their food choices. Food items demanded

included Maggie, biscuits, chocolates, chips, sweets and soft drinks. Thus, it was observed that the food preferences after viewing television coincided with adolescents favourite foods. Hence, it may inferred that food advertisements on television have an effect on the food choices of the adolescents. Seventy three to 88 percent of the adolescents had an unhealthy eating environment, they dine while watching television.

3. Dietary Pattern of the Selected Adolescents

As there is diverse pattern in dietary habits among the selected adolescents, the dietary pattern, food consumption pattern, habit of skipping meals and nibbling habits among the adolescents is presented below

a. Type of Food Consumed

The type of food consumed by the selected adolescents is shown in Table XIII.

Table XIII
Type of Food Consumed by the Selected Adolescents

BMI Classification (NHANES I)	Vegetarian (N=507)				Ova Vegetarian (N=288)				Non Vegetarian (N=2371)			
	BOYS		GIRLS		BOYS		GIRLS		BOYS		GIRLS	
	N	%	N	%	N	%	N	%	N	%	N	%
Underweight	87	3	67	2	63	2	54	2	669	21	391	12
Risk of Under weight	126	4	29	1	34	1	27	1	148	5	205	6
Normal weight	84	3	104	3	54	2	45	1	493	16	378	12
Overweight	6	0.2	2	0.1	4	0.1	3	0.1	38	1	25	1
Obesity	1	0.03	1	0.03	4	0.13	-	-	12	0.38	12	0.38

Analysis of data collected with regard to the dietary habits of the selected adolescents revealed that the proportion of non vegetarians dominated by constituting 21

percent and 12 percent boys' and girls' population respectively in underweight category, whereas in normal weight category, 16 percent boys and 12 percent girls were non vegetarians. In the case of risk of underweight category five percent boys and six percent girls had the habit of taking fleshy food.

Among the selected 3166 adolescents, only 10 percent boys and six percent girls were pure vegetarians, remaining five percent boys and four percent girls were ova vegetarians.

The present finding is in line with Karagapandi et al., (2006) that Tamilnadu has highest consumption of animal foods in India. Another study by Pellelier (2000) revealed that majority (82 %) of Asians were non vegetarians, only less percentage were vegetarians, lacto vegetarians and ova vegetarians.

b. Meal Pattern and Preference of Meals by the Selected Adolescents

Most of the selected adolescents, 52 percent boys and 32 percent girls had four meals a day which include breakfast, lunch, evening tea and dinner. Whereas six percent boys and 20 percent girls had three meals a day. The findings coincide with Kanchwala and Husain (2003) that 50 percent boys and 36 percent girls in Delhi schools were having four meals per day. Only few percentages observed irregular meal timings.

It was obvious from the study, that majority of (36%) boys and 25 percent girls preferred meals and they also reported that it gave fullness to the stomach. Twenty percent boys and 12 percent girls prefer to have tiffin items like dosai, poori, noodles and paratha. Only five percent girls and two percent boys preferred to have both meals and tiffins.

b. Habit of Skipping Meals by the Selected Adolescents

Table XIV shows the habit of skipping meals by the selected adolescents.

Table XIV
Pattern of Skipping Meals by the Selected Adolescents

BMI Classification (NHANES I)	BREAKFAST				TEA				DINNER			
	BOYS		GIRLS		BOYS		GIRLS		BOYS		GIRLS	
	N	%	N	%	N	%	N	%	N	%	N	%
Underweight	218	7	201	6	124	4	189	6	16	1	33	1
Risk of Under weight	43	1	6	0.2	12	0.4	5	0.2	19	1	22	1
Normal weight	172	5	136	4	55	2	35	1	21	1	18	1
Overweight	13	0.4	15	0.5	14	0.4	3	0.1	9	0.3	1	0.03
Obesity	2	0.1	3	0.09	2	0.1	-	-	-	-	2	0.1

Among the 3166 adolescents, none of them skipped their lunch at school. Majority of the selected adolescents, 13 percent boys and 11 percent girls skipped their breakfast often. The selected adolescents also reported that they do not have time for breakfast which was supported by Rampersaud (2005) when compared to other BMI group, more number of underweight adolescents have the habit of skipping meals.

A similar study by The Consumer Magazine (2002) reported that breakfast is to replenish blood glucose levels and it acts as a brain food. The fact that skipping breakfast tends to make adolescents to select irregular meals supports this.

d. Snacks Consumed by the Selected Adolescents

The type of snacks consumed by the selected adolescents is projected in Table XV

TABLE XV
Snacks Consumed by the Selected Adolescents

BMI Classification (NHANES I)	FOOD ITEMS																											
	ICE CREAMS				BISCUITS				CHIPS				SAVORIES				FAST FOODS				FRUITS				SOFT DRINKS			
	BOYS		GIRLS		BOYS		GIRLS		BOYS		GIRLS		BOYS		GIRLS		BOYS		GIRLS		BOYS		GIRLS		BOYS		GIRLS	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Underweight	174	5	103	3	132	4	123	4	132	4	118	4	108	3	120	4	321	10	288	9	128	4	82	(6)	203	(15)	94	(7)
Risk of Underweight	209	7	168	5	198	6	164	5	160	5	126	4	156	5	162	5	369	12	293	9	112	4	5	(1)	70	(12)	106	(19)
Normal weight	340	11	295	9	345	11	295	9	398	13	293	9	216	7	187	6	471	15	457	14	247	8	131	(11)	157	(14)	136	(12)
Overweight	14	0.4	11	0.3	30	0.9	14	0.4	34	1	14	0.4	22	0.7	11	0.3	35	1	25	0.8	9	0.3	-	-	16	(21)	15	(19)
Obesity	11	0.3	5	0.2	13	0.4	5	0.2	13	0.4	4	0.1	12	0.4	2	0.1	3	0.1	7	0.2	10	0.3	2	(7)	11	(38)	2	(7)
Total	748	24	582	18	718	23	601	19	737	23	555	18	514	16	482	15	1,199	38	1070	34	506	16	235	(7)	457	(14)	353	(11)

It was noted that among 3166 adolescents, 38 percent boys and 34 percent girls have the habit of consuming fast foods like bhel puri, pani puri, masala puri, chilly gobi and gobi manchurian as snack items; sometimes this itself constituted their main meal. Biscuits still remain the favourite for 23 percent boys and 19 percent girls and they reported to consume them every day because it is very cheap in price. Henry (2006) also reported that fast food meals and snacks are becoming common among adolescents.

Chips was taken by 23 percent boys and 19 percent girls from the entire BMI category. It was understood that chips is most often eaten as a snack by itself or frequently taken along with lunch or dinner as an accompaniment. Majority of the selected adolescents consumed tapioca chips because it is less in price. Wenlock (2000) found a similar trend among school children where it was seen that chips and milk which provide substantial amount of fat, were the main item in the diet.

Sixteen percent selected boys and girls respectively consumed fruits in between meals. Fruits commonly consumed were amla, mango, papaya, guava and some seasonal fruits like sapota, watermelon, pineapple and pears which were sold near school premises.

A total of 24 percent boys and 18 percent girls have the habit of taking ice creams during their school interval. Mostly they prefer to have stick ice and ice creams sold in packet. A very few (14% boys and 11% girls) have the habit of consuming soft drinks (locally available packet flavoured drink for one rupee) during the lunch break.

e. Habit of Dining Away from Home

The frequency of eating out and preference of food items is shown in Table XVI.

Table XVI
Frequency of Dining Outside

BMI Classification (NHANES I)	WEEKLY TWICE				WEEKLY ONCE				MONTHLY ONCE				OCCASIONALLY			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Underweight	-	-	-	-	5	0.001	-	-	82	3	64	2	356	11	209	7
Risk of Underweight	-	-	15	0.5	24	1	14	0.004	46	1	86	3	122	4	127	4
Normal weight	17	0.54	44	1	56	2	39	1	115	4	132	4	223	7	156	5
Overweight	-	-	-	-	2	0.06	2	0.06	22	0.69	11	0.35	20	1	15	0.47
Obesity	-	-	-	-	-	-	1	0.03	2	0.06	2	0.06	14	0.004	8	0.25
Total	17	0.54	59	2	87	3	56	2	267	8	295	9	735	23	515	16

It was clear from Table XVI that 23 percent and 16 percent of selected adolescents occasionally went out to have their food, whereas only nine percent girls and eight percent boys have the habit of taking food outside atleast once in a month.

Ice cream was the most favourite item consumed by 48 percent of boys and 32 percent girls, which was followed by snacks like puffs, pastries, pizza and sambar vadai which was taken by 35 percent boys and 29 percent girls. Thirty three percent boys and 19 percent girls preferred to have fast foods like bhel puri, pani Puri, chilly mushroom, chilly cauliflower, chilly chicken and gobi manchurian in the outlet. Chinese recipes like noodles and fried rice were preferred by 23 percent boys and 14 percent girls. Only less percentage of the selected adolescents go out once or twice a week to have their snacks or fast foods or ice creams or carbonated drinks.

Majority of the selected boys (34 %) and girls (30 %) from all the BMI category group dined outside with their families for evening snacks/dinner. More number of underweight and overweight boys (17 %) respectively dined outside with their peer group which was followed by normal weight and obese boys. Very few percentages of the selected adolescents go out with their relatives.

Among 3166 adolescents, 36 percent of selected adolescents reported that they do not have the habit of dinning out because their parents are not able to afford money, so they prefer home food.

f. Consumption of Hot Beverages

Table XVII shows the consumption pattern of hot beverages by the selected adolescents.

Table XVII
Hot Beverages Consumed by the Selected Adolescents

BMI Classification (NHANES I)	TEA				COFFEE				MILK				HEALTH DRINKS			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Underweight	238	8	187	6	111	4	84	3	108	3	89	3	51	2	46	1
Risk of Under weight	155	5	63	2	62	2	71	2	39	1	38	1	6	0.19	15	0.47
Normal weight	141	4	112	4	86	3	70	2	167	5	185	6	136	4	125	4
Overweight	6	0.19	7	0.22	24	1	9	0.28	8	0.25	3	0.09	10	0.32	6	0.19
Obesity	2	0.06	3	0.09	5	0.16	6	0.19	3	0.09	2	0.06	4	0.13	3	0.09
Total	542	17	372	12	288	9	240	8	325	10	317	10	207	7	195	6

Among the selected 3166 adolescents, 17 percent boys and 12 percent girls had the habit of taking tea daily. Nine percent boys and eight percent girls consumed coffee regularly. Thangaleela and Priya (2002) reported that iron absorption is reduced to about 60 percent by tea and 40 percent by coffee. Ten percent boys and girls respectively consumed 75ml to 100ml of milk and coffee respectively. Only less percentage (7% and 6%) drank health drinks. According to Kalkawarf et al., (2003) a study had proved that

low intake during adolescence period was associated with three percent reduction in bone mineral density.

g. Consumption of Non Vegetarian Food by the Selected Adolescents

Table XVIII shows the frequency of consumption of non vegetarian food by the selected adolescents

Table XVIII
Frequency of Consumption of Non Vegetarian Food by the Selected Adolescents

BMI Classification (NHANES I)	SEX		FISH			CHICKEN			MUTTON			BEEF			PORK		
			W	M	R	W	M	R	W	M	R	W	M	R	W	M	R
Underweight	BOYS	N	319	87	60	221	68	35	186	47	51	11	6	7	-	3	3
		%	13	4	3	9	3	1	8	2	2	1	0.3	0.3	-	0.1	0.1
	GIRLS	N	139	36	27	240	74	32	153	61	23	-	1	-	-	-	-
		%	6	1	1	10	3	1	6	3	1	-	0.04	-	-	-	-
Risk of Underweight	BOYS	N	61	14	24	64	25	24	38	33	36	-	-	-	-	-	-
		%	3	1	1	3	1	1	2	1	2	-	-	-	-	-	-
	GIRLS	N	90	32	14	134	19	15	91	39	14	-	-	2	-	2	-
		%	4	1	1	6	1	1	4	2	1	-	-	0.1	-	0.1	-
Normal	BOYS	N	278	47	13	347	75	6	243	93	9	20	6	2	2	2	-
		%	12	2	1	15	3	0	10	4	0.4	1	0.3	0.1	0.1	0.1	-
	GIRLS	N	202	44	18	241	39	21	210	45	25	16	-	6	5	3	-
		%	9	2	1	10	2	1	9	2	1	1	-	0.3	0.2	0.1	-
Overweight	BOYS	N	22	7	2	25	5	6	12	15	-	-	-	1	-	-	1
		%	1	0.3	0.1	1.1	0.2	0.3	1	1	-	-	-	0.04	-	-	0.04
	GIRLS	N	13	1	1	17	2		16	1	-	-	-	-	-	-	1
		%	1	0.04	0.04	1	0.1	0.0	1	0.04	-	-	-	-	-	-	0.04
Obesity	BOYS	N	3	4	2	4	3	2	2	4	1	-	-	-	-	-	-
		%	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.04	-	-	-	-	-	-
	GIRLS	N	4	-	-	9	-	-	9	-	-	-	-	-	-	1	-
		%	0.2	-	-	0.4	-	-	0.4	-	-	-	-	-	-	0.04	-

W-Weekly: M-Monthly: R-Rarely

The findings of the present study show that among the selected 3166 adolescents, 33 percent boys and 22 percent girls have the habit of consuming one to three eggs per week. Only six percent boys and four percent girls consumed four to six eggs per week. In the case of underweight and risk of underweight adolescents very less percentage consumed one to three eggs per week.

Among the selected 2371 non vegetarian adolescents, 46 percent, 49 percent and 42 percent of the adolescents from the entire group consumed chicken, fish, mutton respectively every week. The mean quantity of consumption ranges from 50 to 75g. Whereas only very few percentage of the adolescents have the habit of taking beef and pork.

A majority of 28 percent boys and 22 percent girls preferred to have non vegetarian items in the form of fry, whereas 14 percent boys and nine percent girls preferred kolambu. Thick gravies were preferred by 11 percent boys and eight percent girls.

h. Type of Cooking Oil

From the study it was observed that refined oil, ground nut oil, gingelly oil, palm oil and coconut oil were the major oils used by the families of selected adolescents. Refined oil has become the most important cooking oil because of its less cholesterol content and due to the increasing advertisement. Totally 28 percent of selected boys and 22 percent girls used refined oil for cooking. Thirteen percent boys and nine percent girls used gingelly and groundnut oil respectively. Only two percent boys and one percent girls switched over to use corn oil from other oils because of the awareness on cholesterol levels and its health benefits. Among 3166 adolescents, only 37 boys' and 27 girls' families were using coconut oil for cooking. Majority of the adolescents reported that castor oil was used while cooking dhal for sambar and other preparations.

Thirty one percent of the boys and 22 percent girls do not have the habit of using ghee while eating. More number of adolescents from the selected group had the habit of taking podi with idly or dosai either with or without oil.

C. DETAILS ON THE HAEMOGLOBIN LEVELS OF THE SELECTED UNDERWEIGHT ANAEMIC ADOLESCENTS

Table XIX. a, XIX. b and Figure 5 presents the classification of underweight anaemic adolescents according to WHO (1989).

Table XIX.a

Haemoglobin Levels of the Selected Underweight Anaemic Adolescents

AGE (years)	BOYS (N=819)						GIRLS (N=512)					
	7.1-10 g/dl (moderate anaemia)		10.1-11.9 g/dl (mild anaemia)		≥13 g/dl (normal)		7.1-10 g/dl (moderate anaemia)		10.1-11.9 g/dl (mild anaemia)		≥12g/dl (normal)	
	N	%	N	%	N	%	N	%	N	%	N	%
10-12	101	8	84	6	26	2	58	4	98	7	20	2
13-15	127	9	197	15	160	12	56	4	147	11	53	4
16-18	18	1	39	3	72	5	11	1	43	3	26	2

Normal haemoglobin level Boys ≥13g/dl: Girls ≥12g/dl (WHO, 1989).

Table XIX.b

Classification of the Selected Underweight Anaemic Adolescents

Haemoglobin Classification (WHO,1989)	N
Moderate anaemia	371
Mild anaemia	603
Normal	357
Total	1331

Among the selected 1331 underweight adolescents, 24 percent boys, 21 girls had 10.1 to 11.9g/dl blood haemoglobin level and they were classified as mild anaemic (WHO, 1989). The present study is in line with Devi and Nath (2003) that 45 percent of the adolescents in urban and rural areas of Bangalore were mild anaemic with mean haemoglobin level of 10.75g /dl. In a study conducted by Ganga (1997) the prevalence of anaemia in Nagai district of Tamil Nadu state was found to be 43 percent among school children of both sexes.

Moderate anaemia was identified among 18 percent boys and nine percent girls. Rest of the underweight adolescents were non anaemic and had normal haemoglobin level ≥ 12 g /dl. These findings are in tune with Kapil and Bhavana (2002) that 53 percent Indians have iron deficiency. The prevalence rate of anaemia among adolescents in certain places like rural Hyderabad and rural Delhi was 67 percent and 64.8 percent respectively, whereas in rural Chennai 21 percent of boys and 22 percent of girls were anaemic.

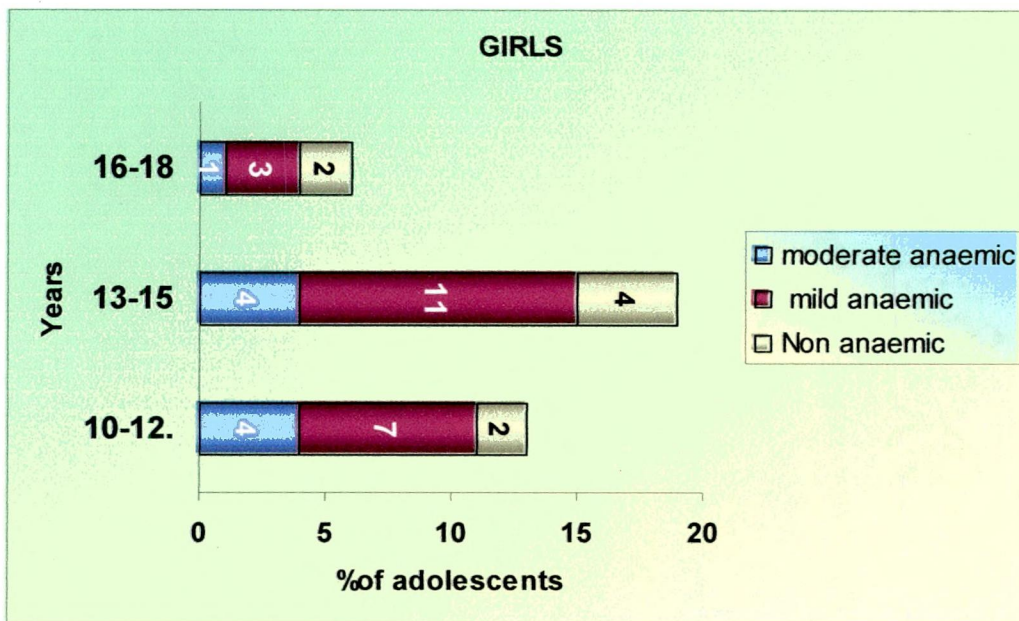
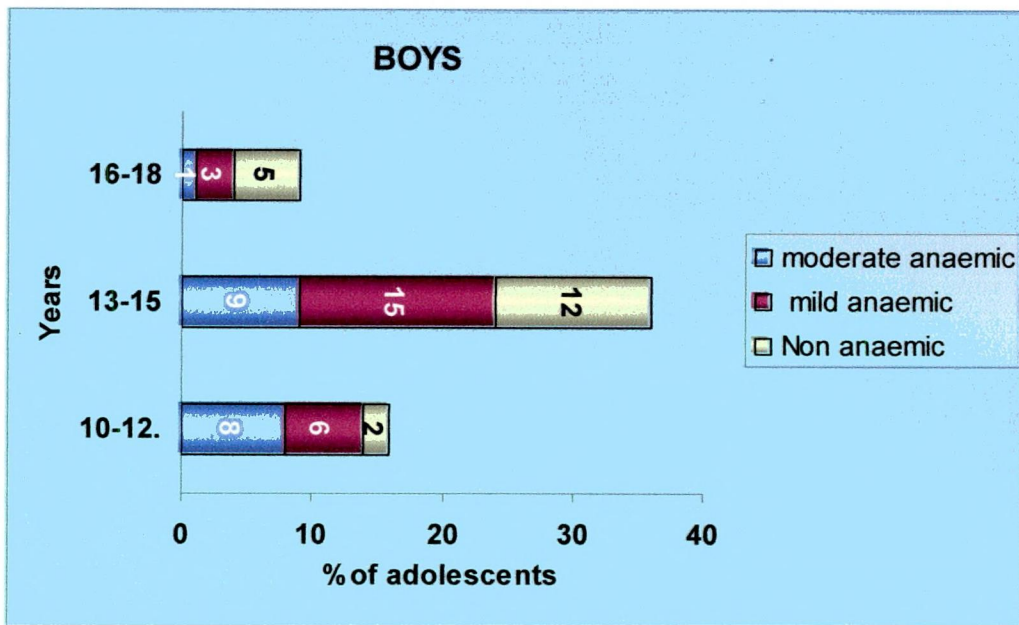


Figure 5

CLASSIFICATION OF UNDERWEIGHT ANAEMIC ADOLESCENTS

D. IMPACT OF SUPPLEMENTATION OF NUTRITIOUS SUPPLEMENT

1. Changes in the Mean BMI of the Selected Sub sample

Table XX and Figure 6 presents the change in mean BMI of the moderate anaemic and mild anaemic underweight sub sample (Appendix VIII).

Table XX
Changes in the Mean BMI of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=114)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean±SEM	" t "
10-12	(50)	14.0±0.7	14.0±1.1	0.1±0.2	0.4NS	14.2±0.6	14.3±1.0	0.0±0.2	0.2 NS
13-15	(38)	14.4±0.7	14.8±0.7	0.3±0.0	7.5**	14.6±1.0	14.8±0.9	0.2±0.0	3.7**
16-18	(26)	15.4±0.9	15.6±0.9	0.2±0.0	5.8**	14.6±1.2	14.8±1.2	0.2±0.0	5**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=181)									
10-12	(75)	14.0±0.8	14.4±0.8	0.3±0.0	8.2**	14.1±0.7	14.5±0.7	0.3±0.0	8.5**
13-15	(68)	14.4±0.9	14.5±1.2	0.1±0.1	0.6NS	14.6±0.9	15.0±1.0	0.4±0.1	6.8**
16-18	(38)	15.3±0.9	15.6±0.9	0.2±0.0	6.4**	15.4±0.8	15.8±1.0	0.3±0.1	5.3**

Normal BMI - 15th to 85th percentile (NHANES I, 2004)

SEM-Standard Error Mean

** - significant at one percent level

NS- Not Significant

* - significant at five percent level

The mean BMI of the selected moderate anaemic underweight sub sample was lower than NHANES I (2004). Difference of BMI between initial and final values showed a significant difference at one percent level in the age group of 13 to 18 years in boys and girls but in the age group of 10 to 12 years no statistical significance was obtained.

Whereas in mild anaemic underweight sub sample the mean difference values showed a significant difference at one percent level in 10 to 12 years, 16 to 18 years boys and girls respectively. But in boys from 13 to 15 years there was a meager increment in BMI values and was not statistically significant. Coconut protein favorably shows an improvement in the growth and nutritional support of undernourished school children when fed with a protein supplement containing coconut meal has been reported by Prasanna et al., (1995).

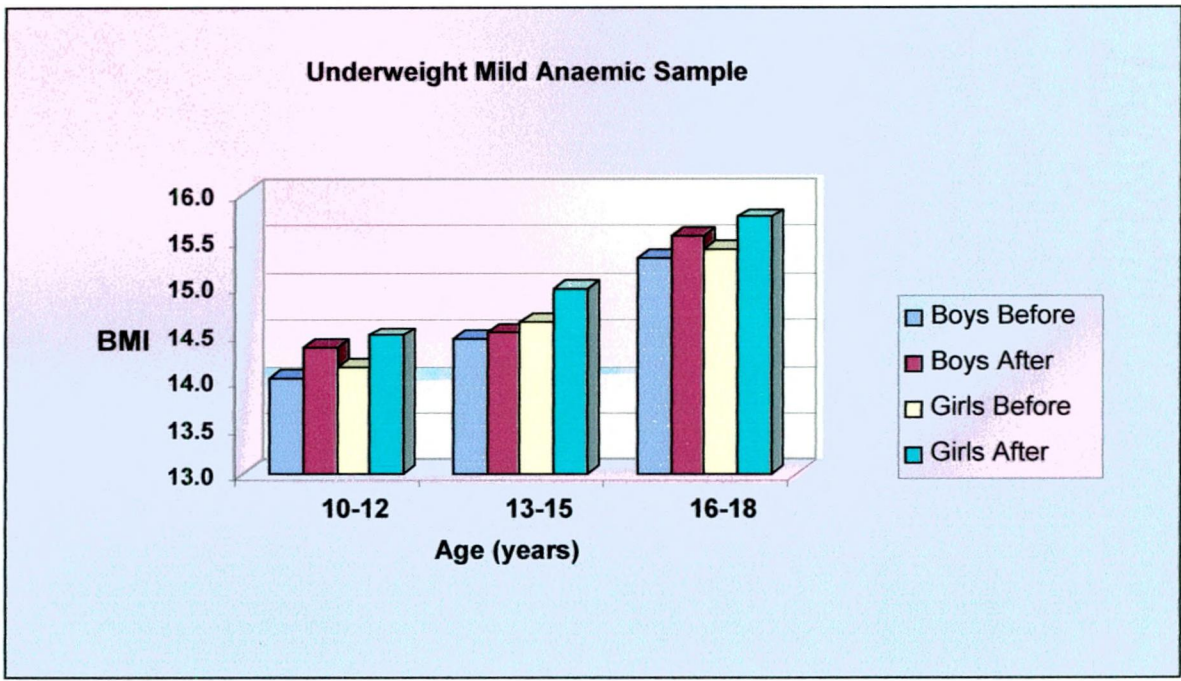
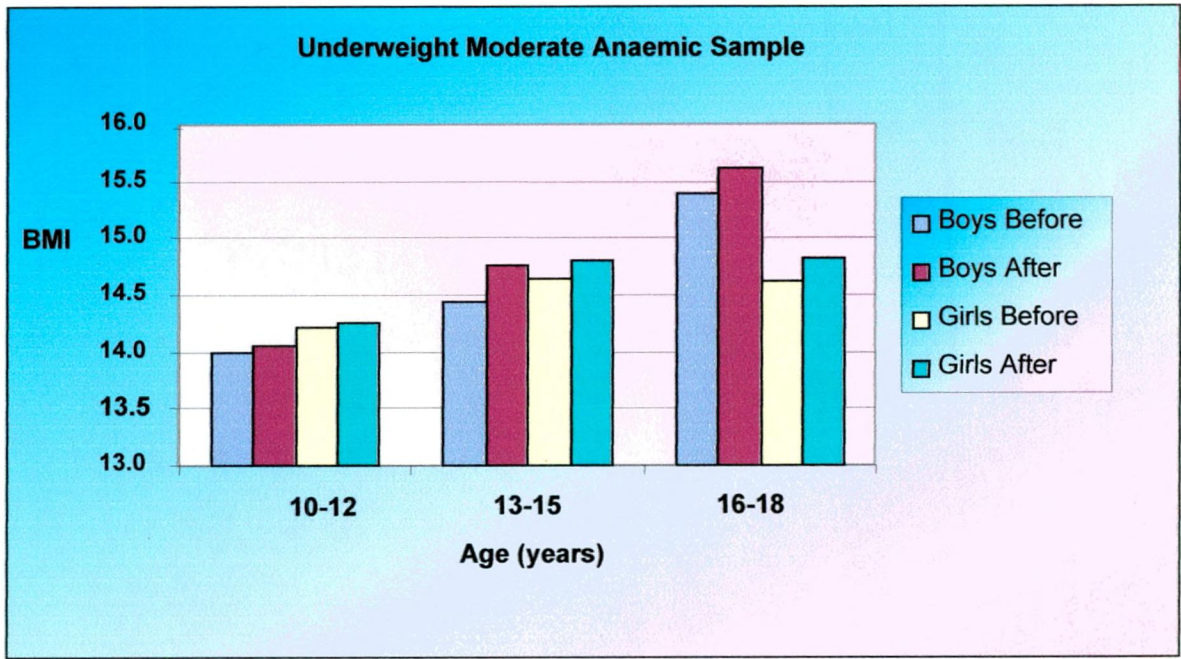


Figure 6

MEAN BMI OF THE SELECTED SAMPLE (Before and After Supplementation)

2. Changes in Haematological Parameters of the Selected Sub sample

a. Changes in Mean Haemoglobin Levels

Table XXI and Figure 7 presents the trends in mean haemoglobin levels of the selected sub sample before and after supplementation (Appendix IX).

Table XXI
Changes in the Mean Haemoglobin of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=114)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean± SEM	" t "
10-12	(50)	8.3±0.6	11.6±0.8	3.3±0.1	23.9**	8.4±0.5	11.5±0.7	3.1±0.1	20.9**
13-15	(38)	8.1±0.8	11.3±1.0	3.3±0.2	16.4**	9.0±0.4	11.1±0.5	2.2±0.1	15.1**
16-18	(26)	8.6±0.6	12.1±1.0	3.5±0.3	11.4**	9.0±0.4	11.5±0.8	2.5±0.3	8.8**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=181)									
10-12	(75)	10.9±0.46	13.2±0.3	2.3±0.1	27**	11.1±0.5	13.2±0.5	2.1±0.1	17.5**
13-15	(68)	10.9±0.5	13.8±0.8	2.9±0.1	25.8**	11.0±0.4	13.8±0.5	2.8±0.1	26.4**
16-18	(38)	11.1±0.4	13.5±0.7	2.4±0.2	10.9**	10.8±0.5	13.5±0.7	2.6±0.2	16.1**

Normal haemoglobin level Boys ≥ 13 g/dl: Girls ≥ 12 g/dl (WHO, 1989).

The mean initial haemoglobin levels of the moderate anaemic sub sample were lower than the normal value as suggested by WHO (1989). The fluctuation in the haemoglobin levels was higher among the selected boys (10 to 18years) with the uniform gradual increment and was statistically significant at one percent level when compared with the girls' sub sample. At the end of the study only 16 to 18 year old boys had 12.1 g/dl of haemoglobin indicating normal haemoglobin level, which was significant at one percent level.

The mean initial haemoglobin levels of mild anaemic sub sample were 10.8 to 11.1 g/dl. After supplementation there was an increase in haemoglobin levels and 't' values showed one percent level of significance. This revealed that the sub sample showed a better haemoglobin picture. It is important to note that 40 adolescents whose haemoglobin level was (8.14g/dl) fed with lotus stem powder (10g) for a period of three months had increase in haemoglobin level (10.46g/dl) and significant at one percent level (Sharma and Jain, 2003) which is in par with the present study.

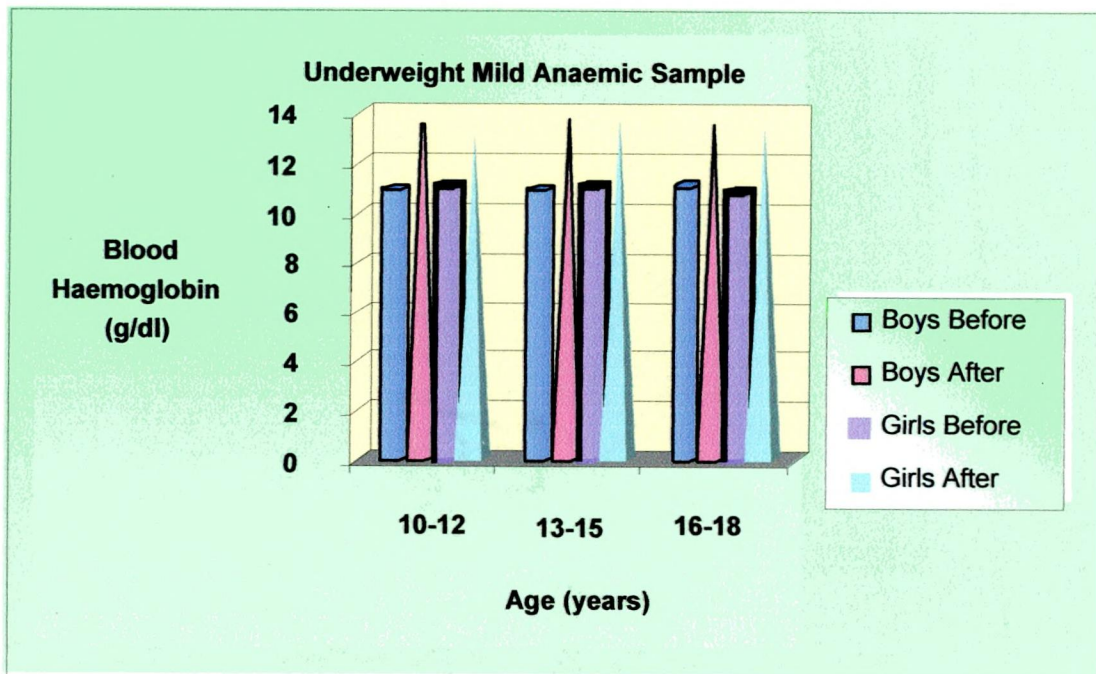
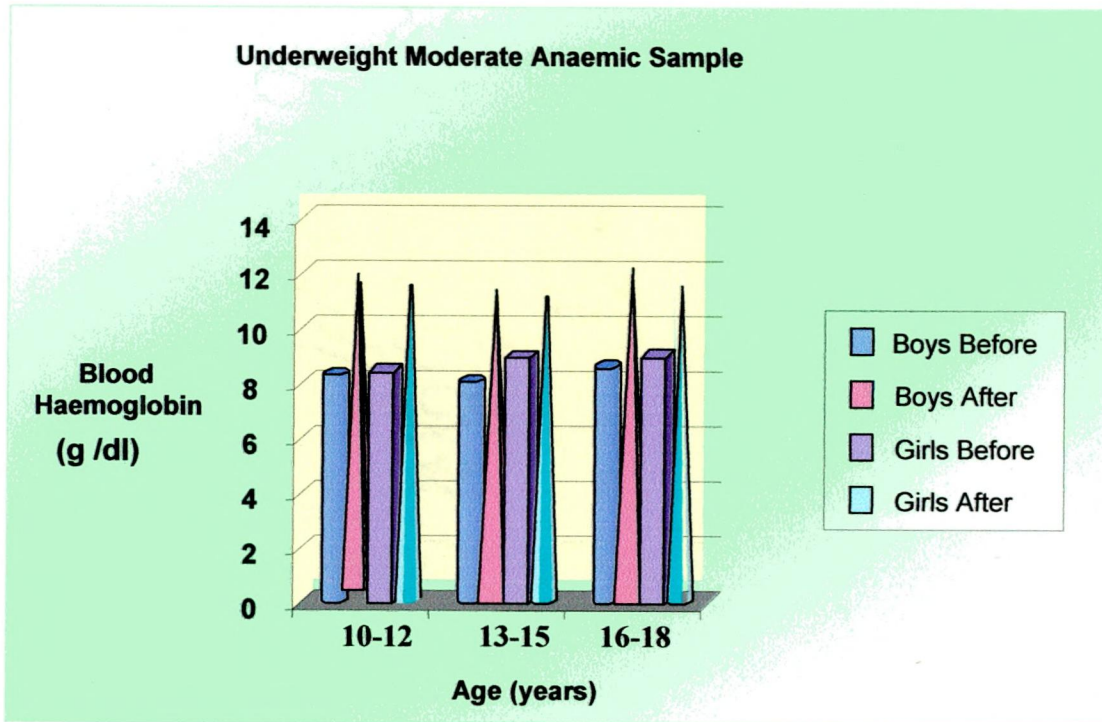


Figure 7

**MEAN BLOOD HAEMOGLOBIN LEVELS OF THE SELECTED SAMPLE
(Before And After Supplementation)**

b. Serum Iron

Mean serum iron levels of underweight sub sample with iron deficiency is presented in Table XXII, Figure 8 and Appendix Xa, b

Table XXII
Changes in the Mean Serum Iron of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=36)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean±SEM	" t "
10-12	(10)	43.4±3.2	81.4±18.0	38.0±7.3	5.2**	4.6 ±2.8	67.4±20.1	22.8±8.6	2.6**
13-15	(17)	43.7±4.1	77.7±12.0	34.0±3.6	9.5**	43.8±3.7	78.3±15.9	34.5±4.5	7.6**
16-18	(9)	44.3±4.5	56.0±15.4	11.8±6.0	1.9NS	42.8±4.5	67.6±7.7	24.8±3.8	6.5**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=67)									
10-12	(26)	45.2±3.4	65.0±4.5	19.8±1.2	15.5**	45.7±6.2	76.7±15.5	31.0±4.7	6.5**
13-15	(25)	50.4±9.7	77.8±13.5	27.4±3.4	8.1**	48.7±6.3	77.5±15.2	28.7±4.0	7.1**
16-18	(16)	42.6±3.9	77.6±16.2	35.0±7.1	4.9**	47.5±5.5	63.8±12.1	16.3±2.7	6**

Normal values- 50-175 µg/dl (Deb, 2000)

The mean initial serum iron levels of moderate boys and girls were found to be lower than the normal values 50 to 75µg/dl (Deb, 2000). At the end of the supplementation one percent level of significance was observed in boys (10 to 15 years) and girls (10 to 18 years). Whereas 16 to 18 year old boys did not show appreciable improvement in their serum iron levels and hence it was not statistically significant.

The mean differences between the initial and final values of serum iron within mild groups were found to be highly significant at one percent level. The present study is in line with Swaranalatha and Yegammai (2006) study that 17.57µg/dl of increment was observed on supplementation of iron tablet, guava and carrot to the adolescent girls for a period of three months.

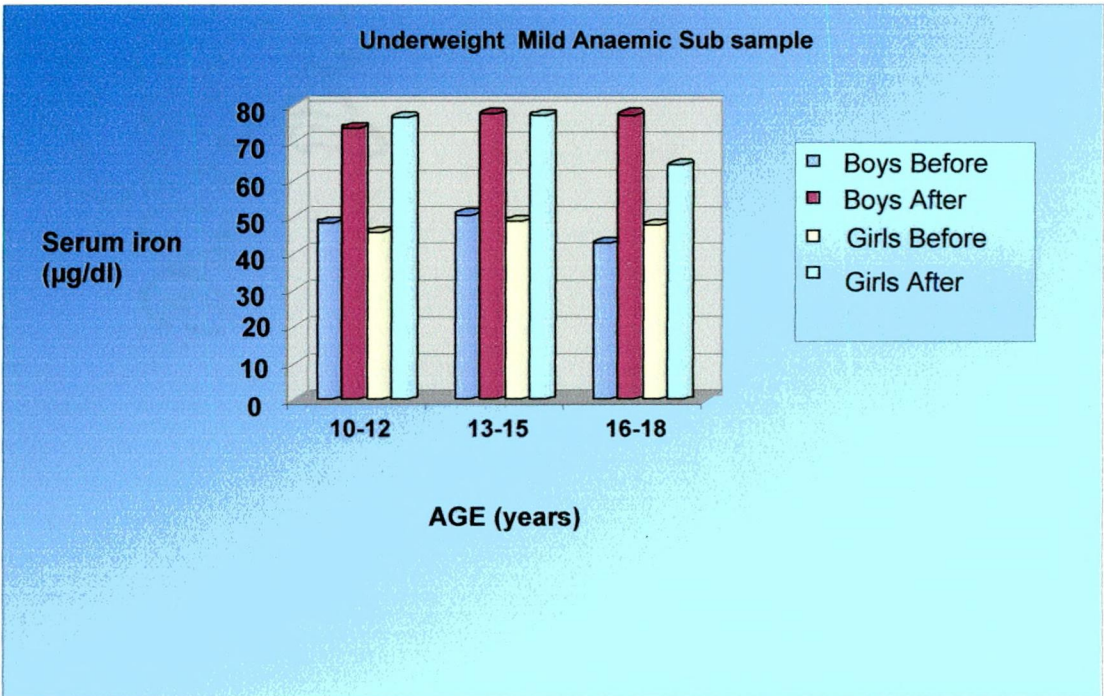
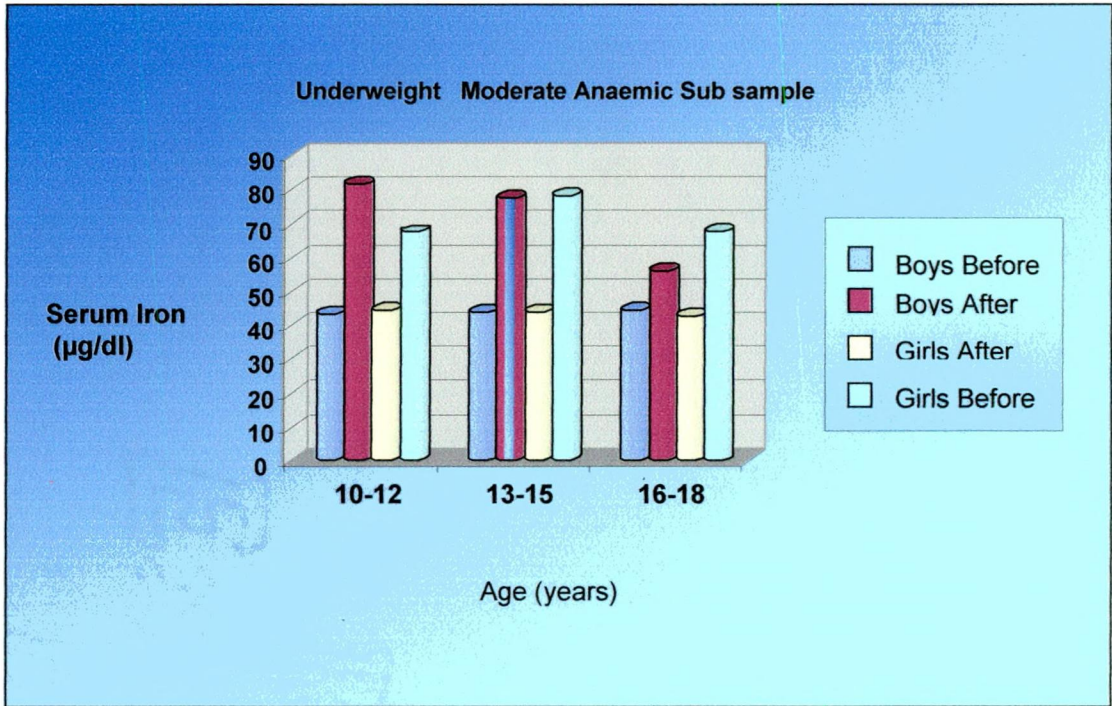


Figure 8

**MEAN INCREMENTS IN THE SERUM IRON LEVELS OF THE
SELECTED SUB SAMPLE
(Before and After Supplementation)**

c. Serum Ferritin

The changes in serum ferritin of moderate and mild anaemic underweight groups are depicted in Table XXIII, Figure 9 and Appendix Xa, b.

Table X XIII
Changes in the Mean Serum Ferritin of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=36)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean±SEM	" t "
10-12	(10)	9.2±0.9	13.5±0.9	4.3±0.2	20.4**	9.6±0.6	11.3±2.0	1.7±0.9	1.8NS
13-15	(17)	9.2±0.8	13.5±0.6	4.4±0.2	18.6**	9.4±0.9	13.4±0.9	4.0±0.1	39.2**
16-18	(9)	9.0±0.6	11.7±1.7	2.7±0.9	3**	9.0±0.7	12.6±0.6	3.6±0.3	9.5**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=67)									
10-12	(26)	9.9±1.0	13.8±1.1	3.9±0.3	13.8**	10.1±1.0	13.1±1.0	3.0±0.4	7.9**
13-15	(25)	10.0±0.9	13.8±0.7	3.9±0.3	14.7**	10.3±0.6	12.9±1.0	2.6±0.4	6.9**
16-18	(16)	10.6±0.8	13.6±1.0	3.0±0.2	14.4**	10.2±0.8	13.3±1.5	3.1±0.5	6.3**

Normal values- >12 µg/dl (Deb, 2000)

The initial and final values of moderate anaemic boys from the age group of 10 to 18 years and for girls 13 to 18 years were significant at one percent level (Figure 9a) which was similar to the normal value indicated by Bauer, (1994). Whereas the selected 10 to 12 year old girls did not show appreciable improvement in the serum ferritin levels and it was not statistically significant.

At the same time mild anaemic boys and girls, from all the age groups showed a significant difference in their serum ferritin values at one percent level of significance and all the sub sample had normal serum ferritin level 12 µg /dl. Kotecha et al., (2003) in their study showed that supplementation of iron folic acid tablet to adolescent school children in Vadora district showed increase in mean serum ferritin up to 5µg /dl.

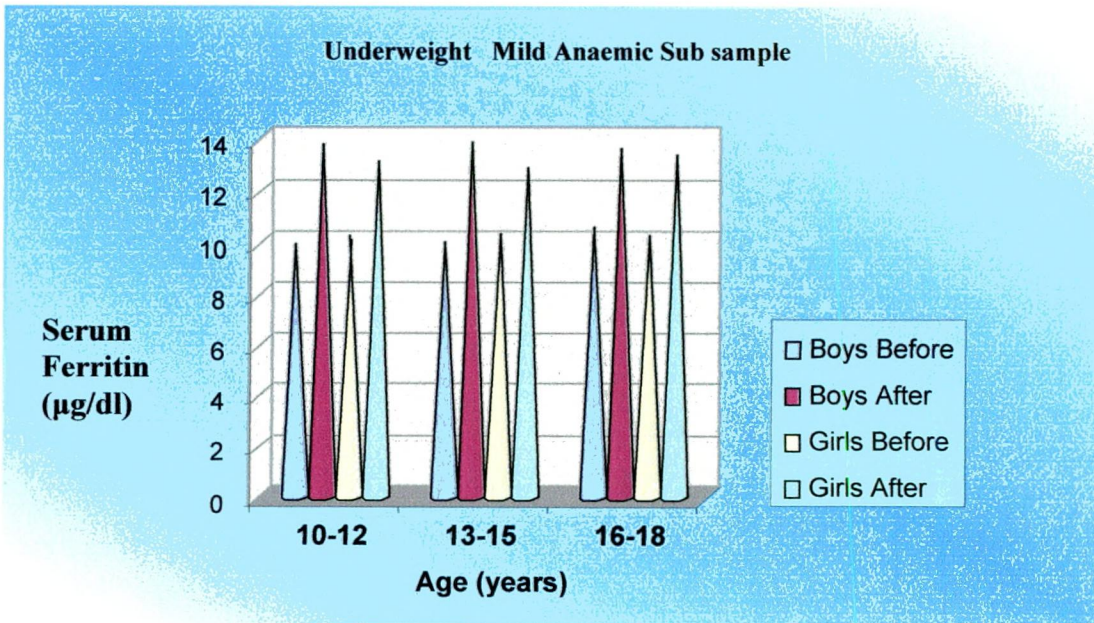
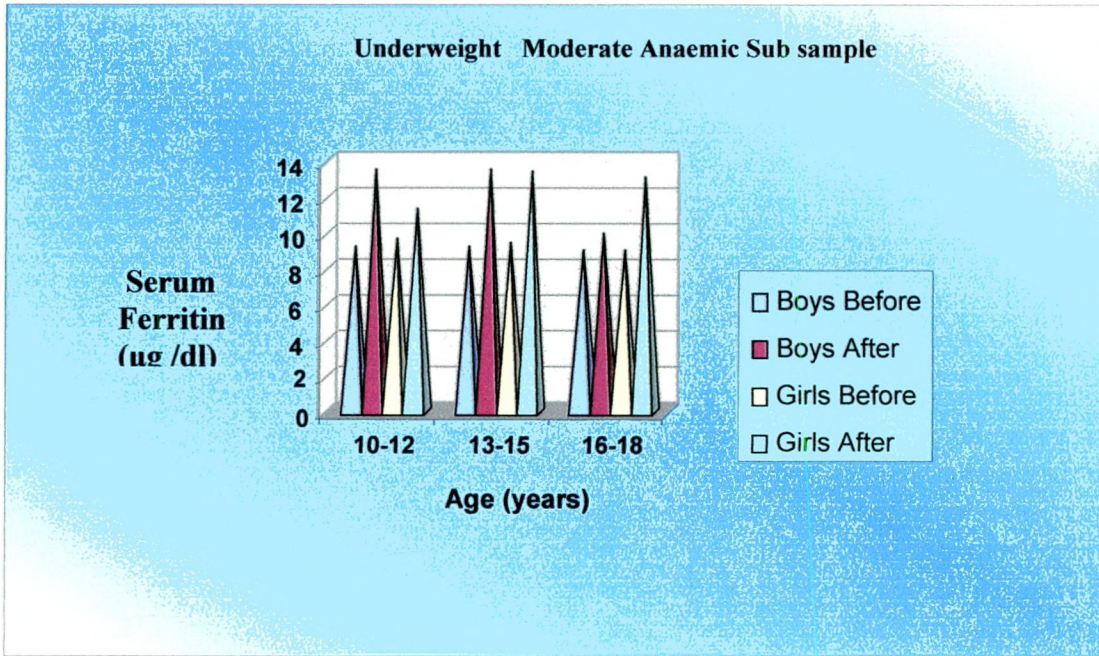


Figure 9

**MEAN INCREMENTS IN THE SERUM FERRITIN LEVELS OF THE
SELECTED SUB SAMPLE
(Before and After Supplementation)**

d. Total Iron Binding Capacity (TIBC)

Table XXIV, Figure10 and Appendix X.a,b shows the mean TIBC values of the selected moderate and mild anaemic underweight sub sample.

Table XXIV
Changes in the Mean TIBC of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=36)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean±SEM	" t "
10-12	(10)	454.8±21.0	363.0±69.9	91.8±28.4	3.2**	466.8±17.5	451.6±12.7	15.2±7.6	2*
13-15	(17)	450.7±12.5	335.0±88.2	115.7±37.8	3.1**	459.6±5.9	439.4±18.1	20.3±4.9	4.2**
16-18	(9)	461.3±4.4	454.8±14.3	6.5±7.6	0.9NS	462.6±6.3	447.0±8.2	15.6±2.9	5.3**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=67)									
10-12	(26)	428.7±59.6	376.1±85.9	52.6±1.3	2.5*	390.7±87.5	351.3±71.9	39.5±29.0	1.4NS
13-15	(25)	443.4±38.1	305.6±83.7	137.9±23.3	5.9**	433.7±34.1	336.8±93.5	96.9±25.2	3.8**
16-18	(16)	457.0±2.1	373.6±59.5	83.4±26.8	3.1**	410.9±74.5	280.5±65.0	130.5±29.5	4.4**

Normal values - 200-450 µg/dl (Deb,2000).

Estimation of TIBC provides a useful measurement in the diagnosis of iron deficiency anaemia (Sood, 1990). In 10 to 15 year old boys and 13 to 15 year old girls sub sample in moderate anaemic underweight group showed a significant difference in initial and final TIBC values at one percent level respectively. In the case of 10 to 12 year old girls five percent level of significance was obtained. Whereas in 16 to 18 year old boys, final values were not statistically significant.

In the case of mild anaemic underweight group maximum difference was noted in 13 to 15 year old boys, 16 to 18 year old girls and it was significant at one percent level. Whereas in 10 to 12 year old boys five percent level of significance was obtained but for girls in the same age TIBC values were not statistically significant. TIBC values will decrease when iron nutritional status improves and hence the mean values indicated a greater reduction after supplementation.

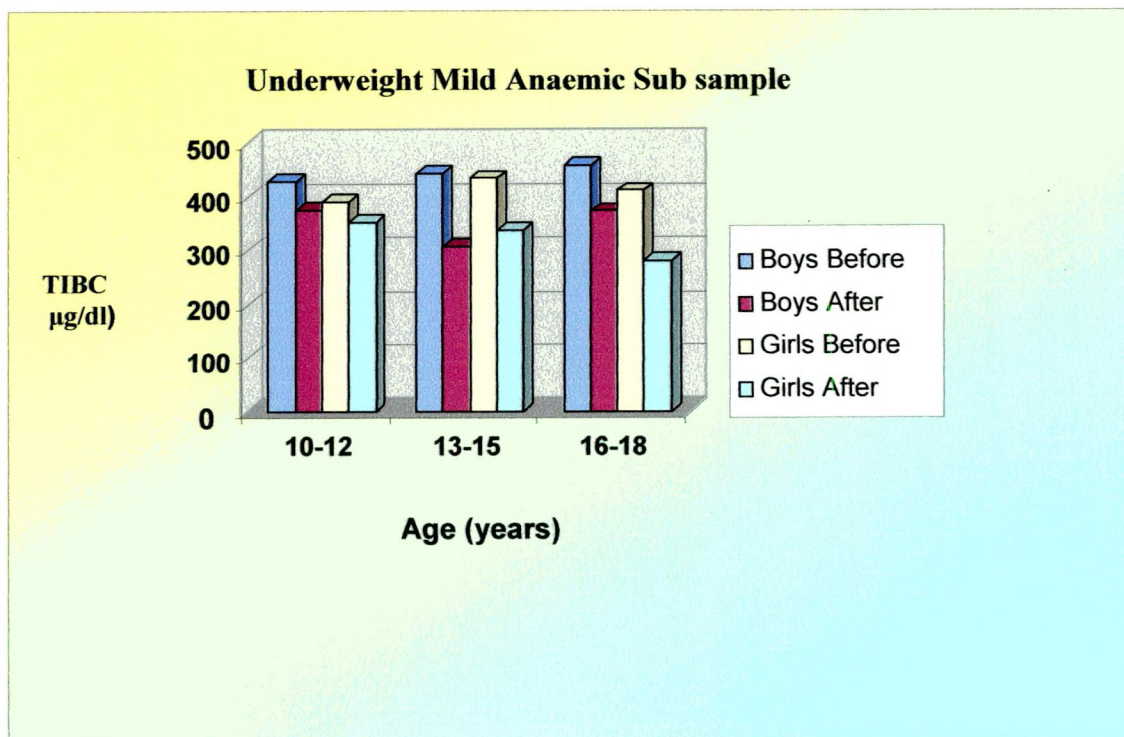
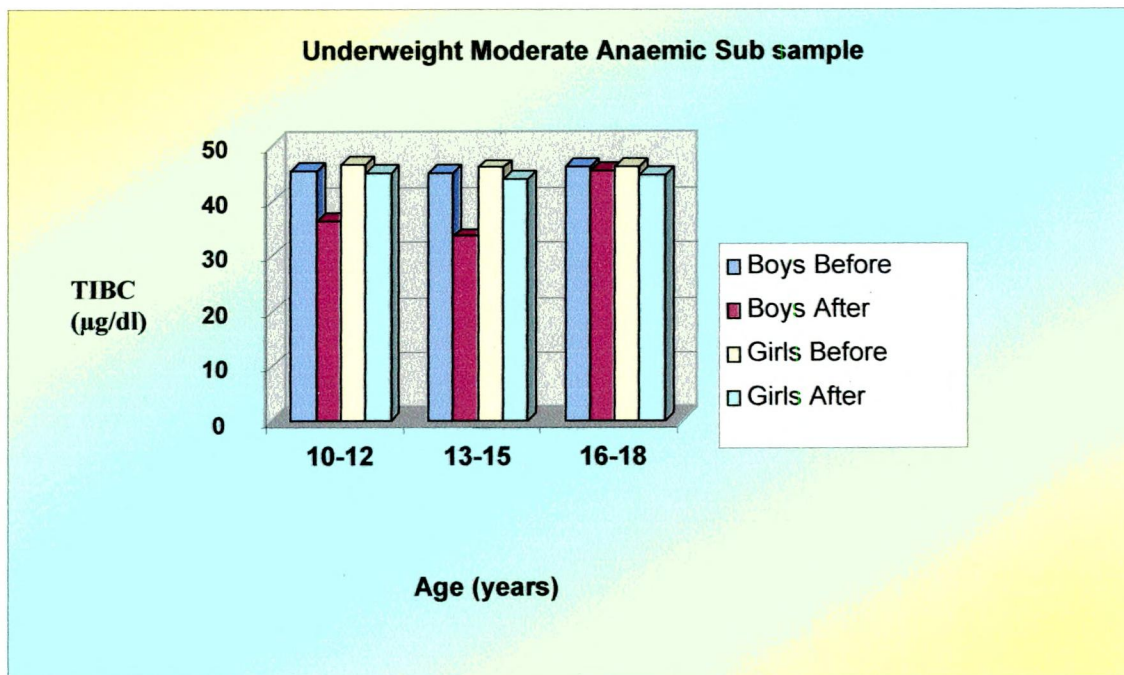


Figure 10

**MEAN INCREMENTS IN THE TOTAL IRON BINDING CAPACITY LEVELS
OF THE SELECTED SUB SAMPLE
(Before and After Supplementation)**

e. Transferrin Saturation

Table XXV and Figure 11 shows the mean transferrin saturation stores of the selected sub sample.

Table XXV
Changes in the Mean Transferrin Saturation of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=36)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean±SEM	" t "
10-12	(10)	9.5±0.9	21.7±6.4	12.18±2.66	4.5**	9.5±0.8	15.0±4.8	5.45±4.5	2.6*
13-15	(17)	9.6±0.83	24.7±8.4	15.0±3.3	4.4**	9.5±0.8	17.9±4.05	8.3±3.8	7.2**
16-18	(9)	9.4±1.1	12.9±4.7	3.5±2.3	1.5NS	9.2±0.9	15.1±1.9	5.9±0.9	6.6**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=67)									
10-12	(26)	11.5±2.7	20.4±4.6	8.9±1.3	6.6**	12.6±4.7	23.1±7.8	10.5±2.4	4.2**
13-15	(25)	11.3±2.7	27.0±7.7	15.6±1.8	8.2**	11.3±1.8	25.0±8.9	13.7±2.6	5.1**
16-18	(16)	9.3±0.8	21.4±6.6	12.1±2.9	4.1**	12.0±3.0	23.7±6.4	11.6±1.9	5.9**

Normal values- 35 percent and above (Deb, 2000)

Transferrin saturation gives an estimate of functional iron status as well as iron stores (Tait, 1996). One percent level of significance was observed among the moderate anaemic boys in 10 to 15 years and girls in 13 to 18 years. Whereas five percent significance was seen in 10 to 12 years girls. No statistical difference was seen in 16 to 18 years boys.

The mean difference between the initial and final values of transferrin saturation was found to be significant at one percent level in mild anaemic underweight group. Tumbi and Dodd (1996) reported an increase of transferrin saturation by only five percent level of significance after iron supplementation in anaemic subjects. "t" test showed that all the age groups in mild anaemic showed a significant difference at five percent level in transferrin saturation values.

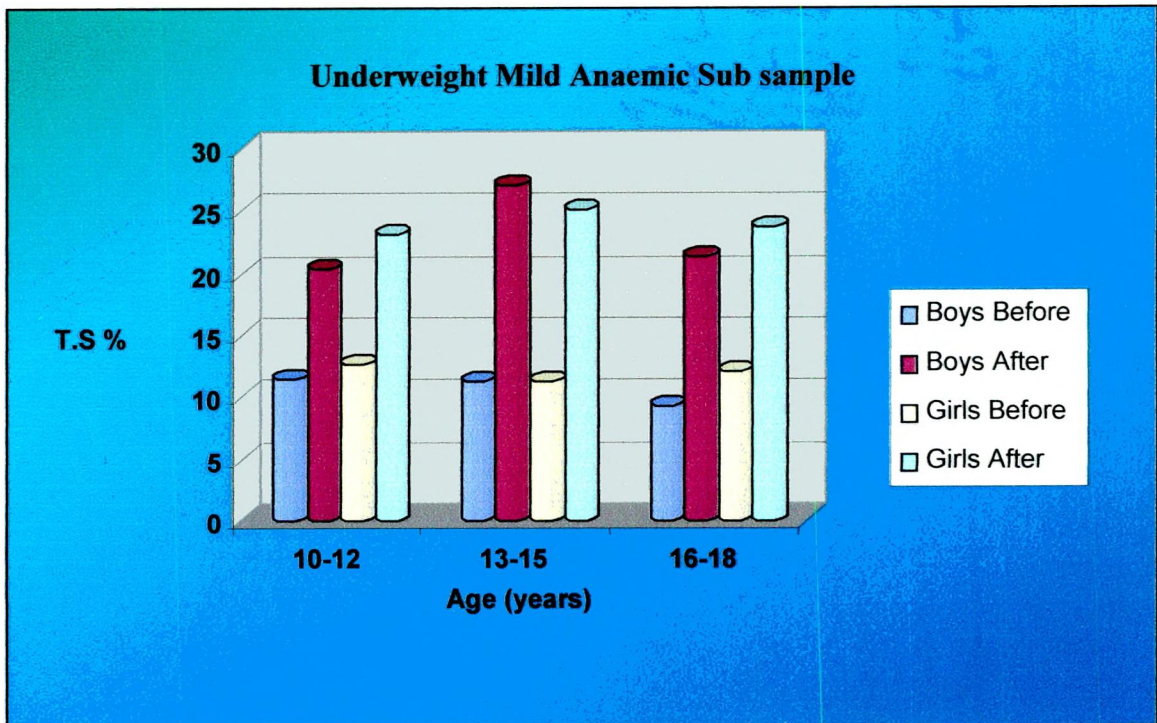
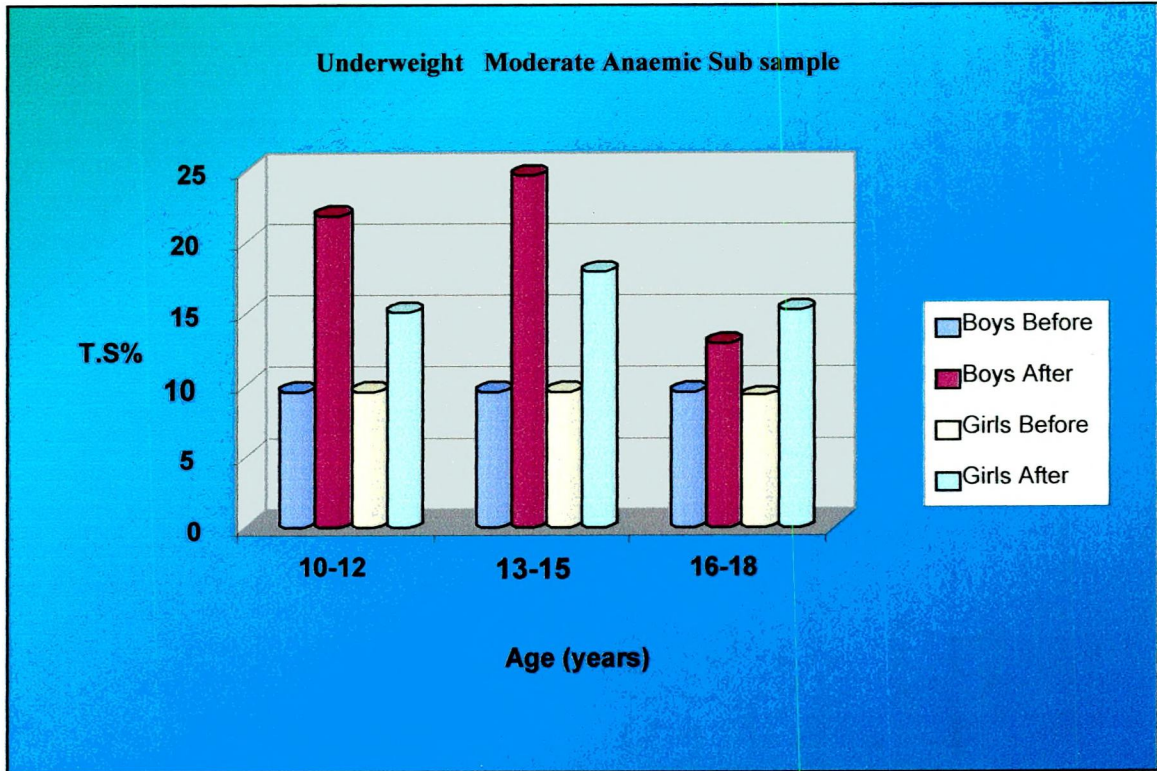


Figure 11

**MEAN INCREMENTS IN THE TRANSFERRIN SATURATION LEVELS OF
THE SELECTED SUB SAMPLE
(Before and After Supplementation)**

f. Serum Total Protein

Changes in the serum total protein of the selected moderate and mild anaemic underweight sub sample is indicated in Table XXVI, Figure 12 and Appendix X.a, X.b

Table XXVI
Changes in the Serum Total Protein of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=36)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean±SEM	" t "
10-12	(10)	4.5±0.4	7.4±0.5	3.0±0.1	21.5**	5.1±0.5	7.0±0.7	1.9±0.3	7.3**
13-15	(17)	4.4±0.3	6.8±1.0	2.0±0.3	8.9**	5.3±0.5	6.5±1.0	1.3±0.3	3.9**
16-18	(9)	4.9±0.2	6.8±0.7	1.9±0.4	4.6**	4.8±0.2	7.0±0.8	2.1±0.3	8.1**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=67)									
10-12	(26)	4.5±0.4	7.4±0.4	2.9±0.2	13.5**	4.5±0.5	7.4±0.5	2.9±0.2	11.9**
13-15	(25)	4.5±0.2	7.4±0.7	2.9±0.3	9.9**	5.0±0.7	7.7±0.5	2.7±0.2	15.2**
16-18	(16)	4.5±0.4	7.5±0.5	3.1±0.1	24.2**	5.1±0.9	7.7±0.6	2.6±0.3	9.9**

Normal values- 6.8 to 8.3g/dl (Deb, 2000)

Table XXVI highlights the increase in mean serum total protein levels of the moderate anaemic underweight group which was significant at one percent level in all the ages and both sex after supplementation.

An appreciable increment in serum total protein levels of mild anaemic underweight boys in 10 to 12 year olds was compared with other age and was found to be significant at one percent level. Among the girls serum protein value was increased to normal level (6.8 to 8.3g/dl) as indicated by (Deb, 2000) and significant at one percent level.

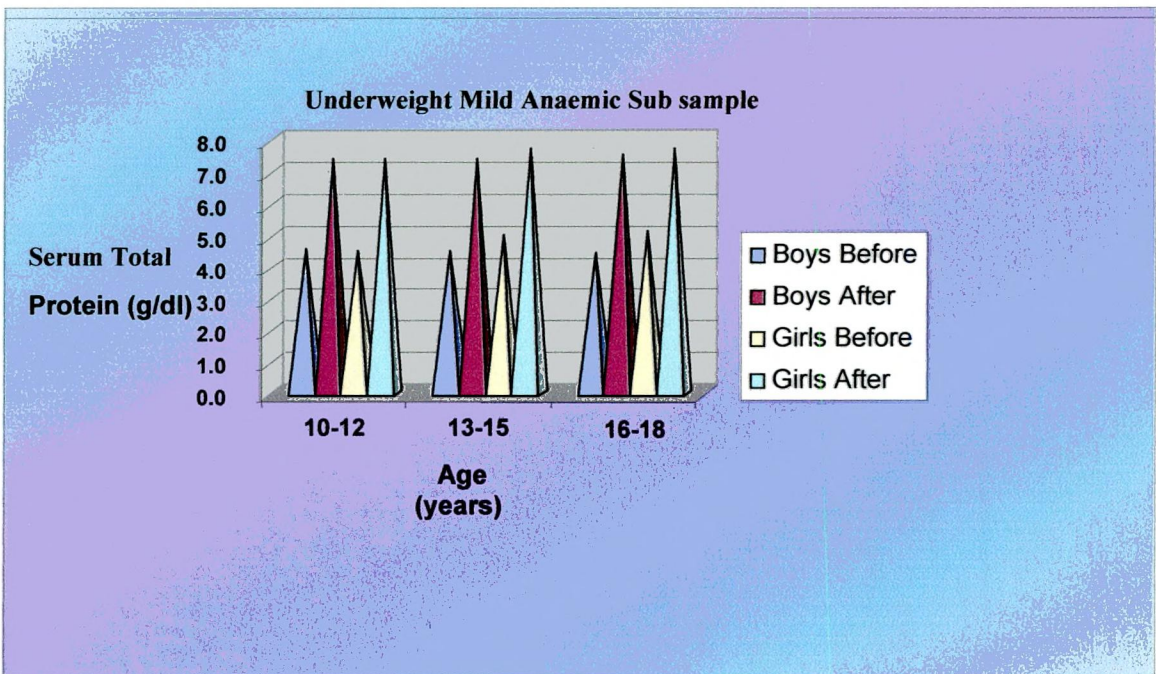
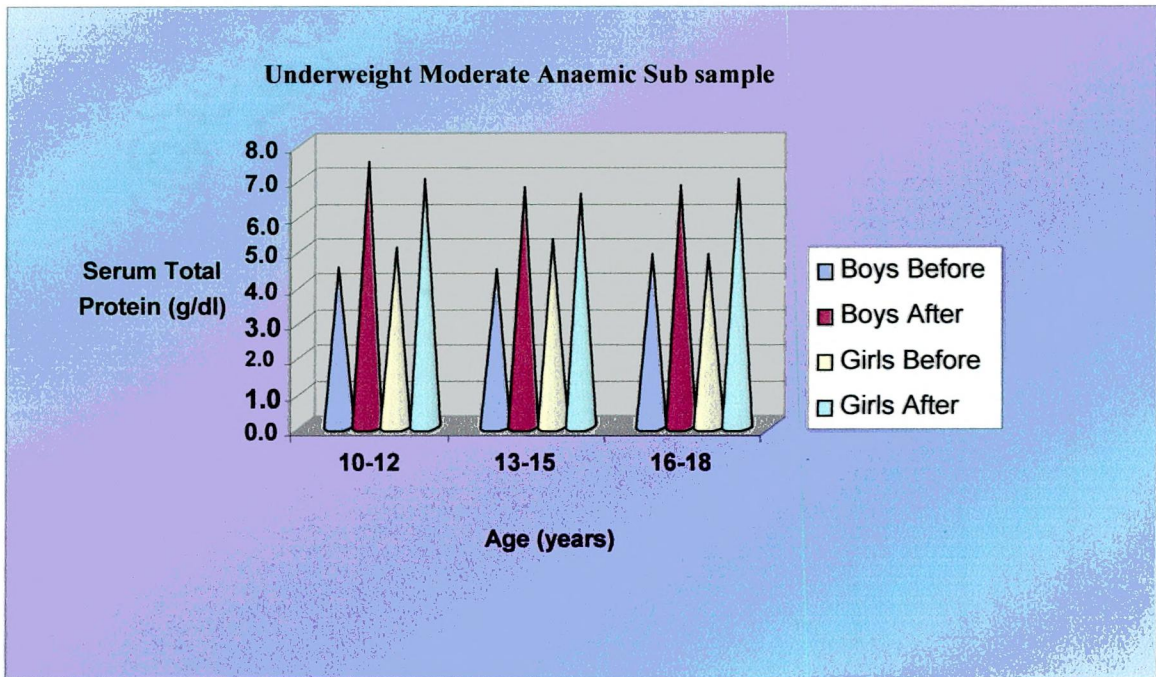


Figure12

**MEAN INCREMENTS IN THE SERUM TOTAL PROTEIN LEVELS OF THE
SELECTED SUB SAMPLE
(Before and after Supplementation)**

g. Serum Albumin

Mean serum albumin levels of moderate and mild anaemic underweight sub sample is presented in Table XXVII, Figure 13.

Table XXVII
Changes in the Serum Albumin of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=36)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean±SEM	" t "
10-12	(10)	2.9±0.4	5.5±0.2	2.6±0.2	14.5**	2.8±0.1	5.0±0.6	2.2±0.3	7.7**
13-15	(17)	2.7±0.3	5.4±0.4	2.7±0.2	11**	2.9±0.1	5.0±0.8	2.1±0.2	8.6**
16-18	(9)	2.8±0.1	5.5±0.3	2.7±0.1	26.9**	2.9±0.1	4.9±0.8	2.0±0.4	5.5**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=67)									
10-12	(26)	2.8±0.3	5.4±0.4	2.6±0.1	21.1**	2.9±0.3	3.7±0.8	0.8±0.2	3.7**
13-15	(25)	3.3±1.0	4.8±1.2	1.5±0.2	6.2**	3.1±0.5	3.6±0.3	0.5±0.2	3**
16-18	(16)	3.0±0.1	4.4±1.2	1.4±0.5	3.1**	3.2±0.9	5.1±0.9	1.8±0.2	7.7**

Normal values- 3.7-5.8g/dl (Deb, 2000)

It was interesting to note that the selected moderate anaemic underweight boys and girls had low serum albumin levels before supplementation. After supplementation there was an appreciable increment in albumin values of the boys and girls and it was found to be significant at one percent level.

In the case of mild anaemic underweight boys and girls (10 to 18 years) serum albumin showed significant increment at one percent level and their values was similar to the normal values 3.7 to 5.8g/dl.

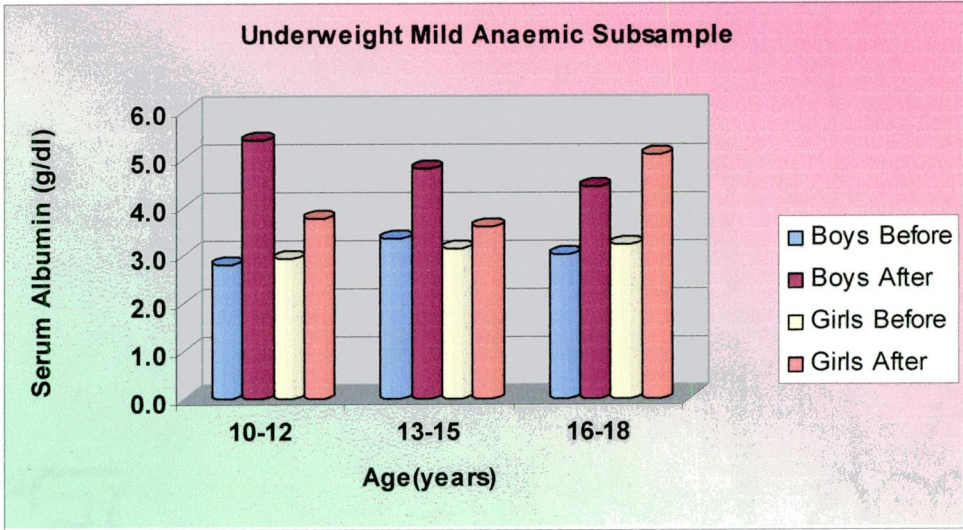
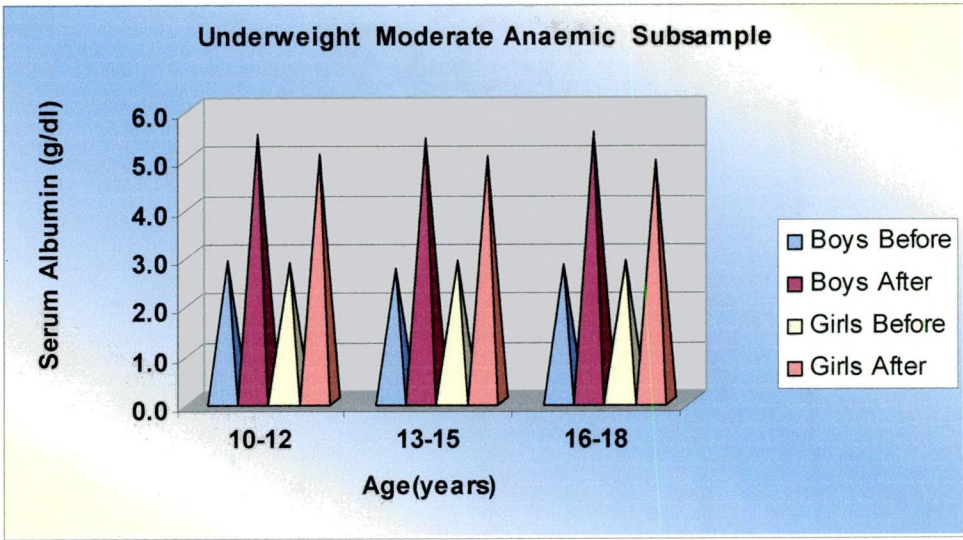


Figure12

MEAN INCREMENTS IN THE SERUM ALBUMIN LEVELS OF THE SELECTED SUBSAMPLE (Before and after Supplementation)

h. Serum Globulin

Table XXVIII and Figure 14 presents the changes in the mean serum globulin levels of the moderate and mild anaemic underweight sub sample.

Table XXVIII
Changes in the Serum Globulin of the Selected Sub sample

UNDERWEIGHT SAMPLE (MODERATE ANAEMIC N=36)									
Age (yrs)	N	BOYS				GIRLS			
		Before	After	Mean±SEM	" t "	Before	After	Mean±SEM	" t "
10-12	(10)	1.7±0.1	2.0±0.4	0.3±0.2	1.4NS	1.7±0.4	2.4±0.5	0.7±0.3	2.3*
13-15	(17)	1.7±0.2	2.0±0.4	0.4±0.2	2.4*	2.1±0.7	2.7±0.9	0.6±0.1	4.7**
16-18	(9)	1.6±0.3	2.0±0.4	0.5±0.2	3**	2.3±0.8	2.8±1.1	0.6±0.2	3.2**
UNDERWEIGHT SAMPLE (MILD ANAEMIC N=67)									
10-12	(26)	1.7±0.3	2.1±0.5	0.4±0.1	3.1**	1.9±0.4	2.8±.7	0.9±0.2	5.2**
13-15	(25)	1.7±0.2	2.2±0.4	0.6±0.1	5.4**	1.8±0.4	2.2±0.7	0.4±0.1	3.1**
16-18	(16)	1.5±0.2	2.1±0.5	0.6±0.2	2.9**	1.7±0.1	2.4±0.5	0.7±0.2	4.2**

Normal values-2.2 mg/dl

The mean differences in initial and final serum globulin levels of the moderate anaemic underweight were found to be significant at one percent level in 16 to 18 year old boys and 13 to 18 year old girls. But 13 to 15 years boys' and 10 to 12 years girls', serum globulin values were significant at five percent level, whereas no significance result was seen in 10 to 12 year old boys.

In mild anaemic underweight boys and girls from all the age group one percent significance was obtained. After supplementation study, two groups (moderate and mild anaemic underweight sub sample) showed better changes in various blood parameters.

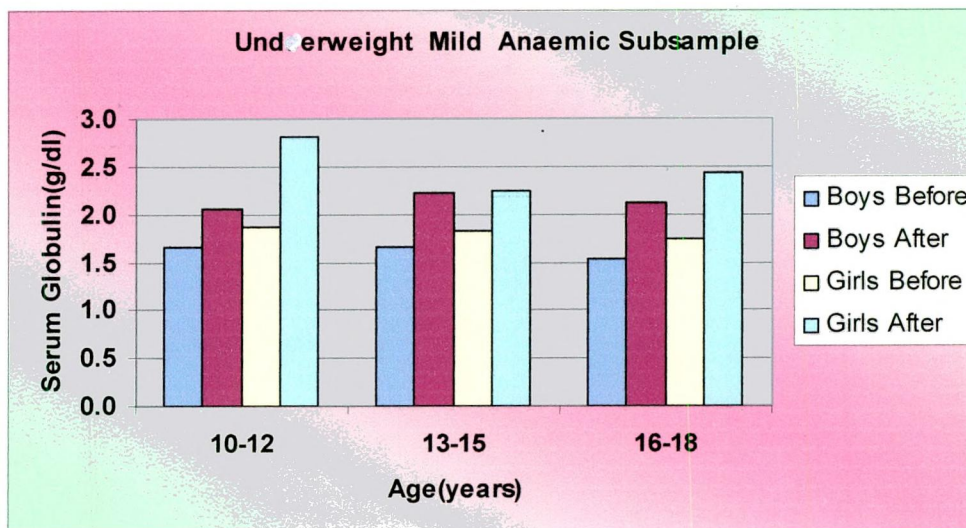
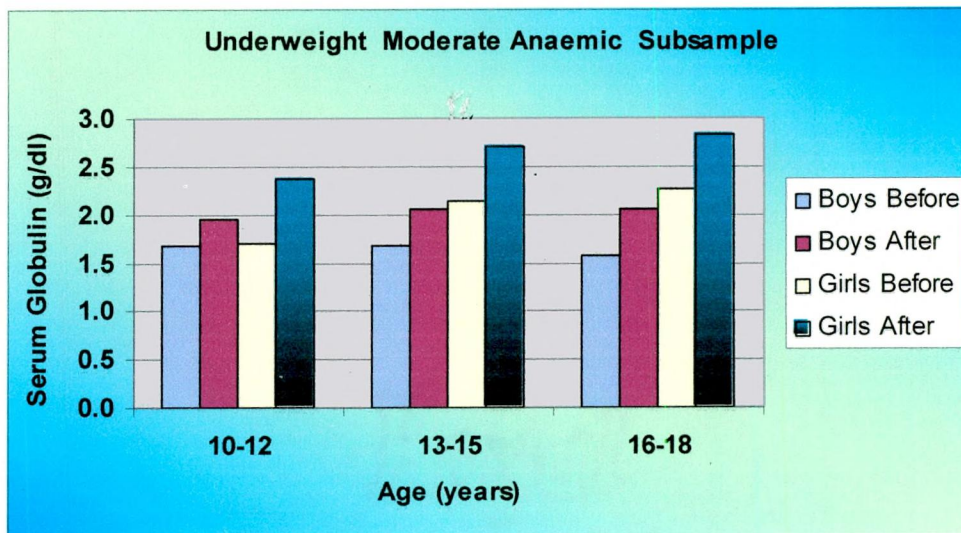


Figure12

**MEAN INCREMENTS IN THE SERUM GLOBULIN LEVELS OF THE
SELECTED SUBSAMPLE
(Before and after Supplementation)**

3. Clinical symptoms

Clinical Picture of the selected moderate and mild anaemic underweight sub sample is given in Table XXIX.

Table XXIX
Clinical Picture of the Selected Adolescents in the Supplemented Group

Parts of the body	Signs and Symptoms	Moderate Anaemic (N=114)				Mild Anaemic (N=181)			
		Boys (54)		Girls (60)		Boys (98)		Girls (83)	
		N	%	N	%	N	%	N	%
Hair	Discolouration	6	5	2	2	3	2	-	-
	Dry and brittle	23	20	16	14	18	10	2	11
	Loss of luster	31	27	20	18	21	12	2	11
Eyes	Poor vision	7	6	4	4	11	6	8	4
	Pale conjunctiva	15	13	11	10	20	11	9	5
Mouth	Angular stomatitis	28	25	15	13	31	17	15	8
	Chelosis	3	3	2	2	4	2		
	Dental caries	36	32	23	20	38	21	22	12
	Glossitis	7	6	4	4	4	2		
	Bleeding gums	14	12	17	15	11	6	4	2
Nails	Brittle and dry	6	5	2	2			1	0.5
	Pallor of nail	18	6	13	11	1	0.5	2	1
Muscles	Nutritional edema	3	3	-	-	-	-	-	-
	Poor Musculature	9	8	-	-	-	-	-	-
	Calf tenderness	8	7	4	4	2	1	-	-
	Rough and dry skin	24	21	20	18	17	9	15	8
Skeleton	Bow legs	2	2	-	-	-	-	-	-
General	Anorexia	18	16	15	13	21	12	10	6
	Easily fatigued	38	33	41	36	64	35	48	27
	Poor concentration	30	26	33	29	33	18	41	23
	General weakness	47	41	46	40	77	43	48	27

In the present study among moderate anaemic underweight sub sample 33 percent boys and 36 percent girls easily get fatigued. Whereas general weakness was reported by 41 percent boys and 40 percent girls. Dental caries was a common problem seen among adolescents (32 % boys and 20 % percent girls) while angular stomatitis was found in 25 percent boys and 12 percent girls and 15 percent girls had bleeding gums. Pale conjunctiva is a common symptom among anaemic children. Occurrence of pale conjunctiva in 24 percent boys and 15 percent girls was also noted.

Chandrasekhar et al., (1993) reported pale conjunctiva as the most common symptom among the anaemic subjects followed by angular stomatitis and bleeding gums.

The incidence of general weakness was more in mild anaemic boys (43%), poor concentration was observed among 23 percent girls and 35 percent boys, 27 percent girls in mild anaemic group reported that they easily get fatigued. Other signs and symptoms like discoloured hair, pale conjunctiva, angular stomatitis, dental caries, anorexia, dry hair, and dry skin were also present in greater percentage. After supplementation, there was no significant change in clinical symptoms.

E. Impact of HOEP on the Selected Sub sample

1. Nutrition knowledge Scores of the Selected Sub sample

Table XXX and Figure 15 depicts the nutritional knowledge scores of the selected sub sample.

Table XXX

Percentage Scores Obtained for Nutrition Knowledge by the Selected Sub sample

Knowledge Aspect	Supplemented Group # (N=295)				Non Supplemented Group## (N=656)			
	Pre test	Post test	Increase	't 'value	Pre test	Post test	Increase	't 'value
Nutrients and related risk factors	28	46	17	14.04**	12	31	19	18.49**
Dietary factors	21	46	25	18.55**	12	23	11	10.73**
Life style factors	23	43	19	15.45**	12	33	21	22.23**
Dental and physical hygiene	16	40	24	19.25**	17	34	17	16.45**
Sanitation and hygiene	28	47	19	18.29**	9	31	22	22.63**

-underweight mild and moderate anaemic:
 **-significant at one percent level

##underweight anaemic,
 under weight, risk of underweight

A significant difference ($p < 0.01$) was found in the scores of pre test and post test of nutrition knowledge and health practice (Table XXX). The mean percentage pre test scores of the non supplemented group were less when compared with the pre test scores

of the supplemented group. After administration of HOEP nutrition knowledge was increased and the gain in scores was shown in Figure 15. The maximum increase in scores 25 percentage was noted in dietary factor scores of the supplemented group, whereas in the aspects of nutrients and related risk factors only 17 percentage gain in scores were seen.

In the case of the selected sub sample in non supplemented group, maximum gain in scores 22 percentage was obtained for sanitation and personal hygiene. The gain in scores related dietary factor scores was only 11 percentages. The percentage of improvement in nutrition knowledge, sanitation and hygiene was improved after HOEP and one percent level of significance was obtained. The present finding was supported by Baring et al., (2002) that there was a significant improvement in nutrition education imparted to adolescent girls in urban Mumbai.

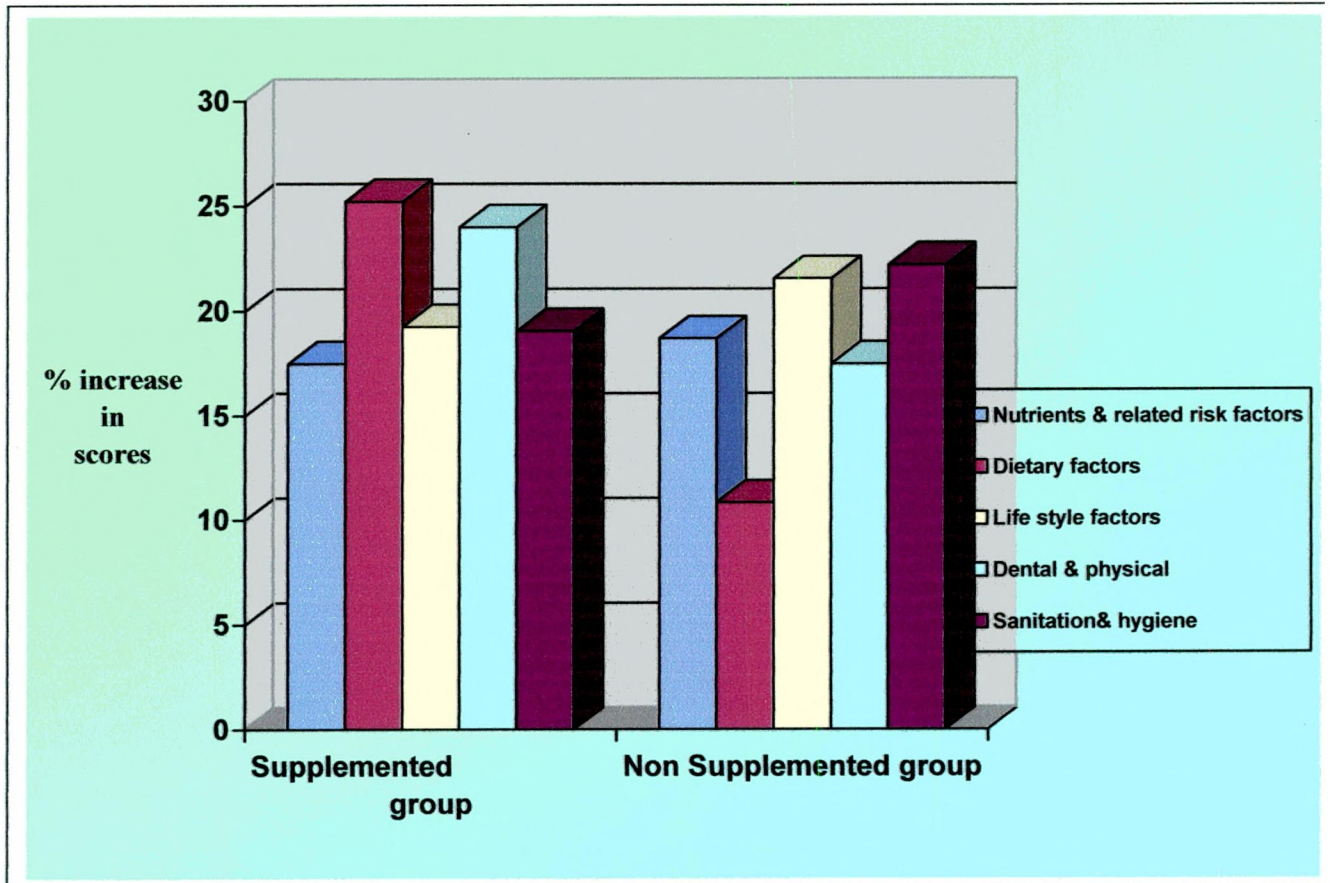


Figure 15

IMPACT OF HOEP ON NUTRITION KNOWLEDGE OF THE SELECTED SUB SAMPLE

2. Changes in Attitude of the Selected Sub sample

Changes in attitude of the selected sub sample is shown in Table XXXI and Figure 16.

Table XXXI
Changes in Attitude of the Selected Sub sample

ATTITUDE	Supplemented Group (N=295)				Non Supplemented Group (N=656)			
	Before HOEP		After HOEP		Before HOEP		After HOEP	
	N	%	N	%	N	%	N	%
Role of nutrition in the body	149	44	276	76	211	32	351	62
Misconception in relation to dietary factors	173	59	289	64	333	51	382	58
Life style factors	158	54	225	69	232	35	509	78
Maintaining sanitation hygiene while eating	143	48	245	73	331	50	428	65
Nutrition to combat several diseases	139	47	261	78	283	43	473	72

On pre testing, 51 percent of supplemented and 32 percent in non supplemented sub sample had prior knowledge on role of nutrient in the body building but on post testing change in attitude was noticed among 76 percent and 62 percent in both the group respectively. Misconception about dietary factors was prevalent among the selected adolescents but after HOEP change in attitude was however seen in 64 percent in supplemented and 58 percent in non supplemented group.

After HOEP counselling their general attitude towards lifestyle factors was changed in 69 percent and 78 percent sub sample in supplementary and non supplementary group. Where as 73 percent and 65 percent had positive attitude in maintaining personal and sanitation hygiene while eating.

On pre testing various nutrients to combat several diseases was believed by 47 percent and 43 percent in supplementary and non supplementary group. After counselling 78 percent and 72 percent believed that taking nutritious balanced diet can help to overcome several deficiency diseases.

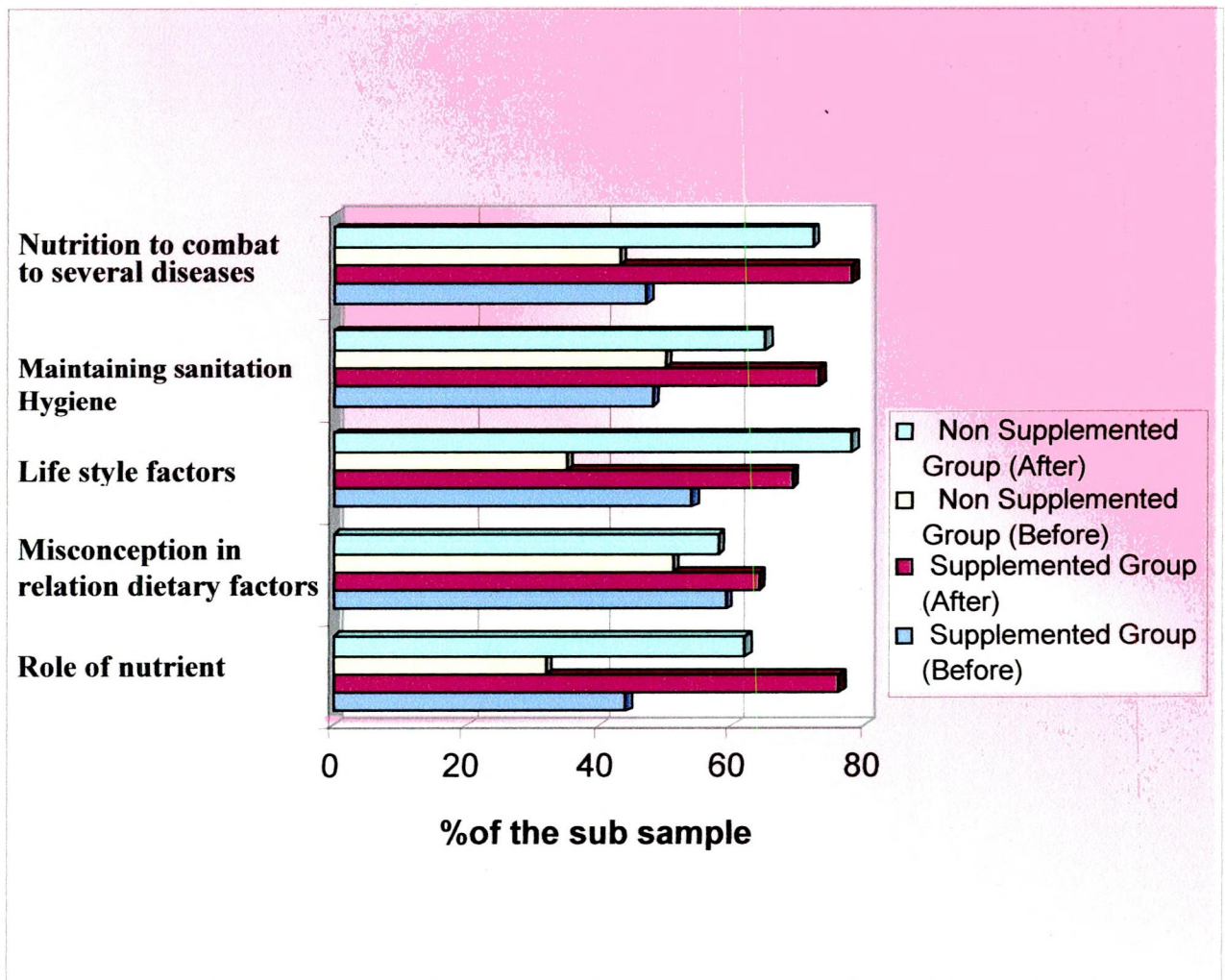


Figure 16

CHANGES IN ATTITUDE OF THE SELECTED SUB SAMPLE

3. Adoption of Desirable Practices by the Selected Sub sample

Adoption of desirable practices by the selected sub sample is picture out in Table XXXII and Figure17.

Table XXXII
Adoption of Desirable Practices by the Selected Sub Sample

PRACTICES	Supplemented Group (N=295)				Non supplemented Group (N=656)			
	Before HOEP		After HOEP		Before HOEP		After HOEP	
	N	%	N	%	N	%	N	%
Inclusion of nutritious food	176	60	235	80	225	34	454	69
Skipping meal and adherence to strict meal timing	72	24	63	21	204	31	159	24
Habit of taking junk foods	254	86	116	39	481	73	209	32
Combination of food groups	167	57	237	80	336	51	502	77
Personal hygiene	199	67	241	82	282	43	409	62

The selected 80 percent and 77 percent sub sample in supplemented and non supplemented group respectively adopted combination of food groups to their daily diet. After imparting the HOEP, skipping the meal and adherence to meal timing was changed from 24 percent to 21 percent sub sample in supplemented group and 31 percent to 24 percent in non supplemented group.

HOEP also imparted the benefits of avoiding the junk foods and street foods but the selected sub sample number was only 73 percent in supplemented group and 32 percent in non supplemented group. Practices of personal and sanitation hygiene was also observed by 82 percent and 62 percent the selected sub sample in both the group respectively. Schiller et al ., (1998) reported that nutritional counselling imparted in non formal way showed positive out comes in adolescent school children.

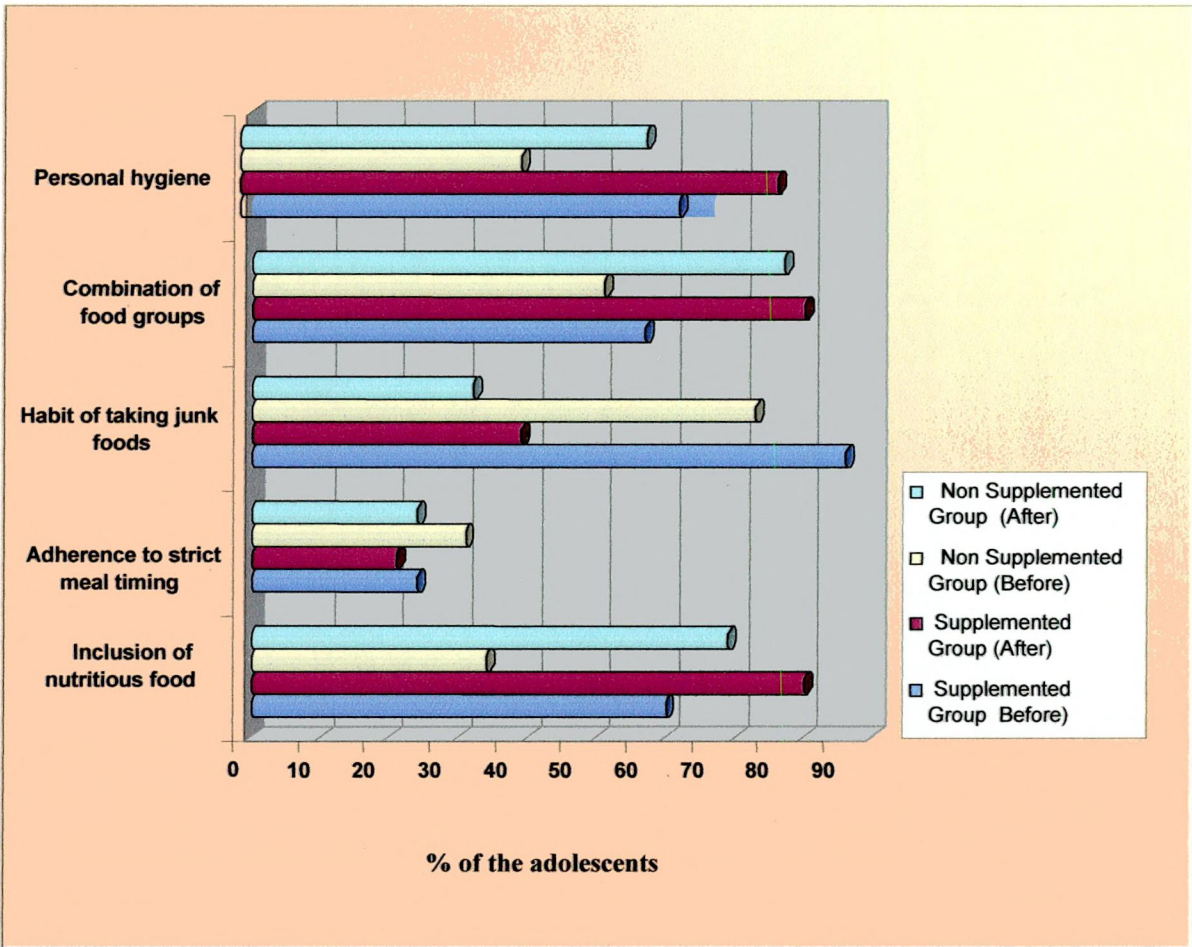


Figure 17

ADOPTION OF DESIRABLE PRACTICES BY THE SELECTED SUB SAMPLE

4. Distribution of the Selected Sub sample Based on the KAP Scores.

Mean KAP Scores obtained by the selected sub sample is picture out in Table XXXIII and Figure 18.

Table XXXIII
Mean KAP Scores Obtained by the Selected Sub sample

Details	SA	Supplemented Group (N=295)				Non Supplemented Group (N=656)			
		Pre test	Post test	Gain in scores	't' test	Pre test	Post test	Gain in scores	't' test
Knowledge	25	9.8	18.7	8.9	3.28**	6.36	13.4	7.04	4.32**
Attitude	25	11.69	19.25	7.1	2.23*	7.27	9.67	2.42	1.87NS
Practices	25	7.71	13.22	5.5	2.23*	6.50	10.67	4.17	2.09*

SA-Scores Allotted

The above Table XXXIII shows that nutrition knowledge and health practices of the selected sub sample in supplemented group had scored more when compared with non supplemented group. The supplemented and non supplemented group had one percent level of significance.

However for changes in attitude of the selected sub sample in supplemented group showed five percent level of significance. Whereas in non supplemented group gain in scores was 2.42, no statistical significance was observed. Incase of adoption of desirable practices in nutrition and health aspects five percent level of significance was achieved by the both group.

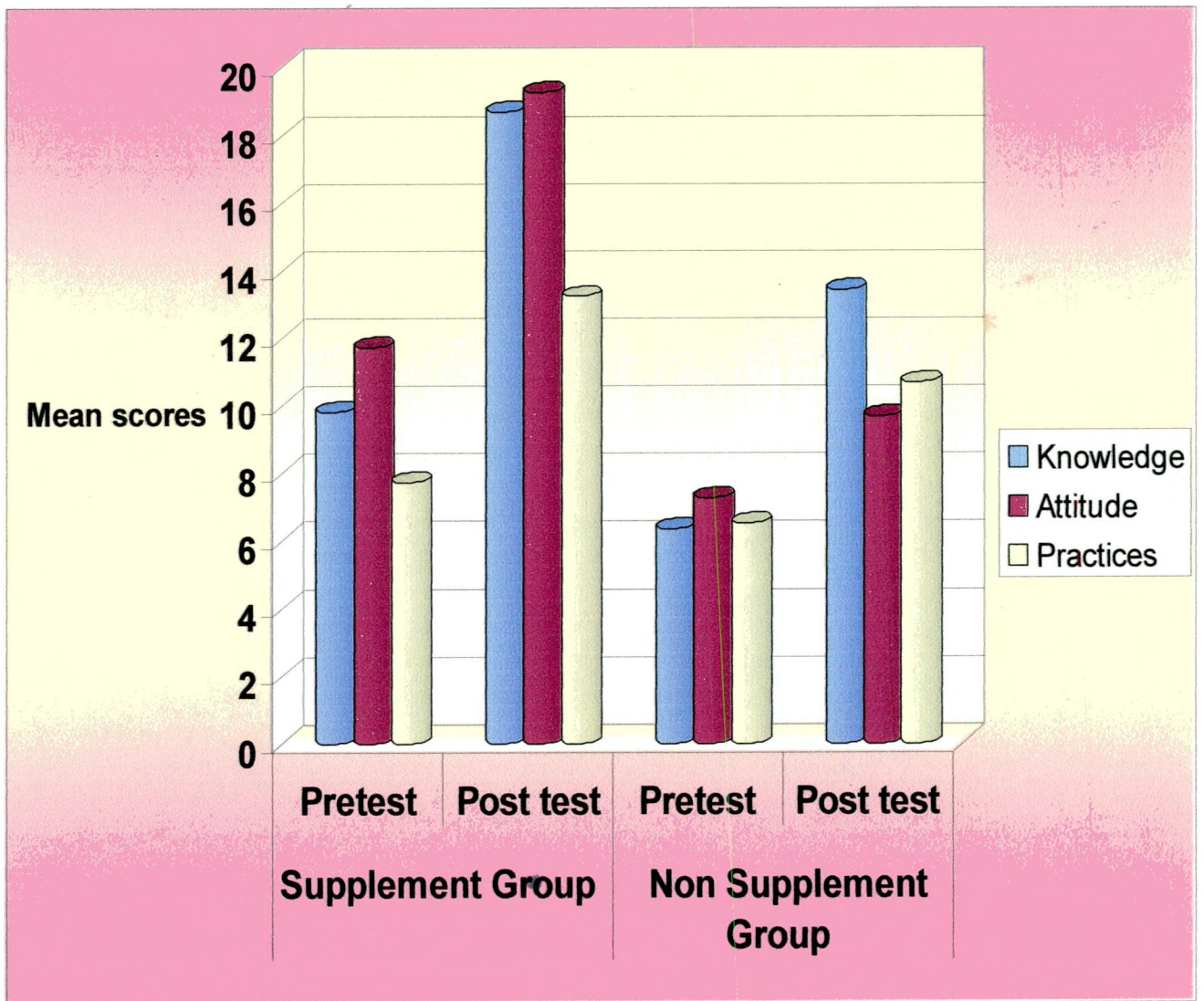


Figure 18

MEAN KAP SCORES OF THE SELECTED SUB SAMPLE

5. a. Mean Nutrient Intake of the Selected Sub sample in Supplemented Group

Table XXXIV and Figure19 reveals the mean nutrient intake of the selected underweight anaemic adolescents in supplemented group

Table XXXIV
Mean Nutrient Intake of the Selected Sub Sample in Supplemented Group (N= 295)

NUTRIENTS	SEX	RDA	AGE (years)										
			10-12			13-15				16-18			
			BEFORE	AFTER	INCREASE	RDA	BEFORE	AFTER	INCREASE	RDA	BEFORE	AFTER	INCREASE
Energy (Kcals)	Boys	2190	1496 (68)	1886 (86)	390 (18)	2450	1688 (69)	2144 (88)	456 (19)	2640	1789 (68)	2136 (81)	25
	Girls	1970	1352 (69)	1562 (79)	210 (10)	2060	1432 (70)	1568 (76)	136 (6)	2060	1489 (72)	1659 (81)	17
Protein (g)	Boys	54	23 (42)	38 (71)	15 (29)	70	34 (49)	46 (66)	12 (17)	78	51 (65)	61 (78)	11
	Girls	57	33 (58)	42 (74)	9 (16)	65	31 (48)	48 (74)	17 (26)	63	39 (62)	48 (76)	9
Fat (gm)	Boys	22	9 (43)	16 (74)	7 (31)	22	8 (36)	16 (73)	8 (36)	22	12 (55)	17 (77)	5
	Girls	22	11 (50)	16 (73)	6 (23)	22	10 (45)	15 (68)	5 (23)	22	11 (50)	16 (73)	5
Iron (mg)	Boys	34	18 (54)	24 (73)	6 (19)	41	25 (61)	33 (80)	8 (20)	50	26 (52)	34 (68)	8
	Girls	19	7 (37)	15 (79)	8 (42)	28	12 (43)	21 (75)	9 (32)	30	14 (47)	26 (87)	12
Calcium (mg)	Boys	600	300 (50)	470 (78)	170 (28)	600	265 (44)	453 (76)	188 (31)	600	345 (58)	488 (81)	14
	Girls	600	301 (50)	487 (81)	186 (31)	600	331 (55)	442 (74)	111 (19)	600	394 (66)	465 (78)	7
β carotene (mcg)	Boys	2400	1860 (78)	2018 (84)	158 (7)	2400	1654 (69)	2210 (92)	256 (11)	2400	1777 (74)	2071 (86)	19
	Girls	2400	1775 (74)	2146 (89)	371 (15)	2400	1733 (72)	1968 (82)	235 (9)	2400	1664 (69)	2187 (91)	52
Vit.B1 (mg)	Boys	1.1	0.5 (45)	0.9 (82)	0.4 (37)	1.2	0.5 (42)	0.8 (67)	0.3 (25)	1.3	0.5 (38)	0.7 (54)	0.2
	Girls	1	0.4 (40)	0.7 (70)	0.3 (30)	1	0.4 (40)	0.7 (70)	0.3 (30)	1	0.4 (40)	0.6 (60)	0.2
Vit.B2 (mg)	Boys	1.3	0.6 (46)	0.9 (69)	0.3 (23)	(2)	0.7 (47)	1 (67)	0.3 (20)	1.6	0.7 (44)	0.9 (56)	0.1
	Girls	1.2	0.5 (42)	0.8 (67)	0.3 (25)	1.2	0.6 (50)	0.9 (75)	0.3 (25)	1.2	0.4 (33)	0.6 (50)	0.1
Vit.C (mg)	Boys	40	11 (28)	23 (58)	12 (30)	40	18 (45)	26 (65)	8 (20)	40	9 (23)	19 (48)	10
	Girls	40	15 (38)	29 (73)	14 (35)	40	17 (43)	28 (70)	11 (27)	40	11 (28)	23 (58)	12
Fiber (g)	Boys		9	16	7		10	15	5		16	19	3
	Girls		10	15	5		12	19	7		15	20	5

Number in parenthesis indicate % of RDA

Perusal of data in Table XXXIV clearly shows that mean nutrient intake of the selected underweight anaemic sub sample revealed that their diet was deficient in all the nutrients. Surveys carried out in India have shown that the diet consumed by the majority of the vulnerable population is inadequate in quantity and quality leading to one or more deficiency diseases (Sommer and West, 1996).

The mean nutrient intake and percentage adequacy was significantly low as compared to RDA. Majority of nutrient intake was less even after HOEP but there was an increase in mean nutrient intake when compared with before data as shown in Figure. It was found that change in eating behaviour and income directly influenced the food availability intake higher, 19 percent and 22 percent energy deficit was seen among 13 to 15 year old boys and girls respectively.

In the present study before HOEP irrespective of age, sex, the intake of protein, energy and calcium were only 65 percent of RDA. Whereas for fat, iron, vitamin C, vitamin B1 and vitamin B2 were less than 45 percent of RDA. Studies concluded that other part of country also reported similarly. This is obvious because as children grow older they demonstrate growing autonomy in food choices which in turn reflects on their health (Kanani and Poojara, 2002).

None of the age groups in both sexes could meet the recommended values for calcium. This would be due to the poor intake of green leafy vegetables and milks. These findings also coincide with observations made by Kumari and Singh (2003).

Most of the age groups of both sexes could not meet even 50 percent of day's requirements of iron because of insufficient consumption of green leafy vegetables and other iron rich foods especially from animal origin which are highly bioavailability. A poor intake of green leafy vegetables coupled with an intake of refined foods could be major contributors to the picture. The fibre intake was very less in all the age groups.

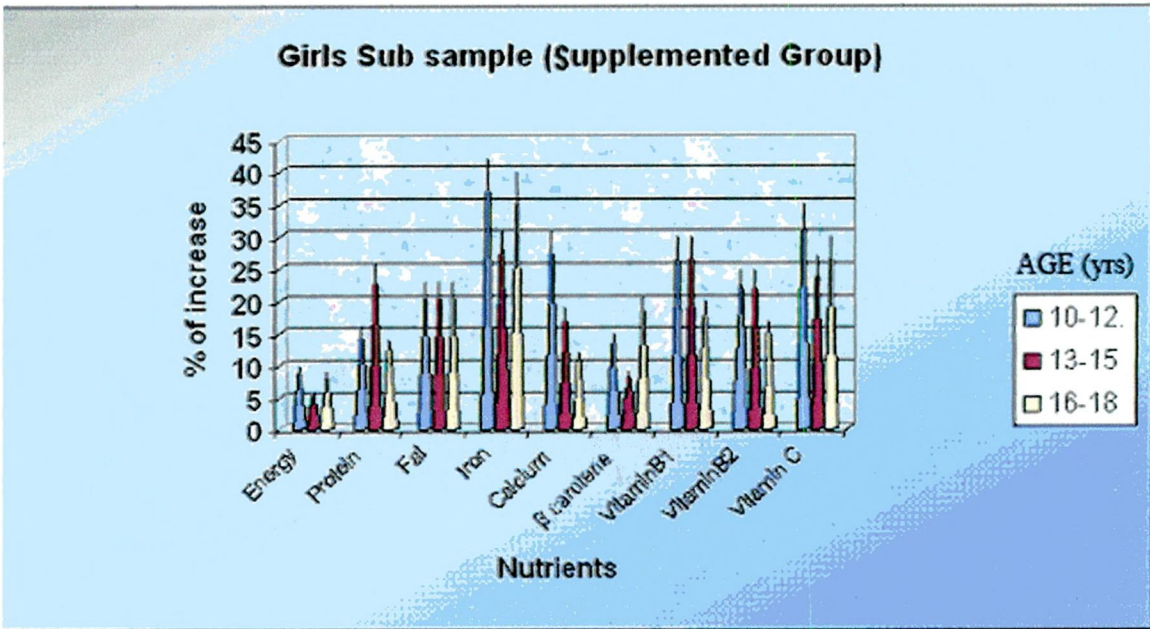
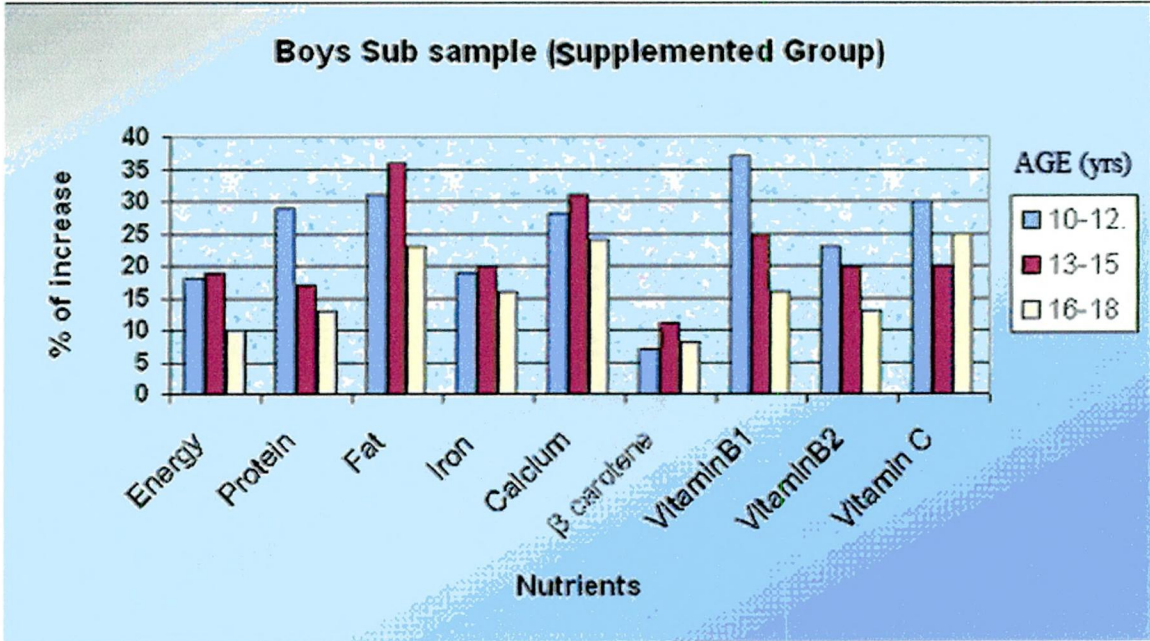


Figure 19

IMPROVEMENT OBSERVED IN THE MEAN NUTRIENT INTAKE OF THE SELECTED SUB SAMPLE (SUPPLEMENTED GROUP)

b. Mean Nutrient Intake of the Selected Sub sample in Non Supplemented Group

The mean nutrient intake of the selected sub sample who do not participated in supplementation study but HOEP was imparted to them and the result is summarized in Table XXXV and Figure20.

Table XXXV
Mean Nutrient Intake of the Selected Sub sample in Non Supplemented Group
(N= 656)

NUTRIENTS	SEX	RDA	AGE (years)										
			10-12			13-15				16-18			
			BEFORE	AFTER	INCREASE	RDA	BEFORE	AFTER	INCREASE	RDA	BEFORE	AFTER	INCREASE
Energy (Kcals)	Boys	2190	1696 (77)	1956 (89)	260 (12)	2450	1779 (73)	1976 (81)	197 (8)	2640	1748 (66)	2158 (82)	41 (16)
	Girls	1970	1690 (86)	1875 (95)	185 (9)	2060	1609 (78)	1945 (94)	336 (16)	2060	1677 (81)	(91)	19 (10)
Protein (g)	Boys	54	36 (67)	47.6 (88)	11.6 (21)	70	47.8 (68)	51 (73)	3.18 (4)	78	42.3 (54)	59 (76)	16. (21)
	Girls	57	38 (67)	46 (81)	8 (14)	65	43 (66)	54 (83)	11 (17)	63	45.8 (73)	51 (81)	5.2 (8)
Fat (gm)	Boys	22	10.4 (47)	15 (68)	4.56 (21)	22	10.3 (47)	14 (64)	3.75 (17)	22	10.2 (46)	14 (64)	3.7 (17)
	Girls	22	10 (45)	16 (73)	6 (27)	22	9.4 (43)	17 (77)	7.6 (35)	22	10.9 (50)	15 (68)	4.0 (19)
Iron (mg)	Boys	34	14.4 (42)	28 (82)	13.6 (40)	41	16.6 (41)	29 (71)	12.4 (30)	50	17.9 (36)	34 (68)	16. (32)
	Girls	19	7.9 (42)	16.6 (88)	8.75 (46)	28	17 (61)	22 (79)	5 (18)	30	14 (47)	26 (87)	1. (40)
Calcium (mg)	Boys	600	394 (66)	457 (76)	62.7 (10)	600	389 (65)	465 (78)	76 (13)	600	374 (62)	489 (82)	11. (19)
	Girls	600	406 (68)	478 (80)	72.1 (12)	600	393 (65)	487 (81)	94.2 (16)	600	392 (65)	457 (76)	65. (11)
β carotene (mcg)	Boys	2400	1254 (52)	1675 (69)	421 (17)	2400	1348 (56)	1687 (70)	339 (16)	2400	1223 (51)	1475 (61)	25. (10)
	Girls	2400	1321 (55)	1556 (65)	235 (10)	2400	1454 (61)	1762 (73)	308 (12)	2400	1424 (59)	1762 (73)	33. (14)
Vit.B1 (mg)	Boys	1.1	0.51 (46)	0.7 (64)	0.19 (18)	1.2	0.72 (60)	0.9 (75)	0.18 (15)	1.3	0.54 (41)	0.79 (61)	0.2. (19)
	Girls	1	0.5 (50)	0.59 (59)	0.09 (9)	1	0.5 (50)	0.58 (58)	0.8 (8)	1	0.58 (58)	0.65 (65)	0.0 (7)
Vit.B2 (mg)	Boys	1.3	0.55 (42)	0.9 (69)	0.35 (27)	1.5	0.51 (34)	0.9 (60)	0.39 (26)	1.6	0.51 (32)	0.81 (51)	0. (19)
	Girls	1.2	0.51 (43)	0.8 (67)	0.29 (24)	1.2	0.46 (38)	0.95 (79)	0.49 (41)	1.2	0.53 (44)	0.84 (70)	0.3 (26)
Vit.C (mg)	Boys	40	13.7 (34)	28 (70)	14.3 (36)	40	9.5 (24)	28 (70)	18.5 (46)	40	10.9 (27)	29 (73)	18. (45)
	Girls	40	9.65 (24)	26 (65)	16.4 (41)	40	10.9 (27)	29 (73)	18.1 (45)	40	14.2 (35)	24 (60)	9.8. (25)
Fiber (g)	Boys		8.39	17	8.61		8.15	15	6.85		8.34	15	6.6
	Girls		9.24	19	9.76		10.2	16	5.76		8.58	14	5.4

Number in parenthesis indicate % of RDA

The mean nutrient intake of the individual sub sample could be considered as a true picture of the actual intakes. It was evident from the Table XXXV and Figure 20 that after HOEP counselling small percentage deficit indicating the intake to remain essentially similar among all the age groups and both sex, hence the inter individual difference were small. Intake of all the nutrients considerably lowers than the RDA.

Before counselling pattern of intake for iron, vitamin C, vitamin B1, vitamin B2 was disturbing, since there was a deficit more than 40 percent of RDA. But after counselling percentage intake was increased to considerable level. While a mean deficit calcium after counselling was increased to about 76 to 82 percentage in all age groups and both sex. Whereas mean energy and protein intake appeared to be better since literature suggest intake of snacks.

Further it was noted during the study that maximum preference was recorded for daily intake of biscuits and other snacks over other foods by selected sub sample. Therefore less percentage deficit for energy, fat, protein can be attributed to consumption of different snacks. However in view of different nutrient intake, missing one meal can be threat for a sweeping deficiency to develop.

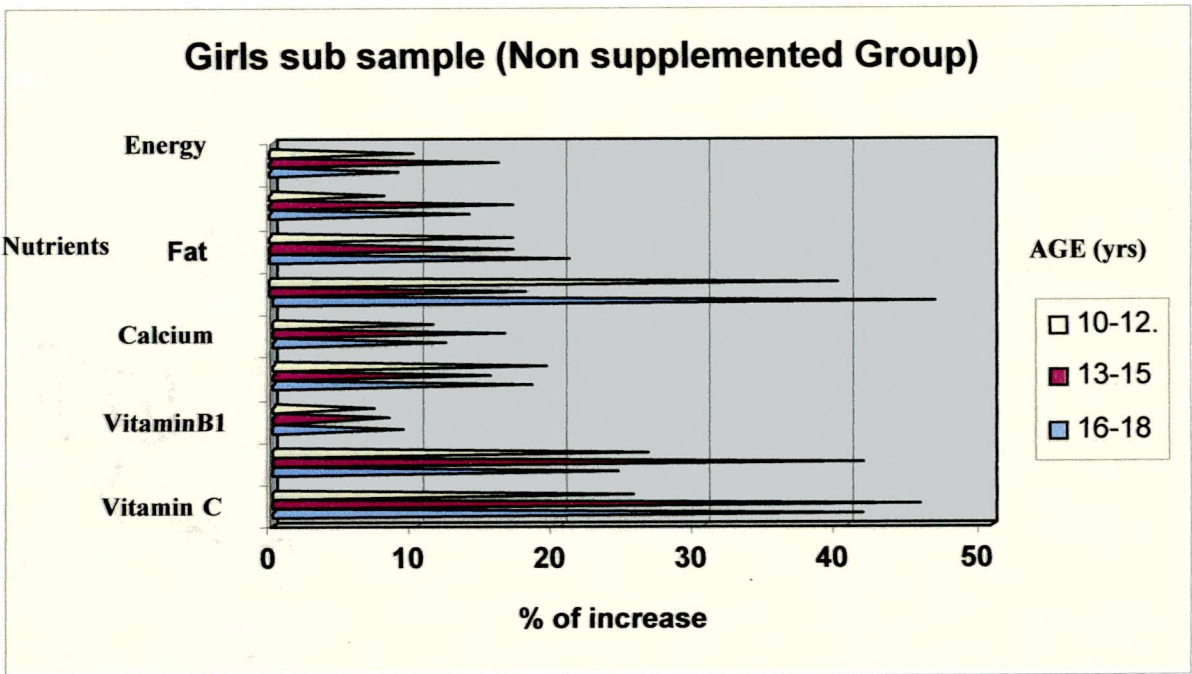
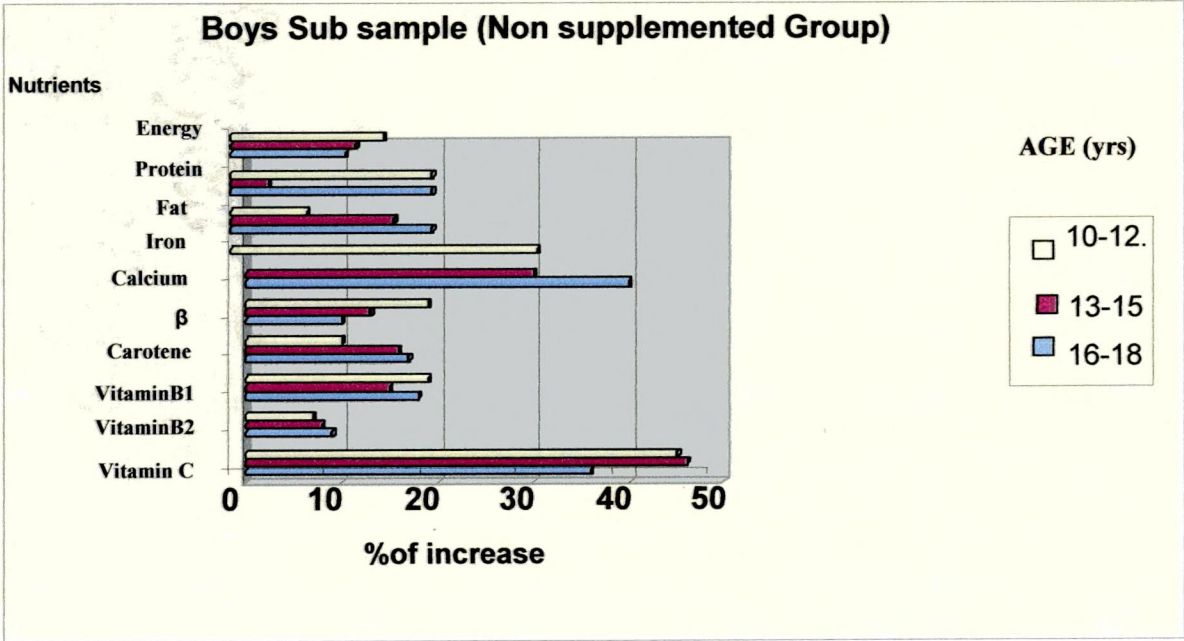


Figure 20

IMPROVEMENT OBSERVED IN THE MEAN NUTRIENT INTAKE OF THE SELECTED SUB SAMPLE (NON SUPPLEMENTED GROUP)