4

RESULTS AND DISCUSSION

The results of the study titled **"Effect of Interventions on Vitamin A and Iron Nutritional Status among Primitive Tribal Children in Nilgiris District"** are discussed under the following headings:

Phase I

Prevalence of VAD and IDA among PTG Children in Nilgiris District

A. Clinical Symptoms of VAD and IDA among PTG Children
B. Socio Economic Background of PTG Children
C. Nutritional Anthropometry of PTG Children
D. Dietary Pattern of PTG Children

Phase II

Background Information and Nutritional Status of PTG Children Included for Supplementation

A. Socio Economic Background of Supplementation Group Children
B. Nutritional Status of Children

Phase III

Acceptability and Nutritive Value of Spirulina Supplement

A. Acceptability Trials
B. Nutritive Value of Spirulina Supplements
C. Storage Stability of Spirulina Incorporated Food Supplement

Phase IV

Impact of Interventions on Nutritional status and KAP

A. Impact of Supplementation
B. Impact of Kitchen garden and Nutrition Education

Phase I

Prevalence of VAD and IDA among PTG Children in Nilgiris District

A. Clinical Symptoms of VAD and IDA among PTG Children

Tables VII and VIII, figures 6, 7 and 8 present the details on prevalence of clinical symptoms of VAD and IDA found among the 4376 PTG children.

Table VII

Clinical Symptoms among PTG Children (N=4376)

Clinical Picture #	Thodas				Kotas				Kurumbas				Irulas				Paniyas				Kattunaickers				Total	
	1-5 yrs		6-14 yrs		1-5 yrs		6-14 yrs		1-5 yrs		6-14 yrs		1-5 yrs		6-14yrs		1-5 yrs		6-14 yrs		1-5 yrs		6-14 yrs			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bitot's spot	0	0	2	0.5	0	0	1	0.8	2	0.8	3	0.4	2	0.4	0	0	4	0.7	12	1.5	1	1.5	3	1.3	30	0.7
Conjuctival Xerosis	1	0.5	0	0	0	0	0	0	3	1.3	3	0.4	4	0.9	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	28	0.6
Koilonychia	1	0.5	2	0.5	1	2	0	0	0	0	0	0	2	0.4	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	25	0.5
Emaciation	1	0.5	0	0	1	2.0	0	0	2	0.8	3	0.4	3	0.7	1	0.1	5	0.9	4	0.4	2	3.1	2	0.9	24	0.5
Dry, brittle hair	0	0	0	0	0	0	0	0	1	0.4	0	0	0	0	0	0	1	0.2	1	0.1	1	1.5	1	0.4	5	0.1
Angular Stomatitis	3	1.7	7	1.9	1	2	1	0.8	8	3.5	19	3.1	8	1.9	25	3	20	3.7	32	3.9	2	3.1	3	1.3	129	2.9
Cheilosis	3	1.7	7	1.9	0	0	3	2.6	8	3.5	12	2	8	1.9	12	1.4	20	3.7	21	2.6	2	3.1	3	1.3	99	2.2
Glossitis	0	0	2	0.5	0	0	5	4.3	8	3.5	5	0.8	12	2.9	13	1.5	15	2.8	15	1.8	2	3.1	3	1.3	80	1.8
Phrynoderma	0	0	0	0	1	2	1	0.8	2	0.8	3	0.4	2	0.4	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	26	0.6
Gingivitis	6	3.4	2	0.5	4	8.2	1	0.8	8	3.5	7	1.2	2	0.4	11	1.3	15	2.8	12	1.5	8	12.5	15	6.7	30	0.7
Dental caries	6	3.4	7	1.9	4	8.2	5	4.3	8	3.5	19	3.1	12	2.9	25	3	20	3.7	32	3.9	8	12.5	15	6.7	161	3.7
Thyroid gland Palpable	0	0	0	0	0	0	0	0	1	0.4	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0	2	0.1
Dermatitis	3	1.7	4	1.1	2	4.1	1	0.8	12	5.2	2	0.3	8	1.9	8	0.9	12	2.2	11	1.4	5	7.8	2	0.9	70	1.6

 # - Jelliffe (1966)

Table VIII

Clinical Symptoms of VAD and IDA among PTG Children (N=4376)

Clinical Picture for VAD	Thodas				Kotas				Kurumbas				Irulas				Paniyas				Kattunaickers				Total	
	1-5 yrs		6-14 yrs		1-5 yrs		6-14 yrs		1-5 yrs		6-14 yrs		1-5 yrs		6-14yrs		1-5 yrs		6-14 yrs		1-5 yrs		6-14 yrs			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bitot's spot	0	0	2	0.5	0	0	1	0.8	2	0.8	3	0.4	2	0.4	0	0	4	0.7	12	1.5	1	1.5	3	1.3	30	0.7
Conjuctival Xerosis	1	0.5	0	0	0	0	0	0	3	1.3	3	0.4	4	0.9	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	28	0.6
Conjuctival inflammation	1	0.5	0	0	0	0	0	0	3	1.3	3	0.4	4	0.9	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	28	0.6
Phrynoderrma	0	0	0	0	1	2	1	0.8	2	0.8	3	0.4	2	0.4	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	26	0.6
Broken Finger nails	0	0	0	0	1	2	1	0.8	2	0.8	3	0.4	2	0.4	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	26	0.6
Dry Hair	0	0	0	0	0	0	0	0.	3	1.3	8	3.5	4	0.9	4	0.4	15	2.8	12	1.5	2	3.1	3	1.3	51	1.2
Dry Skin	0	0	0	0	0	0	0	0.	3	1.3	8	3.5	4	0.9	4	0.4	15	2.8	12	1.5	2	3.1	3	1.3	51	1.2
Total prevalence of VAD																										5.5
Clinical Picture for IDA																										
Pallor	0	0	2	0.5	0	0	1	0.8	2	0.8	3	0.4	2	0.4	0	0	4	0.7	12	1.5	1	1.5	3	1.3	30	0.7
Swelling or soreness in tongue	0	0	2	0.5	1	2	0	0	0	0	0	0	2	0.4	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	24	0.5
Koilonychia	1	0.5	2	0.5	1	2	0	0	0	0	0	0	2	0.4	4	0.4	4	0.7	4	0.5	2	3.1	3	1.3	25	0.5
Total Prevalence of IDA																										**1.7**
Total prevalence of VAD and IDA																										**7.2***

*All children with VAD were also anemic

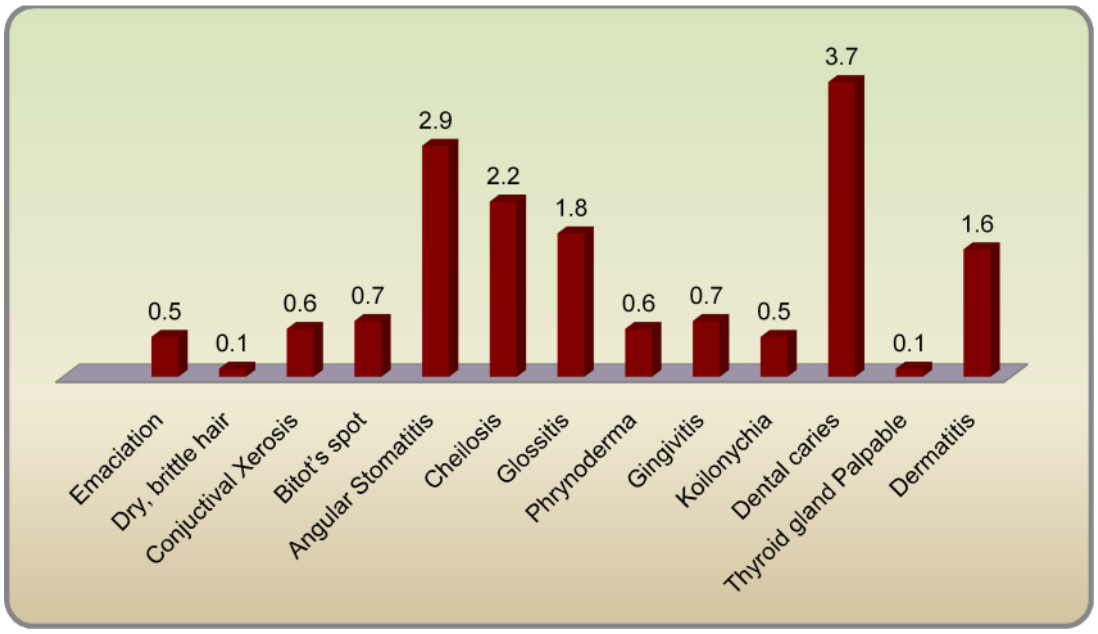


Figure 6. Clinical Symptoms among PTG Children

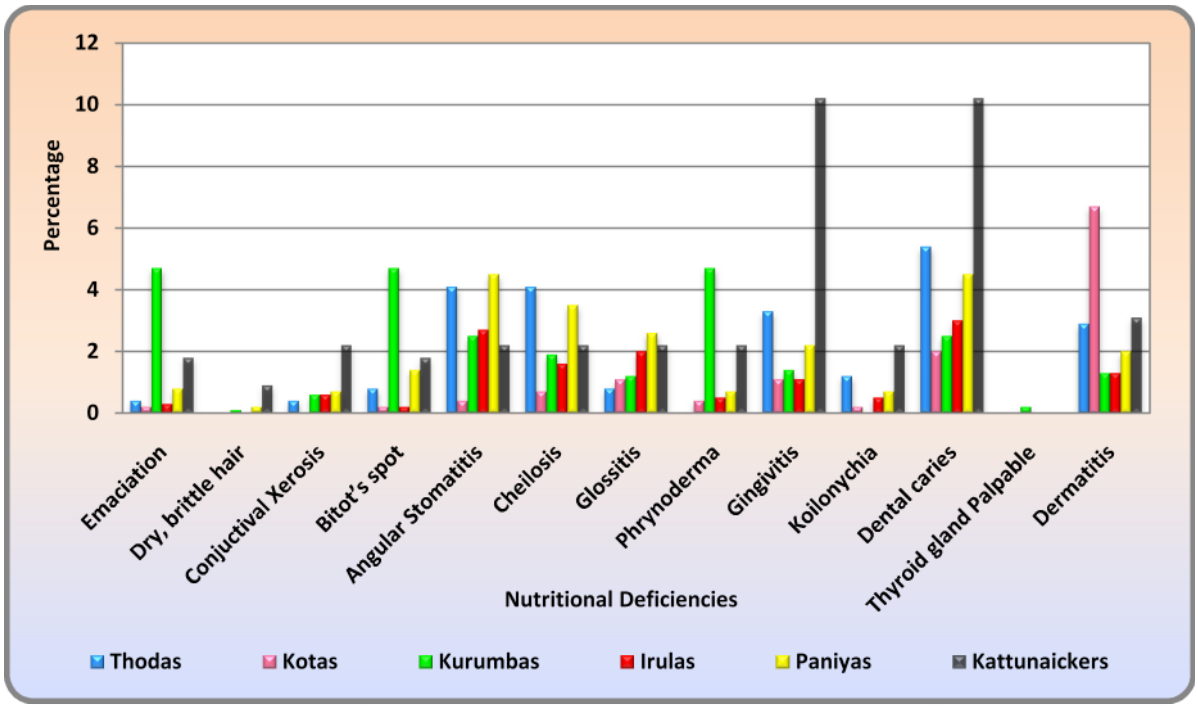


Figure 7. Clinical symptoms among PTG children - Tribewise

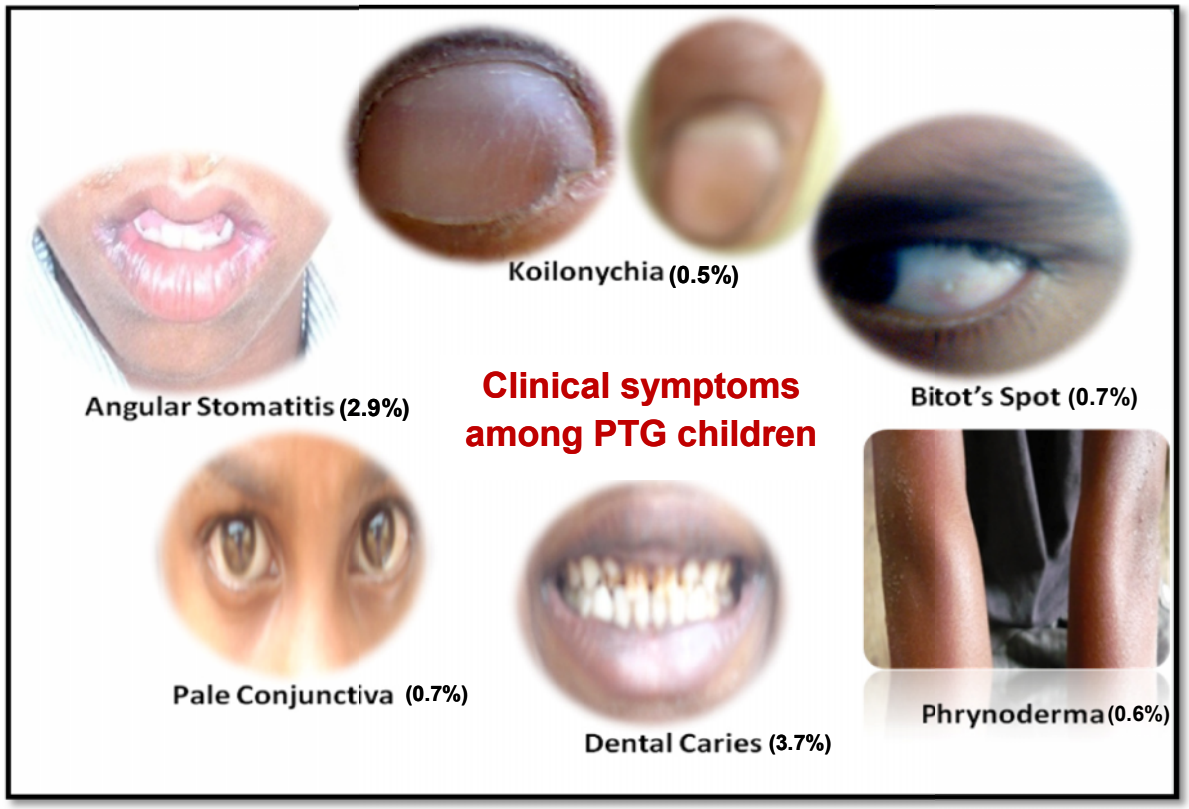


Figure 8. Clinical Symptoms observed among the PTG Children

The mean prevalence of Bitot's spots, an objective sign of VAD was 0.7 per cent (and ranged from 0 per cent in Thoda and Kota children to 1.5 per cent in Kattunaicker children, 1-5 years and 0 per cent in Irula children to 1.5 per cent in Paniya children 6-14 years). The Bitot's spot among 1- 5 years of Kurumba, Irula, Paniya and Kattunaicker children were 0.8, 0.4, 0.7,1.5 per cent respectively and nil among Thoda and Kota children. In 6-14 year old children, the prevalence of Bitot's spot was 0.5, 0.8, 0.4, 1.5, 1.3 per cent among Thoda, Kota, Kurumba, Paniya and Kattunaicker respectively and nil among Irula children. The mean prevalence value of 0.7 per cent for Bitot's spots is well above the cut off value (of >0.5per cent) indicated by WHO (2007). Thus VAD is a problem of public health significance among the PTG screened in the present study. Although night blindness and Bitot's spots are considered mild stages of eye disease, yet both represent moderate-to-severe systemic VAD, as they denote and are evidenced by low serum retinol concentrations (Sommer *et al.*, 1980).

Mean prevalence of conjuctival xerosis was about 0.6 per cent (ranging from 0 prevalence among Kota children to 3.1 per cent in Kattunaicker children).

The prevalence among 1-5 years of Thoda, Kurumba, Irula, Paniya, Kattunaicker were 0.5, 1.3, 0.9, 0.7, 3.1 per cent respectively, while this symptom was not observed among Kota children. Among children aged 6-14 years, the prevalence of conjunctival xerosis was 0.4 per cent among Kurumbas and Irulas, 0.5 and 1.3 per cent among Paniyas and Kattunaickers respectively.

Koilonychia, the most visible symptom of IDA was observed among Thoda Kota, Irula, Paniya and Kattunaicker children and it ranged from 0.5 per cent to 3.1per cent in 1-5 years age group and 0.5 to 1.3per cent in 6-14 years age group. The symptoms of koilonychia were not observed among Kurumbas. Kota children had the symptoms of koilonychia in 1-5 years age group, while the symptoms were not present in 6-14 years age groups in the same tribe. As many as 0.5, 2, 0.4, 0.7, 3.1 per cent of 1-5 year old Thoda, Kota, Irula, Paniya and Kattunaicker children and 0.5, 0.4, 0.5, 1.3 per cent of 6-14 year old Thoda, Irula, Paniya and Kattunaicker children had koilonychia while none of the 6-14 year old Kurumbas and Kota children showed koilonychia.

Other than VAD and IDA symptoms of other deficiencies were also observed among the children. The highest prevalence of emaciation, a major symptom of Protein Energy Malnutrition, was observed among Kattunaicker children (0.9- 3.1 per cent) compared to children from other tribal groups. Overall prevalence of B-complex deficiencies such as glossitis was 1.8 per cent and angular stomatitis was 2.9 per cent, among all the groups, while cheilosis was observed among 1.4 per cent of Irula children and 3.7 per cent of Paniya children. Bleeding gums, a symptom of Vitamin C deficiency was observed among 0.4 per cent of Irula children and 3.7 per cent of Paniya children. Prevalence of phrynoderma was 0.6 per cent; dermatitis was 1.6 per cent while 3.7 per cent of the PTG children had dental caries. Bleeding gums and dental caries occurred as twin disorders and showed the same level of prevalence among Thodas (3.4 per cent), Kotas (8.2 per cent) and Kattunaickers (12.5 per cent). Dermatitis was observed among 5.2 per cent Kurumbas. Glossitis and dental caries were observed among 2.9 per cent Irulas and among Paniyas, Angular stomatitis, cheilosis, dental caries were more prevalent (3.7- 3.9 per cent).

The prevalence rate of Bitot's spot reported in the present study is less (0.7 per cent) than the reported NNMB value of 1.9 per cent (Tribal Survey, 2007-2009). An earlier study by Reddy (1988), which did not include Kattunaicker, reported that nutritional deficiency signs were more among Paniyas when compared with Irulas,

Kurumbas, Thodas and Kotas of Nilgiris district. The present study corroborates this finding i.e., the second highest prevalence of malnutrition was observed among Paniyas. The findings of the present study are also on par with those of Rao (2013), on the nutritional profile of preschool children of Chenchu- a primitive tribe of Andhra Pradesh which revealed that 0.5 per cent was emaciated, 0.7 per cent had conjunctival xerosis, 0.9 per cent had Bitot's spots and 0.9 per cent had angular stomatitis. Among school age children, three per cent had angular stomatitis, two per cent had glossitis, four per cent had dental caries and three per cent had dental fluorosis.

In the present study, out of 4376 children, 317 (7.2 per cent) of children had clinical symptoms of VAD and IDA, 5.5 per cent had VAD and 1.7 per cent of children had clinical symptoms of only Iron Deficiency Anemia. This finding is similar to that reported among the Baiga tribe of Madhya Pradesh wherein the prevalence of conjunctival xerosis and Bitot's spots the signs of vitamin 'A' deficiency in the children were found to be 9.7 per cent and 4.9 per cent respectively. About 3.1 per cent population had angular stomatitis indicative of B-complex deficiency (Chakma *et al.*, 2014).

B. Socio Economic Background of PTG Children

1. Background Information on Children

Details on the background information of the children are presented in Table IX and figures 9 and 10.

Of the 1-3 year old children, 26.4 per cent lived in joint families and 73.6 per cent in nuclear families. In the 4-6 year age group, 27 per cent lived in joint families and 73 per cent in nuclear families. A majority (84.9per cent) of the children in the 7-9 years age group lived in nuclear families and 15.1 per cent lived in joint families. In 10-12 years 22.8 per cent lived in joint families and 77.2 per cent lived in nuclear families. Among 13-15 years age group 22.8 per cent lived in joint families while 77.2 per cent lived in nuclear families. On the whole, 23.3 per cent of the children were from joint and 76.7 per cent were from nuclear families. Thus it is evident that even in tribal areas, nuclear family system is predominant. These findings are similar to those reported by Rao (2013) wherein 83 per cent of Chenchu tribals belong to nuclear families. Out of 698 households among four PTGs namely Irula, Kota, Paniya and Thoda in Nilgiris District surveyed by Sasicoumar *et al*., (2006) 541 were (77.5 per cent) nuclear families and 148 (21.2 per

cent) were joint family types. Chakma *et al*., (2014) reported that 82.3 per cent of the families were nuclear while about 17.7 per cent were joint families.

Table IX

Background Information on PTG Children

(N=317)

Family Details	Age (in Years)										Total (N=317)	
	1-3		4-6		7-9		10-12		13-15			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Type of Family												
Joint	23	26.4	17	27	8	15.1	13	22.8	13	22.8	74	23.3
Nuclear	64	73.6	46	73	45	84.9	44	77.2	44	77.2	243	76.7
Total	**87**	**100**	**63**	**100**	**53**	**100**	**57**	**100**	**57**	**100**	**317**	**100**
No. of children per household												
1	14	16.1	4	6.4	8	15.1	5	8.7	7	12.3	38	12
2	16	18.4	16	25.4	6	11.3	1	19	11	19	60	19
3	26	29.9	22	34.9	15	28.3	14	25	19	33.3	96	30.3
4	16	18.4	14	22.2	15	28.3	13	22.8	9	15. 9	67	21.1
5	13	14.9	5	7.9	7	13.2	7	12.3	6	10. 5	38	12
6	2	2.3	2	3.2	2	3.8	6	10.5	3	5.3	15	4.7
7	0	0	0	0	0	0	1	1.7	2	3.5	3	0.9
Total	**87**	**100**	**63**	**100**	**53**	**100**	**57**	**100**	**57**	**100**	**317**	**100**
Gender												
Male	45	51.7	35	55.6	27	50.9	27	47.4	26	45.6	160	50.5
Female	42	48.3	28	44.4	26	49.1	30	52.6	31	54.4	157	49.5
Total	**87**	**100**	**63**	**100**	**53**	**100**	**57**	**100**	**57**	**100**	**317**	**100**

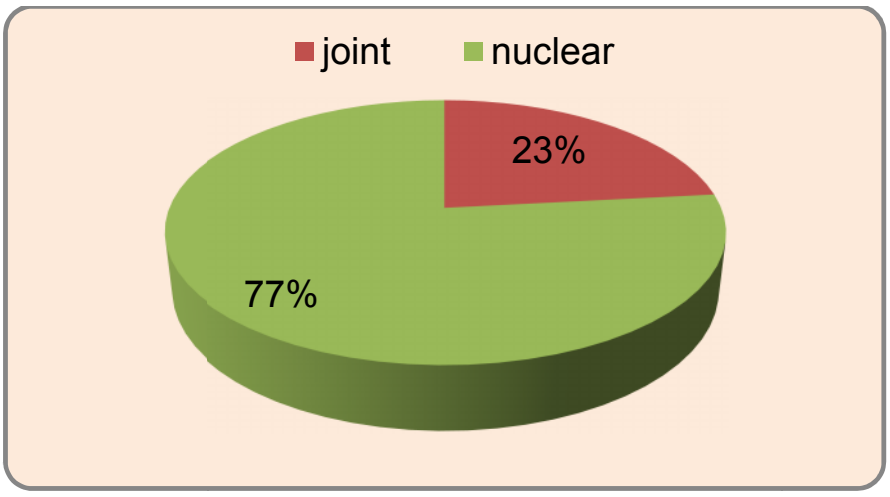


Figure 9. Type of Family

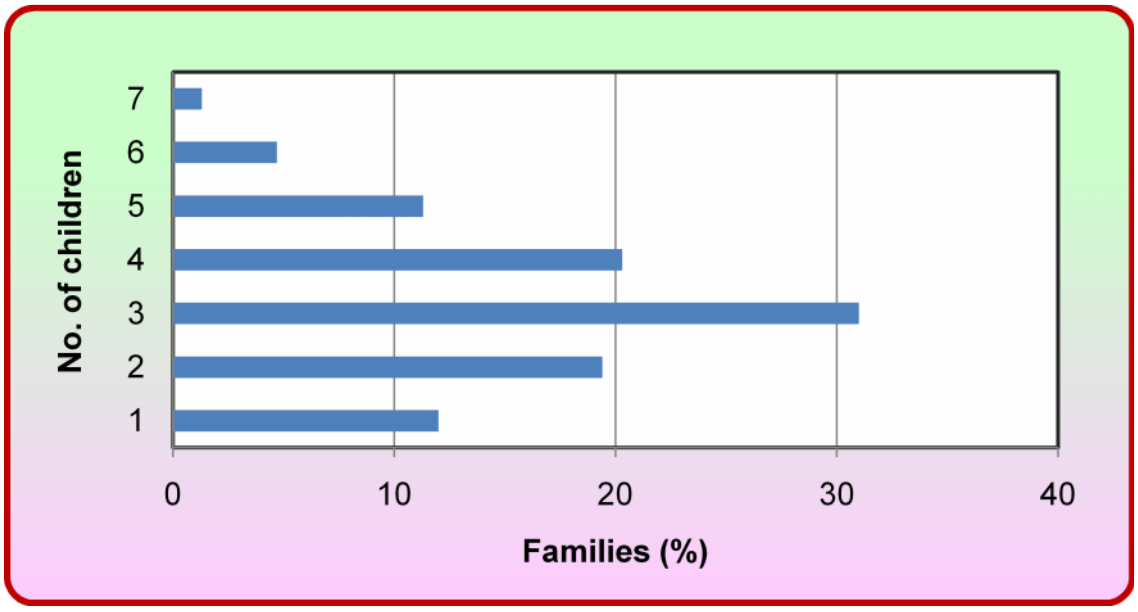


Figure 10. Number of Children per Household

In the present study, among 1-3 year old children, 16.1 per cent were from single child families, 18.4 per cent each of the children were from households with two and four children respectively, whereas 29.9 per cent were from three children families, 14.9 per cent from five children and 2.3 per cent from families with six children. In 4-6 years, 6.4 per cent were single children, 25.4, 34.9, 22.2, 7.9, 3.2 per cent were from two, three, four, five, six and seven children families respectively. In 7-9, 10-12 and 13-15 years 15.1, 8.7 and 12.3 per cent were single children, 11.3, and 19 per cent each were from two children families, 28.3, 25 and 33.3 per cent were from three children families, 28.3, 22.8 and 15.9 per cent were from four children families, 13.2, 12.3 and 10.5 per cent from five children families and 3.8, 10.5 and 5.3 per cent were from six children families. None of the children below nine years were from families with seven children or more and the maximum average number of children in these families was four. Younger families had less number of children probably due to the family planning norms propagated by the grass root level health workers who work in these areas. Older children (1.7 per cent 10-12 years of age and 3.5 per cent, 13-15 years of age, from families in the older age group), were from seven children families. Totally, 12 per cent were single children in their homes, 19 per cent belonged to two children families, 30.3 per cent belonged to three children families, 21.1, 12, 4.7 and 0.9 per cent were from four, five, six and seven children families respectively.

The number of boys and girls in the study were almost equal. There were 51.7 per cent boys and 48.3per cent girls in 1-3 year age group, 55.6 per cent were boys and 44.4per cent were girls in 4-6 years age group, 50.9per cent were boys and 49.1 per cent were girls in 7-9 years age group, 47.4 per cent were boys and 52.6 per cent were girls in 10-12 years age group and 45.6per cent were boys and 54.4 per cent were girls in the 13-15 years age group). It is heartening to note that the number of tribal females shows an increase over the last census data of 978/ 1000males (Census, 2001). The male female ratio is 99 per cent i.e 1000:990 (Census, 2011).

Mean age at menarche ranged from 11 to 13 years, mean age at marriage 16 to 17 years and mean age at first child 18 to 19 years, indicative of the twin burden of adolescent malnutrition and pregnancy. No case of infertility was observed among tribal couples.

2. Monthly Income and Expenditure of the Families

Table X and figure 11 gives the distribution of families according to monthly income and details of monthly expenditure of the families.

Table X

Monthly Income and Expenditure of the Families

(N=317)

Income/ Month* (₹)	Age (in Years)										Mean	
	1-3		4-6		7-9		10-12		13-15			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
< 5000 EWS	87	100	63	100	53	100	56	98.2	57	100	316	99.7
5001-10,000 LIG	0	0	0	0	0	0	1	1.8	0	0	1	0.3
Total	**87**	**100**	**63**	**100**	**53**	**100**	**57**	**100**	**57**	**100**	**317**	**100**
Details of Expenditure	₹	%	₹	%	₹	%	₹	%	₹	%	₹	%
Food	1722	60.1	1734	64.5	1854	63.5	1722	60.1	1734	64.5	1753	62.5
Paan/Betel Nut/ Alcoholic Drinks	639	22.3	459	17.7	592	20.3	639	22.3	459	17.7	558	19.9
Clothing	119	4.2	142	5.3	120	4.1	119	4.2	142	5.3	128	4.6
Purchase of household items /Repair work	124	4.3	142	5.3	130	4.5	124	4.3	142	5.3	132	4.7
Transport	113	3.9	91	3.4	112	3.8	113	3.9	91	3.4	104	3.7
Debts	148	5.2	120	4.4	113	3.8	148	5.2	120	4.4	130	4.6
Total	**2865**	**100**	**2688**	**100**	**2921**	**100**	**2864**	**100**	**2687**	**100**	**2805**	**100**

*(HUDCO, 2010); EWS – Economically Weaker Section; LIG- Low Income Group

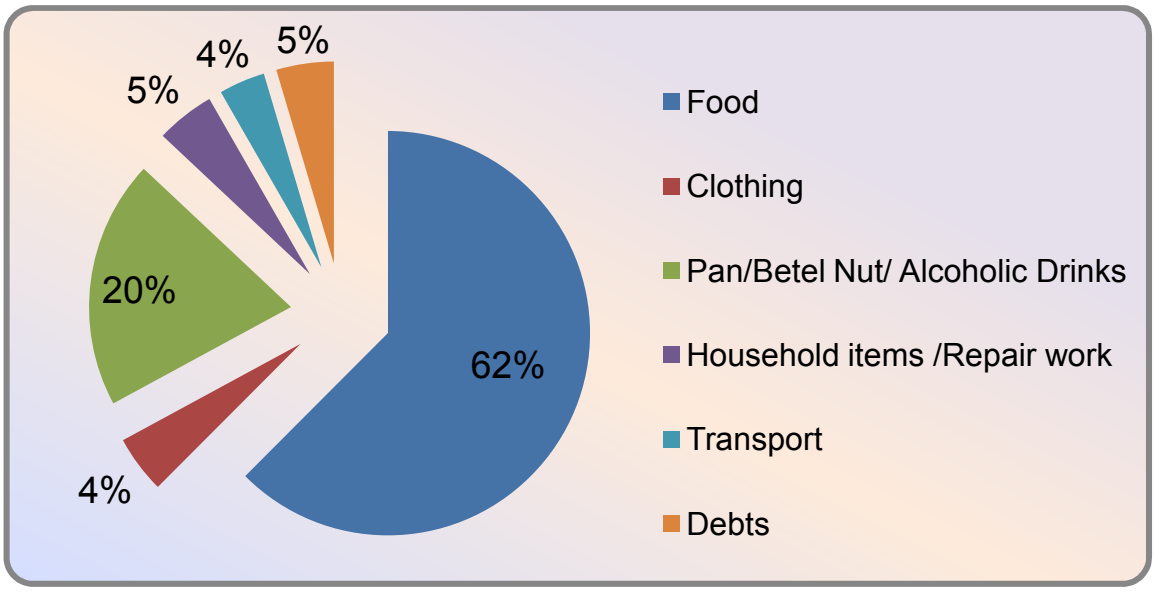


Figure 11. Monthly Expenditure Pattern

All children in the age group of 1-14 years were from EWS (Economically Weaker Section) families except 1.8 per cent of children in the age group of 10-12 years who belonged to Low Income Group families with monthly income of ₹ 5001 to 10,000 as per the HUDCO (2010). On the whole, 99.7 per cent of the families belonged to EWS and only 0.3 per cent were from LIG.

The average monthly per capita income for Indians reported by NNMB (2012) is ₹1356/. In the present study however, the average monthly income of the family is ₹ 3,033/. Sasicoumar *et al*., (2006), report that the socio-economic conditions of all the four tribes are far from satisfactory. On a, relative basis, the economic status of Thodas and Kotas is better than that of the Irula and Paniya tribe. Majority of the Paniya work as daily wage labourers, their economic status and living conditions are very poor. Only 63 per cent of the tribes occupy their own land which has to come under their possession legally in future. The rest of them work as daily wage labourers.

Premakumari *et al*., (2011), on basis of HUDCO (2007) Classification, report that 95 per cent of the tribal families were below Poverty Line (₹<3300) and only five per cent were above poverty line (₹3301-7300 -Low income).

Padmavathy and Ramadas (2012), report that 39 per cent of tribals surveyed in their study were in the income range of ₹3001-4000. Only seven per cent were in the income range ₹ 3001- 4000. Thus majority of tribes live under poverty line which tunes with the studies conducted by Rao *et al.,* (2006).

In the present study, all the families spent a major part of their income on food. In the families of 1-3 year old children, 60.1per cent of the income was spent on food. Families of 4-6 year age group spent 64.5 per cent, families of 7-9 year age group spent 63.5 per cent, families of 10-12 year age group spent 60.1 per cent and all families of 13-15year age group spent 64.5 per cent of their income on food. It was shocking to note that, the next sizeable expenditure, i.e., 22.3 per cent of income of 1-3 years age group, 17.7 per cent of 4-6 years age group, 20.3 per cent of 7-9 years age group, 22.3 per cent of 10-12 years age group and 17.7 per cent of 13-15 years was spent on paan, betel nut and alcoholic drinks and both the parents in the families were addicted to these habits. Similar findings were reported by Padmavathy and Ramadas (2012), where maximum of 52-55 per cent of income of tribes was spent on food which was followed by the expense on tobacco ranging between 23-24 per cent. The tribals justified these addictions and attributed them to the cold weather of the tribal habitats.

On calculation, they incurred a monthly expenditure of ₹558 and an annual expenditure of ₹ 6696 per family on these addictions out of a total annual family income of ₹33, 660/. Health problems associated with these addictions ranged from mild forms of deficiencies to severe crippling effect leading to loss of limbs and a series of nerve disorders. This led to severe debilitation making them invalids, unable to pursue any income generating activity or take up jobs which further impoverished them.

Similar conclusions were arrived at by Sasicoumar *et al*., (2006), wherein Nilgiri tribal villagers themselves recognized the loss of individual wealth through tobacco addiction. The retail price of tobacco in the villages varies from 3 to 5 rupees and on an average the average of consumption of tobacco is five times a day. The average expense for each addiction i.e. smoking, alcohol, tobacco and betel chewing is a minimum of 15 to 25 rupees daily and it comes around an average of ₹600 per month or ₹7,200 annually. For households whose annual income is nearly ₹27,000 on expenditure of ₹7,200 on addiction and the effect of addiction in terms of health problems are the reasons for the severe economic drain. There is very limited chance for these poor addicts to find a way out of this vicious cycle of poverty-anxiety- addiction.

While 4.2 per cent of 1-3 year age group, 5.3 per cent of 4-6 years age group, 4.1 per cent of 7-9 years age group, 4.2 per cent of 10-12 years age group and 5.3 per cent of income of 13-15 years age group was spent on clothing, around 4.3 per cent of income (of families of 1-3 year old children), 5.3 per cent (4-6 years age group), 4.5 per

cent (7-9 years age group) 4.3 per cent (10-12 years age group) and 5.3 percent (13-15 years age group) i.e., an average of 4.7 per cent of the income was spent on purchase of household items and repair work. Expenses on transport constituted 3.9, 3.4, 3.8, 3.9 and 3.4 per cent of income of families of 1-3, 4-6, 7-9, 10-12 and 13-15 years respectively. None of the families had saving habit. Debts were incurred by all of them up to 5.2 per cent in 1-3 year group, 4.4 per cent in 4-6 year group, 3.8 per cent in 7-9 year group, 5.2 per cent in 10-12 year group and 4.4 percent in 13-15 year group. None of the families spent any money on recreation.

On the whole, 62.5 per cent, 4.6 per cent, 19.9 per cent, 4.7 per cent, 3.7 and 4.6 per cent of income was spent on various heads of expenditure namely, food, clothing, pan/betel nut/ alcoholic drinks, maintenance of household /repair work, transport and debts. This tunes with study of Premakumari *et al*., (2011) where 58.8 per cent, 8.8 per cent, 10.8 per cent 13.4 per cent, 7.4 and 0.8 per cent of income was spent on various expenses namely, food, clothing, pan/betel nut/ alcoholic drinks, maintenance of household /repair work, transport and debts.

C. Nutritional Anthropometry of PTG Children

The mean anthropometric measurements such as height, weight, MUAC, Chest circumference and Head Circumference of the children are presented according to age and gender in Tables XI to XIII.

1. Mean Height of Children

The mean height of children is given in Table XI and distance charts for heights of children are presented in figure 12 and 13.

The mean height of all the boys and girls above two years in the present study was less than both the WHO and ICMR standard values for height in the respective age groups, except for two year old girls and eleven year old boys whose heights were on par with the respective ICMR standard values. Male children at the end of infancy measured 77.51cm in body length which is more than the WHO and ICMR standard values. The mean body length of girls in this age group was 72.49 cm which is less than the standard values. The mean height of two year old boys and girls were 84.06 cm and 84.70 cm which is less than the standard values. Similarly the mean height of three year old boys and girls were 90.90 cm and 89.26 cm, four year old boys and girls were 96.10 cm and 94.84 cm, five year old boys and girls were 99.30 cm and 93.88 cm, seven year old boys and girls were 117.61cm and 117.28 cm, eight year old boys and girls were 125.51cm

and 120.15 cm, nine year old boys and girls were 124.99cm and 124.49cm, ten year old boys and girls were 126.64cm and 132.28cm, 11 year old boys and girls were 140.80 cm and 133.56cm , 12 year old boys and girls were 138.27cm and 130.92cm, 13 year old boys and girls were 137.52cm and 143.84cm, 14 year old boys and girls were 146.57cm and 145.65 cm which is less than the respective standard values. The heights of boys was compared statistically with WHO standards since these were more recent and it was observed that most of boys and girls were significantly ($p<0.01$; $p<0.05$) shorter than their WHO counterparts.

Table XI

Mean Height (cm) of Children

(N=317)

Age Group (years)	Standard				Height (cm)		't' value Mean Ht vs WHO(2006)	
	WHO (2006)		ICMR(1990)					
	Boys	Girls	Boys	Girls	Boys(160)	Girls(157)	Boys	Girls
1+	75.7	74	76.1	75.0	77.51±1.20	72.49±0.70	2.19*	2.64*
2+	87.8	86.4	85.6	84.5	84.06±1.40	84.70±0.67	3.80*	3.47*
3+	96.1	95.1	94.9	93.9	90.90±1.23	89.26±1.14	7.59**	4.63**
4+	103.3	102.7	102.9	101.6	96.10±1.80	94.84±1.50	9.25**	8.16**
5+	110	109.4	109.9	108.4	99.30±1.20	93.88±1.25	10.62**	12.64**
7+	124.3	123.6	121.7	120.6	117.61±0.60	117.28±0.90	3.12*	2.57*
8+	130.1	129.2	127.0	126.4	125.51±0.90	120.15±1.90	4.10**	4.56**
9+	134.6	135	132.2	132.2	124.99±1.70	124.49±2.10	13.76**	4.95**
10+	140	140	137.5	138.3	126.64±3.00	132.28±0.60	3.77*	5.84**
11+	144.8	145.3	140.0	142.0	140.80±0.50	133.56±3.60	10.37**	3.31*
12+	151.1	150.2	147.0	148.0	138.27±2.50	130.92±4.90	3.36*	3.61*
13+	157	153.8	153.0	150.0	137.52±2.80	143.84±4.10	9.14**	2.51*
14+	163.0	157.0	160.0	155.0	146.57±0.95	145.65±3.70	7.22**	3.54*

**- Significant at 1%; * - Significant at 5%; NS- Not significant

Earlier studies by Clements and Pickett (1957) augment the findings of the present study that linear physique of populations belonging to lower SES is revealed in lower height weight ratio. This finding is further corroborated by Bhasin and Jain (2007) who report that tribal groups in general show lower height-weight ratios than the reference standards, since they exhibit a more linear or ectomorphic physique than other population groups. This can be attributed to the lower socio-economic status of PTG.

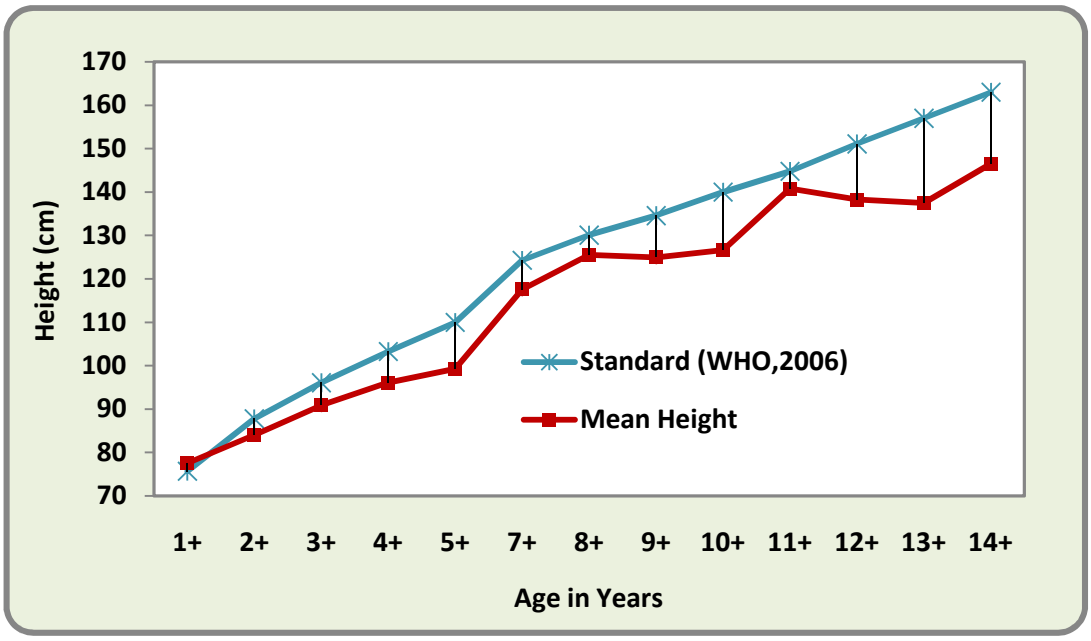


Figure 12. Mean Height of Boys

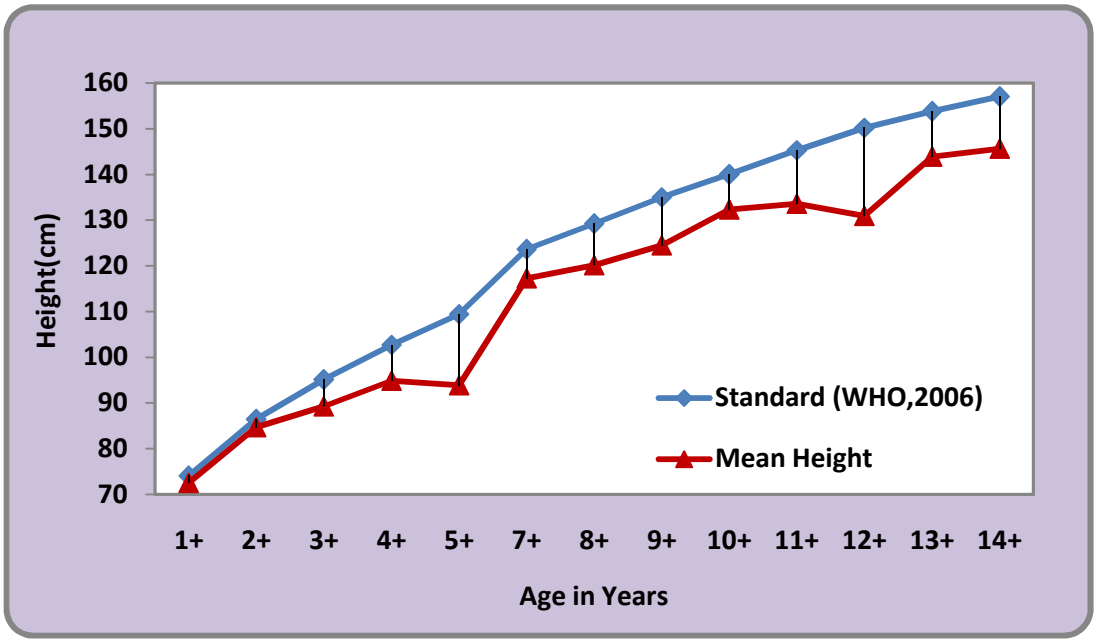


Figure 13. Mean Height of Girls

2. Mean Weight of Children

The mean weights of children are given in Table XII and distance charts for weights of children are presented in figure 14 and 15.

Table XII

Mean Weight (kg) of Children

(N=317)

Age Group (years)	Standard				Weight (kg)		't' value Mean Wt vs WHO(2006)	
	WHO (2006)		ICMR(1990)					
	Boys	Girls	Boys	Girls	Boys(160)	Girls(157)	Boys	Girls
1+	9.6	8.9	10.2	9.5	8.12±0.60	7.89±0.43	2.67*	2.11*
2+	12.2	11.5	12.3	11.8	10.53±0.60	10.70±0.49	2.35*	3.34*
3+	14.3	13.9	14.6	14.1	12.18±0.84	11.08±0.83	2.30*	2.95*
4+	16.3	16.1	16.7	16.0	12.99±1.00	12.99±1.80	3.18*	2.43*
5+	18.3	18.2	18.7	17.7	13.67±1.80	12.52±3.00	2.09*	2.32*
7+	22.7	22.3	22.9	21.8	19.01±0.75	18.89± 0.60	3.27*	5.54**
8+	25.2	25	25.3	24.8	23.55±0.73	20.28±0.70	3.21*	6.50**
9+	28	27.6	28.1	28.5	19.94±1.20	20.28±1.40	7.62**	5.16**
10+	30.8	31.2	31.4	32.5	23.34±3.90	25.34±3.10	2.49*	2.29*
11+	34.1	34.8	32.2	33.7	31.20±1.20	28.57±2.60	2.96*	2.83*
12+	38	39	37.0	38.7	29.41±2.70	26.77±5.30	3.79*	2.82*
13+	43.3	43.4	40.9	44.0	28.71±2.20	36.02±1.20	8.44**	5.25**
14+	48.0	47.1	47.0	48.0	34.27±1.70	36.55±1.20	9.24**	7.86**

**- Significant at 1%; * - Significant at 5%; NS- Not significant

Similarly PTG children were much lighter than both their standard counterparts (WHO and ICMR). The mean weight of one year old boys and girls was 8.12 and 7.89 kg which is less than the standard values. The mean weight of boys and girls in the age group of two to 14 years were 10.53 kg and 10.70kg, 12.18kg and 11.08kg, 12.99kg and 12.99kg, 13.67kg and 12.52kg, 19.01kg and 18.89kg, 23.55kg and 20.28kg, 19.94kg and 20.28kg, 19.94kg and 20.28kg, 23.34kg and 25.34kg, 31.20kg and 28.57kg, 29.41kg and 26.77kg, 28.71kg and 36.02kg, 34.27kg and 36.55kg respectively which is much less than the respective standard values. Thus the weight of boys and girls in all the age groups were significantly ($p<0.01$; $p<0.05$) less than the respective standard values.

Similar findings were reported by Chakma *et al.*, (2014) that Baiga Tribal children of one to 17 years of age were shorter and lighter than their American counterparts. Gakhar and Malik (2001) reported higher mesomorphic component in males as compared to females, which was a measure of strength in boys in 10-18 years. From the earlier studies of Singh and Sidhu (1980), Singh and Bhasin (1990), Bhasin and Singh (1991), Singh and Singh (1991) and Bhasin and Singh (1992), it can be reported that

Indian population groups are ectomorph, endo-ectomorph, meso-ectomorph and balanced ectomorph and their ratings are considerably lower than their western counterparts.

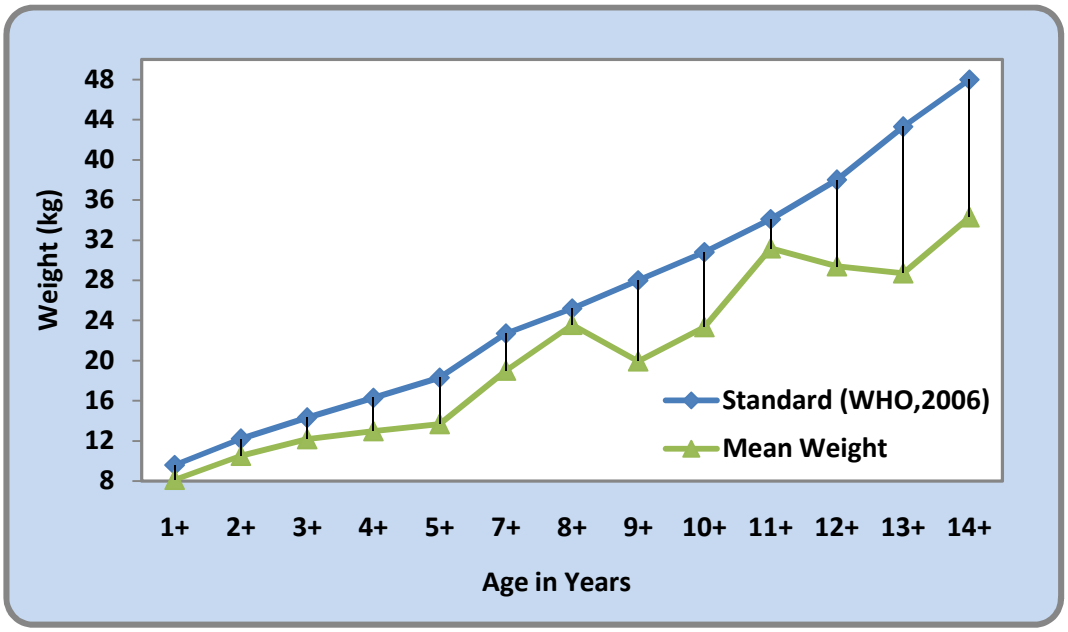


Figure 14. Mean Weight of Boys

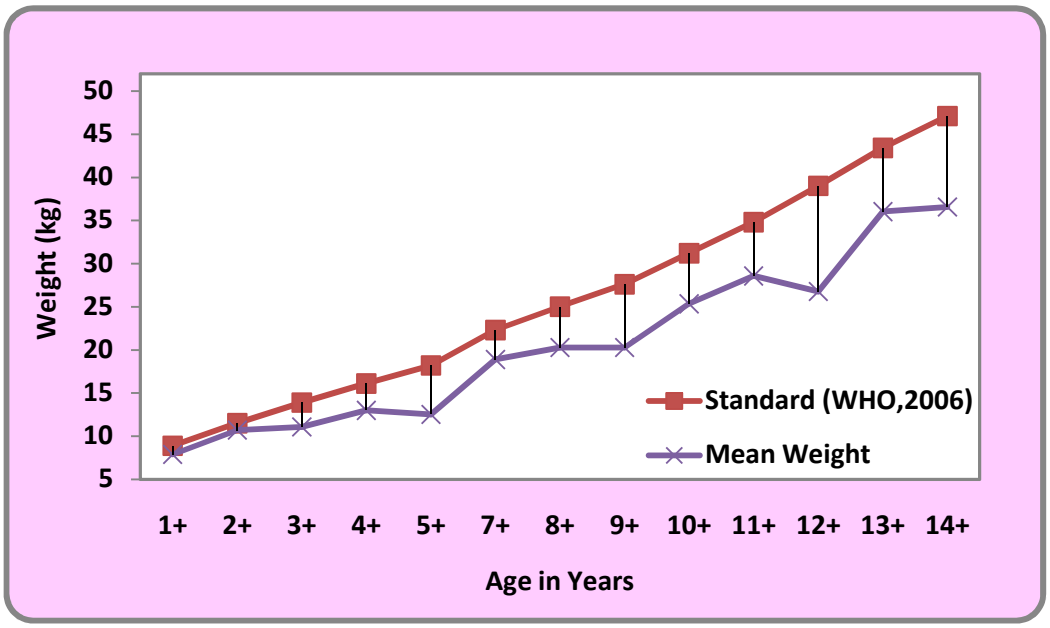


Figure 15. Mean Weight of Girls

3. Mean MUAC Chest Circumference and Head Circumference of Children

The mean MUAC of 1-5 year old children are presented in Table XIII and Figures 16, 17 and 18 as these parameters are highly relevant to this age group only.

Table XIII

Mean MUAC, Chest Circumference and Head Circumference (cm) of Children

(N=150)

Age Group (years)	Standard Values				Mean MUAC		't' value Mean MUAC vs Std.		Mean Chest Circumference		't' value Mean CC vs Std.		Mean Head Circumference		't' value Mean HC vs Std.	
	MUAC@		CC#	HC#												
	Boys	Girls			Boys(80)	Girls(70)	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
1-2	13.1	12.8	50	49	13.73±0.23	13.64±0.13	3.43**	2.56 *	44.84±1.70	44.37±1.70	5.47**	5.15**	45.25±1.10	45±1.60	5.49**	4.49**
2-3	13.3	12.9	52	50	13.81±0.32	13.94±0.25	2.77*	3.36 **	47.89±0.85	47.64±1.30	7.29**	6.21**	47.28±1.30	46.27±1.70	3.15*	3.75*
3-4	14.0	13.7	53	50.5	14.28±0.32	13.85±0.31	4.13**	2.85 *	49.04±0.68	48.28±1.30	4.08**	4.40**	47.60±1.70	46.19±1.50	2.77*	4.6**
4-5	14.1	13.9	55	50.8	15.05±0.32	15.24±1.10	3.73*	4.22**	50.47±1.50	49.65±2.70	3.79**	4.34**	47.51±1.90	47.29±0.80	3.14*	5.03**

**- Significant at 1%; * - Significant at 5%;

@ Jelliffe (1966); #Watson and Lowrey (1962)

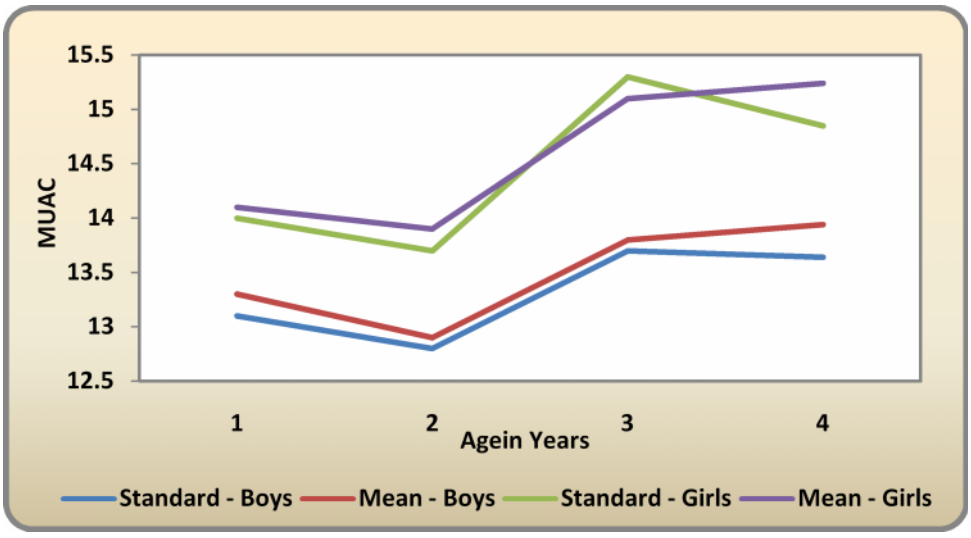


Figure 16. Mean MUAC of Children

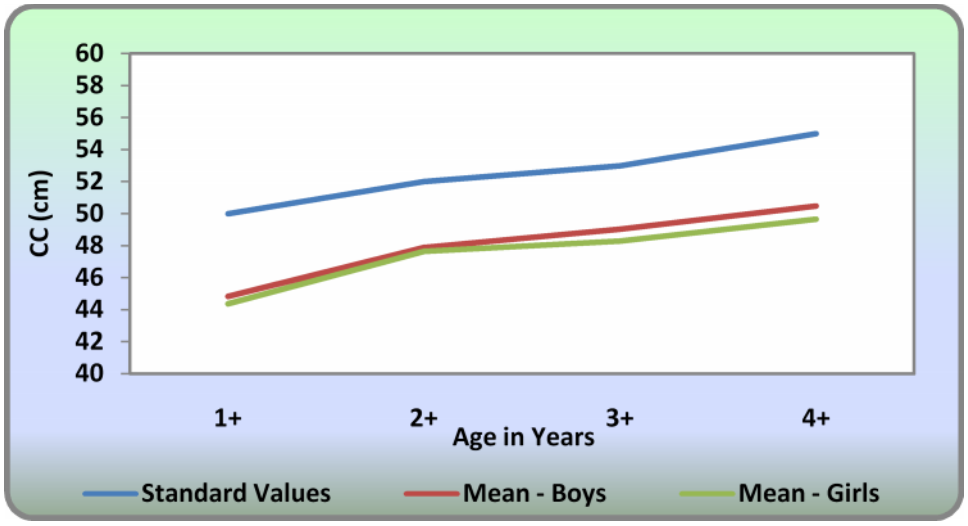


Figure 17. Mean Chest Circumference of Children

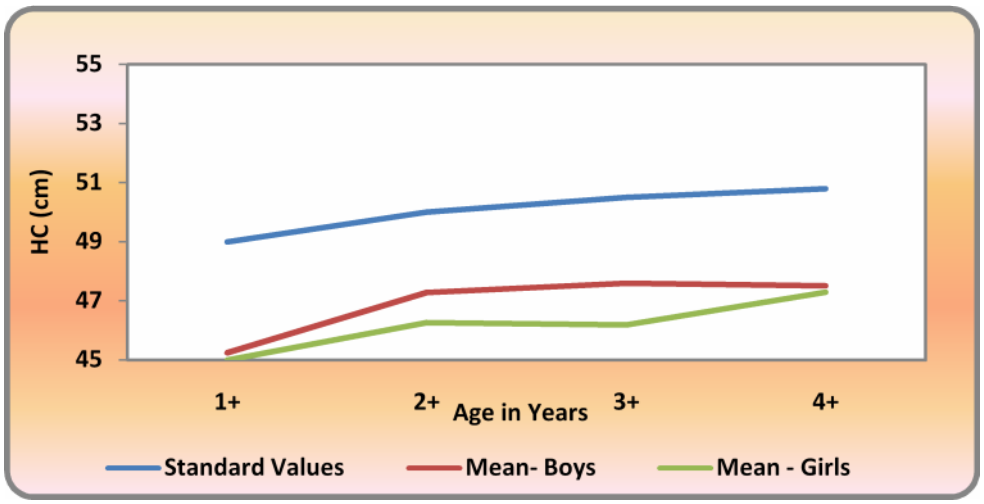


Figure 18. Mean Head Circumference of children

Mean MUAC of all the children was significantly ($p<0.01$; $p<0.05$) higher than normal standard values (Jelliffe, 1966) of MUAC for the respective age groups. The mean MUAC of 1-2 year old boys and girls were 13.73 cm and 13.64 cm respectively (which was more than the respective standard values of 13.1cm and 12.8 cm). Similarly the mean MUAC of 2-3 years boys and girls were 13.81 cm and 13.94 cm respectively (more than the standard values of 13.3cm and 12.9cm), and 3-4 years boys and girls were 14.28cm and 13.85 cm respectively (more than the standard values of 14cm and 13.7cm) and in 4-5 years boys the mean MUAC was 15.05 cm and in girls 15.24 cm (against the standard values of 14.1cm and 13.9 cm).

Similar findings of MUAC higher than the corresponding standards have been reported in an earlier study by Premakumari *et al.,* (2011) among the same PTG children (<5 years) of the Nilgiris. In their study, mean MUAC of 1-5 year boys and girls were 13.97cm and 13.34 cm (13.1 cm and 12.8 cm), 13.88 cm and 13.85 (13.3 cm and 12.9cm), 14.34cm and 13.73cm (14cm and13.7cm), 13.7cm and14.18 cm (14.1cm and 13.9cm) which were higher than the respective standard values.

According to Farquharson (1976) the cut- off point for MUAC of 1-5 years children was 14.0cm, while Shakir and Morley (1975) found that most children above 13.5 cm were normal. Anderson (1979) noted however, that a cut-off of 13.5 cm was too low. The appropriate cut-off point to use may differ according to country. The normal mean MUAC (Jelliffe, 1966) among 1 to 5 year olds ranges from 13.1 cm to 14.1cm among boys and 12.9cm to 13.8 cm among girls. The higher than normal values observed in the present study could probably be attributed to the ectomorphism exhibited by the PTG. However an indepth analysis is necessary to explain this phenomenon observed in the study.

Mean chest circumference of 1- 5 years children was significantly ($p<0.01$) below the standard values of respective age groups. The mean chest circumference of 1-2 years boys and girls were 44.84 cm and 44.37 cm respectively. Similarly the mean chest circumference of 2-3, 3-4 and 4-5 years were 47.89 cm and 47.64 cm, 49.04 cm and 48.28 cm, 50.47 cm and 49.65 cm respectively. Hurbo (2008), based on their study on east European children of Minsk, Belarus found that the height, weight and chest circumference and BMI of boys 4–7 years age was greater than in girls. Similar findings have been recorded among 1-5 year olds in the present study also.

Mean head circumference of 1- 5 year old children was below the standard values of the respective age groups. The mean head circumference of 1-2 years boys and girls

were 45.25 cm and 45 cm which is less than the standard values. Similarly the mean head circumference of 2-3, 3-4 and 4-5 years boys and girls were 47.28 cm and 46.27 cm, 47.60 cm and 46.19 cm, 47.51cm and 47.29 cm which is less than the respective standard values. The head circumference of boys and girls were significantly ($p<0.01$; $p<0.05$) less than the standard values of the respective age groups.

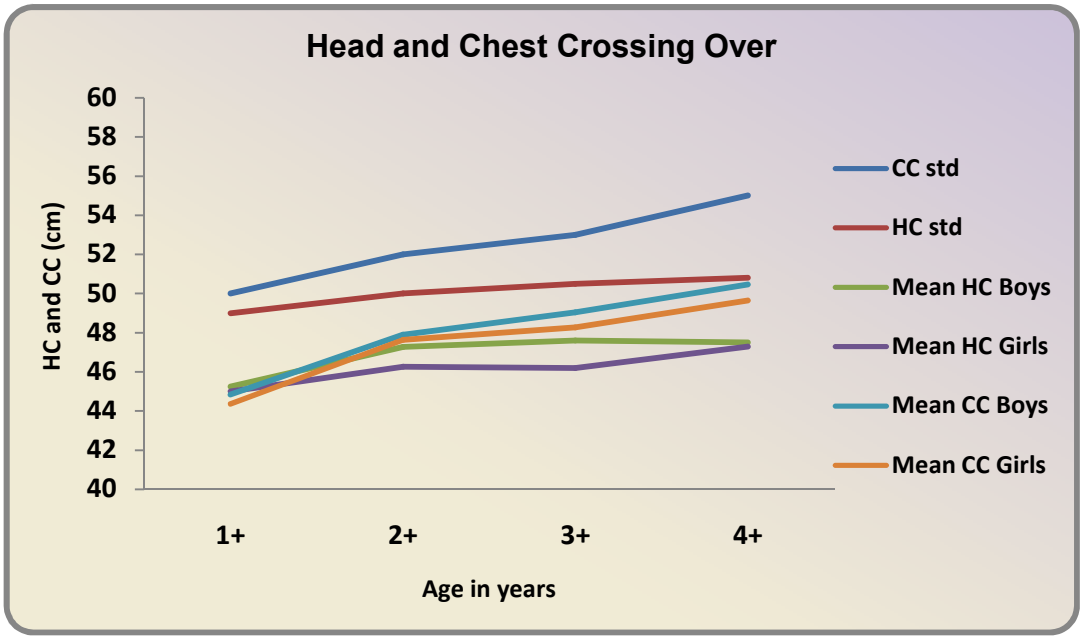


Figure 19. Head and Chest Crossing Over

Among normal newborns, the head circumference is larger than the chest circumference (at birth - 35 cm; increases by 1 cm per month upto 6 months. The next 6 months totally increases by 4 cm. By one year it should be 45 cm add 2 cm upto 2 years and 3 cm upto 5 years; at 5 years- 50 cm. Head and chest circumference ratio is equal at 1 year and any delay in the crossing over phenomenon indicates malnutrition. Delay in HC and CC is attributed to wide prevalence of malnutrition (Kamalam, 2005).

In the present study, HC-CC crossing over occurred well above one year indicative of malnutrition. According to Sundaram *et al* (1995), longer the delay in cc overtaking HC, the chances are higher for the children to be severely malnourished. Survey on 1206 children in rural Haryana and 1505 from slum in Delhi revealed that HC and CC crossing over occurred at 31.36 in rural and at 28 months in urban set up. Among children with Grade I malnutrition, cross over was delayed by about 10 months and among those with grade II or worse malnutrition, it was delayed by 19-23 months.

In totality while all the anthropometric parameters of the tribal children were less than the respective standard values. However boys were better off than girls.This could be attributed to the gender bias among tribals. Moreover, the mean MUAC values alone were higher than the cut offs given by Farquharson (1976) or Shakir and Morley (1975) or standards given by Jelliffe (1966). This could be probably due to the ethnicity and specific demographic influences on these tribals.

4. Grading of Children according to Height for Age

The percent distribution of children according to age groups and gender by different grades of nutritional status, based on weight-for- age, height-for-age and weight-for-height (SD classification) using WHO growth standards are presented in the following tables:

The grading of children according to height for age is presented in Table XIV.

Table XIV

Grading of Children according to Height for Age

(N=150)

Age Group (Years)	Grades (WHO, 2007)											
	Normal				Moderate				Severe			
	Boys		Girls		Boys		Girls		Boys		Girls	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1 – 2	7	87.5	6	75	0	0	1	12.5	1	12.5	1	12.5
2 – 3	14	66.7	10	62.5	3	14.3	3	18.8	4	19.0	3	18.8
3 - 4	10	62.5	9	50	3	18.8	4	22.2	3	18.8	5	27.8
4 - 5	14	60.9	9	50	6	26.1	5	27.8	3	13.4	4	22.2
5 - 6	5	41.7	5	50	5	41.7	2	20.0	2	16.7	3	30.0
TOTAL	**50**	**62.5**	**39**	**55.7**	**17**	**21.3**	**15**	**21.4**	**13**	**16.2**	**16**	**22.9**

It was observed that the percentage of children in the normal category decreased with increasing age. The 1-2 year age group showed the highest proportion of children with normal body weight (87.5 per cent of boys and 75 per cent of girls were in the normal category). This could be attributed to the beneficial effect of breast feeding during infancy. None of the boys showed moderate stunting while 12.5 per cent of girls were moderately stunted and 12.5 per cent each of boys and girls were severely stunted. In 2-3 year olds, 66.7and 62.5 per cent of boys and girls respectively were normal, 14.3 and

18.8 per cent showed moderate stunting, 19.0 and 18.8 per cent were severely stunted. Similarly among 3-4 years, 62.5 and 50 per cent of boys and girls respectively were normal, 18.8 and 22.2 per cent showed moderate stunting, 18.8 and 27.8 per cent were of severely stunted. Among 4-5 years, 60.9 and 50 per cent of boys and girls were normal, 26.1 and 27.8 per cent of boys and girls showed moderate stunting, 13.4 and 22.2 per cent boys and girls were severely stunted. In 5-6 years 41.7 and 50 per cent of boys and girls respectively were normal, 41.7 and 20 per cent of boys and girls were moderately stunted, 16.7 and 30 per cent boys and girls were severely stunted.

The overall prevalence of stunting (Height for age< Median -2SD) among boys under five years was about 37.5 per cent, with 16.2 per cent showing severe stunting (Height for age< Median -3SD). The overall prevalence of stunting (Height for age< Median -2SD) among girls under five years was 44.3 per cent, with 22.9 per cent showing severe stunting (Height for age< Median -3SD). Stunting among 1-2 year old boys was 12.5 per cent and girls showed were 25 per cent. In 2-3 year old boys 33.3 per cent of stunting was observed with 19 per cent severe stunting. Among girls 37.6 per cent of stunting was seen with 18.8 per cent of severe stunting. Similarly 33.3, 39.5, 58.4 per cent of boys in 3-4, 4-5 and 5-6 years age group respectively and 50 per cent of girls in each of the age group showed severe stunting of 18.8, 13.4 and 16.7 per cent among boys and 27.8, 22.2 and 30 per cent of girls of this age. It was observed by and large that stunting was more prevalent and severe among girls than among boys, which is suggestive of gender bias

Similar results were observed by Premakumari *et al*., (2011) wherein the overall prevalence of stunting among under five year boys was about 41.2 per cent, with 20.3 per cent of severe stunting. Among under five girls, the overall prevalence of stunting was about 47.6 per cent, with 25.9 per cent of severe stunting. Among Baiga Tribal children 49.6 per cent showed stunting (<Median- 2SD) and 28.8 per cent report severe lestunting (Chakma *et al*., 2014). Dasgupta *et al.,* (2013) opine that stunting levels are higher in Indian children than African children, that is, nearly 57 per cent of marginalized children (including tribals) had heights <-3 SD.

Biswas *et al*.,(2008) investigated age and sex variations in height, weight and levels of stunting among 673, 1-5 year old rural children of Bengalee ethnicity in 30 ICDS Centers of West Bengal. They reported that boys were significantly heavier and taller

than girls at ages 2-4 years. Significant age differences existed in mean height and weight in both sexes. Mean HAZ was less than those of NCHS for both sexes at all ages. The overall rate of stunting was 39.2 per cent. However, stunting was higher among boys (43.4%) than girls (35.4%). This could be because of open defecation practice common among tribals.

Studies pin point that lack of sanitation is a potential contributor to stunting in the country. Spears *et al*., (2013) found that a 10 per cent increase in open defecation was associated with a 0.7 per cent increase in both stunting and severe stunting. Stunting figure of the districts where people defecate in the open is higher. Over half of the children are stunted, and almost a third of children are severely stunted. The early-life disease environment is poor: over 70 per cent of households defecate in the open and 71 out of every 1,000 babies born alive die before they are one year old.

Spears (2012) explain the Indian paradox of stunting being more severe among economically richer Indian children than among their African counterparts. This phenomenon is attributed to open defecation, more common in India than in Africa and the effect of 'negative spill overs' in communities. More than a billion people worldwide defecate openly without using a toilet or latrine. India, with some of the world's worst stunting, also has one of the very highest rates of open defecation: more than half of the Indian population does not use any toilet or latrine.

5. Grading of Children according to Weight for Age

Table XV gives the grading of children according to weight for age.

Weight for age also showed similar trends as height for age. It decreased with increasing age beyond infancy, probably due to the effect of breast feeding during infancy. In the 1-2 year age group, 87.5 and 75 per cent of boys and girls were normal, 12.5 per cent of boys and girls were moderately underweight. None of the boys and 12.5 per cent of girls were severely underweight. In 2-3 years 66.7 and 75 per cent of boys and girls were normal, 33.3 and 12.5 per cent were of moderate underweight, none of the boys and 12.5 per cent girls were in the category of severe underweight. Similarly among 3-4 years 75 and 55.6 per cent of boys and girls were normal, 12.5 and 22.2 per cent of boys and girls were of moderate underweight and of severe underweight respectively. in 4-5 years 60.9 and 55.6 per cent of boys and girls were normal, 30.4 and 38.9 per cent of boys and girls were of moderate underweight, 8.7 and 10 per cent

boys and girls were of severe underweight. In 5-6 years 58.3 and 40 per cent of boys and girls were normal, 25 and 50 per cent were of moderate underweight, 16.7 and 10 per cent were of severe underweight respectively.

Table XV

Grading of Children according to Weight for Age

(N=150)

Age Group (Years)	Grades (WHO, 2007)											
	Normal				Moderate				Severe			
	Boys		Girls		Boys		Girls		Boys		Girls	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1 – 2	7	87.5	6	75	1	12.5	1	12.5	0	0	1	12.5
2 – 3	14	66.7	12	75	7	33.3	2	12.5	0	0	2	12.5
3 - 4	12	75	10	55.6	2	12.5	4	22.2	2	12.5	4	22.2
4 - 5	14	60.9	10	55.6	7	30.4	7	38.9	2	8.7	1	10
5-6	7	58.3	4	40	3	25	5	50	2	16.7	1	10
TOTAL	**54**	**67.5**	**42**	**60**	**20**	**25**	**19**	**27.1**	**6**	**7.5**	**9**	**12.9**

The overall prevalence of underweight (Weight for age< Median -2SD) among under 5 year boys was about 32.5 per cent, with 7.5 per cent of severe underweight (weight for age< Median -3SD). The overall prevalence of underweight (Weight for age< Median -2SD) among under 5 year girls was about 40 per cent, with 12.9 per cent of severe underweight (weight for age< Median -3SD). The underweight among 1-2 years boys were 12.5 per cent and in girls 25 per cent of underweight with 12.5 per cent of severe underweight. In 2-3 years boys 33.3 per cent were underweight and in girls 25 per cent were underweight with 12.5 per cent severe underweight. Similarly in 3-4 years boys 25 per cent were underweight with 12.5 per cent severe underweight and in girls 44.4 per cent were underweight with 22.2 per cent severe underweight, in 4-5 years 39.1per cent of boys and 48.9 per cent of girls in this age were underweight with severe underweight of 8.7 per cent among boys and 10 per cent among girls of this age, in 5-6 years 41.7 per cent of boys and 60 per cent of girls were underweight with severe underweight of 16.7 per cent among boys and10 per cent among girls.

According to Rao *et al*., (2004), more than 60 per cent of tribal children were underweight. Premakumari *et al*., (2011) report an overall prevalence of 34.7 per cent

underweight among under five year boys and 12.1 per cent of severe underweight. The overall prevalence of underweight among under five year girls was about 37.3 per cent, with 16.6 per cent of severe underweight. According to Chakma *et al.,* (2014) the proportion of underweight Baiga Tribal children (<Median-2SD) was 65.9 per cent and severe underweight (<Median-3SD) was 35.4 per cent.

6. Grading of Children according to Weight for Height

Table XVI gives the grading of children according to weight for height

Table XVI

Grading of Children according to Weight for Height

(N=150)

Age Group (Years)	Grades (WHO, 2007)											
	Normal				Moderate				Severe			
	Boys		Girls		Boys		Girls		Boys		Girls	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1 – 2	5	62.5	7	87.5	3	37.5	0	0	0	0	1	12.5
2 – 3	19	90.5	14	87.5	2	9.5	0	0	0	0	2	12.5
3 - 4	16	100	13	72.2	0	0	4	22.2	0	0	1	5.6
4 - 5	19	82.6	18	100	3	13	0	0	1	4.4	0	0
5-6	11	91.7	9	90	1	8.3	1	10	0	0	0	0
TOTAL	**70**	**87.5**	**61**	**87.1**	**9**	**11.2**	**5**	**7.1**	**1**	**1.3**	**4**	**5.7**

In 1-2 year age group, 62.5 and 87.5 per cent of boys and girls respectively were normal, 37.5 per cent boys were moderately wasted, while none of the girls showed moderate wasting. None of the boys and 12.5 per cent girls were severely wasted. Among 2-3 years 90.5 and 87.5 per cent boys and girls respectively were normal, 9.5 per cent boys and none of the girls were moderately wasted and 0 per cent and 12.5 per cent of boys and girls respectively were severely wasted. In 3-4 years, all the boys and 72.2 per cent of girls were normal. None of the boys and 22.2 per cent girls were moderately wasted and 0 per cent of boys and 5.6 per cent girls were severely wasted. Among 4-5 years 82.6 of boys and all girls were normal, 13 per cent of boys and none of the girls were moderately wasted, while 4.4 per cent of boys and none of the girls were severely wasted. In 5-6 years 91.7 and 90 per cent of boys and girls respectively were normal, 8.3 and 10 per cent of boys and girls respectively were moderately wasted and no child showed severe wasting. The overall prevalence of wasting (Weight for height<

Median -2SD) among under 5 year boys was about 12.5 per cent, with 1.3 per cent of severe wasting (weight for height< Median -3SD). The overall prevalence of wasting (Weight for height< Median -2SD) among under 5 year girls was about 12.8 per cent, with 5.7 per cent of severe wasting (weight for height< Median -3SD**).**

These findings coincide with those of the study on tribes of Andaman and Nicobar islands wherein a majority of Shompen children under five years of age (66.67per cent) had low weight for height compared with the NCHS reference data and more than 58 per cent of the under -fives had weight for height <2SD of the NCHS reference data for their age and sex (Rao *et al.*, 2002). According to Aditi (2009), of 1009 under 5 PTG children surveyed in Nilgiris district, 40 per cent showed Grade I malnutrition, followed by, Grade II (28per cent), normal (26per cent) and Grade III (6per cent) malnutrition. Chakma *et al*., (2014) report that, more than two thirds of Baiga children (65.9per cent) had body weights below Median- 2SD. The proportion of moderate wasting (<Median-2SD) was 42.3 per cent and severe wasting at 10.7 percent.

The overall prevalence of underweight and stunting in the present study was 36.25 and 40.9 per cent which was way above the prevalence rates recorded among their urban slum counter parts of Kolkata. Prevalence of wasting was only 12.65 per cent in the present study. According to Mandal *et al.,* (2015) assessing the nutritional status of urban slum of Chetla, Kolkata involving children of age group, 1-5 years, 36.25 per cent were underweight, 40.9 per cent were stunted and 12.65per cent were wasted.

Bisai *et al*., (2012) report the overall prevalence of underweight, stunting and wasting among 65 Munda and Oraon Tribal children aged 13-60 months in Paschim Medinipur District of West Bengal was 61.5, 38.5 and 55.4 per cent respectively. Rao *et al.,* (2005) reported widespread undernutrition (60per cent underweight) among the preschool children of Gond tribe of Madhya Pradesh. Mittal and Srivasatava (2006) In West Bengal, report that 54 per cent of children (6-12 years of age) of Oraon tribe are suffer from severe malnutrition. Rao and Vijay (2006) observed similar percent of severe underweight (6per cent) among the Santal children of Purnia district of Bihar. Chowdhury *et al.,* (2007), report that 17.88per cent, 33.72 per cent and 29.42 per cent of Santal children were stunted, underweight and wasted, respectively, according to the reference criteria (Z-score below –2) recommended by WHO (2007). Severe (below –3 Z-score) stunting, underweight and wasting were reported 4.98 per cent, 7.92 per cent and 9.51per cent of Santal children respectively.

Renuka *et al.,* (2011) report that the prevalence of underweight, stunting and wasting of one to five years children belonging to Jenukuruba tribe of Mysore district was 38.6, 36.8 and 18.6 per cent respectively.

7. Percentage Prevalence of Underweight Stunting and Wasting among Children

Table XVII gives the percentage prevalence of underweight stunting and wasting among children.

Table XVII

Percentage Prevalence of Underweight, Stunting and Wasting among Children

(N=150)

Age Group (Years)	Grades (WHO, 2007)					
	Boys			Girls		
	Underweight	Stunting	Wasting	Underweight	Stunting	Wasting
	%	%	%	%	%	%
1 – 2	12.5	12.5	37.5	25.0	25.0	12.5
2 – 3	33.3	33.3	9.5	25.0	37.6	12.5
3 - 4	25.0	37.6	00	44.4	50.0	27.8
4 - 5	39.1	39.5	17.4	48.9	50.0	0.0
5-6	41.7	58.4	8.3	60.0	50.0	10.0
TOTAL	**32.5**	**37.5**	**12.5**	**40**	**44.3**	**12.8**

Prevalence of underweight among 1-2 year boys was 12.5 per cent and in girls 25 per cent. In 2-3 years, boys 33.3 per cent were underweight and in girls 25 per cent were underweight. Similarly in 3-4 years boys 25 per cent and in girls 44.4 per cent were underweight, in 4-5 years 39.1per cent of boys and 48.9 per cent of girls were underweight, in 5-6 years 41.7 per cent of boys and 60 per cent of girls were underweight. The overall prevalence of underweight (Weight for age< Median -2SD) among under 5 year boys was about 32.5 per cent and girls was about 40 per cent.

Stunting among 1-2 year old boys were 12.5 per cent and girls showed 25 per cent. In 2-3 year old boys and girls showed 33.3 and 37.6 per cent of stunting. Similarly in boys and girls of 3-4 years showed 37.6 and 50.0 per cent of stunting, 4-5 years showed 39.5 and 50.0 per cent of stunting and 5-6 years showed 58.4 and 50.0 per cent of stunting respectively. It was observed by and large that stunting was more prevalent and severe among girls than among boys, which is suggestive of gender bias. The

overall prevalence of stunting (Height for age< Median -2SD) among boys under five years was about 37.5 per cent. The overall prevalence of stunting (Height for age< Median -2SD) among girls under five years was 44.3 per cent.

Wasting among 1-2 year boys and girls were 37.5 per cent and 12.5 per cent. Among 2-3 years 9.5 per cent boys and12.5 per cent girls were wasted. In 3-4 years, none of the boys and 27.8 per cent girls were wasted. Among 4-5 years 17.4 per cent of boys and none of the girls were wasted. In 5-6 years 8.3 and 10 per cent of boys and girls respectively were wasted. The overall prevalence of wasting (Weight for height< Median -2SD) among under 5 year boys was about 12.5 per cent. The overall prevalence of wasting (Weight for height< Median -2SD) among under 5 year girls was about 12.8 per cent**.**

On the whole prevalence of stunting, wasting and underweight was higher among girls (97.1%) than among boys (82.5%).

8. Grading of Children according to MUAC for Age

Grading of children according to MUAC for age were presented in Table XVIII.

Table XVIII

Grading of Children according to MUAC for Age

(N=150)

Grades (WHO, 2007)												
Age Group (Years)	Normal				Moderate				Severe			
	Boys		Girls		Boys		Girls		Boys		Girls	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1 – 2	8	100	7	87.5	0	0	1	12.5	0	0	0	0
2 – 3	18	85.7	15	93.8	3	14.3	1	6.3	0	0	0	0
3 - 4	14	87.5	13	72.2	2	12.5	5	27.8	0	0	0	0
4 - 5	16	69.6	13	72.2	6	26.1	5	27.8	1	4.3	0	0
5-6	12	100	8	80	0	0	0	0	0	0	2	20
TOTAL	**68**	**85**	**56**	**80**	**11**	**13**	**12**	**17.1**	**2**	**2.5**	**2**	**2.9**

In 1-2 years all boys and 87.5 per cent of girls were normal, none of the boys and 12.5 per cent of girls showed moderate and no child showed severe category of MUAC. Among 2-3 years 85.7 per cent boys and 93.8 per cent girls respectively were normal,

14.3 per cent of boys 6.3 per cent of girls showed moderate category of MUAC and no child showed severe category of MUAC. In 3-4 years 87.5 and 72.2 per cent boys and girls respectively were normal, 12.5 and 27.8 per cent of boys and girls respectively were moderate and no child showed severe category of MUAC. In 4-5 years 69.6 and 72.2 per cent of boys and girls respectively were normal, 26.1 and 27.8 per cent boys and girls showed moderate category of MUAC and 4.3 per cent of boys and none of the girls showed severe category of MUAC. In 5-6 years all boys and 80 per cent of girls were normal, no child showed moderate category of MUAC and none of the boys and 20 per cent girls showed severe category of MUAC. The overall prevalence of moderate (MUAC for age < Median -2SD) and severe (MUAC for age < Median -3SD) category of MUAC among under five year boys was about 13 per cent and two per cent respectively. The overall prevalence of moderate and severe category of MUAC among under five year girls was Normal MUAC was observed among a majority (85 and 80%) of children respectively. about 14 per cent and two per cent respectively. It is paradoxical that normal MUAC was observed among a majority (85 and 80%) of children respectively, though 97.1per cent of girls and 82.5 per cent boys were malnourished.

According to Premakumari *et al* (2011) the overall prevalence of moderate and severe category of MUAC among under five year boys was about 31 per cent, with 6.4 per cent showing signs of severe malnutrition. The overall prevalence of moderate and severe category of MUAC among under five year girls was about 37.6 per cent, with 5.1 per cent of severe malnutrition.

9. Grading of Children according to BMI for Age

The distribution of 6-14 years children (Boys and Girls) according to nutritional status based on BMI Z-scores (WHO reference values) are presented in the Table XIX.

The overall prevalence of thinness (BMI<-2SD) among 6-14 years boys was about 14.2 per cent, with 7.1 per cent showing severe thinness. The overall prevalence of thinness (BMI<-2SD) among 6-14 years girls was about 12.5 per cent, with 1.2 per cent showing severe thinness. This could be because of hyper activity observed among boys and adolescent growth spurt among girls.

Table XIX

Grading of Children according to BMI for Age

(N=167)

Age Group (Years)	Normal				Moderate				Severe			
	Boys		Girls		Boys		Girls		Boys		Girls	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
6-7	3	100	5	100	0	0	0	0	0	0	0	0
7 – 8	7	100	7	100	0	0	0	0	0	0	0	0
8 - 9	1	33.3	1	50	0	0	1	50	2	66.7	0	0
9 - 10	15	88.2	5	71.4	0	0	2	28.6	2	11.8	0	0
10 - 11	5	100	5	100	0	0	0	0	0	0	0	0
11-12	6	100	5	62.5	0	0	3	37.5	0	0	0	0
12-13	11	100	17	100	0	0	0	0	0	0	0	0
13-14	12	66.7	25	86.2	5	27.8	3	10.3	1	5.6	1	3.5
TOTAL	**60**	**85.7**	**70**	**87.5**	**5**	**7.1**	**9**	**11.3**	**5**	**7.1**	**1**	**1.2**

The overall prevalence of thinness observed among 6-14 year old children in the present study was 13.35 per cent, which is almost double the emaciation values (6.7%) reported by Sasicoumar *et al* ., among the same tribal groups in 2006. This is a matter of concern which has to be brought to the attention of policy makers and stake holders. However 48 per cent thinness is reported among urban slum children of Chetla, Kolkata, aged 5-14 years, by Mandal *et al.,* (2015).

10. Morbidity Pattern Over Three Months

Table XX shows the morbidity pattern of children over three months

Table XX

Morbidity Pattern Over Three Months

(N=317)

Morbidity Pattern	No. of days	Scores*
Diarrhoea	4-6 days	10
Fever	For 5-9 days	10
Bronchitis	5 days	5
Cold	10 days	10
Others	Within 10 days	10
Degree of Morbidity		**II**

*Arroyave and Pineda (1974)

Over the past three months, diarrhoea was reported for 4-6 days, fever for 5-9 days, bronchitis for 5 days, cold for 10 days and others within 10 days. The scores for diarrhoea, fever, cold and others are 10 each and the scores for bronchitis is 5. Total of the scores is 45, which shows II degree of morbidity among PTG children.

According to Divakar *et al*., 2015 more of tribal under five children than non-tribal suffered from various morbid disorders. In a study among Warli tribal children, Thane district, Maharastra, India, it was found that Diarrhoea was observed to be maximum (37%) (Tekale, 2012). A study by Singh and Gupta (2012), diarrhoea was the main problem faced by children under 5 years of age followed by acute respiratory infection (pneumonia) being the second most common problem.

D. Dietary Pattern of PTG Children

1. Dietary Habits

Each tribal population has its unique food habits (Mandal, 2002). In the present study, all the families were non-vegetarians and all of them consumed three meals a day. Adults, both men and women consumed alcohols and tobacco, due to which they developed progressive neurogenic disorders and consequent crippling effect of the limbs (Plate 12). Mostly, Kattunayakans ate what they hunt, but avoid monkey's flesh and beef due to their tribal customs and belief. The flesh of the rat is a special delicacy and they hunt rats inside the burrows on the side of the paddy fields by inserting their hand in the burrows and collect paddy from the burrows where rodents store their grains.

Mostly all of them cooked rice in the night time. After consumption the left over was used as breakfast the next morning. It was observed that their diet lacked variety. Usually, the tribals consumed steamed rice with chutney made of chillies and salt, in the morning. Their lunch included forest tuber, mango and jack fruit. Dinner comprised mostly of non-vegetarian curry with steamed rice, or bamboo rice. Malnutrition among these tribal groups is further accentuated by the junk-food practices of settlers, predominantly that of consuming parathas* made from refined wheat flour (maida). This practice is becoming popular among the tribals since they are ignorant of the fact that parathas provide only starch and fat in the diet. In fact prevalence of Diabetes mellitus is now reported among the PTG of Nilgiris which is probably due to this consistent faulty food practice.

Plate 12. Crippling Effect on the limbs

Plate 13. Consumption of black tea in feeding bottle by a four year old

2. Frequency of Black Tea Consumption

Table XXI gives the frequency of black tea consumption by the children in the tribal hamlets.

Table XXI

Frequency of Black Tea Consumption

(N=317)

Black Tea	1-3 (87)		4-6(63)		7-9 (53)		10-12 (57)		13-15 (57)		Total (N=317)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
3 times	0	0	0	0	4	7.5	8	14	9	15.8	21	6.6
4 times	87	100	63	100	49	92.5	49	86	48	84.2	296	93.4

All the children right from one year of age consumed black tea (Plate 13), since milk is expensive and probably because tea is relatively inexpensive and easily available in the Nilgiris. Around 7.5 per cent, 14 per cent and 15.8 per cent of 7-9 years, 10-12 years and 13-15 years respectively drank black tea thrice daily. All children in 1-3 years age group and 4-6 years, 92.5 per cent in 7-9 years, 86 per cent of 10-12 years and 84.2 per cent of 13-15 years respectively drank black tea four times a day. These children did not have the habit of consuming any other beverage, as their families could not afford them. On the whole, 6.6 and 93.4 per cent of the children drank black tea, three and four times each day respectively.

3. Cooking Methods

Details of the methods adopted for cooking different foods is given in Table XXII.

Table XXII

Cooking Methods

(N=317)

Foods	Boiling		Roasting		Shallow fat frying	
	No	%	No	%	No	%
Cereals	317	100	-	-	-	-
Pulses	317	100	-	-	-	-
Vegetables	317	100	-	-	-	-
Egg	-	-	21	6.6	280	93.4
Fish	317	100	-	-	317	100
Green Leafy vegetables	317	100	-	-	-	-
Meat	317	100	-	-	64	20.2

The predominant method adopted for cooking all food items by the women was boiling. All the families boiled cereals, pulses, vegetables, fish, greens and meat for consumption. None of the families used steaming and pressure cooking methods. Eggs were roasted by 6.6 per cent while 93.4 percent shallow fried eggs. All the women shallow fried fish and 20.2 per cent cooked meat by shallow frying.

4. Frequency of Consumption of Food Items

Details on frequency of consumption of food items are given in the Table XXIII.

Table XXIII

Frequency of Consumption of Food Items

(N=317)

S.No.	Food Items	Daily		Weekly		Monthly		Occasionally		Not at all	
		No	%	No	%	No	%	No	%	No	%
1	**Cereals**										
	Jowar	-	-	-	-	-	-	127	40	190	60
	Maize	-	-	-	-	21	6.7	106	33.3	190	60
	Ragi	-	-	-	-	-	-	127	40	190	60
	Rice										
	-parboiled	317	100	-	-	-	-	-	-	-	-
	-raw	-	-	-	-	190	60	127	40	-	-
	-flakes	-	-	-	-	182	57.3	-	-	135	42.7
	-puffed	-	-	-	-	-	-	127	40	190	60
	Wheat flour										
	-whole	-	-	-	-	127	40	-	-	190	60
	-refined	-	-	317	100	-	-	-	-	-	-
	Semolina	-	-	125	39.3	106	33.3	-	-	86	27.3
	Vermicelli	-	-	-	-	-	-	317	100	-	-
	Bread	-	-	-	-	85	26.7	232	73.3	-	-
2	**Pulses**										
	Bengal gram										
	-whole	-	-	-	-	-	-	200	66.7	100	33.3
	-dhal	-	-	85	26.7	232	73.3	-	-	-	-
	-roasted	-	-	127	40	190	60	-	-	-	-
	Black gram	-	-	-	-	190	60	127	40	-	-
	Green gram										
	-whole	-	-	-	-	-	-	-	-	317	100
	-dhal	-	-	-	-	-	-	-	-	317	100
	Peas										

S.No.	Food Items	Daily		Weekly		Monthly		Occasionally		Not at all	
		No	%	No	%	No	%	No	%	No	%
	-green	-	-	-	-	-	-	317	100	-	-
	-dry	-	-	-	-	-	-	317	100	-	-
	-roasted	-	-			-	-	317	100	-	-
	Red gram	-	-	-	-	-	-	-	-	317	100
3	**Roots and Tubers**										
	Beet root	-	-	317	100	-	-	-	-	-	-
	Carrot	-	-	317	100	-	-	-	-	-	-
	Onion										
	-big	190	60	127	40	-	-	-	-	-	-
	-small	-	-	64	20	-	-	253	80	-	-
	Potato	-	-	317	100	-	-	-	-	-	-
	Radish	-	-	317	100	-	-	-	-	-	-
	Sweet potato	-	-	-	-	-	-	317	100	-	-
	Yam	-	-	317	100	-	-	-	-	-	-
	Turnip	-	-	-	-	-	-	317	100	-	-
	Tapioca	-	-	317	100	-	-	-	-	-	-
4	**Greens**										
	Agathi	-	-	-	-	317	100	-	-	-	-
	Amaranth	-	-	317	100	-	-	-	-	-	-
	Cabbage	-	-	64	20	253	80	-	-	-	-
	Coriander leaves	-	-	-	-	317	100	-	-	-	-
	Curry leaves	317	100	-	-	-	-	-	-	-	-
	Drumstick leaves	-	-	-	-	-	-	317	100	-	-
	Fenugreek leaves	-	-	-	-	-	-	317	100	-	-
	Manathakkali leaves	-	-	317	100	-	-	-	-	-	-
	Mint leaves	-	-	-	-	-	-	317	100	-	-
	Paruppu keerai	-	-	317	100	-	-	-	-	-	-
	Ponnangani	-	-	317	100	-	-	-	-	-	-
	Spinach	-	-	-	-	317	100	-	-	-	-
5	**Other vegetables**										
	Ash gourd	-	-	-	-	-	-	317	100	-	-
	Beans	-	-	317	100	-	-	-	-	-	-
	Bitter gourd	-	-	317	100	-	-	-	-	-	-

S.No.	Food Items	Daily		Weekly		Monthly		Occasionally		Not at all	
		No	%	No	%	No	%	No	%	No	%
	Bottle gourd	-	-	-	-	-	-	317	100	-	-
	Brinjal	-	-	317	100	-	-	-	-	-	-
	Cauliflower	-	-	-	-	-	-	317	100	-	-
	Cluster beans	-	-	-	-	317	100	-	-	-	-
	Cucumber	-	-	-	-	-	-	317	100	-	-
	Drumstick	-	-	317	100	-	-	-	-	-	-
	Ladies finger	-	-	317	100	-	-	-	-	-	-
	Pumpkin	-	-	317	100	-	-	-	-	-	-
	Tomato (green)	-	-	-	-	-	-	-	-	317	100
6	**Fruits**										
	Amala	-	-	-	-	-	-	317	100	-	-
	Apple	-	-	-	-	-	-	317	100	-	-
	Banana	-	-	317	100	-	-	-	-	-	-
	Dates	-	-	-	-	-	-	-	-	317	100
	Grapes	-	-	-	-	-	-	317	100	-	-
	Guava	-	-	-	-	-	-	317	100	-	-
	Jack fruit	-	-	-	-	-	-	317	100	-	-
	Lemon	-	-	-	-	-	-	317	100	-	-
	Mango	-	-	-	-	-	-	317	100	-	-
	Papaya	-	-	-	-	-	-	317	100	-	-
	Pineapple	-	-	-	-	-	-	-	-	317	100
	Tomato	-	-	317	100	-	-	-	-	-	-
	Water melon	-	-	-	-	-	-	-	-	317	100
7	**Non-Vegetarian Foods**										
	Chicken	-	-	317	100	-	-	-	-	-	-
	Egg	-	-	317	100	-	-	-	-	-	-
	Fish	-	-	317	100	-	-	-	-	-	-
	Mutton	-	-	64	20	42	13.3	211	66.7	-	-
8	**Milk and Milk Products**										
	Butter milk	-	-	-	-	-	-	317	100	-	-
	Cows milk	-	-	-	-	-	-	317	100	-	-
	Curd	-	-	-	-	-	-	317	100	-	-

S.No.	Food Items	Daily		Weekly		Monthly		Occasionally		Not at all	
		No	%	No	%	No	%	No	%	No	%
9	**Nuts**										
	Cashew nut	-	-	-	-	-	-	-	-	317	100
	Coconut	64	20	253	80	-	-	-	-	-	-
	Ground nut	-	-	-	-	-	-	317	100	-	-
10	**Fats and Oils**										
	Coconut oil	-	-	317	100	-	-	-	-	-	-
	Ghee	-	-	-	-	-	-	-	-	317	100
	Gingelly oil	-	-	-	-	-	-	-	-	317	100
	Refined oil	317	100	-	-	-	-	-	-	-	-
11	**Sugar**										
	Honey	-	-	-	-	-	-	317	100	-	-
	Jaggery	-	-	-	-	-	-	317	100	-	-
	Sugar	317	100	-	-	-	-	-	-	-	-

Forty per cent of the tribal children consumed jowar occasionally while the remaining 60 per cent did not consume jowar in their diet. Maize was consumed on monthly basis by 6.7 per cent and occasionally by 33.3 percent while 60 per cent did not consume maize. Ragi was consumed occasionally by 40 per cent, while 60 per cent of families did not consume ragi. Parboiled rice was the only cereal consumed by the children every day. The consumption of raw rice was three, 20 and 77.5 per cent on daily, weekly and monthly basis respectively. Sixty per cent consumed raw rice every month and 40 per cent consumed raw rice occasionally. According to Sasicoumar *et al.,* (2006) report that Paniya tribes take rice as staple food. While 57.3 percent consumed rice flakes on monthly basis, 42.7 per cent of the families did not consume rice flakes. Forty per cent of families consumed puffed rice occasionally, while 60 per cent did not consume puffed rice. Whole wheat flour was included each month by 40 per cent, while it was not at all used by the rest of the families. It was disappointing to note that all the families used refined wheat flour (maida) on a weekly basis. The women were ignorant of the benefits of dietary fibre in whole wheat flour and the health problems associated with the consumption of refined cereals. Nearly 39.3 per cent of them consumed preparations out of semolina every week, while 33.3 per cent used semolina every month and 27.3 per cent did not consume semolina. Vermicelli was used occasionally by all the families. Bread was used by 26.7 per cent monthly and 73.3 per cent occasionally.

Pulses were not included in their daily diet. Bengal gram dhal and black gram dhal were the predominantly consumed pulses, used only once a week. The consumption of other pulses was very rare. Big onions were the only tubers consumed daily. Other roots and tubers such as carrot, beet root, small onions, radish, potato, sweet potato and yam were consumed once a week by majority of the children.

Curry leaves (*Murraya koenigii*) were included daily in all the families. Other green leafy vegetables like amaranth (*Amaranthas caudatus*), manathakkali leaves (*Solanum nigrum*), paruppu keerai (*Portulaca oleracea*), spinach (*Spinacia oleracea*) and ponnanganni (*Alternathera sessilis*) were consumed once a week by all the children. Agathi (*Sesbania grandiflora*), coriander leaves (*Coriandrum sativum*), spinach were consumed on monthly basis. Drumstick leaves (*Moringa oleifera*), fenugreek leaves (*Trigonella foenum graecum*) and mint leaves (*Mentha spicata*) were consumed occasionally. Other vegetables such as beans (*Phaseolus coccineus*), bitter gourd (*Momordica charantia*), brinjal (*Solanum melongena*), drumstick (*Moringa oleifera*), lady's finger (*Abelmoschus esculentus*), pumpkin (*Cucurbita maxima*) were consumed by all children once a week. Cluster beans were consumed monthly once. Ash gourd, bottle gourd, cauliflower and cucumber were consumed occasionally. The intake of fruits and milk was very rare. Banana and tomato were consumed weekly. Amla, apple, grapes, guava, jack fruit, lemon, mango and papaya were consumed occasionally. Dates, pine apple and water melon were not consumed at all. Milk products like butter milk, cows milk and curd were consumed occasionally. While non-vegetarian foods like chicken, egg, fish, mutton were consumed by all the children only once a week.

Coconut was consumed daily by 20 per cent of the families and weekly by remaining 80 per cent of the families. Ground nut was consumed occasionally while other nuts were not used. Refined oil was used for cooking and hence consumed daily and coconut oil weekly. Ghee and gingelly oil were not consumed by the families. Sugar was used daily, while honey and jaggery were used occasionally.

5. Mean Food Intake

Table XXIV and XXV and figure 20 represent the mean daily food intake of the children and percentage adequacy in comparison with the suggested allowances of ICMR (2009).

Table XXIV

Mean Food Intake (1-9yrs)

(N=203)

Food Stuffs	Suggested Allowances @	1-3 years		Suggested Allowances@	4-6 years		Suggested Allowances@	7-9 years	
		Actual Intake (g)	Adequacy (%)		Actual Intake (g)	Adequacy (%)		Actual Intake (g)	Adequacy (%)
Cereals & Millets	60	50	83.3	120	105	87.5	180	165	91.6
Pulses/Fleshy foods	30	16	53.3	30	17	56.6	60	37	61.6
Green Leafy Vegetables	50	25	50	50	32	64	100	50	50
Roots and tubers	50	30	60	100	65	65	100	66	66
Other vegetables	50	38	76	100	76	76	100	46	46
Fruits	100	50	50	100	50	50	100	54	54
Milk and Milk products	500	120	40	500	190	38	500	260	52
Sugar & Jagerry	15	10	66.6	20	15	75	20	15	75
Fats & Oil	25	12.5	50	25	15	60	30	15	50

@ICMR, 2009

Table XXV

Mean Food Intake (10-14 yrs)

(N= 114)

Food Stuffs	10-12 years						13-14 years					
	Boys			Girls			Boys			Girls		
	Suggested Allowances @	Mean Intake (g)	Adequacy (%)	Suggested Allowances @	Mean Intake (g)	Adequacy (%)	Suggested Allowances @	Mean Intake (g)	Adequacy (%)	Suggested Allowances @	Mean Intake (g)	Adequacy (%)
Cereals	300	278	92.6	240	223	92.9	420	380	90.5	330	300	90.9
Pulses/Fleshy foods	60	36	60.0	60	37	61.6	75	48	64.0	60	37	61.7
Green Leafy Vegetables	100	56	56.0	100	52	52.0	100	60	60.0	100	57	57.0
Roots and tubers	100	63	63.0	100	56	56.0	150	94	62.6	100	56	56.0
Other vegetables	200	115	57.5	200	88	44.0	200	106	53.0	200	110	55.0
Fruits	100	54	54.0	100	54	54.0	100	54	54.0	100	54	54.0
Milk and Milk products	500	260	52.0	500	262	52.4	500	260	52.0	500	260	52.0
Sugar & Jagerry	30	24	80.0	30	24	80.0	20	15	75.0	25	19	76.0
Fats & Oil	35	27	77.1	35	23	65.7	45	34	75.5	40	25	62.5

@ICMR, 2009

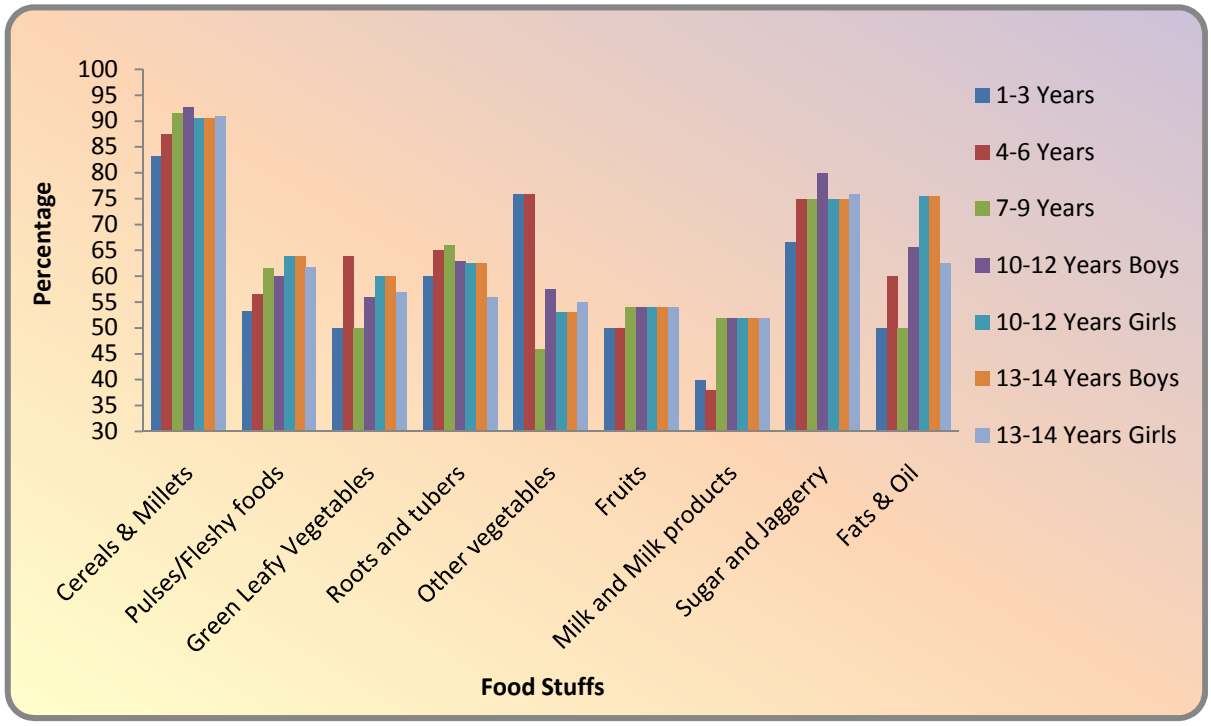


Figure 20. Percentage Adequacy of Mean Food Intake

The amounts of each of the food stuff consumed by children in the three age groups were similar. The mean intake of foodstuffs was way below the recommended dietary intakes, with percentage adequacy ranging from 38 for milk and milk products among 4-6 year olds to 91.6 for cereals and millets among 7-9 year olds. Among 1- 3, 4 - 6 and 7-9 years, cereals and millets formed the bulk of dietaries, constituting 83.3 to 91.6 per cent of the suggested allowances (ICMR, 2009). Notably inadequate intakes were observed for qualitative foods like pulses (53.3 to 61.6 per cent), green leafy vegetables (50 to 64per cent), other vegetables (46 to 76per cent), fruits (50 to 54per cent) and milk and milk products (38 to 52per cent) as compared to the ICMR (2009) suggested allowances.

Among 10 - 12 and 13-14 year old boys and girls, cereals and millets were consumed at 90.9 to 92.6 per cent of the suggested allowances (ICMR, 2009). Notably inadequate intakes were observed for pulses (60 to 64 per cent), green leafy vegetables (52 to 60 per cent), other vegetables (44 to 57.5 per cent), fruits (54 per cent) and milk and milk products (52 to 52.4 per cent) as compared to the suggested allowances of ICMR (2009).

Among Baiga Tribal children the average intake of cereals and millets was significantly higher than recommended level, while the intake of qualitative food such as pulses, vegetables, milk and milk products, oil and fat, sugar and jaggery were significantly lower than the recommended level except for roots and tubers ($P<0.001$). The consumption of milk and milk products was grossly inadequate in their daily diet (Chakma *et al.*, 2014).

A study on diet, and food related traditions of Oraon tribes of New Mal, West Bengal (Mittal and Srivastava, 2006) found that the intakes of all groups are deficient in all food groups to a similar extent. The deficit of pulses and flesh foods was most severe in the diet of the Oraon women. The consumption of green leafy vegetables was also very deficient, and it consisted mostly of little known locally available greens. Large deficits in intake of protective foods such as milk, vegetables including green leafy vegetables, and fruit were found. Also, it was noteworthy that the mean BMI of women fell in the normal range, despite energy intakes of the order of 52-53 per cent of ICMR- RDA.

6. Mean Nutrient Intake

Table XXVI and XXVII and figure 21 represent the mean daily nutrient intake of the children.

The intake of almost all the nutrients was below the Recommended Allowances (2010), among 1-3, 4-6 and 7-9 years energy (91.1 to 91.7 per cent), protein (59.7 to 61 per cent), fat (50 to 56 per cent), calcium (66.7 to 75per cent), especially micronutrients such as Vitamin A (50 to 54.7per cent), β-Carotene (51.1 to 52.1per cent), iron (44.4 to 57.1per cent), thiamine (40 to 57.1per cent) and vitamin C (62.5 to 70 per cent). Tribal diets are generally deficient in calcium, vitamin A, vitamin C, riboflavin and animal protein (Sasicoumar *et al.*, 2006).

The adequacy of the diets of 10-12 and 13-14 years boys and girls in terms of energy (90.1 to 92 per cent), protein (60.1 to 64.5per cent), fat (51.4 to 60 per cent), calcium (56.3 to 62.5 per cent), especially micronutrients such as Vitamin A (49.7 to 50.8per cent), β-Carotene (52.1per cent), iron (44.4 to 57.1per cent), thiamine (45.5 to 57.1per cent) and vitamin C (62.5 to 75per cent) revealed that they were grossly inadequate.

Table XXVI

Mean Nutrient Intake (1-9yrs)

(n=203)

Nutrients	1-3 years			4-6 years			7-9 years		
	RDA*	Mean Intake (g)	Adequacy (%)	RDA*	Mean Intake (g)	Adequacy (%)	RDA*	Mean Intake (g)	Adequacy (%)
Energy (kcal)	1060	973	91.7	1350	1230	91.1	1690	1550	91.7
Protein (g)	16.7	10	59.8	20.1	12	59.7	29.5	18	61.0
Fat (g)	27	15	55.5	25	14	56.0	30	15	50.0
Calcium (mg)	600	450	75.0	600	400	66.7	600	400	66.7.0
Iron (mg)	9	5	55.5	13	7	53.8	16	7.5	46.9
Vitamin A (IU)	400	200	50.0	400	200	50.0	600	328	54.7
β-Carotene (mcg)	3200	1650	51.5	3200	1635	51.1	4800	2500	52.1
Thiamine (mg)	0.5	0.2	40.0	0.7	0.4	57.1	0.8	0.4	50.0
Vitamin C (mg)	40	28	70.0	40	25	62.5	40	25	62.5

***RDA, 2010**

Table XXVII

Mean Nutrient Intake (10-14 yrs)

(N=114)

Nutrients	10-12 years						13-14 years					
	Boys			Girls			Boys			Girls		
	RDA*	Mean Intake (g)	Adequacy (%)	RDA*	Mean Intake (g)	Adequacy (%)	RDA*	Mean Intake (g)	Adequacy (%)	RDA*	Mean Intake (g)	Adequacy (%)
Energy (kcal)	2190	2010	91.8	2010	1850	92.0	2750	2500	90.9	2330	2100	90.1
Protein (g)	39.9	24	60.1	40.4	25	61.9	54.3	35	64.5	51.9	32	61.7
Fat (g)	35	20	57.1	35	18	51.4	45	27	60.0	40	23	57.5
Calcium (mg)	800	500	62.5	800	450	56.3	800	500	62.5	800	450	56.3
Iron (mg)	21	12	57.1	27	12	44.4	32	17	53.1	27	15	55.5
Vitamin A (IU)	600	300	50.0	600	298	49.7	600	305	50.8	600	298	49.7
β-Carotene (mcg)	4800	2500	52.1	4800	2500	52.1	4800	2500	52.1	4800	2500	52.1
Thiamine (mg)	1.1	0.5	45.5	1	0.5	50.0	1.4	0.8	57.1	1.2	0.6	50.0
Vitamin C (mg)	40	30	75.0	40	25	62.5	40	30	75.0	40	25	62.5

***RDA, 2010**

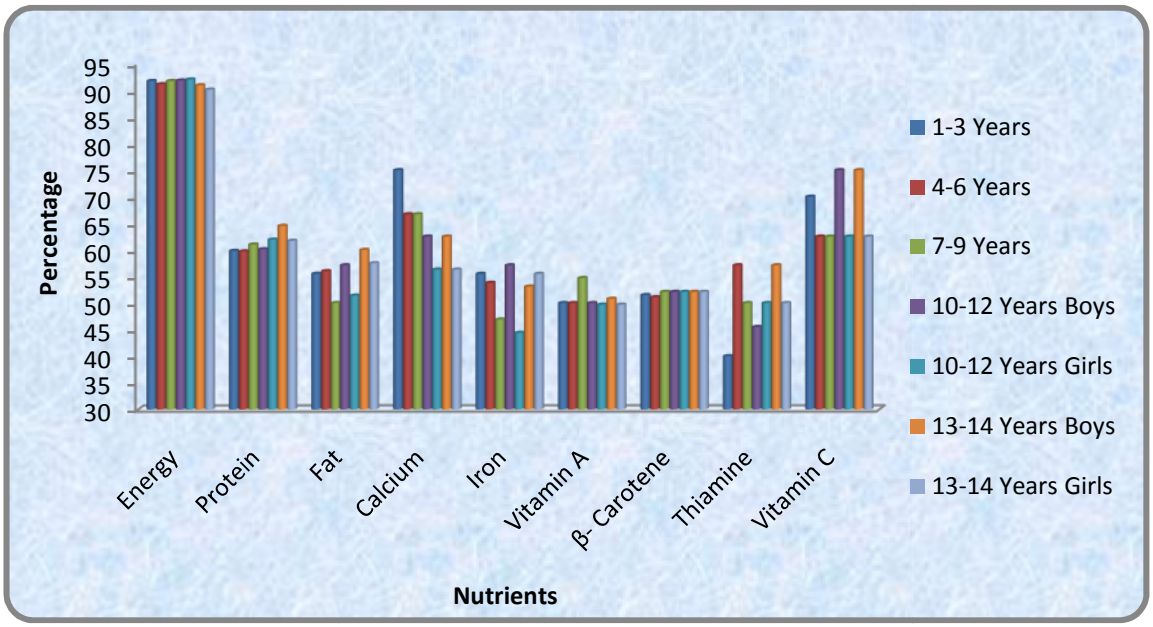


Figure 21. Percentage Adequacy of Mean Nutrient Intake

According to Chakma *et al*.,(2014), the average intake of all the nutrients of Baiga tribal children were considerably lower than the recommended dietary allowances for Indians (P<0.0001). The extent of deficit in the intake of micronutrients in daily diet such as vitamin A (62per cent), calcium (60per cent), iron (46per cent), riboflavin (36per cent) and vitamin C (35per cent) was relatively more compared to energy (25per cent) and protein.

7. Correlation between Energy Intake and BMI

Table XXVIII shows the correlation between energy intake and BMI

Table XXVIII

Correlation between Energy Intake and BMI

Age group (in years)	N	Energy Intake and BMI	
		Correlation coefficient of 'r'	p value
7+	8	+0.949	0.017**
8+	8	+0.556	0.1193^{NS}
9+	8	+0.810	0.0235*
10+	8	+0.6927	0.0363*
11+	9	+0.7518	0.0291*
12+	9	+0.9057	0.0124**
13+	10	+0.9156	0.0146**
14+	10	+0.8964	0.0135**

**- Significant at 1% level * - Significant at 5% level NS – Not significant

Energy intake and BMI have a statistically significant linear relationship (p<0.001) and (p<0.005) except in 8 years which is not significant. The direction of the relationship is positive (i.e., Energy intake and BMI are positively correlated), meaning that these variables tend to increase together

Phase II

Background Information and Nutritional Status of PTG Children included for Supplementation

A. Socio Economic Background of Supplementation Group Children

1. Background Information of the Supplementation Group Children

Details on the background information of the children are presented in Table XXIX.

Table XXIX

Background Information of the Children included for Supplementation

N=167

Family Details	E I (N=52)		E II (N=51)		P I (N=32)		P II (N=32)		Total (N=167)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Type of Family										
Joint	7	13.5	8	15.7	13	40.6	13	40.6	41	24.6
Nuclear	45	86.5	43	84.3	19	59.4	19	59.4	126	75.4
Total	**52**	**100**	**51**	**100**	**32**	**100**	**32**	**100**	**167**	**100**
Distribution of Tribe										
Kurumbas	12	23	11	21.6	15	46.9	15	46.9	53	31.7
Paniyas	20	38.5	20	39.2	7	21.9	7	21.9	54	32.3
Kattunaickers	20	38.5	20	39.2	10	31.2	10	31.2	60	35.9
Total	**52**	**100**	**51**	**100**	**32**	**100**	**32**	**100**	**167**	**100**
Gender										
Male	23	44.2	27	52.9	15	46.9	15	46.9	80	47.9
Female	29	55.8	24	47.1	17	53.1	17	53.1	87	52.1
Total	**52**	**100**	**51**	**100**	**32**	**100**	**32**	**100**	**167**	**100**

It was observed that VAD and IDA were common only among Kurumbas, Paniyas and Kattunaickers. In the E I group, 13.5 per cent lived in joint families and 86.5 per cent in nuclear families. In the E II group, 15.7 per cent lived in joint families and 84.3 per cent in nuclear families; 40.6 per cent of the children in the P I and PII lived in nuclear families and 59.4 per cent of P I and P II lived in joint families. Thus it is evident that even among tribals the joint family system of life is fast changing. These findings are similar to those reported by Rao (2013) wherein he states that 83 per cent of Chenchu tribals belong to nuclear families.

In the E I group, 38.5 per cent each of the children belonged to Paniya and Kattunaicker tribe and 23 per cent belonged to Kurumba tribe. In E II group 39.2 per cent of the children belonged to Paniya and Kattunaicker tribe and 21.6 per cent belonged to Kurumba tribe. In P I and II, 46.9 per cent children belonged to Kurumba, 21.9 per cent belonged to Paniya tribe and the remaining 31.2 per cent belonged to Kattunaicker community respectively. Totally, 31.7, 32.3 and 35.9 per cent of children belonged to Kurumba, Paniya and Kattunaicker community respectively, The number of boys and girls in the study were almost equal (44.2 per cent boys and 55.8 per cent girls in E I, 52.9 per cent boys and 47.1per cent girls in E II, 46.9per cent boys and 53.1per cent girls in P I and P II) on the whole, 47.9 per cent were boys, 52.1 per cent were girls.

2. Monthly Income and Expenditure of the Supplementation Group Families

Table XXX gives the distribution of families according to monthly income and details of monthly expenditure of the families.

Ninety eight per cent of children in the E I, all children in E II and placebo groups, were from EWS (Economically Weaker Section) families as per the HUDCO classification (2010). Nearly two per cent of children in the EI group belonged to Low Income Group families with monthly income of ₹ 5001 to 10,000.

On the whole, 99.4 per cent of the families belonged to EWS and only 0.6 per cent were in LIG. The average monthly per capita income for Indians reported by NNMB (2012) was ₹ 1356/-in the present study.

Table XXX

Monthly Income and Expenditure of the Supplementation Group Families

N=167

Income/ Month*	E I(N=52)		E II(N=51)		P I (N=32)		PII (N=32)		Total (N=167)	
	No.	%	No.	%	No.	%	No.	%	No.	%
< 5000 EWS	51	98.1	51	100	32	100	32	100	**166**	**99.4**
5001- 10,000 LIG	1	1.9	0	0	0	0	0	0	**1**	**0.6**
Total	**52**	**100**	**51**	**100**	**32**	**100**	**32**	**100**	**167**	**100**
Details of Expenditure	₹	%	₹	%	₹	%	₹	%	₹	%
Food	1794	59.6	1578	51.1	1860	62	1860	62	1744	57.6
Pan/Betel Nut/ Alcoholic Drinks	458	15.2	583	18.9	414	13.8	414	13.8	485	16
Clothing	176	5.9	187	6.1	159	5.3	159	5.3	174	5.8
Purchase of household items /Repair work	204	6.8	236	7.6	235	7.8	235	7.8	225	7.4
Transport	125	4.2	134	4.3	137	4.6	137	4.6	132	4.4
Debts	51	1.7	104	3.4	76	2.5	76	2.5	77	2.5
Total	**2808**	**93.3**	**2821**	**91.4**	**2880**	**96.1**	**2880**	**96.1**	**2837**	**93.6**

*(HUDCO, 2010) EWS – Economically Weaker Section, LIG- Low Income Group

All the families in E I group spent 59.6per cent, families in E II group spent 51.1 per cent, families in P I and P II spent 62 per cent each of their income on food. It was shocking to note that 15.2 per cent of families of E I children, 18.9 per cent in E II group, 13.8 per cent in placebo group spent their money on pan, betel nut and alcoholic drinks and both the parents in the families had this habit. While 5.9 per cent of families in E I, 6.1 per cent in E II, 5.3 per cent in P I and P II each spent their income on clothing, 6.8 per cent of tribal families (E I), 7.6 per cent (E II), 7.8 per cent (P I and P II) of the income was spent on purchase of household items and repair work. Expenses on transport constituted 4.2, 4.3 and 4.6 per cent of income respectively. None of the three groups had any saving habit. Debts were incurred up to 1.7 per cent in E I, 3.4 per cent in E II, 2.5 per cent in placebo groups. None of the families spent any money on recreation.

On the whole, 57.6 per cent, 16 per cent, 5.8 per cent,7.4 per cent, 4.4 and 2.5 per cent of income was spent on various expenses namely, food, pan/betel nut/ alcoholic drinks, clothing, maintenance of household /repair work, transport and debts.

Many details of socio economic status of the supplementation groups were similar to the corresponding data of the universe. Thus the supplementation group was a true sample of the larger group accessed in the prevalence study (Phase I).

B. Nutritional Status of Children

1. Nutritional Anthropometry

The mean anthropometric measurements, namely, height, weight and MUAC of the children are presented according to age and gender in Table XXXI to Table XXXIV.

i) Mean Height of children

The mean height of boys in the age group of 7-14 years of E I ranged from 117.61 cm to 151.67 cm and that of E II was from 121.62 cm to 150.46 cm. In the P I group, heights ranged from 121.05 cm to 157.49 and in P II 122.24 cm to 150.92 cm respectively. Similarly the mean heights of girls in the age group of 7-14 years in E I were from 117.28 cm to 147.61 cm, in E II the mean height ranged from 113 cm to 150.52 cm and in P I 112.25 cm to 148.95 cm and in P II 112.05 cm to 148.95 cm. Mean heights of children in all age and intervention groups were much below the standard values (by 4.cm to 19.48 cm) of the respective age groups. The values are significantly less ($p<0.01$ and $p<0.05$) than the respective age group.

ii) Mean Weight of children

The mean weight of children in the age group of 7-14 years of E I boys was 19.01 kg to 38.69 kg, in E II the mean weight of 7 years was 24.62 kg which is only above the standard value of the respective age groups, where the mean weight of 8 to 14 years were 22.04 kg to 39.91 kg. In the placebo group, the mean weight ranged from 20.05 kg to 43.35 kg in P I boys and 17.10 kg to 36.55 kg among P II girls, 22.18 kg to 43.59 kg in P II boys and 17.15 kg to 36.55 kg among P II girls which were all below the standard values of the respective age groups. The values are significantly less ($p<0.01$ and $p<0.05$) than the respective age group.

Table XXXI

Mean Anthropometry of EI Children

Age (years)	Standard WHO (2006)		E I (N=52)			
	Boys	Girls	Boys	't' value Mean vsStd.	Girls	't' value Mean vsStd.
Mean Height2						
7+	75.7	74	117.61±4.6	17.48**	117.28±5.9	16.84**
8+	87.8	86.4	123.28±2.8	15.36**	123.98±2.8	13.47**
9+	96.1	95.1	124.99±1.7	12.06**	124.49±2.1	12.75**
10+	103.3	102.7	129.80±8.3	9.49**	129.10±10.0	10.50**
11+	110	109.4	137.57±6.4	8.42**	132.78±6.2	5.43**
12+	124.3	123.6	142.65±2.9	6.18**	144.78±8.3	7.20**
13+	130.1	129.2	137.98±11.9	1.35^{NS}	145.93±5.6	10.44**
14+	134.6	135	151.67±10.6	4.62**	147.61±4.4	4.96**
Mean Weight						
7+	9.6	8.9	19.01±3.1	4.27**	18.89±2.6	5.18**
8+	12.2	11.5	21.52±1.6	5.07**	20.55±0.2	4.62**
9+	14.3	13.9	19.94±1.2	2.68*	20.79±0.7	3.75 *
10+	16.3	16.1	24.74±5.2	3.57*	26.15±6.4	5.18**
11+	18.3	18.2	29.90±3.1	5.53**	26.56±3.7	9.06**
12+	22.7	22.3	31.98±1.4	4.90**	24.56±5.7	0.69 ^{NS}
13+	25.2	25	30.51±8.9	2.64*	29.86±0.8	2.48*
14+	28	27.6	38.69±1.2	7.46**	30.10±3.6	1.53 ^{NS}
Mean MUAC						
7+	9.6	8.9	15.29±1.4	3.25*	15.05±1.1	4.79**
8+	12.2	11.5	15.97±1.4	2.15*	15.97±1.4	2.85*
9+	14.3	13.9	15.64±1.15	1.07^{NS}	15.97±1.4	2.36*
10+	16.3	16.1	17.27±2.0	0.86^{NS}	16.87±2.4	0.93 ^{NS}
11+	18.3	18.2	19.14±1.2	1.28 ^{NS}	17.66±2.0	1.37 ^{NS}
12+	22.7	22.3	18.35±1.0	2.79*	19.90±2.5	2.68*
13+	25.2	25	19.15±2.7	4.53**	20.83±0.6	3.29*
14+	28	27.6	21.16±0.6	6.91**	20.38±1.0	4.46**

** - Significant at 1% level; *- Significant at 5% level; NS – Not significant

Table XXXII

Mean Anthropometry of E II Children

Age (years)	Standard WHO (2006)		E II (N=51)			
	Boys	Girls	Boys	't' value Mean vsStd.	Girls	't' value Mean vsStd.
Mean Height						
7+	75.7	74	121.62±4.0	13.57**	113.00±1.0	10.55**
8+	87.8	86.4	125.27±4.4	15.89**	118.83±0.8	11.47**
9+	96.1	95.1	125.60±5.0	12.06**	124.40±0.5	9.43**
10+	103.3	102.7	128.12±6.6	8.37**	128.53±0.5	8.60**
11+	110	109.4	136.33±1.5	10.63**	131.83±0.8	11.68**
12+	124.3	123.6	140.88±0.4	7.28**	144.66±1.5	7.59**
13+	130.1	129.2	137.77±3.0	3.68*	143.99±1.7	5.62**
14+	134.6	135	150.46±10.5	2.90*	150.52±8.0	6.10**
Mean Weight						
7+	9.6	8.9	24.62±0.9	9.25**	17.40±0.4	5.48**
8+	12.2	11.5	22.04±3.0	7.16**	18.27±0.3	3.76**
9+	14.3	13.9	24.61±4.1	6.34**	20.33±0.4	6.15**
10+	16.3	16.1	24.97±0.2	4.97**	25.23±0.2	7.90**
11+	18.3	18.2	28.45±2.7	5.08**	27.27±0.3	7.85**
12+	22.7	22.3	30.93±1.2	4.85**	30.40±0.4	6.72**
13+	25.2	25	29.03±2.2	2.37*	35.13±0.8	5.86**
14+	28	27.6	39.91±1.8	6.10**	37.19±2.3	4.69**
Mean MUAC						
7+	9.6	8.9	16.44±1.8	2.76*	16.23±0.3	7.95**
8+	12.2	11.5	16.88±1.9	1.98*	16.77±0.3	3.71*
9+	14.3	13.9	17.22±2.2	2.53*	17.50±0.5	3.57*
10+	16.3	16.1	18.42±0.8	1.95*	18.50±0.5	1.97*
11+	18.3	18.2	18.66±0.6	0.63 NS	19.40±0.4	1.48 NS
12+	22.7	22.3	19.93±0.4	2.09*	20.43±0.7	2.38*
13+	25.2	25	18.90±0.9	3.45*	21.82±0.8	3.16*
14+	28	27.6	21.82±0.8	4.79**	22.58±2.3	3.85*

** - Significant at 1% level; *- Significant at 5% level; NS – Not significant

Table XXXIII

Mean Anthropometry of P I Children

Age (years)	Standard WHO (2006)		P I (N=32)			
	Boys	Girls	Boys	't' value Mean vsStd.	Girls	't' value Mean vsStd.
Mean Height						
7+	75.7	74	121.05±0.1	12.67**	112.25±0.4	7.42**
8+	87.8	86.4	123.56±0.7	13.78**	122.96±16.3	11.59**
9+	96.1	95.1	124.50±0.7	16.84**	124.25±0.4	14.86**
10+	103.3	102.7	129.90±7.1	13.17**	132.50±0.7	17.20**
11+	110	109.4	134.50±0.7	10.79**	135.00±1.4	12.78**
12+	124.3	123.6	137.97±4.2	6.38**	141.50±0.7	8.16**
13+	130.1	129.2	139.49±2.1	4.83**	145.43±6.4	7.93**
14+	134.6	135	157.49±2.1	6.30**	148.95±5.7	4.19**
Mean Weight						
7+	9.6	8.9	20.05±0.1	10.64**	17.10±0.1	5.63**
8+	12.2	11.5	24.15±0.2	8.96**	22.67±4.0	3.82*
9+	14.3	13.9	25.25±0.4	7.45**	27.74±1.1	6.15**
10+	16.3	16.1	26.73±1.5	5.82**	27.74±1.1	6.48**
11+	18.3	18.2	30.80±0.7	9.58**	31.35±0.4	10.60**
12+	22.7	22.3	32.20±0.7	6.49**	33.76±2.4	5.29**
13+	25.2	25	35.29±4.7	2.67*	35.55±0.6	4.81**
14+	28	27.6	43.35±2.8	7.19**	36.55±2.7	4.42**
Mean MUAC						
7+	9.6	8.9	15.37±0.4	3.95*	14.34±1.1	3.57*
8+	12.2	11.5	15.93±0.7	2.89*	15.36±0.3	2.90*
9+	14.3	13.9	16.52±0.1	2.37*	16.28±0.7	3.06*
10+	16.3	16.1	17.88±0.4	2.14*	17.28±0.7	1.92*
11+	18.3	18.2	18.70±0.4	0.69 NS	17.57±0.2	1.69 NS
12+	22.7	22.3	19.31±0.2	3.28*	18.43±0.5	2.75*
13+	25.2	25	19.82±0.3	4.10**	20.89±0.5	1.58 NS
14+	28	27.6	20.56±0.8	5.27**	21.64±0.5	4.68**

** - Significant at 1% level; *- Significant at 5% level; NS – Not significant

Table XXXIV

Mean Anthropometry of P II Children

Age (years)	Standard WHO (2006)		P II (N=32)			
	Boys	Girls	Boys	't' value Mean vsStd.	Girls	't' value Mean vsStd.
Mean Height						
7+	75.7	74	122.24±2.5	13.10**	112.05±1.4	16.48**
8+	87.8	86.4	123.75±0.4	19.21**	124.05±1.7	14.83**
9+	96.1	95.1	125.25±0.4	14.72**	127.16±6.7	10.72**
10+	103.3	102.7	125.90±7.1	12.59**	133.00±1.4	9.65**
11+	110	109.4	135.50±0.7	12.60**	140.43±6.4	11.34**
12+	124.3	123.6	138.48±3.5	7.94**	143.00±1.4	6.39**
13+	130.1	129.2	146.51±17	5.28**	147.99±2.8	5.95**
14+	134.6	135	150.92±7.1	6.18**	148.95±5.7	5.74**
Mean Weight						
7+	9.6	8.9	22.18±2.5	10.53**	17.15±0.2	9.53**
8+	12.2	11.5	24.75±0.4	9.36**	23.32±5.1	6.18**
9+	14.3	13.9	24.35±2.3	8.47**	25.10±0.1	9.20**
10+	16.3	16.1	29.03±1.5	9.29**	30.45±1.4	7.33**
11+	18.3	18.2	31.35±0.5	9.63**	32.20±0.6	6.71**
12+	22.7	22.3	34.74±5.4	5.84**	34.16±2.4	5.48**
13+	25.2	25	40.05±0.5	7.35**	35.37±2.0	4.84**
14+	28	27.6	43.59±3.2	7.51**	36.55±2.7	3.96*
Mean MUAC						
7+	9.6	8.9	15.87±0.6	4.64**	14.04±0.7	4.59**
8+	12.2	11.5	16.38±0.1	5.73**	15.73±0.1	3.84*
9+	14.3	13.9	17.01±0.6	3.98**	16.48±1.0	3.25*
10+	16.3	16.1	17.69±0.9	1.45^{NS}	16.99±0.3	1.90*
11+	18.3	18.2	18.87±0.6	0.86^{NS}	17.53±0.1	2.16*
12+	22.7	22.3	19.61±0.4	3.68*	19.49±0.4	3.42*
13+	25.2	25	19.64±0.7	4.13**	20.89±0.5	4.37**
14+	28	27.6	20.75±0.4	4.79**	21.64±0.5	4.72**

** - Significant at 1% level; *- Significant at 5% level; NS – Not significant

iii) Mean MUAC of children

The mean MUAC of 7- 14 years boys of E I ranged from 15.29 cm to 21.16 cm, in E II the mean MUAC was 16.44 cm to 21.82 cm and in placebo (P I and P II) the mean MUAC were 15.37 cm to 20.75 cm and all the mean values were above the standard values of the respective age groups. Similarly the mean MUAC of 7-14 years girls of E I were 15.05 cm to 20.38 cm, E II were 16.23 cm to 22.58 cm and in placebo (P I and P II) the mean MUAC was 14.04 cm to 21.64 cm and all the values were above the standard values of the respective age groups and there was a marginal increase in the MUAC of the children. This study coincides with NNMB 2012 survey where the mean anthropometric measurements such as height, weight and MUAC had a marginal increase especially among school age children and adolescents in all the states. The values are significantly more ($p<0.01$ and $p<0.05$) than the respective age group.

In a separate study conducted by Regional Medical Research Centre (RMRC, 1998-1999), Bhubaneswar, 66 per cent of primitive tribal population (6 – 15 years age group) of Mayurbhanj and Sundergarh districts was found to be malnourished

2. Biochemical Picture

i) Mean Hemoglobin of Children

The mean haemoglobin of children were given in the Table XXXV

Table XXXV

Mean Haemoglobin (g/dl) of Children

(N=60)

Age Group (years)	N	Standard Values# (g/dl)	Mean Haemoglobin (g/dl)	't' Value Mean vsStd.
8+	8	11.5	10.22 ± 0.5	4.491**
9+	8	11.5	9.35 ± 1.42	2.088*
10+	8	11.5	10.56 ± 0.21	2.963*
11+	8	11.5	9.27 ± 1.14	2.694*
12+	9	12	10.41 ± 0.57	4.168**
13+	9	12	10.65 ± 0.18	3.529*
14+	10	12	10.77 ± 0.31	3.748*

* - Significant at 5% ($p<0.05$), ** - Significant at 1% ($p<0.01$), # WHO, 2001

The mean blood haemoglobin levels of the children were below the standard values in all the age groups. Among 8, 9, 10 and 11 years the mean haemoglobin was 10.22, 9.35, 10.56 and 9.27 g/dl which is less than the standard value (11.5 g/dl). Similarly the mean haemoglobin levels of 12, 13 and 14 years were 10.41, 10.65 and 10.77 g/dl which is less than the standard value (12 g/dl), suggestive of IDA. The mean haemoglobin values of all children were statistically significant at one per cent level except 8 and 12 years were statistically significant at five per cent level. Similar findings have been reported by ICMR (2003) who report, microcytic hypochromic blood picture suggestive of iron deficiency anaemia among 51.2 per cent of anemic primitive tribal population of Orissa.

The haemoglobin values were below the threshold level (WHO, 2001) in all the age groups, indicative of anaemia. Hence, according to WHO (2001), IDA is a problem of public health significance among the PTG children.

ii) Grouping of children according to Degree of Anemia

Table XXXVI and figure 22 represents the Grouping of children according to degree of anemia.

Table XXXVI

Grouping of Children according to Degree of Anemia

(N=60)

Age in years	N	Degree of anaemia*							
		Normal (Hb >11.5g/dl)		Mild anaemia (Hb: 11-11.4 g/dl)		Moderate anaemia (Hb: 8-10.9 g/dl)		Severe anaemia (Hb: <8 g/dl)	
		No.	%	No.	%	No.	%	No.	%
8+	8	0	0	0	0	8	13.3	0	0
9+	8	0	0	2	3.3	4	6.7	2	3.3
10+	8	0	0	3	5	5	8.3	0	0
11+	8	0	0	0	0	7	11.7	1	1.7
		Normal (Hb>12g/dl)		Mild anaemia (Hb: 11-11.9 g/dl)		Moderate anaemia (Hb: 8-10.9 g/dl)		Severe anaemia (Hb: <8 g/dl)	
12+	9	1	1.7	3	5	4	6.7	1	1.7
13+	9	2	3.3	2	3.3	5	8.3	0	0
14+	10	2	3.3	2	3.3	6	10	0	0
Total	**60**	**5**	**8.3**	**12**	**20**	**39**	**65**	**4**	**6.7**

*WHO standards (2001)

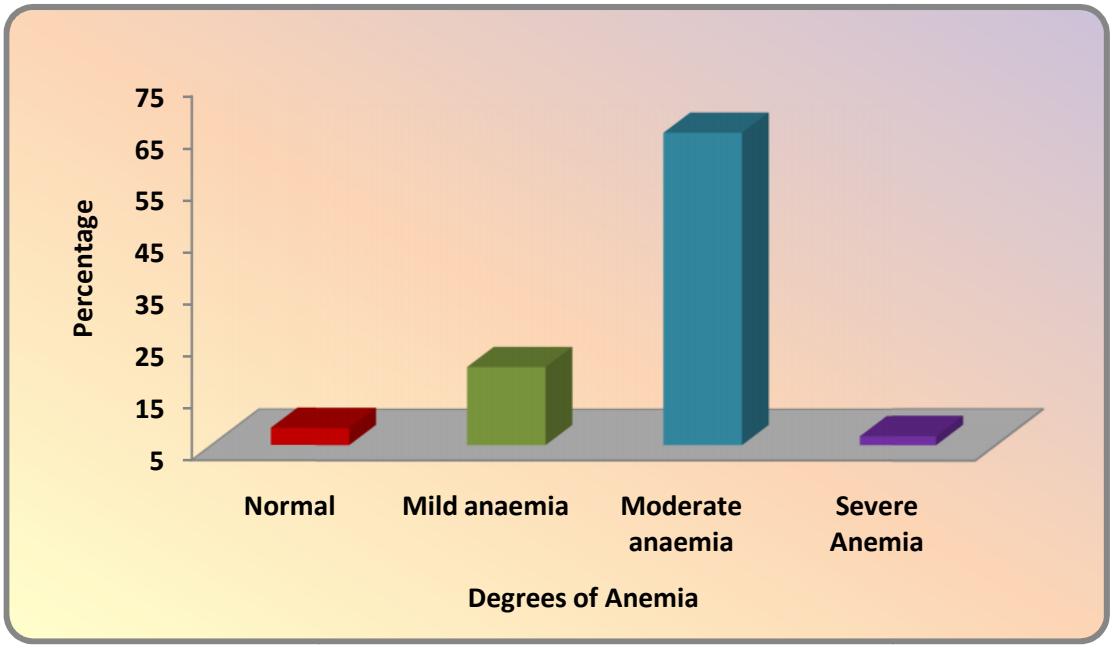


Figure 22. Grouping of Children according to Degree of Anemia

None of the children between 8 and 11years were non anaemic, while 1.7 per cent of 12 years and 13.3 per cent of 13 and 14 years were normal. About 3.3 per cent of 9, 13 and 14 years, 5 per cent of 10 and 12 years of children were mildly anaemic. About 13.3 per cent of 8 year, 6.7 per cent of 9 and 12 years, 8.3 per cent of 10 and 13 years, 11.7 per cent of 11 year and 10 per cent of 14 year old children were moderately anaemic. None of the 8, 10, 13 and 14 year old children were severely anaemic. On the whole 8.3 per cent of the children were normal, 20 per cent were mildly anaemic, 65 per cent were moderately anaemic and remaining 6.7 per cent were in the severely anaemic category. In this study the total prevalence of anaemia among PTG children was 91.7 per cent.

WHO (2001), categorises the prevalence of above 40 per cent as a severe public health problem. Thus anemia is a severe problem of public health significance (with a prevalence of 91.7%) among the PTG children surveyed in the study.

According to Rao *et al*., (2002), anemia among tribes in Andaman and Nicobar islands was as high as 94.3 per cent among Great Andamanese, 86.6 per cent in the Onges and 85.5per cent among Shompens, as per WHO definition of anemia.

ICMR (2003) reported different grades of anaemia (as per WHO classification) as an important clinical manifestation among a majority of Bondo, Didayi, Kondha and Juanga primitive tribes of Orissa. Severe anaemia (Hb<7 g/dl) ranged from 0.6 to 2.3 per cent, moderate (Hb 7–9 g/dl) from 7.4 to 13.6 per cent and mild (Hb 9–11 g/dl) 30.7 to 48.2per cent of population. Anaemia was more common in females than males. Another study reported 85per cent of Paudi Bhuyan primitive tribes of Sundergarh district to be suffering from different grades of anaemia (Bulliya *et al.*, 2000). A cross sectional study conducted in Madhya Pradesh revealed severe anaemia in 40 per cent of Abhujmaria, 29 per cent of Birhor and 42.2 per cent of Baiga primitive tribes (RMRC for Tribals,1995). The Micronutrient Deficiencies Survey (NNMB, 2003) carried out in eight states revealed that the overall prevalence of anaemia ranged from 70 to 80 per cent in various age, sex and physiological groups.

iii) Correlation between iron intake and haemoglobin

The correlation between iron intake and haemoglobin is given in table XXXVII

Table XXXVII

Correlation between Iron Intake and Haemoglobin (N=60)

Age group (in years)	N	Iron intake vs Haemoglobin	
		Correlation coefficient of 'r'	p value
8+	8	+0.5372	0.014**
9+	8	+0.4162	0.025*
10+	8	+0.5015	0.012**
11+	8	+0.6348	0.035*
12+	9	+0.3369	0.618^{NS}
13+	9	+0.4826	0.042*
14+	10	0.4165	0.025*

**- Significant at 1% level, * - Significant at 5% level, NS- Not significant

Iron intake and haemoglobin have a statistically significant linear relationship (p<0.001) and (p<0.005) except in 12 years which is not significant. The direction of the relationship is positive (i.e., Iron intake and haemoglobin are positively correlated), meaning that these variables tend to increase together.

iv) Mean Serum Retinol of Children

The mean serum retinol of children were given in the Table XXXVIII.

Table XXXVIII

Mean Serum Retinol (mg/l) of Children

(N=60)

Age Group (years)	n	Standard Values# (mg/L)	Mean serum retinol (mg/L)	't' Value Mean vsStd.
8+	8	0.20-0.50	0.22 ± 0.1	3.542**
9+	8	0.20-0.50	0.21 ± 0.03	7.034**
10+	8	0.20-0.50	0.26 ± 0.1	3.036**
11+	8	0.30-0.60	0.19 ± 0.1	4.815**
12+	9	0.30-0.60	0.25 ± 0.1	5.247**
13+	9	0.30-0.60	0.27 ± 0.1	4.39**
14+	10	0.30-0.60	0.27 ± 0.1	5.133**

* - Significant at 5% (p<0.05), ** - Significant at 1% (p<0.01); **#** Raghuramulu (2003)

The mean serum retinol of 8 -10 years children was between the standard values of 0.2 – 0.5 mg/l of the respective age groups. Among 11 to 14 years children the mean serum retinol was significantly below (p<0.01) the standard values of the respective age groups.

v) Correlation between β- Carotene Intake and Serum Retinol

Table XXXIX gives the correlation between beta- carotene intake and serum retinol

Table XXXIX

Correlation between β - Carotene Intake and Serum Retinol (N=60)

Age group (in years)	N	β - carotene vs Serum Retinol	
		Correlation coefficient of 'r'	p value
8+	8	+0.8451	0.001**
9+	8	+0.9214	0.003**
10+	8	+0.9483	0.001**
11+	8	+0.8905	0.002**
12+	9	+0.9039	0.001**
13+	9	+0.8516	0.002**
14+	10	+0.9472	0.001**

**- Significant at 1% level

Beta- carotene and serum retinol have a statistically significant linear relationship (p<0.001). The direction of the relationship is highly positive (i.e., Beta- carotene and serum retinol are positively correlated), meaning that these variables tend to increase together. This drives home the fact that vitamin A nutritional status can be improved by increasing the intake of food sources of the vitamin.

vi) Correlation between Haemoglobin and Serum Retinol level

Table XL represents the Correlation between Haemoglobin and Serum Retinol level of the children.

Table XL

Correlation between Haemoglobin and Serum Retinol level (n = 60)

Age Group (years)	Mean serum retinol (mg/L)	Mean Haemoglobin (g/dl)	Correlation coefficient	
			r value	p value
8+	0.22±0.10	10.22±0.5	+0.907	0.002**
9+	0.21±0.03	9.35 ±1.4	+0.937	0.001**
10+	0.26±0.10	10.56±0.7	+0.986	0.001**
11+	0.19±0.10	9.27±1.1	+0.782	0.02*
12+	0.25±0.10	10.41±1.4	+0.984	0.001**
13+	0.27±0.10	10.65±0.9	+0.826	0.003**
14+	0.27±0.10	10.77±0.8	+0.960	0.002**

** Correlation is significant at the 0.01 level (2-tailed)

Serum retinol and haemoglobin have a statistically significant linear relationship ($p<0.001$). The direction of the relationship is positive (i.e., serum retinol and haemoglobin are positively correlated), meaning that these variables tend to increase together.

According to Gondim *et al.,* (2012) who studied the relationship among hemoglobin level, serum retinol level and nutritional status in children aged 6 to 59 months from the state of *Paraíba,* Brazil reported that Multivariate analysis showed anemia was directly associated with low serum retinol level.

Similarly Hamdy *et al.,* (2013) in their study showed that Mothers with VAD had a significantly lower mean Hb (8.95±1.63 gm per cent) compared to mothers without VAD (10.11±0.83 gm per cent), with a significant positive correlation between maternal serum retinol concentrations and maternal haemoglobin.

3. Clinical Picture of the Children

The clinical picture of the children were given in Table XLI

Table XLI

Clinical Picture of the Children

(N=167)

Clinical Picture	E I(N=52)		E II(N=51)		PI (N=32)		P II(N=32)	
	No	%	No	%	No	%	No	%
Emaciation	4	7.7	3	5.9	1	3.1	2	6.3
Bitot's spot	8	15.4	7	13.7	1	3.1	2	6.3
Conjunctival Xerosis	5	9.6	5	9.8	2	6.3	2	6.3
Glossitis	10	19.2	15	29.4	5	15.6	5	15.6
Angular Stomatitis	35	67.3	32	62.7	10	31.3	10	31.3
Cheilosis	20	38.5	20	39.2	8	25	8	25
Gingivitis	18	34.6	16	31.3	5	15.6	5	15.6
Koilonychia	5	9.6	3	5.9	1	3.1	2	6.3
Dental Caries	2	3.8	3	5.9	1	3.1	0	0
Thyroid gland Palpable	1	1.9	-	-	-	-	-	-
Dermatitis	10	19.2	6	11.8	3	9.4	4	12.5

Emaciation, a major symptom of Protein Energy Malnutrition, was seen among 7.7, 5.9, 3.1 and 6.3 per cent of the children in E I, E II, P I and P II respectively. Bitot's spot, a predominant symptom of Vitamin A Deficiency was seen among 15.4 per cent, 13.7 per cent, 3.1 and 6.3 per cent of E I, E II and P I, P II children respectively. Conjunctival Xerosis was observed among 9.6 per cent and 9.8 per cent of E I and E II respectively and 6.3 per cent of children in P I and P II group. B complex deficiency symptoms such as glossitis were seen in 19.2 per cent of E I, 29.4 per cent of EII and 15.6 per cent of P I and P II group. Angular stomatitis was seen among 67.3 per cent of E I, 62.7 per cent of E II and 31.3 per cent of P I and P II group children. Cheilosis was observed in 38.5 per cent of E I, 39.2 per cent of E II and in 25 per cent each of P I and PII group respectively. Vitamin C deficiency symptoms like gingivitis was seen among 34.6per cent of E I, 31.3 per cent of E II and 15.6 per cent each of P I and PII. Symptoms of IDA , koilonychia, was seen in 9.6 per cent of E I, 5.9 per cent of E II and 3.1 per cent of P I and 6.3 per cent of P II respectively. Dental caries were seen among 3.8 per cent of E I, 5.9 per cent of E II and 3.1 per cent of P I and none in P II group. Iodine deficiency symptom, namely, palpable thyroid gland was seen in 1.9 per cent of E I, while it was not observed either in E II or in the placebo groups. Dermatitis was observed among 19.2 per cent of E I, 11.8 per cent of E II and 9.4 and12.5 per cent of P I and PII.

High prevalence of nutritional deficiency signs such as conjunctival xerosis (9.7per cent) and Bitot's spots (4.9per cent) have indicated that vitamin 'A' deficiency is a major public health problem among Baiga tribe. This may be due to less consumption of green leafy vegetables and milk in their daily diet (Chakma *et al.*, 2014)

Vitamin A deficiency (conjunctival xerosis) was prevalent at 18.7 per cent, while night blindness and Bitot's spot were not present among Raj Gond tribes of Madhya Pradesh. Vitamin B complex deficiency had higher prevalence (32.5per cent of angular stomatitis and 20.3per cent of cheilosis). 17.1 per cent of children suffered from dental carries but very few from spongy and bleeding gums (Sharma *et al.*, 2006).

4. Dietary pattern

i) Dietary Habits

All the families were non-vegetarians and all of them consumed three meals a day.

ii) Consumption of Beverages

Table XLII gives details of beverages consumed by the children in the tribal hamlets.

Table XLII

Consumption of Beverages

N=167

Beverage	E I (N=52)		EII (N=51)		PI (N=32)		P II (N=32)		Total (N=167)	
Black Tea	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
3 times	0	0	9	17.6	2	6.3	2	6.3	13	7.8
4 times	52	100	42	82.4	30	93.7	30	93.7	154	92.2

All the children consumed black tea 17.6 and 6.3 per cent of E II and placebo groups drank black tea thrice daily. All children in E I, 82.4 and 93.7 per cent of E II and placebo groups children respectively drank black tea four times a day. These children did not have the habit of consuming any other beverage, as their families could not afford them. On the whole, 7.8 and 92.2per cent of the children drank black tea three and four times each day respectively.

iii) Cooking Methods

Details of the methods adopted for cooking different foods is given in Table XLIII.

Table XLIII

Cooking Methods

N=167

Foods	Boiling		Roasting		Shallow fat frying	
	No.	**%**	**No.**	**%**	**No.**	**%**
Cereals	167	100	-	-	-	-
Pulses	167	100	-	-	-	-
Vegetables	167	100	-	-	-	-
Egg	-	-	17	10.2	150	89.8
Fish	167	100	-	-	167	100
Green Leafy vegetables	167	100	-	-	-	-
Meat	167	100	-	-	34	20.4

The predominant method adopted for cooking all food items by the women was boiling. All the families boiled cereals, pulses, vegetables, fish, greens and meat for consumption. None of the families used steaming and pressure cooking methods. Eggs were roasted by 10.2 per cent while 89.8 per cent shallow fried eggs. All the women shallow fried fish and 20.4 per cent cooked meat by shallow frying.

Phase III

Acceptability and Nutritive value of Spirulina supplement

A. Acceptability Trials

The mean values of scores for colour and appearance, texture, flavor, taste and overall acceptability are presented in the Table XLIV.

Table XLIV

Acceptability Trials

Formulation	Amount of Spirulina (g)	Colourand appearance	Texture	Flavour	Taste	Overall acceptability
A	1	4.6±0.5	4.6±0.5	4.5±0.6	4.7±0.5	4.6±1.0
B	1.5	4.0±1.4	4.2±0.7	4.0±1.0	4.2±0.7	4.1±0.5
C	2	3.6±0.9	3.6±0.9	3.6±1.1	3.5±0.8	3.6±0.6

Among the three different variations of 1, 1.5 and 2 g of Spirulina incorporated health mix, the one incorporated with 1 g of Spirulina obtained the maximum mean score of 4.6 in the acceptability trials. So, this formulation was selected for supplementation. The trials also revealed that on an average, the children could consume a maximum of 30g of the health mix at a time.

B. Nutritive Value of Spirulina Supplements

i) Nutrient content of Spirulina Candies

Nutrient content of spirulina candies as analyzed by Food Safety and Standards Division, National Agro Foundation- R&D center, Chennai is provided in Table III.

ii) Nutrient content of Spirulina Incorporated Food Supplement

The nutrient content of spirulina health mix is given in Table XLV.

Table XLV

Nutrient Content of Spirulina Incorporated Food Supplement

Nutrients	100 g	Per Serving (30g)
Energy (kcal)	350	105
Protein (per cent)	8.81	2.643
Vitamin A (IU)	1.39	0.417
Vitamin C(mg)	25	7.5
Iron(mg)	13.66	4.098
Calcium(mg)	280	84

One hundred grams of Spirulina health mix provided 350 kcal of energy, 8.81 per cent of protein, 1.39 IU of Vitamin A, 25 mcg of vitamin C, 13.66 mg of iron, and 280 mg of calcium. Per serving (30g) showed that it was 105 kcal of energy, 2.643 per cent of protein, 0.417 IU of Vitamin A, 7.5mcg of vitamin C, 4.098 mg of iron and 84 mg of calcium respectively.

C. Storage stability of Spirulina Incorporated Food Supplement

The results of microbial examination are given in Table XLVI.

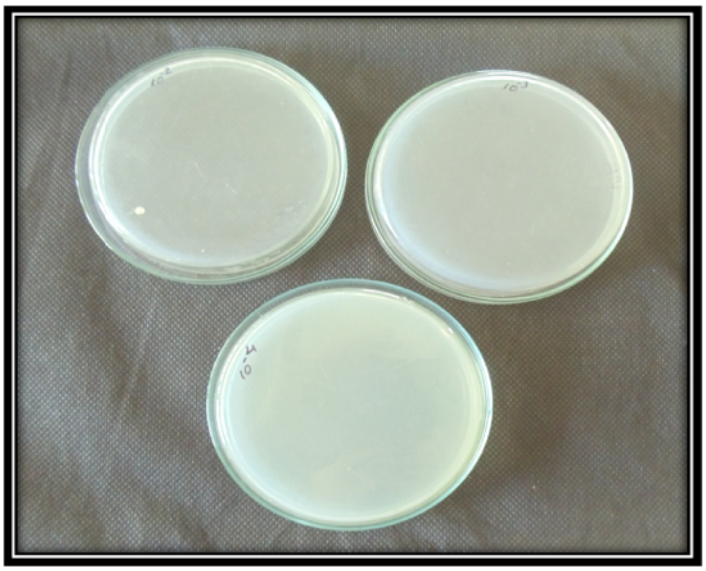
Table XLVI

Storage Stability of Spirulina Incorporated Food Supplement

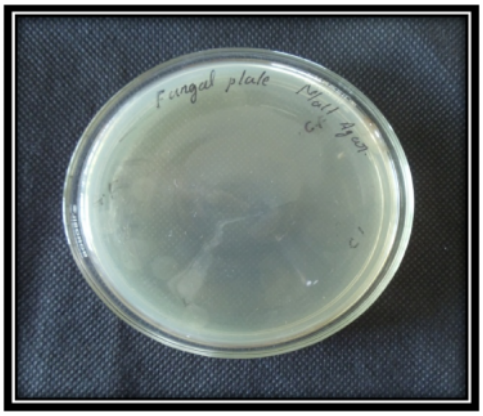
Presence of Micro organisms		
Total Bacterial Count		Fungi
Dilution	No. of colonies	
10^{-2}	01	Nil
10^{-3}	Nil	Nil
10^{-4}	Nil	Nil

The mean TBC count in the sample was 01 in 10^{-2} dilution. No bacterial colony was observed in the 10^{-3} and 10^{-4} dilution. The fungal (yeast and mold) count of sample was also nil (Plate 14).

Microbial counts in flour can vary from one storage period to another depending on moisture content and storage conditions. The maximum storage stability of dry food mixes is usually four months beyond which insect and microbial contamination occur.



One bacterial colony detected after six months of storage



No fungal colony detected even after six months of storage

Assessing Microbial Count in Lamina Air Flow Chamber

Plate 14 Microbial Count

The SIFS samples even over a period of six months did not show any insect infestation and the microbiological quality of the product was found satisfactory during the storage period. This could be attributed to the anti bacterial effect of spirulina.

El Baz *et al*., (2013) have proved that ethanol extract of Spirulina platensis exhibits antibacterial effect against different bacterial strains (Escherichia coli, Staphylococcus aureus, Salmonella typhi and Enterococcus faecalis) in addition to Candida albicans, inhibition zones were observed with Enterococcus faecalis and Candida albicans.

Phase IV

Impact of Interventions on Nutritional status and KAP

A. Impact of Supplementation

1. Nutritional Anthropometry

a, Mean Height of Boys Before and After Supplementation

Table XLVII and figure 23, 24 and 25 shows the mean height of boys before and after supplementation. Comparison was made with WHO standards, since they are more recent reference values.

In the E I group, the mean initial heights of boys were below the standard values. The mean final height of boys showed that they had grown significantly ($p<0.01$; $p<0.05$) taller. However still the final height was less than the height values reported by WHO (2007). Earlier and longer duration intervention could have a better impact. The range in height increase was 3.32 to 5.98 cm. In E II, The range in height increase was 3.46 to 5.33 cm the mean final height of boys increased significantly ($p<0.01$; $p<0.05$) but could not reach the standard values. However, in the seven year age group, the mean height reached at the end of SIFS supplementation was 125.93 cm which was more than the WHO standard of the respective age. This showed that the SIFS could greatly improve the stature of boys when supplemented at an early age. In P I the range in height increase is 0.80 to 2.50 cm which was statistically significant at five per cent level except in seven years which was significant at one per cent level and in P II the range in height increase is 1.25 to 3.29 cm which was statistically significant at five per cent level. The height graph which was skewed initially, assumed a near normal pattern by the end of the supplementation period. In the placebo group height increments were less than in the supplementation groups. According to Varalakshmi and Anangamathi (2013)

supplementation of Spirulina candies for a period of six months showed noticeable improvement in the height of the experimental children and no marked improvement in the control group.

Table XLVII

Mean Height (cm) of Boys Before and After Supplementation (N=82)

Age Group (years)	Standard Values			Mean Height			
				E I (N=23)			
	n	WHO (2006)	ICMR (1990)	Before	After	D	t value Before vs After
7+	3	124.3	121.7	117.61±2.62	122.29±2.04	4.68	14.00**
8+	2	130.1	127.0	123.28±1.83	128.21±2.60	4.93	3.40*
9+	3	134.6	132.2	124.99±1.73	130.97±1.46	5.98	6.00**
10+	3	140.0	137.5	129.80±2.28	134.21±2.58	4.41	4.46**
11+	3	144.8	140.0	137.57±1.35	140.89±1.93	4.00	2.18*
12+	3	151.1	147.0	142.65±1.89	146.72±1.83	3.32	2.58*
13+	3	157.0	153.0	137.98±1.88	142.14±1.70	4.16	3.58*
14+	3	163.0	160.0	151.67±0.58	155.46±1.01	3.79	15.10**
E II (N=27)							
7+	3	124.3	121.7	121.62±1.04	125.93±1.20	4.31	2.50*
8+	3	130.1	127.0	125.27±1.39	129.78±1.03	4.51	3.96**
9+	4	134.6	132.2	125.60±1.03	130.41±1.09	4.81	4.02**
10+	3	140.0	137.5	128.12±1.60	132.74±1.88	4.62	2.73**
11+	3	144.8	140.0	136.33±1.53	141.66±2.08	5.33	5.27**
12+	3	151.1	147.0	140.88±0.44	144.34±1.43	3.46	22.00**
13+	5	157.0	153.0	137.77±0.95	141.79±1.05	4.02	7.30**
14+	3	163.0	160.0	150.46±1.50	155.75±1.45	5.29	4.78**
P I (N=16)							
7+	2	124.3	121.7	121.05±0.07	122.15±0.21	1.10	5.50**
8+	2	130.1	127.0	123.56±0.41	124.75±0.35	1.19	2.18*
9+	2	134.6	132.2	124.50±0.26	125.30±0.42	0.80	2.00*
10+	2	140.0	137.5	129.90±1.07	131.42±1.36	1.52	2.57*
11+	2	144.8	140.0	134.50±0.71	136.50±0.71	2.00	2.49*
12+	2	151.1	147.0	137.97±1.24	140.23±1.08	2.26	3.75*
13+	2	157.0	153.0	139.49±1.12	141.99±0.83	2.50	3.04*
14+	2	163.0	160.0	157.49±1.12	159.69±0.40	2.20	2.73*
P II (N=16)							
7+	2	124.3	121.7	122.24±0.47	123.49±0.12	1.25	2.56*
8+	2	130.1	127.0	123.75±0.35	125.20±0.29	1.45	3.22*
9+	2	134.6	132.2	125.25±0.35	127.49±0.12	2.24	3.28*
10+	2	140.0	137.5	125.90±1.07	129.19±0.59	3.29	3.09*
11+	2	144.8	140.0	135.50±0.71	138.22±0.89	2.72	2.22*
12+	2	151.1	147.0	138.48±0.54	140.63±0.18	2.15	3.60*
13+	2	157.0	153.0	146.51±0.97	149.08±0.76	2.57	3.36*
14+	2	163.0	160.0	150.92±1.07	153.16±0.57	2.24	3.42*

** ($p<0.01$) 1% significance, * ($p<0.05$) 5% significance

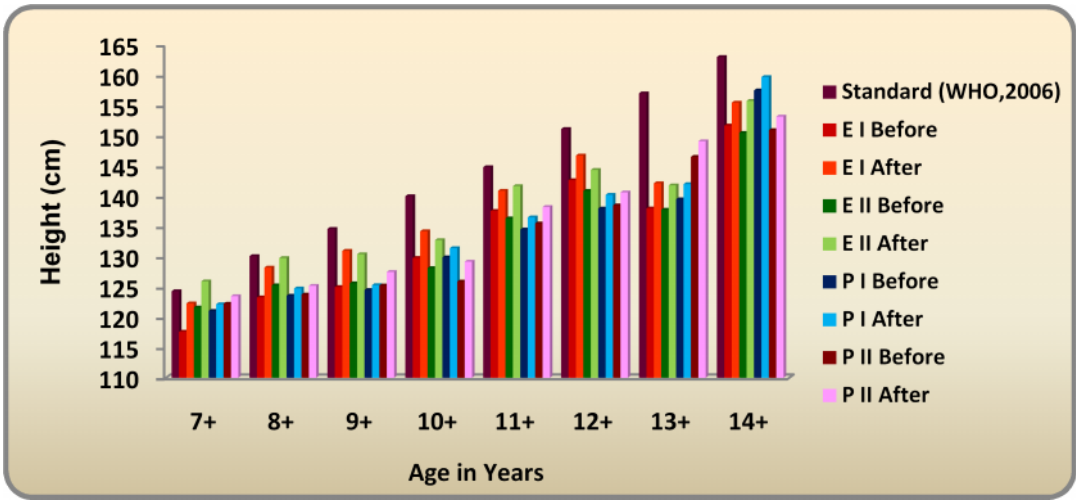


Figure 23. Mean Height of Boys Before and After Supplementation

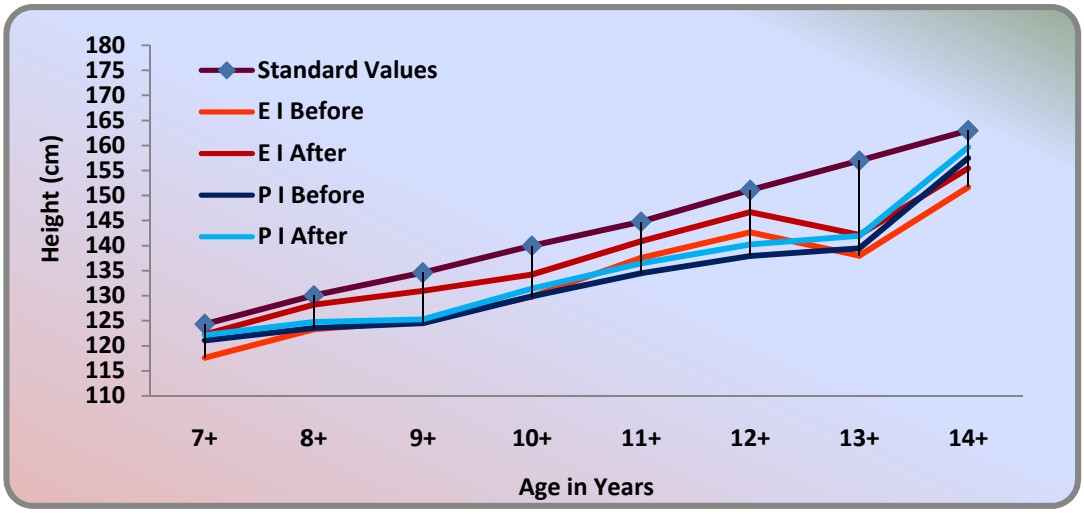


Figure 24. Mean Height of Boys in E I and P I Before and After Supplementation

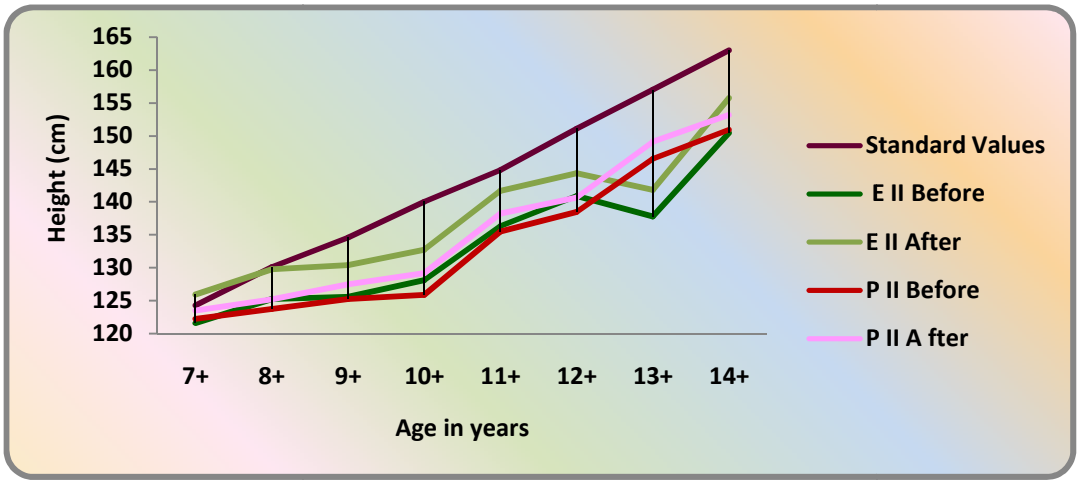


Figure 25. Mean Height of Boys in E II and P II Before and After Supplementation

b. Mean Height of Girls Before and After Supplementation

Table XLVIII and figure 26, 27 and 28 shows the mean height of girls before and after supplementation.

Table XLVIII

Mean Height (cm) of Girls Before and After Supplementation (N=85)

Age Group (years)	Standard Values			Mean Height			
				E I (N=29)			
	n	WHO (2006)	ICMR (1990)	Before	After	D	t value Before vs After
7+	5	123.6	120.6	117.28±0.90	121.40±0.99	4.12	4.25**
8+	2	129.2	126.4	123.98±0.83	128.21±0.60	4.23	3.40*
9+	2	135.0	132.2	124.49±0.12	129.97±0.24	5.48	4.67*
10+	5	140.0	138.3	129.10±1.05	133.54±1.55	4.44	5.05**
11+	3	145.3	142.0	132.78±1.23	137.06±1.15	4.28	3.92**
12+	3	150.2	148.0	144.78±1.26	148.62±1.27	3.84	3.17*
13+	3	153.8	150.0	145.93±0.57	149.25±1.11	3.32	2.76*
14+	6	157.0	155.0	147.61±1.41	151.44±1.55	3.83	3.00*
E II (N=24)							
7+	3	123.6	120.6	113.0 ± 1.05	118.80±0.82	5.80	3.97**
8+	3	129.2	126.4	118.83±0.76	121.53±0.36	2.70	3.69*
9+	3	135.0	132.2	124.40±0.53	128.96±1.02	4.56	2.41*
10+	3	140.0	138.3	128.53±0.50	133.60±0.40	5.07	6.10**
11+	3	145.3	142.0	131.83±0.76	135.50±0.50	3.67	3.53*
12+	3	150.2	148.0	144.66±0.53	147.62±9.42	2.96	3.66*
13+	3	153.8	150.0	143.99±1.73	147.05±1.54	3.06	3.57*
14+	3	157.0	155.0	150.52±1.02	153.49±1.15	2.97	2.16*
P I(N=16)							
7+	2	123.6	120.6	112.25±0.15	113.15±0.35	0.90	2.47*
8+	2	129.2	126.4	122.96±1.26	125.92±1.19	2.96	2.37*
9+	2	135.0	132.2	124.25±0.35	126.95±0.07	2.70	3.52*
10+	2	140.0	138.3	132.50±0.71	134.95±0.07	2.45	3.28*
11+	2	145.3	142.0	134.35±0.41	135.74±0.77	1.74	3.03*
12+	2	150.2	148.0	141.50±0.71	143.90±0.85	2.15	4.00^{NS}
13+	2	153.8	150.0	145.43±0.36	146.23±0.22	0.80	2.80*
14+	2	157.0	155.0	148.95±0.66	149.91±1.16	0.96	1.70^{NS}
P II(N=16)							
7+	2	123.6	120.6	112.05±0.07	113.45±0.24	1.40	3.52*
8+	2	129.2	126.4	124.05±0.07	125.20±0.07	1.15	7.60**
9+	2	135.0	132.2	127.16±0.72	128.22±0.51	1.06	2.63*
10+	2	140.0	138.3	133.45±1.41	134.50±1.20	1.50	0.93^{NS}
11+	2	145.3	142.0	140.43±0.36	141.53±0.51	1.10	2.78*
12+	2	150.2	148.0	143.39±1.41	143.90±1.27	0.90	1.24^{NS}
13+	2	153.8	150.0	147.99±0.83	149.43±0.46	1.44	3.28*
14+	2	157.0	155.0	148.95±0.66	150.91±0.16	1.96	5.50**

** ($p<0.01$) 1% significance, * ($p<0.05$) 5% significance

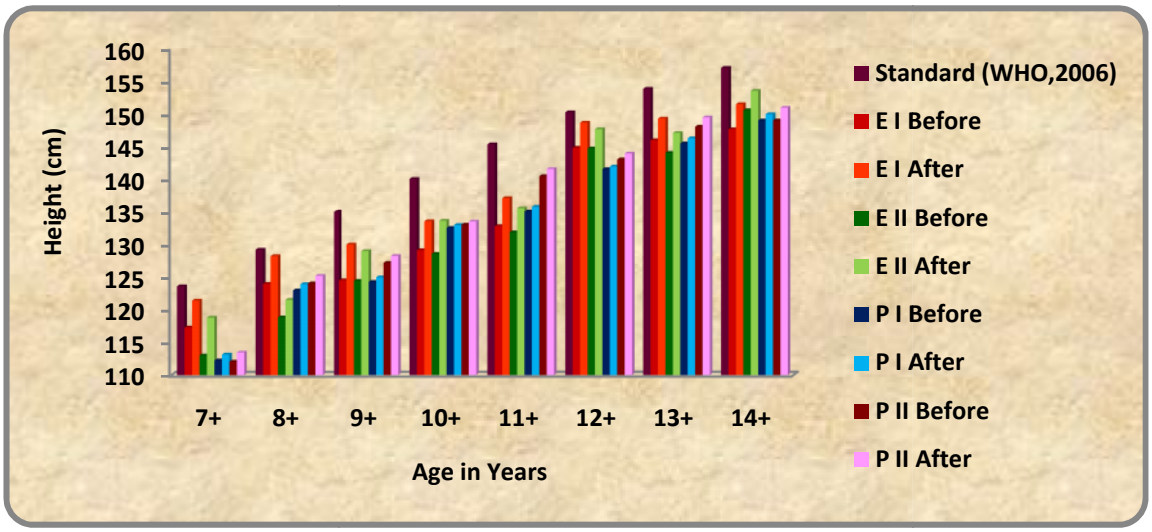


Figure 26. Mean Height of Girls Before and After Supplementation

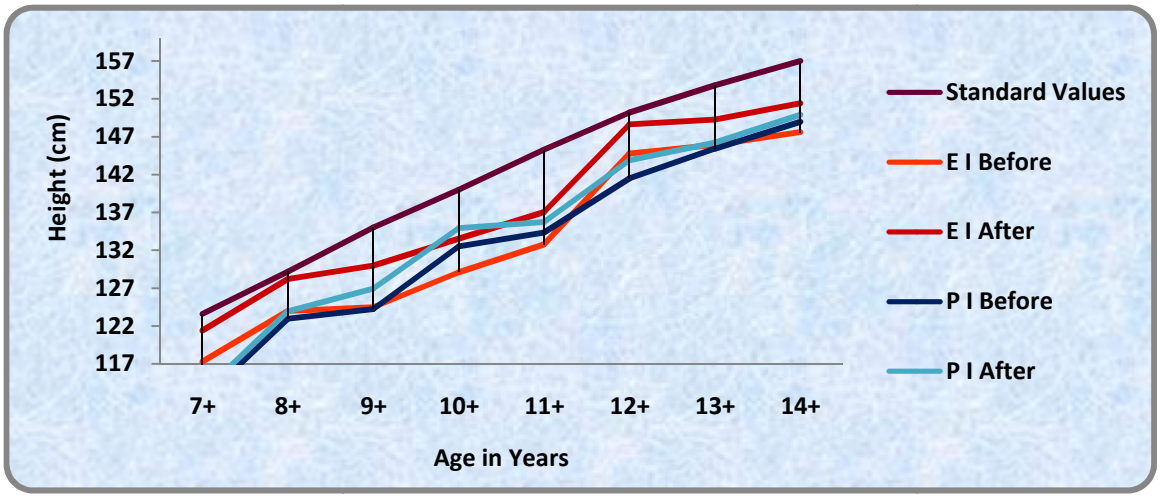


Figure 27. Mean Height of Girls in E I and P I Before and After Supplementation

Figure 28. Mean Height of Girls in E II and P II Before and After Supplementation

The final mean height of girls in all age groups, were significantly (at 1 per cent and 5 per cent level) higher compared to the mean initial values but were not on par with the standard values of the respective age groups in E I and the range in height increase is 3.32 to 5.48 cm. In EII also, the final height increased significantly (at 1 and 5 per cent level) when compared with the mean initial values with the range in height increase of 2.70 to 5.80 cm but could not meet the standard values of the respective age groups. This again stresses the need for early intervention among girl children also. The increase in height in the placebo group was only marginal with the range of 0.80 to 2.96 cm in P I in which was significant at five per cent level except in 12 and 14 years which was non significant and the range of height increase is 0.90 to 1.96 cm in P II which was significant at one and five per cent level except in 10 and 12 years which was non significant, which reiterates the status of height increase in the absence of supplementation.

According to Kazuya *et al*., (2014), there was a 5 per cent significant difference in HAZ during the study period between the children in the spirulina treatment and control group. Treatment group children grow 0.29 points more than the control group on average. This implies that spirulina consumption can be an effective food intervention particularly in Zambia, where severe stunting is widespread.

c) Mean Weight of Boys Before and After Supplementation

Table XLIX and figure 29, 30 and 31 shows the mean weight of boys before and after supplementation.

In the E I, range in weight increase of boys is 0.61 to 2.84 kg which was statistically significant ($p<0.01$; $p<0.05$) near normal pattern on spirulina supplementation. Similarly the mean final weight of boys in the E II also increased to a significant extent at 1and 5 per cent level with range in weight increase of 1.54 to 4.54 kg after supplementation and in 7 and 8 years age group the mean weight was 29.16 and 25.63 kg respectively which was more than the WHO standard values of the respective ages, again bringing out the benefits of spirulina intervention. There was no remarkable difference between the initial and final weights in the placebo group with the range of 0.10 to 0.98 kg in P I which was statistically non significant except in seven years which was significant at five per cent level the range of weight increase is 0.70 to 2.19 kg in P II which was statistically significant at five per cent level except in 11years which was not significant. According to Varalakshmi and Anangamathi (2013) supplementation of

Spirulina candies for a period of six months there was a noticeable improvement in the weight of the experimental children and no marked improvement in the control group.

Table XLIX

Mean Weight (kg) of Boys Before and After Supplementation (N=82)

Age Group (years)	Standard Values			Mean Weight			
				E I (N=23)			
	n	WHO (2006)	ICMR (1990)	Before	After	D	t value Before vs After
7+	3	22.7	22.9	19.01±0.06	19.62±0.16	0.61	2.43*
8+	2	25.2	25.3	21.52±0.63	24.10±0.14	2.58	2.43*
9+	3	28.0	28.1	19.94±0.15	22.53±0.23	2.59	4.81**
10+	3	30.8	31.4	24.74±0.24	26.95±0.58	2.21	6.29**
11+	3	34.1	32.2	29.90±0.12	30.58±0.89	0.68	2.74*
12+	3	38.0	37.0	31.98±0.39	34.15±0.10	2.17	3.86**
13+	3	43.3	40.9	30.51±0.89	32.73±0.61	2.22	2.10*
14+	3	48.0	47.0	38.69±0.21	41.53±0.40	2.84	3.04*
			E II (N=27)				
7+	3	22.7	22.9	24.62±0.92	29.16±0.73	4.54	3.98**
8+	3	25.2	25.3	22.04±1.04	25.63±1.06	3.59	1.92*
9+	4	28.0	28.1	24.61±0.11	27.42±0.21	2.81	5.49**
10+	3	30.8	31.4	24.97±0.15	27.86±0.91	2.89	4.77**
11+	3	34.1	32.2	28.45±0.71	30.85±0.66	2.40	2.53**
12+	3	38.0	37.0	30.93±0.18	34.67±0.90	3.74	4.00**
13+	5	43.3	40.9	29.03±0.22	31.64±0.07	2.61	7.54**
14+	3	48.0	47.0	39.91±0.75	41.45±0.27	1.54	4.13**
			P I (N=16)				
7+	2	22.7	22.9	20.05±0.07	21.03±0.20	0.98	2.27*
8+	2	25.2	25.3	24.15±0.21	24.30±0.42	0.15	1.06^{NS}
9+	2	28.0	28.1	25.25±0.35	25.35±0.21	0.10	1.20^{NS}
10+	2	30.8	31.4	26.73±0.48	25.92±0.77	0.81	1.37^{NS}
11+	2	34.1	32.2	30.80±0.14	31.25±0.07	0.45	0.79^{NS}
12+	2	38.0	37.0	32.20±0.71	33.18±1.41	0.98	0.6^{NS}
13+	2	43.3	40.9	35.28±0.74	35.29±0.10	0.01	0.41^{NS}
14+	2	48.0	47.0	43.35±0.83	43.72±0.19	0.37	0.76^{NS}
			P II (N=16)				
7+	2	22.7	22.9	22.18±0.47	23.19±0.83	1.01	1.96^{*}
8+	2	25.2	25.3	24.75±0.35	26.30±0.71	1.55	2.62^{*}
9+	2	28.0	28.1	24.35±0.26	25.82±0.23	1.47	3.23*
10+	2	30.8	31.4	29.03±0.48	30.62±0.37	1.59	2.89*
11+	2	34.1	32.2	31.35±0.19	32.05±0.21	0.70	3.57^{NS}
12+	2	38.0	37.0	34.74±0.44	35.90±0.37	1.16	2.30*
13+	2	43.3	40.9	40.05±0.49	42.24±0.48	2.19	2.17*
14+	2	48.0	47.0	43.59±0.18	44.65±0.11	1.06	3.21*

** ($p<0.01$) 1% significance, * ($p<0.05$) 5% significance

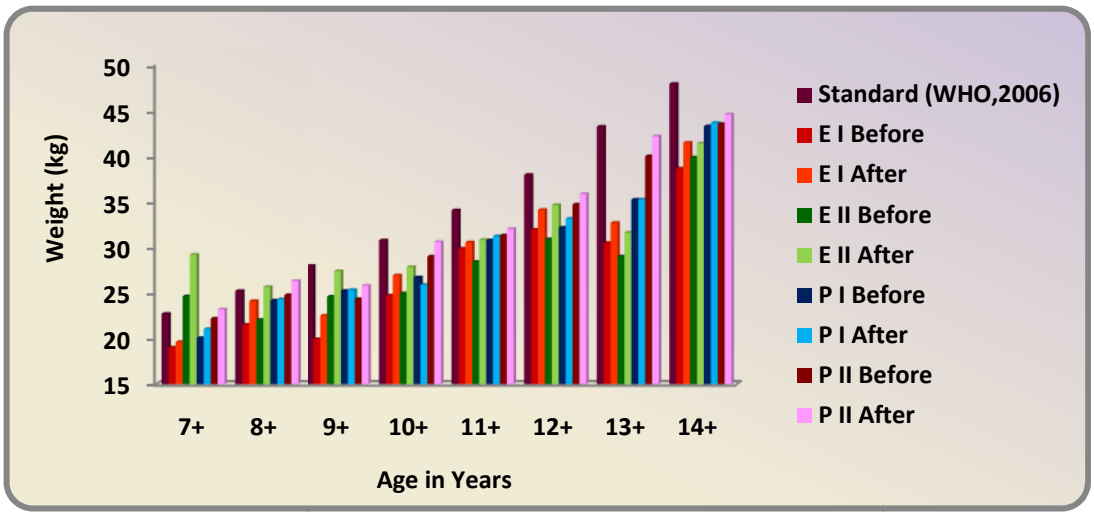


Figure 29. Mean Weight of Boys Before and After Supplementation

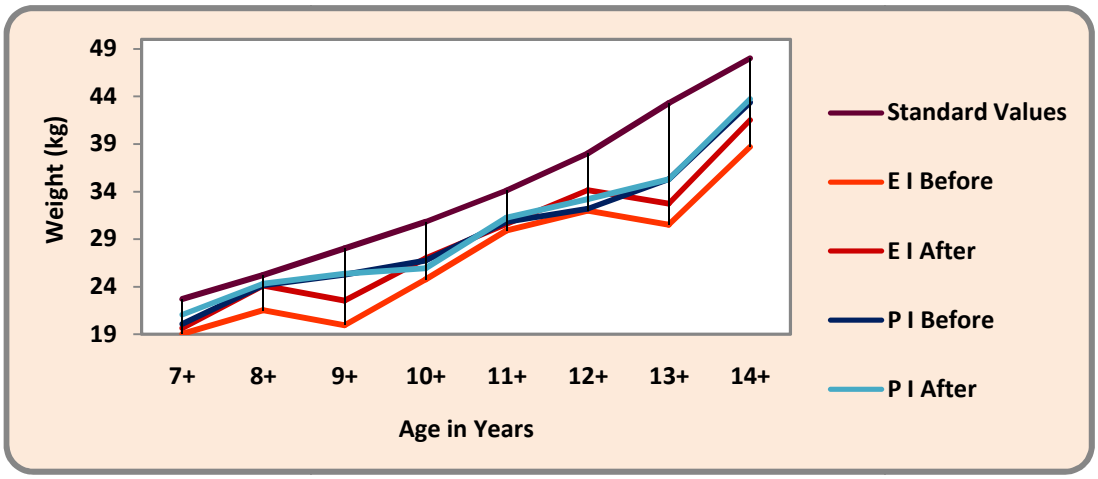


Figure 30. Mean Weight of Boys in E I and P I Before and After Supplementation

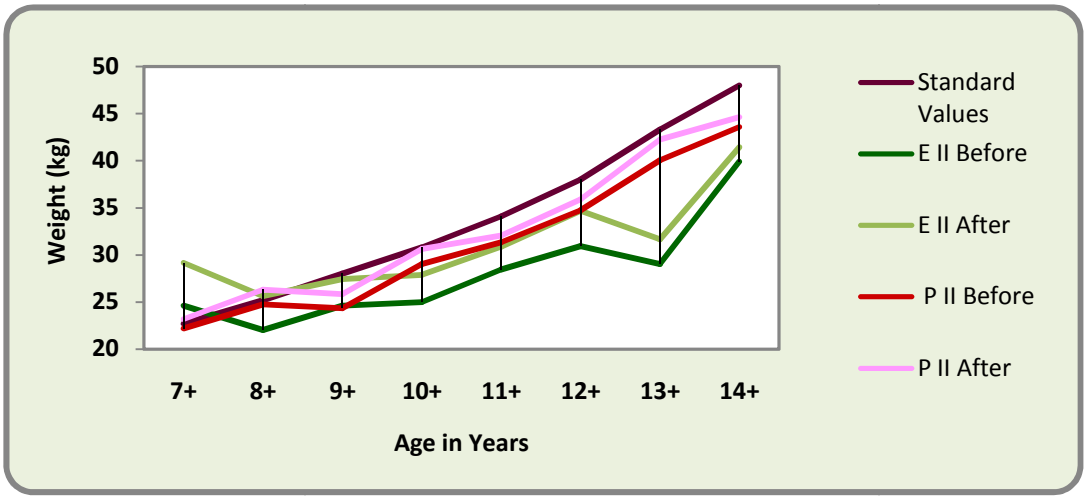


Figure 31. Mean Weight of Boys in E II and P II Before and After Supplementation

d) Mean Weight of Girls Before and After Supplementation

Table L and figure 32, 33 and 34 shows the mean weight of girls before and after supplementation.

Table L

Mean Weight (kg) of Girls Before and After Supplementation (N=85)

Age Group (years)	Standard Values			Mean Weight			
				E I (N=29)			
	n	WHO (2006)	ICMR(1990)	Before	After	D	t value Before vs After
7+	5	22.3	21.8	18.89±0.55	20.68±0.19	1.79	2.32*
8+	2	25	24.8	20.55±0.21	23.60±0.57	3.05	3.55*
9+	2	27.6	28.5	20.79±0.71	23.60±0.28	2.81	3.33*
10+	5	31.2	32.5	26.15±0.39	27.15±0.72	1.00	1.93*
11+	3	34.8	33.7	26.56±0.72	28.83±0.67	2.27	2.75*
12+	3	39	38.7	24.56±0.70	26.00±5.06	1.44	3.29*
13+	3	43.4	44.0	29.86±0.78	35.14±0.76	5.28	4.76**
14+	6	47.1	48.0	30.10±0.64	34.99±0.53	4.89	4.29**
			E II (N=24)				
7+	3	22.3	21.8	17.40±0.36	20.36±0.55	2.96	3.33*
8+	3	25	24.8	18.27±0.25	22.43±0.40	4.16	4.25**
9+	3	27.6	28.5	20.33±0.35	23.50±0.50	3.17	4.24**
10+	3	31.2	32.5	25.23±0.21	27.46±0.42	2.23	2.58*
11+	3	34.8	33.7	27.27±0.25	28.46±0.45	1.19	2.50*
12+	3	39	38.7	30.40±0.36	33.27±0.25	2.87	3.29*
13+	3	43.4	44.0	35.13±0.75	39.47±0.40	4.34	4.50**
14+	3	47.1	48.0	37.19±0.25	40.23±0.68	3.04	3.40**
			P I (N=16)				
7+	2	22.3	21.8	17.10±0.14	18.15±0.21	1.05	3.10*
8+	2	25	24.8	22.67±0.03	23.32±0.09	0.65	2.17*
9+	2	27.6	28.5	27.74±1.06	27.98±1.41	0.24	1.00^{NS}
10+	2	31.2	32.5	27.74±0.06	28.43±0.13	0.69	2.30*
11+	2	34.8	33.7	31.35±0.35	33.10±0.14	1.75	3.35*
12+	2	39	38.7	33.76±0.40	35.89±0.90	2.13	2.61*
13+	2	43.4	44.0	35.55±0.64	36.24±0.06	0.69	2.30*
14+	2	47.1	48.0	36.55±0.69	37.79±0.04	1.24	1.96*
			P II (N=16)				
7+	2	22.3	21.8	17.15±0.21	18.25±0.35	1.10	2.70*
8+	2	25	24.8	23.32±0.09	25.10±0.14	1.78	2.60*
9+	2	27.6	28.5	25.10±0.14	26.90±0.14	1.80	2.19*
10+	2	31.2	32.5	30.45±0.41	31.45±0.49	1.00	3.25*
11+	2	34.8	33.7	32.20±0.27	33.84±0.20	1.64	2.13*
12+	2	39	38.7	34.16±0.40	35.83±0.17	1.67	3.44*
13+	2	43.4	44.0	35.37±0.98	39.14±0.20	3.77	2.67*
14+	2	47.1	48.0	36.55±0.69	38.31±0.33	1.76	2.70*

** ($p<0.01$) 1% significance, * ($p<0.05$) 5% significance

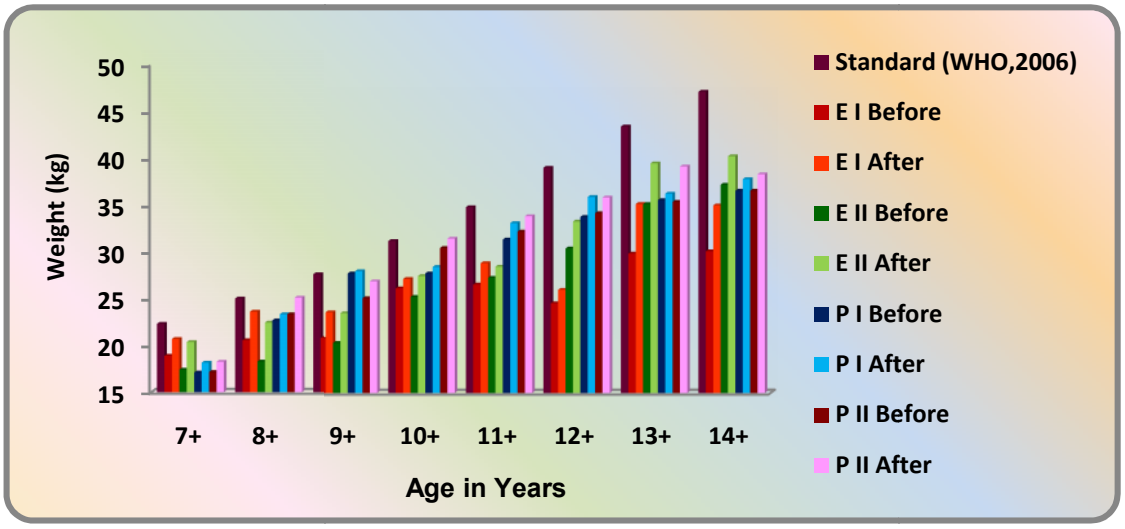


Figure 32. Mean Weight of Girls Before and After Supplementation

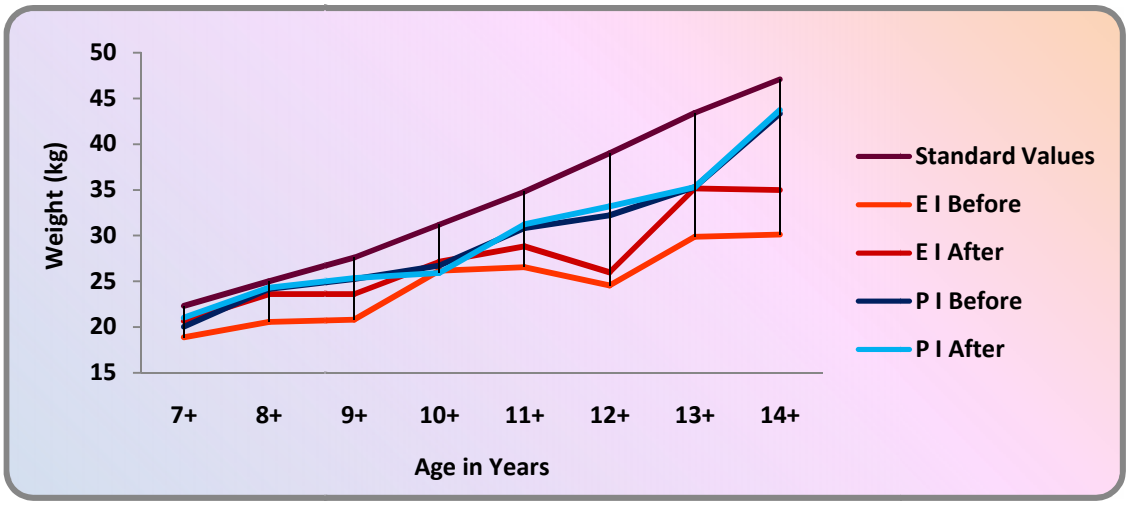


Figure 33. Mean Weight of Girls in E I and P I Before and After Supplementation

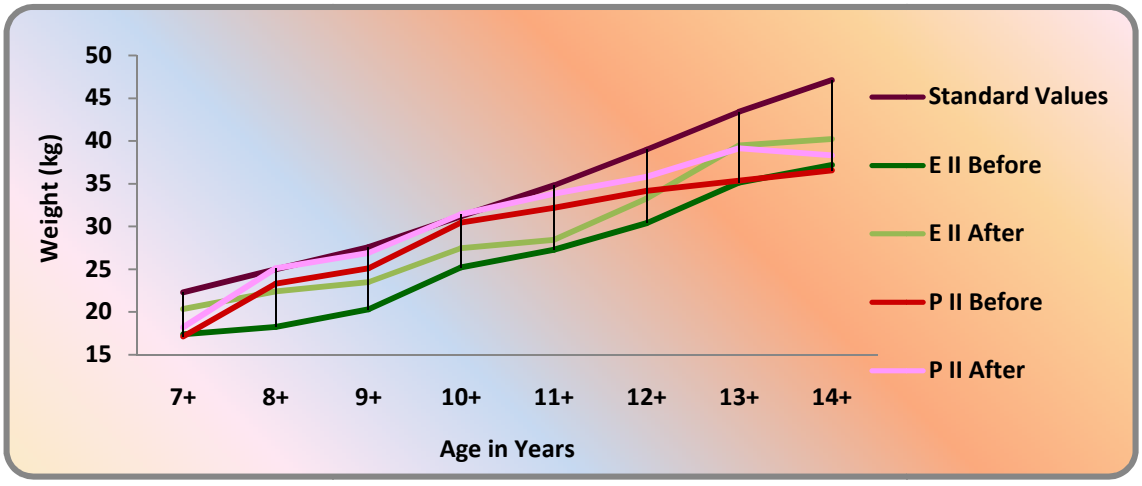


Figure 34. Mean Weight of Girls of E II and P II Before and After Supplementation

In girls also, the same trend was observed as among boys. In EI the range of weight increase is 1.00 to 5.28 kg which was statistically significant at 1 per cent and 5 per cent level when compared with the initial values. In E II the range in weight increase is 1.19 to 4.34 kg which was statistically significant at 1and 5 per cent level when compared with the initial values. The range of weight increase in P I is 0.24 to 2.13 kg and statistically not significant in 9 years and in other age groups it was significant at five per cent level. In P II the range of weight increase is 1.10 to 3.44 kg which was statistically significant at 5 per cent level. Though spirulina as a supplement did not provide substantial quantities of macronutrients, yet it was observed in the study, that the food intake of the children increased. The teachers in the schools/mothers/care givers also reported the same finding. Hence it was concluded that spirulina could stimulate their appetite which increased their food intake and consequently their anthropometry. Both initial and final weights of girls in the placebo group were less than the initial weights of the E group at all age points. Similar findings were observed by Taskeen and Subapriya (2010) who reported that supplementation of two gram of spirulina tablets for four months could improve appetite, food intake, BMI and physical performance significantly among female athletes in Tamil Nadu.

e) Mean MUAC of Boys Before and After Supplementation

Table LI and figure 35, 36 and 37 shows the mean MUAC of boys before and after supplementation.

The mean MUAC measurements of the tribal children per se were much higher than the standards at all age points. These values were erratically high and low for different age groups and did not follow a steady increase pattern with increasing age. The final MUAC values of the placebo group acquired a flat kind of increase.

As among boys, the final mean MUAC values in the E I were significant at 1 and 5 per cent level expect in the 14 years age group which is non significant with the range of MUAC increase of 0.43 to 1.90 cm and in E II the range of MUAC increase is 0.27 to 1.18 cm which was statistically significant at 5 per cent level except in the 13 year age group which was not significant. The mean final values were higher than the initial mean MUAC and increased progressively according to age, which reiterates the efficacy of spirulina supplementation.

Table LI

Mean MUAC (cm) of Boys Before and After Supplementation (N=82)

Age Group (years)	n	Mean MUAC			
		E I (N=23)			
		Before	After	D	t value Before vs After
7+	3	15.29±0.44	16.49±0.02	1.20	2.70*
8+	2	15.97±0.41	17.08±0.27	1.11	3.11*
9+	3	15.64±0.15	16.47±0.21	0.83	2.54*
10+	3	17.27±0.02	17.91±0.20	0.64	4.40**
11+	3	19.14±9.15	19.72±0.02	0.58	4.25**
12+	3	18.35±0.18	19.48±0.04	1.13	3.57*
13+	3	19.15±0.15	20.05±0.24	0.90	2.30*
14+	3	21.16±0.58	21.59±0.69	0.43	0.50^{NS}
E II (N=27)					
7+	3	16.44±0.34	17.62±0.53	1.18	2.15*
8+	3	16.88±0.30	17.73±1.39	0.85	2.12*
9+	4	17.22±0.21	18.28±0.46	1.06	3.12*
10+	3	18.42±0.35	19.06±0.21	0.64	2.50*
11+	3	18.66±0.18	19.29±0.29	0.63	2.62*
12+	3	19.93±0.38	20.60±0.03	0.67	1.97*
13+	5	18.90±0.89	19.17±0.75	0.27	0.66^{NS}
14+	3	21.82±0.16	22.96±0.15	0.64	3.41*
PI (N=16)					
7+	2	15.37±0.42	15.60±0.76	0.23	1.00^{NS}
8+	2	15.93±0.71	16.65±0.07	0.72	1.50^{NS}
9+	2	16.52±0.11	16.80±0.14	0.28	14.00*
10+	2	17.88±0.41	18.49±0.94	0.61	1.60^{NS}
11+	2	18.70±0.37	19.50±0.14	0.80	4.80^{NS}
12+	2	19.31±0.19	19.80±0.31	0.49	1.40^{NS}
13+	2	19.82±0.25	20.19±0.27	0.37	2.50*
14+	2	20.56±0.79	20.98±1.01	0.42	1.60^{NS}
PII (N=16)					
7+	2	15.87±0.62	15.99±0.85	0.12	0.12^{NS}
8+	2	16.38±0.09	16.65±0.07	0.27	2.70*
9+	2	17.01±0.10	17.72±0.17	0.71	2.12*
10+	2	17.69±0.87	18.10±0.43	0.41	1.20^{NS}
11+	2	18.87±0.14	19.79±0.06	0.92	2.10*
12+	2	19.61±0.05	20.38±0.04	0.77	3.40*
13+	2	19.64±0.67	19.85±0.04	0.21	1.00^{NS}
14+	2	20.75±0.36	21.08±0.28	0.33	0.90^{NS}

** ($p<0.01$) 1% significance, * ($p<0.05$) 5% significance

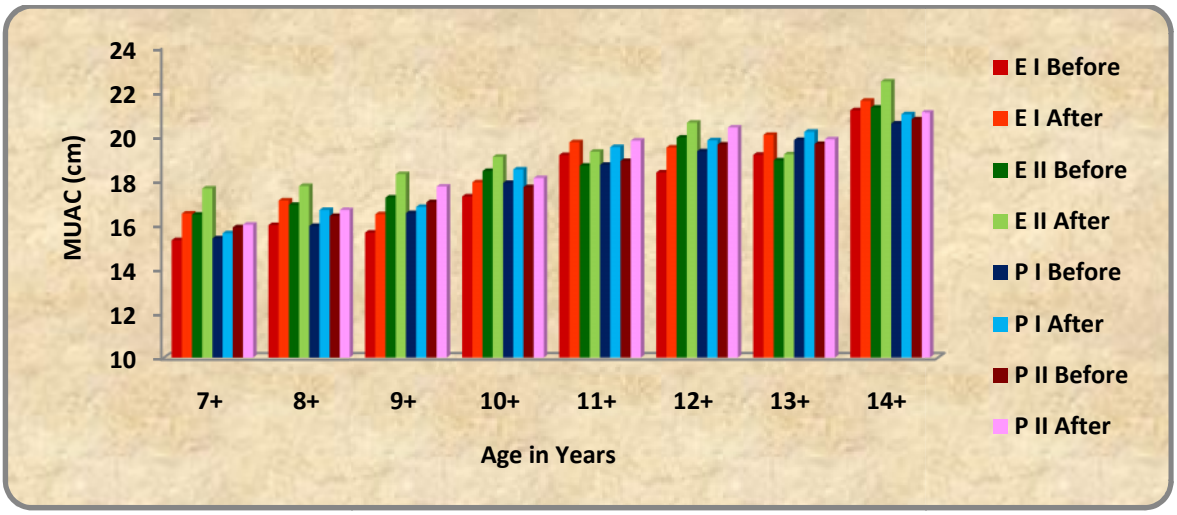


Figure 35. Mean MUAC of Boys Before and After Supplementation

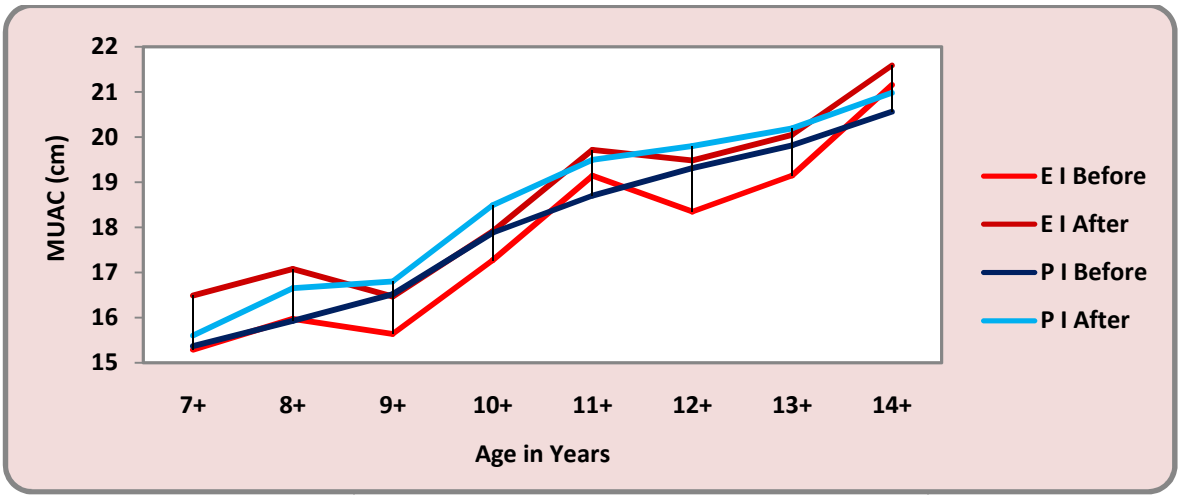


Figure 36. Mean MUAC of Boys in EI and P I Before and After Supplementation

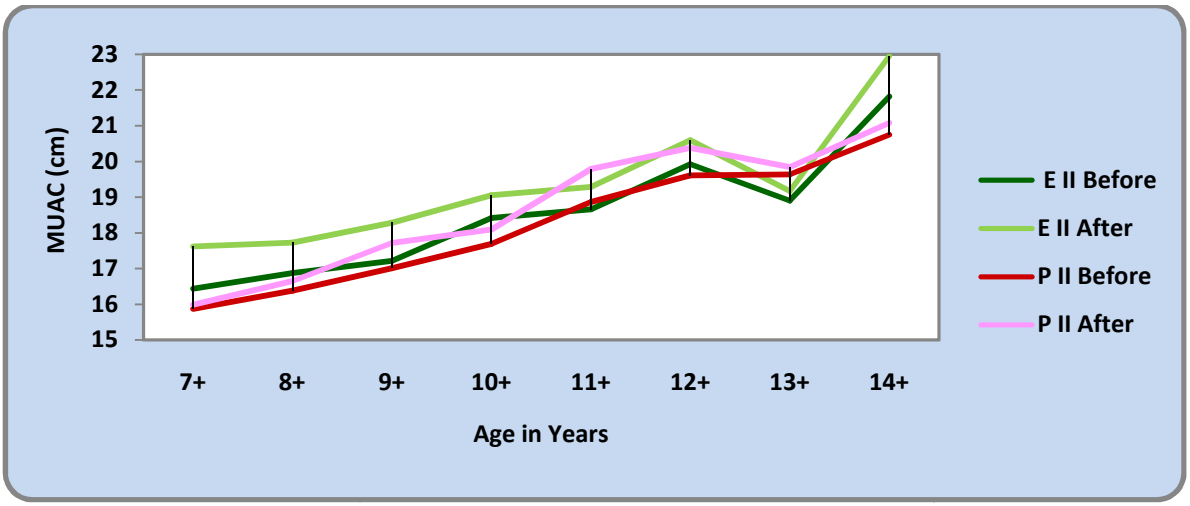


Figure 37. Mean MUAC of Boys in E II and P II Before and After Supplementation

In P I the range of MUAC Increase is 0.23 to 0.80 cm which was statistically non significant except at nine and 13 years which was significant at five per cent level. In P II the range in MUAC increase is 0.12 to 0.92 cm which was statistically significant at five per cent level and non significant at 8, 10, 13 and 14 years respectively. The results coincides with the findings of Varalakshmi and Anangamathi (2013), who supplemented Spirulina candies for a period of six months and noted improvement in the MUAC of the experimental children when compared with the control group.

f) Mean MUAC of Girls Before and After Supplementation

Table LII and figure 38, 39 and 40 shows the mean MUAC of girls before and after supplementation.

In EI the range in MUAC increase is 0.50 to 1.28 cm which was statistically significant at one and five per cent level and in E II the range in MUAC increase is 0.76 to 1.84 cm which was statistically significant at one and five per cent level when compared with the initial values. In P I the range in MUAC increase is 0.06 to 0.51 cm which was significant at one and five per cent level and in P II the range in MUAC increase is 0.06 to 0.90 cm which was statistically non significant. The final MUAC of girls who have given spirulina supplementation were much higher than that of placebo group. This clearly underlines the adequacy of spirulina as a supplement. MUAC of boys was higher than those of girls at all age points. Similar observations have been reported by Mandal and Bose (2008), who opine that this could be due to sexual dimorphism because of differential rate of fat deposition at this site between the sexes, in their assessment of under nutrition by mid-upper arm circumference among pre-school children of Arambag, Hooghly District, West Bengal, India.

Most of the children were mesomorphic. Prabhakar and Gangadhar (2009) report that children of Jenukuruba tribe of Karnataka were also mesomorphic. The higher than standard readings of MUAC could probably be due to the body build and ethnicity of these tribal groups.

Table LII

Mean MUAC of Girls Before and After Supplementation (N=85)

Age Group (years)	n	Mean MUAC			
		E I (N=29)			
		Before	After	D	t value Before vs After
7+	5	15.05±0.15	16.33±0.45	1.28	2.57*
8+	2	15.97±0.41	16.71±0.20	0.74	2.67*
9+	2	15.97±0.41	16.82±0.48	0.85	2.17*
10+	5	16.87±0.40	17.62±0.16	0.75	2.22*
11+	3	17.66±0.15	18.45±0.14	0.79	4.00**
12+	3	19.90±0.45	20.79±0.43	0.89	3.25*
13+	3	20.83±0.28	21.43±0.17	0.50	2.38*
14+	6	20.38±0.02	21.28±0.16	0.90	4.86**
		E II (N=24)			
7+	3	16.23±0.25	17.23±0.21	1.00	3.32*
8+	3	16.77±0.25	18.61±0.16	1.84	4.23**
9+	3	17.50±0.50	18.26±0.16	0.76	2.28*
10+	3	18.50±0.30	19.53±0.21	1.03	4.96**
11+	3	19.40±0.36	21.24±0.32	1.84	2.99*
12+	3	20.43±0.67	22.13±0.51	1.70	4.72**
13+	3	21.82±0.16	22.72±0.13	0.90	4.00**
14+	3	22.58±0.31	23.72±0.19	1.14	3.67*
		P I (N=16)			
7+	2	14.34±1.14	14.77±0.55	0.43	1.00^{NS}
8+	2	15.36±0.27	15.87±0.72	0.51	1.60^{NS}
9+	2	16.28±0.71	16.36±0.78	0.08	1.80^{NS}
10+	2	17.28±0.71	17.36±0.78	0.08	1.80^{NS}
11+	2	17.57±0.15	17.99±0.22	0.42	8.60^{NS}
12+	2	18.43±0.50	18.49±0.59	0.06	1.00^{NS}
13+	2	20.89±0.46	21.10±0.75	0.21	1.00^{NS}
14+	2	21.64±0.46	21.72±0.40	0.08	1.60^{NS}
		PII (N=16)			
7+	2	14.04±0.71	14.87±0.69	0.83	0.55*
8+	2	15.73±0.08	16.53±0.54	0.80	2.41^{*}
9+	2	16.48±0.41	17.38±0.66	0.90	3.53^{*}
10+	2	16.99±0.30	17.38±0.66	0.39	1.50^{NS}
11+	2	17.53±0.09	18.33±0.11	0.80	2.84*
12+	2	19.49±0.02	19.89±0.05	0.40	2.55*
13+	2	20.89±0.06	21.27±0.13	0.38	1.90*
14+	2	21.64±0.46	21.70±0.38	0.06	1.00^{NS}

** ($p<0.01$) 1% significance, * ($p<0.05$) 5% significance, NS- Not significant

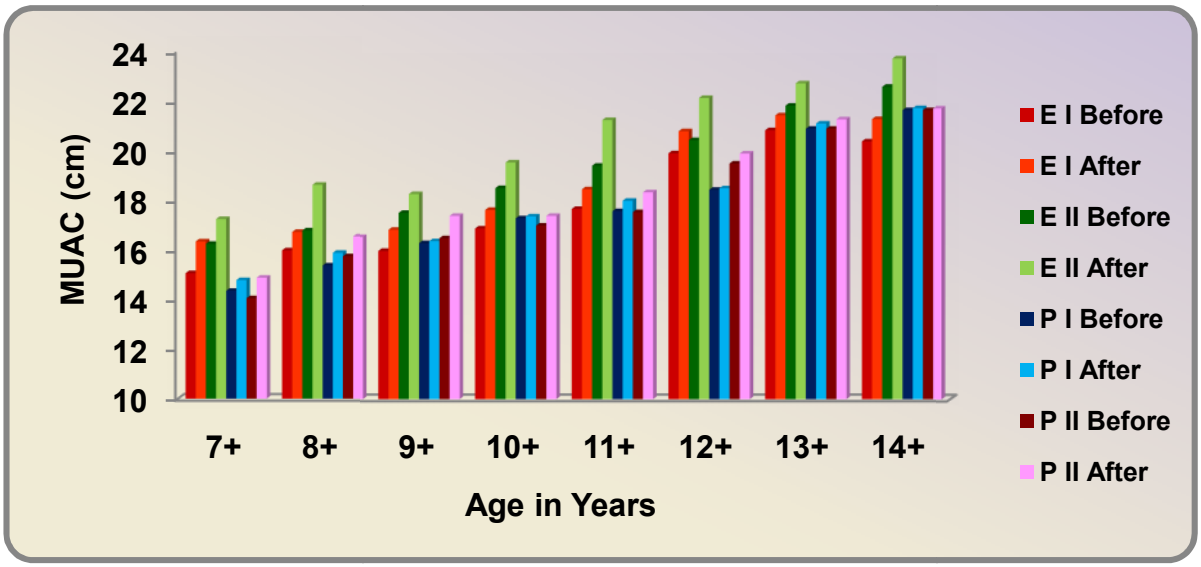


Figure 38. Mean MUAC of Girls Before and After Supplementation

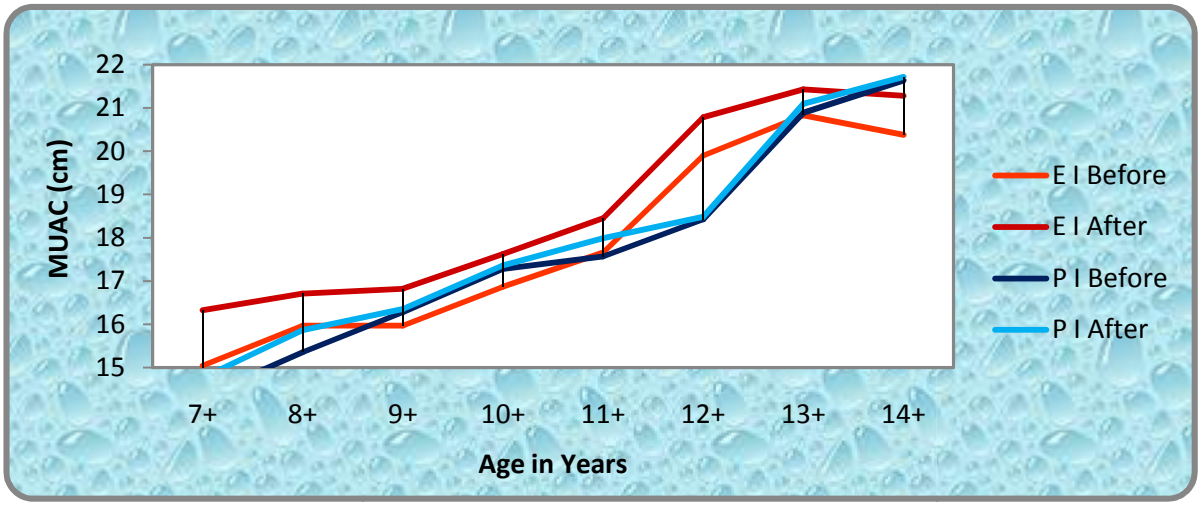


Figure 39. Mean MUAC of Girls in E I and P I Before and After Supplementation

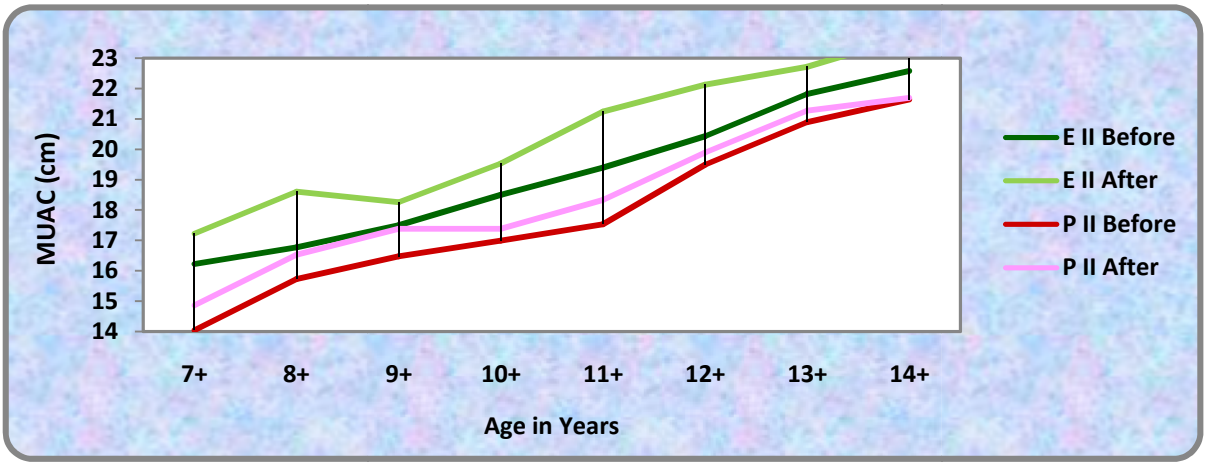


Figure 40. Mean MUAC of Girls in E II and P II Before and After Supplementation

2. Biochemical Picture

a) Mean Hemoglobin of Children Before and After Supplementation

Table LIII and figure 41 shows the mean haemoglobin of children before and after supplementation

Table LIII

Mean Hemoglobin of Children Before and After Supplementation

(N=60)

Age Group (years)	Standard Values	Mean Hb (g/dl)			
		E I (N=15)			
		Before	After	D	t value Before vs After
8+	11.5	10.33±0.77	10.48±0.70	0.15	0.93^{NS}
9+	11.5	8.66±0.16	9.35±0.27	0.69	2.45*
10+	11.5	10.69±0.56	10.94±0.35	0.25	0.75^{NS}
11+	11.5	10.02±0.91	10.39±0.56	0.37	0.57^{NS}
12+	12.0	9.01±0.19	9.53±0.05	0.52	1.94*
13+	12.0	10.59±0.02	11.09±0.17	0.50	2.54*
14+	12.0	10.44±0.03	10.99±0.02	0.55	2.18*
	E II (N=15)				
8+	11.5	9.99±0.28	11.04±0.07	1.05	5.52**
9+	11.5	9.02 ±0.69	9.46±0.76	0.44	0.57^{NS}
10+	11.5	10.02±0.11	10.69±0.14	0.67	4.50**
11+	11.5	8.03±0.17	8.73±0.20	0.70	3.33*
12+	12.0	10.89±0.07	12.23±0.11	1.34	6.56**
13+	12.0	10.74±0.13	11.14±0.21	0.40	3.79*
14+	12.0	10.39±0.05	10.99±0.32	0.60	4.87**
	P I (N=15)				
8+	11.5	10.33±0.77	10.48±0.70	0.15	0.24^{NS}
9+	11.5	10.77±1.13	10.83±0.77	0.06	0.67^{NS}
10+	11.5	10.99±0.14	11.00±0.00	0.01	0.26^{NS}
11+	11.5	9.89±0.14	10.04±0.07	0.15	0.67^{NS}
12+	12.0	10.98±0.65	11.02±0.60	0.04	0.90^{NS}
13+	12.0	10.02±0.11	10.63±0.03	0.61	2.50*
14+	12.0	11.74±1.55	11.61±1.34	0.13	1.30^{NS}
	P II (N=15)				
8+	11.5	10.33±0.70	10.34±0.49	0.01	1.60*
9+	11.5	10.48±0.70	10.64±0.49	0.16	1.40*
10+	11.5	10.99±0.14	10.89±0.14	0.10	0.00^{NS}
11+	11.5	8.99±0.14	9.89±0.14	0.90	0.20^{NS}
12+	12.0	11.11±0.85	10.98±0.60	0.13	0.00^{NS}
13+	12.0	10.66±1.90	10.14±0.21	0.52	0.00^{NS}
14+	12.0	11.74±0.15	10.99±0.12	0.75	2.17*

** ($p<0.01$) 1%t significance, * ($p<0.05$) 5% significance, NS- Not significant

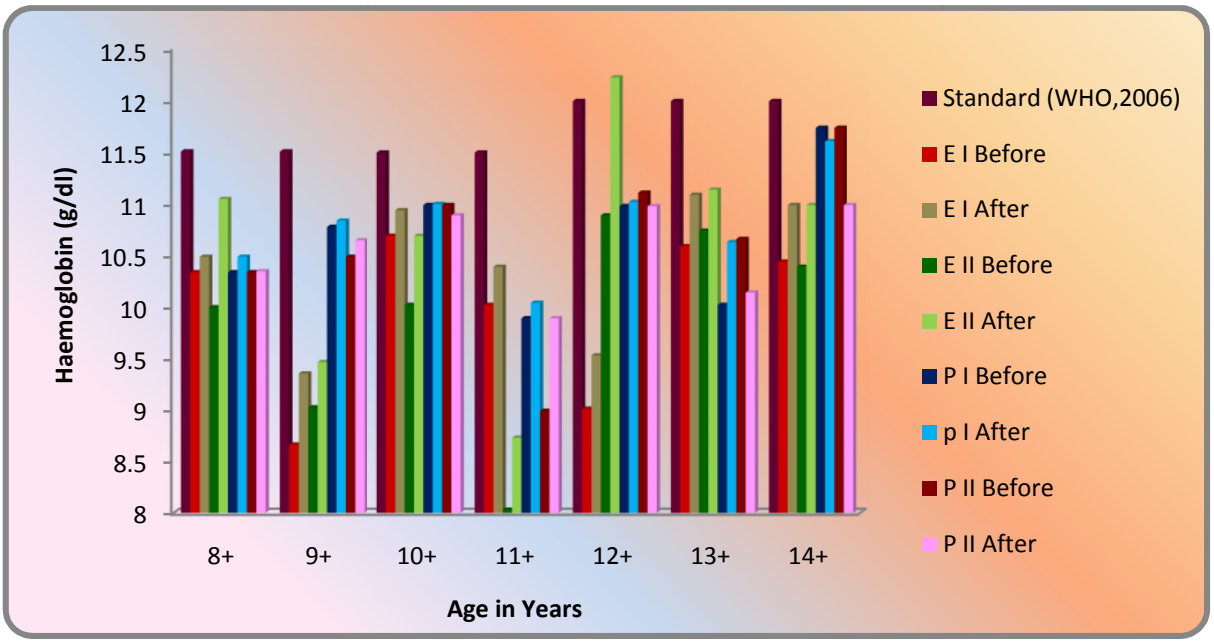


Figure 41. Mean Haemoglobin Values (g/dl) of Children Before and After Supplementation

The mean initial haemoglobin values of children were below the standard values in all the four groups and after supplementation the mean final haemoglobin values had increased significantly at five per cent level and non significant at eight, 10 and 11 years in E I and the increase in range is 0.15 to 0.69 mg/dl and in E II the range in haemoglobin increase is 0.40 to 1.34 mg/dl which was significant at one and five per cent level except in nine years which was not significant and reached near the standard values of the respective age groups. The differences between the mean initial and final values were seen more among the E II except in the nine, 12 and 13 years when compared with the E I. In P I the range of haemoglobin increase is 0.01 to 0.61 mg/dl which was not significant at nine years and significant at one and five per cent level at other age groups, in P II the range of haemoglobin increase is 0.01 to 0.90 mg/dl which was statistically not significant except in eight, nine and 14 years which were significant at five per cent level and in 10 years age group the mean final haemoglobin values had decreased than the mean initial values and in the other age groups the difference is less when compared with the experimental age groups.

This results coincide with the findings of Rajbir *et al.,* (2004) in 7-9 years girls the Hb levels of Experimental and Control group before was 11.7±0.7 and 11.2±0.9g/dl respectively. However the value increased to 12.5±0.7 g/dl for Experimental group with no change in the values of C group after 1g per day spirulina supplementation for a

period of five days a week for two months. The increase in value for E group was statistically significant (p≤0.01), which could be attributed to highly available form of iron present in spirulina. The study among 20 malnourished children in the age group of six years, supplementation of Spirulina at 1g/day for three months showed that there was an increase in serum haemoglobin level (Fathima and Salma, 2001). Henrikson (1989) in Japan report that, supplementation of 4 g of spirulina each for 30 days to eight young hypochromically anemic women, who had been limiting their meals to stay thin, could increase their blood hemoglobin content from 10.9 to 13.2 percent.

b) Categorisation of Children According to Degree Of Anemia

Figure 42 and Table LIV shows the categorisation of children according to degree of anemia before and after supplementation/

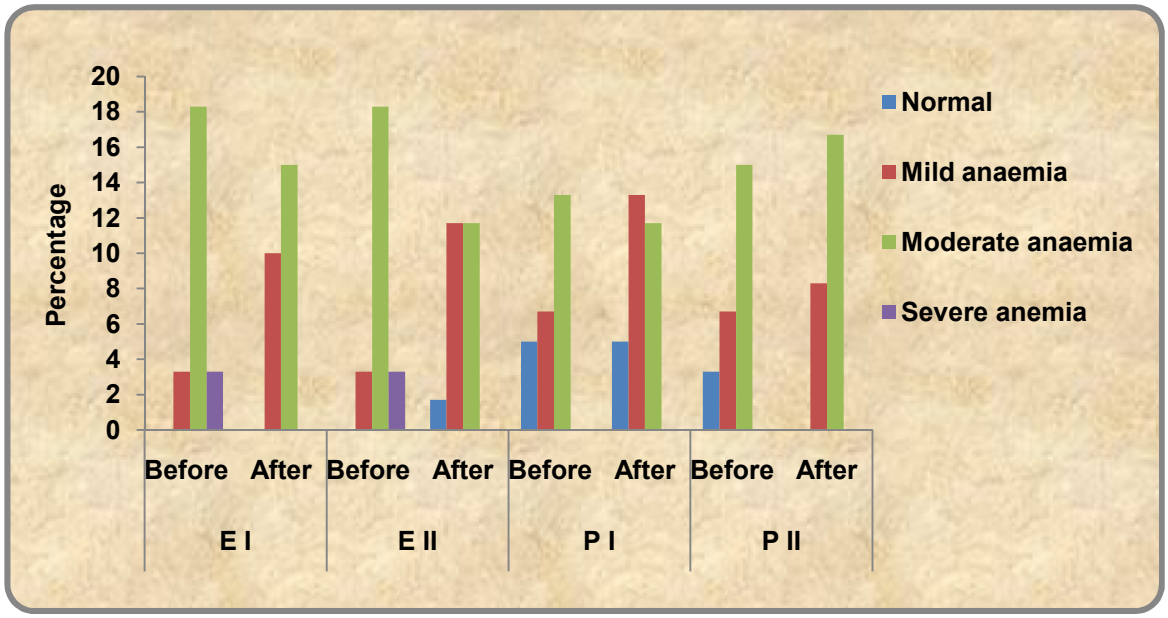


Figure 42. Categorisation of Children according to Degree of Anemia

At the beginning of supplementation, no child was in the normal category in E I and E II and in P I three and PII two were in normal, initially two children were in the mild anaemic group, 11 were in the moderate anaemic group and two were in the severe anaemic group in E I and E II respectively. After six months of supplementation six children were in mild anaemic group and nine in moderate anaemic group in E I, one in normal, seven children each in mild and moderate anaemic group in E II, but in placebo group the shifting over from moderate to mild is very less when compared with the experimental groups.

Table LIV

Categorization of Children according to Degree of Anaemia (N=60)

Degree of Anemia	E I (15)					E II (15)					P I (15)					P II (15)				
	Before		After		D	Before		After		D	Before		After		D	Before		After		D
	No.	%	No.	%		No.	%	No.	%		No.	%	No.	%		No.	%	No.	%	
Normal (Hb>12g/dl)	0	0	0	0	0	0	0	1	1.7	-1	3	5.0	3	5.0	0	2	3.3	0	0	3
Mild anaemia (Hb: 11-11.9 g/dl)	2	3.3	6	10	-4	2	3.3	7	11.7	-5	4	6.7	8	13.3	-4	4	6.7	5	8.3	-1
Moderate anaemia (Hb: 8-10.9 g/dl)	11	18.3	9	15	2	11	18.3	7	11.7	4	8	13.3	7	11.7	-1	9	15.0	10	16.7	-2
Severe anaemia (Hb: 8-10.9 g/dl)	2	3.3	0	0	2	2	3.3	0	0	2	0	0	0	0	0	0	0	0	0	0

In a study reported by Rajbir *et al*., (2004), according to WHO classification, an improvement in Hb level was reported as there was increase in the number of subjects towards normal category in experimental group supplemented with 1g per day of spirulina.

c) Mean Serum Retinol Of Children Before and After Supplementation

Table LV and figure 43 shows the mean serum retinol of children before and after supplementation.

Table LV
Mean Serum Retinol of Children Before and After Supplementation

(N=60)

Age Group (years)	Standard Values	Mean Serum Retinol			
		E I (N=15)			
		Before	After	D	t value Before vs After
8+	0.20-0.50	0.26±0.01	0.31±0.02	0.05	3.58*
9+	0.20-0.50	0.22±0.02	0.29±0.02	0.07	2.74*
10+	0.20-0.50	0.28±0.15	0.33±0.11	0.05	1.96*
11+	0.30-0.60	0.17± 0.01	0.21± 0.02	0.04	2.52*
12+	0.30-0.60	0.25±0.01	0.30±0.02	0.05	3.16*
13+	0.30-0.60	0.23±0.01	0.29±0.02	0.06	3.63*
14+	0.30-0.60	0.26±0.03	0.32±0.01	0.06	2.34*
	E II (N=15)				
8+	0.20-0.50	0.17±0.02	0.23±0.02	0.06	3.07*
9+	0.20-0.50	0.23±0.01	0.28±0.01	0.05	3.56*
10+	0.20-0.50	0.25±0.02	0.31±0.04	0.06	2.19*
11+	0.30-0.60	0.26± 0.03	0.31± 0.02	0.06	3.18*
12+	0.30-0.60	0.18±0.02	0.22±0.03	0.04	2.86*
13+	0.30-0.60	0.32±0.03	0.39±0.02	0.07	3.42*
14+	0.30-0.60	0.24±0.01	0.28±0.02	0.04	2.05*
	P I (N=15)				
8+	0.20-0.50	0.17±0.04	0.23±0.05	0.06	2.18*
9+	0.20-0.50	0.23±0.01	0.28±0.01	0.05	3.55*
10+	0.20-0.50	0.25±0.12	0.31±0.12	0.06	3.19*
11+	0.30-0.60	0.26± 0.09	0.27± 0.02	0.01	1.14NS
12+	0.30-0.60	0.18±0.02	0.22±0.03	0.04	2.52*
13+	0.30-0.60	0.32±0.03	0.36±0.02	0.04	1.56NS
14+	0.30-0.60	0.24±0.10	0.28±0.11	0.04	1.39NS
	P II (N=15)				
8+	0.20-0.50	0.17±0.03	0.18±0.02	0.00	1.26NS
9+	0.20-0.50	0.24±0.11	0.23±0.11	-0.01	1.19 NS
10+	0.20-0.50	0.26±0.09	0.27±0.08	0.00	1.23NS
11+	0.30-0.60	0.28±0.01	0.29±0.00	0.01	1.47NS
12+	0.30-0.60	0.32±0.02	0.29±0.02	-0.03	3.13*
13+	0.30-0.60	0.17±0.03	0.21±0.04	0.04	1.54NS
14+	0.30-0.60	0.25±0.06	0.26±0.02	0.00	1.27NS

** (p<0.01) 1% significance, * (p<0.05) 5% significance, NS- Not significant

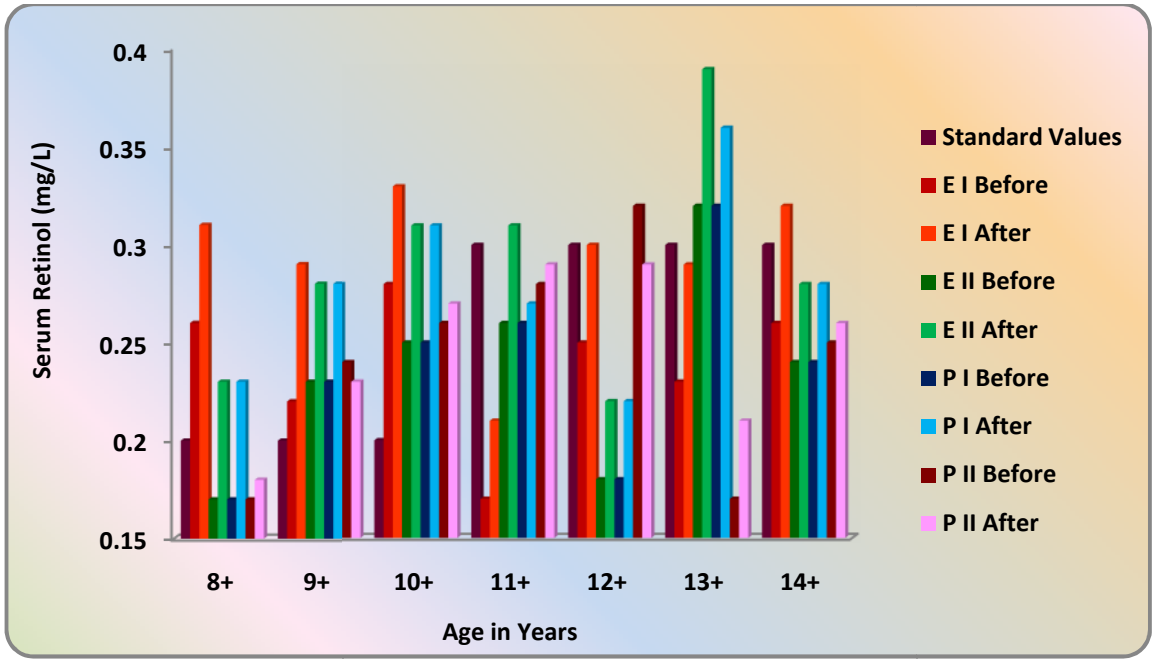


Figure 43. Mean Serum Retinol (mg/L) of Children Before and After Supplementation

The range in serum retinol value increase in E I and E II is 0.04 to 0.07 mg/L which was statistically significant at five per cent level and mean final values of serum retinol have increased in both the experimental groups when compared with the mean initial values of the respective age groups. The difference between the mean initial and final group is high in E II when compared with E I. In P I the range in serum retinol increase is 0.01 to 0.06 mg/L which was significant at 5 per cent level and not significant in 11, 13 and 14 years in PII the range in serum retinol increase is 0.00 to 0.04 which was statistically not significant expect in 12 years which was significant at five per cent level.

According to Seshadri (1993), Spirulina supplementation to pre-school children with 1g/day increased the serum retinol levels.

3. Clinical Examination

Table LVI and figure 44 shows the impact of supplementation in terms of the clinical symptoms.

Table LVI

Clinical Symptoms Before and After Supplementation

(N=167)

Clinical picture	E I(N=52)					E II(N=51)					PI (N=32)					P II(N=32)				
	Before		After		D	Before		After		D	Before		After		D	Before		After		D
	No	%	No	%		No	%	No	%		No	%	No	%		No	%	No	%	
Emaciation	4	7.7	1	1.9	3	3	5.9	1	1.9	2	1	3.1	1	3.1	0	2	6.3	2	6.3	0
Conjunctival Xerosis	5	9.6	3	5.8	2	5	9.8	3	5.9	2	2	6.3	1	3.1	1	2	6.3	2	6.3	0
Angular Stomatitis	35	67.3	25	48.1	10	32	62.7	6	11.7	27	10	31.3	8	25	2	10	31.3	10	31.3	0
Bitot's spot	8	15.4	8	15.4	0	7	13.7	6	11.7	1	1	3.1	1	3.1	0	2	6.3	2	6.3	0
Cheilosis	20	38.5	10	19.2	10	20	39.2	8	15.7	12	8	25	7	21.8	1	8	25	8	25.0	0
Glossitis	10	19.2	5	9.6	5	15	29.4	7	13.7	8	5	15.6	4	12.5	1	5	15.6	5	15.6	0
Gingivitis	18	34.6	5	9.6	13	16	31.3	5	9.8	11	5	15.6	4	12.5	1	5	15.6	5	15.6	0
Koilonychia	5	9.6	3	5.8	2	3	5.9	1	1.9	2	1	3.1	1	3.1	0	2	6.3	2	6.3	0
Dental Caries	2	3.8	2	3.8	0	3	5.9	2	3.9	0	1	3.1	1	3.1	0	0	0	0	0	0
Thyroid gland Palpable	1	1.9	1	1.9	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dermatitis	10	19.2	2	3.8	8	6	11.8	1	1.9	5	3	9.4	3	9.4	0	4	12.5	4	12.5	0

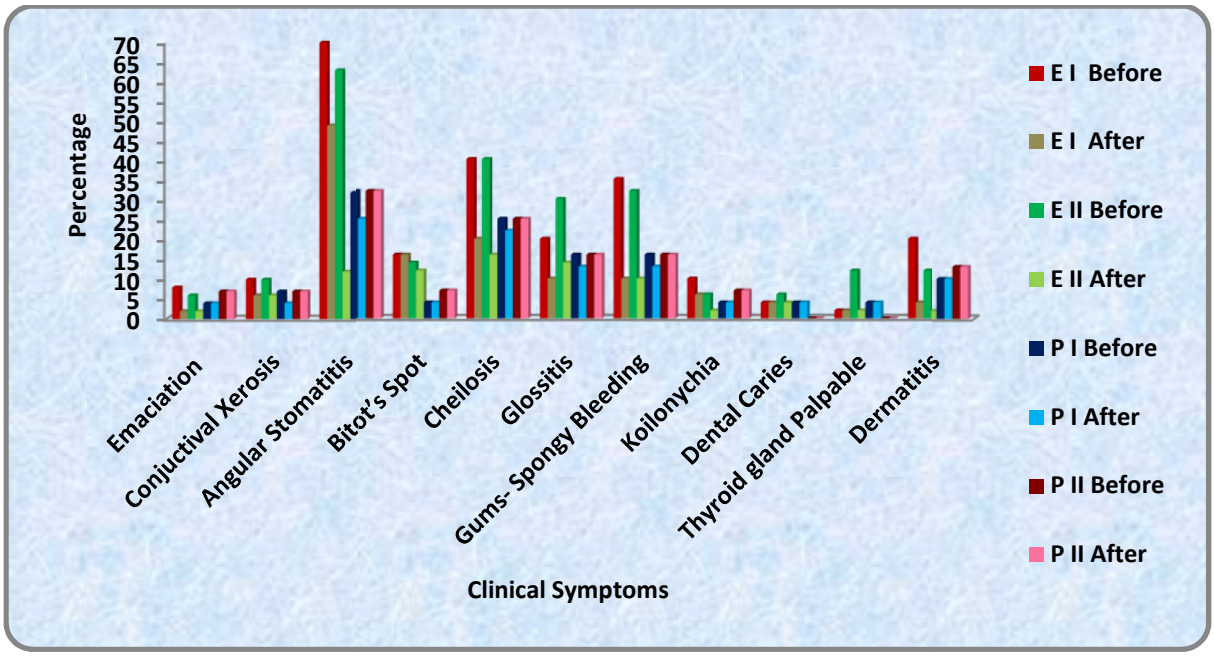


Figure 44. Impact of Supplementation on Clinical Picture

Table LVI reveals that the prevalence of emaciation, a major symptom of Protein Energy Malnutrition before was 7.7, 5.9 and 4.7per cent in selected EI, E II and placebo children. After supplementation for 6 months, it reduced to 1.9 per cent each in EI and EII, while there was no change in the placebo group. The mean prevalence of Bitot's spots, an objective sign of VAD was 15.4, 13.7 and 4.7 per cent before supplementation and it come down to 11.7 per cent in E II. No change was observed among children in the EI and placebo groups. Prevalence of Conjuctival xerosis was about 9.6 per cent in EI, 9.8 per cent in E II and 6.3 per cent in placebo before and after supplementation it reduced to 5.8 per cent in EI, 5.9 per cent in E II and no change in placebo.

The incidence of B- complex deficiencies such as glossitis was 19.2, 29.4 and 15.6 per cent in EI, E II and placebo before and after supplementation it reduced to 9.6 and 13.7 per cent in EI, E II. Angular stomatitis was 67.3, 62.7 and 31.3 per cent before and reduced to 48.1 and 11.7 per cent after supplementation. Cheilosis was observed among 38.5 and 39.2, 25 per cent of EI, EII and placebo children and due to the impact of supplementation it becomes 19.2 and 15.7 in E I and II.

Gingivitis, a symptom of Vitamin C deficiency was observed among 34.6, 31.3 and 15.6 per cent of E I, II and placebo. Due to supplementation, it has come down to 9.6 per cent in both E I and9.8 per cent in E II. Koilonychia, the most visible symptom of IDA was observed among 9.6 per cent, 5.9 per cent and 4.7 per cent of E I, II and

placebo and it reduced to 5.8 and 1.9 per cent in E groups finally Dermatitis was 19.2, 11.8 and 10.9 per cent and there is change as 3.8 and 1.9 per cent in E groups. The incidence of dental caries remained the same after the supplementation also.

This finding coincides with the study of Seshadri (1993), Spirulina fed 5000 rural pre-school children with 1g/day reduced the prevalence of Bitot's spot and prevented the occurrence of severe form of Vitamin A deficiency - Corneal xerosis and reduced the prevalence of B complex deficiency.

According to Praveen (2002), follow-up study among 146 malnourished children for a period of one year indicated, most of the clinical symptoms like pale conjunctiva showing higher incidence of anemia, and symptoms like fever, cough, eye and skin infection were reduced after the Spirulina supplementation.

4. Dietary Pattern

i) Mean Food Intake of Children Before and After Supplementation

Table LVII and figure 45 represent the mean daily food intake of the children before and after supplementation.

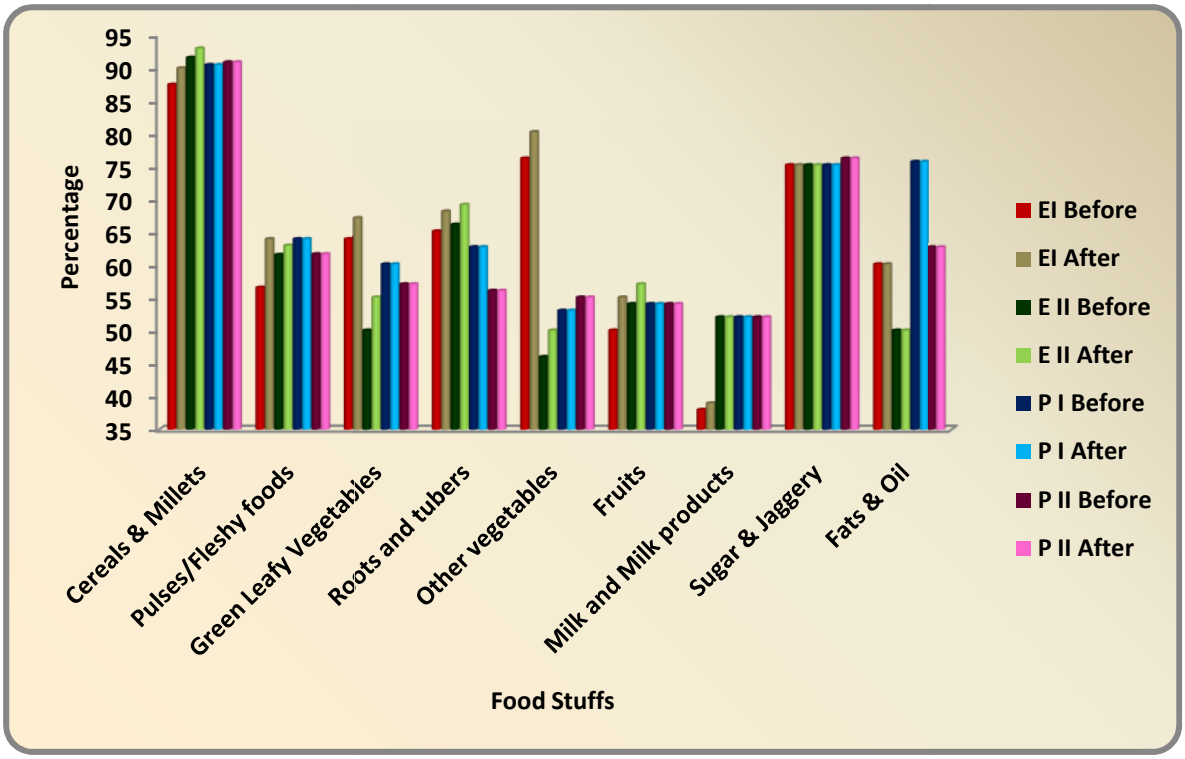


Figure 45. Mean Food Intake of Children Before and After Supplementation

Table LVII

Mean Food Intake Before and After Supplementation

(N=167)

Food Stuffs	Adequacy (%)											
	E I			E II			P I			P II		
	Before	After	D	Before	After	D	Before	After	D	Before	After	D
Cereals & Millets	87.5	90.0	2.5	91.6	94.0	2.4	90.5	90.5	0	90.9	90.9	0
Pulses/Fleshy foods	56.6	64.0	7.4	61.6	64.0	2.4	64.0	64.0	0	61.7	61.7	0
Green Leafy Vegetables	64.0	67.0	3.0	50.0	55.0	5.0	60.0	60.0	0	57.0	57.0	0
Roots and tubers	65.0	68.0	3.0	66.0	69.0	3.0	62.6	62.6	0	56.0	56.0	0
Other vegetables	76.0	80.0	4.0	46.0	50.0	4.0	53.0	53.0	0	55.0	55.0	0
Fruits	50.0	55.0	5.0	54.0	57.0	3.0	54.0	54.0	0	54.0	54.0	0
Milk and Milk products	38.0	39.0	1.0	52.0	52.0	0.0	52.0	52.0	0	52.0	52.0	0
Sugar & Jaggery	75.0	75.0	0.0	75.0	75.0	0.0	75.0	76.0	0	76.0	76.0	0
Fats & Oil	60.0	60.0	0.0	50.0	50.0	0.0	75.5	75.5	0	62.5	62.5	0

The amount of food consumed by each group was similar. The mean intake of foodstuffs was below the recommended dietary intakes. The adequacy percentage of cereals and millets was 87.5 and 91.6 per cent before and after supplementation it increased to 90 and 93 per cent in E I and E II with the range of 1.4 to 2.5 per cent increase. Similarly, adequacy percentage of pulses and fleshy foods, green leafy vegetables, roots and tubers, other vegetables, fruits, milk and milk products were increased after supplementation in EI and EII with the range of 1.4 to 7.4, 3.0 to 5.0, 3.0, 4.0, 3.0 to 5.0, 1.0 per cent respectively with no increase in sugar and jagerry, fats and oil. Thus, food intake has increased in the groups were spirulina was supplemented and no change in the placebo groups.

ii) Mean Nutrient Intake of Children Before and After Supplementation

Table LVIII and figure 46 represent the mean daily nutrient intake of the children before and after supplementation.

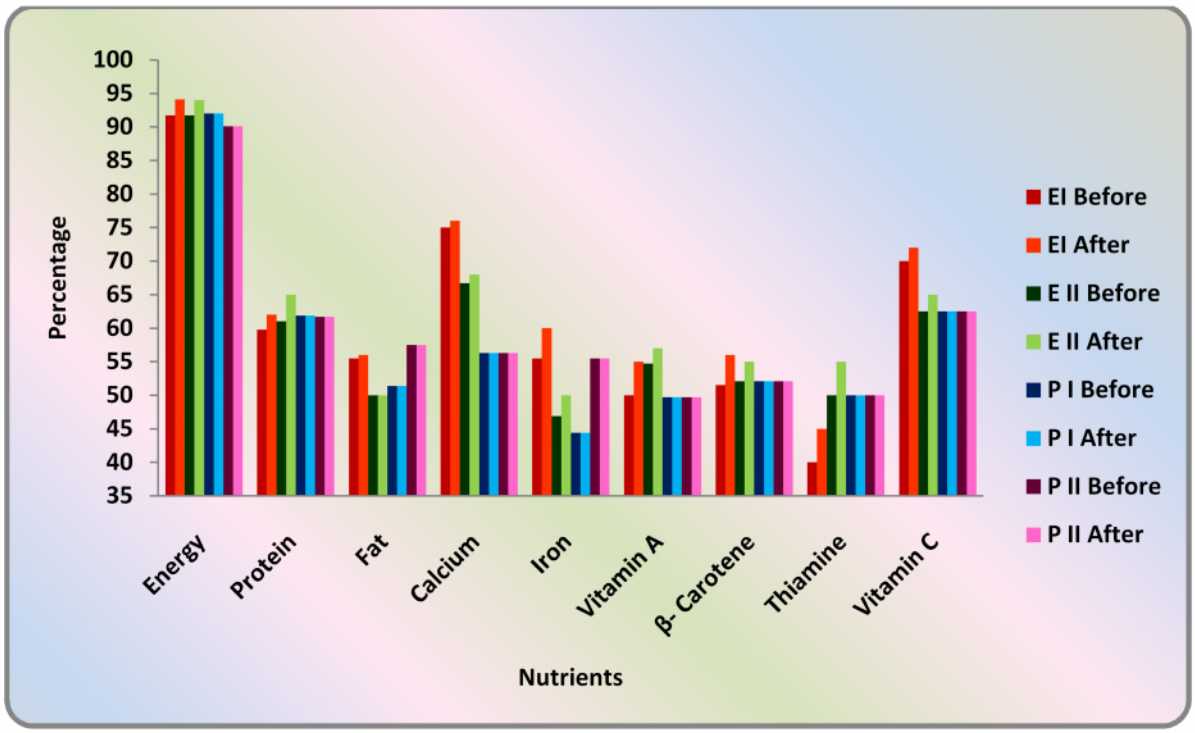


Figure 46. Mean Nutrient Intake of Children Before and After Supplementation

Table LVIII

Mean Nutrient Intake Before and After Supplementation

(N=167)

Nutrients	Adequacy (%)											
	E I			E II			P I			P II		
	Before	After	D	Before	After	D	Before	After	D	Before	After	D
Energy (kcal)	91.7	94.1	2.4	91.7	94.0	2.3	92.0	92.0	0	90.1	90.1	0
Protein (g)	59.8	62.0	2.2	61.0	66.0	5.0	61.9	61.9	0	61.7	61.7	0
Fat (g)	55.5	56.0	0.5	50.0	50.0	0.0	51.4	51.4	0	57.5	57.5	0
Calcium (mg)	75.0	76.0	1.0	66.7	68.0	1.3	56.3	56.3	0	56.3	56.3	0
Iron (mg)	55.5	60.0	5.0	46.9	50.0	3.1	44.4	44.4	0	55.5	55.5	0
Vitamin A (IU)	50.0	55.0	5.0	54.7	57.0	2.3	49.7	49.7	0	49.7	49.7	0
β-Carotene (mcg)	51.5	56.0	0.5	52.1	55.0	2.9	52.1	52.1	0	52.1	52.1	0
Thiamine (mg)	40.0	45.0	5.0	50.0	55.0	5.0	50.0	50.0	0	50.0	50.0	0
Vitamin C (mg)	70.0	72.0	2.0	62.5	65.0	2.5	62.5	62.5	0	62.5	62.5	0

The intake of almost all the nutrients was below the RDA (2010). The adequacy percentage of energy was 91.7 per cent before and after supplementation it increased to 94.1 and 94 per cent in E I and E II with the range of 2.3 to 2.4 per cent increase. Similarly, adequacy percentage of protein, fat, calcium, iron, vitamin A, β-Carotene, thiamine and vitamin C were increased after supplementation in EI and EII with the range of 2.2 to 4.0, 0.5, 1.0 to 1.3, 3.1 to 5.0, 2.3 to 5.0, 0.5 to 2.9, 5.0 and 2.0 to 2.5 per cent were spirulina was supplemented and no change in the placebo groups.

B. Impact of Kitchen garden and Nutrition Education

1. Impact of Kitchen Garden and Nutrition Education on KAP

Table LIX and figure 47 represents the impact of kitchen garden and nutrition education on KAP

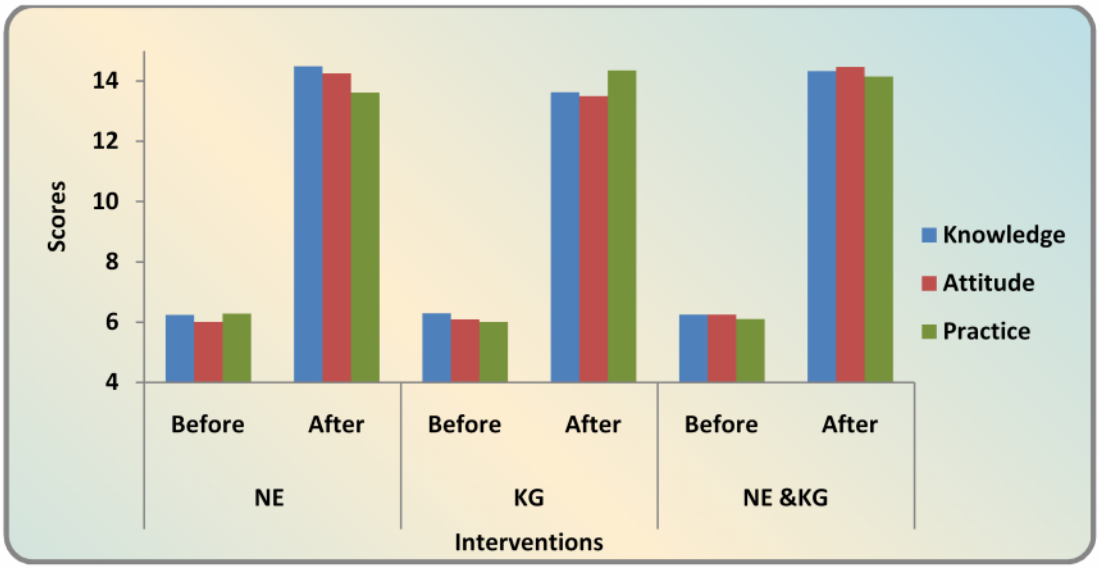


Figure 47. Impact of Kitchen Garden and Nutrition Education on KAP

In group I where only nutrition education was given, the scores for Knowledge had increased from 6.24 to 14.48 with the difference of 8.24, the scores for attitude had increased from 6.01 to 14.25 with the difference of 8.24 and the scores for practice had increased from 6.28 to 13.61 with the difference of 7.33. In group II where only kitchen garden was given, the scores for Knowledge had increased from 6.29 to 13.62 with the difference of 7.33, the scores for attitude had increased from 6.09 to 13.50 with the difference of 7.41 and the scores for practice had increased from 6.01 to 14.35 with the difference of 8.34.

Table LIX

Impact of Kitchen Garden and Nutrition Education on KAP

(N=150)

Parameters	NE (50)			p-value	KG(50)			p-value	NE &KG(50)			p-value
	Initial	Final	D		Initial	Final	D		Initial	Final	D	
Knowledge	6.24±2.1	14.48±1.9	8.24	0.016	6.29±2.2	13.62±2.6	7.33	0.012	6.25±2.1	14.33±1.9	8.08	0.011
Attitude	6.01±2.2	14.25±1.9	8.24	0.001	6.09±2.2	13.50±2.6	7.41	0.002	6.25±2.1	14.46±1.8	8.21	0.001
Practice	6.28±2.2	13.61±2.6	7.33	0.012	6.01±2.2	14.35±1.7	8.34	0.010	6.10±2.2	14.15±1.9	8.05	0.014

p-value < 0.01 (1% significance) Kruskal-Wallis test

In group III where kitchen garden and nutrition education was given, the scores for Knowledge had increased from 6.25 to 14.33 with the difference of 8.08, the scores for attitude had increased from 6.25 to 14.46 with the difference of 8.21 and the scores for practice had increased from 6.10 to 14.15 with the difference of 8.05. All the final scores for knowledge, attitude and practice have increased significantly (P-value <0.01) than the respective initial scores. The scores for knowledge and attitude have increased than scores for practice in group I where only Nutrition Education was given, the scores for attitude and practice have increased than scores for knowledge in group II where only Kitchen Garden was given. In the group III, mothers had given both nutrition education and kitchen garden and all their scores for knowledge, attitude and practice have increased.

This tunes with study of Padmavathy and Ramadas, 2012, it is evident that nutrition knowledge of the tribal women were considerably improved after imparting nutrition education and is statistically significant at one per cent level.

According to Rekha (2012) health and nutrition education provides constructive opportunities for knowing and involving some communication designed to improve health and nutrition literacy thereby improving their knowledge and helps to develop skills which are conducive to community and the individual involved.

A study by Miejinru *et al.,* (2010), on hundred adolescent girls in Korea on healthy nutritional practices showcased that teaching was effective in increasing the nutritional attitude, knowledge and practice of the learners.

Sinha and Sharma (2013) assessed the impact of interventions viz., Horticulture and Nutrition education for raising the nutritional status of selected tribes in the Ranchi district of Jharkhand. Results revealed that there was significant gain in knowledge, change in attitude and enhancement in skill of beneficiaries after exposure to scientific information on nutrition and health through lecture, demonstrations and training. The intake of protective food like vegetables was much below the suggested recommendation, but significant enhancement in green leafy vegetable intake was observed after Horticulture intervention. It may be inferred that both interventions were effective and should be included in the programmes aiming to improve nutritional status of the community.

2. Percentage of mothers with correct KAP before and after Interventions

Table LX and figure 46 represents the impact of kitchen garden and nutrition education on KAP

Table LX

Percentage of mothers with correct KAP before and after Interventions

KAP	NE (50)				KG (50)				NE and KG(50)			
	Before		After		Before		After		Before		After	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	0	0	23	46	0	0	20	40	0	0	25	50

While none of the mothers had the right notion with regard to nutrition knowledge, attitude and practice before the interventions were given, only 46, 40 and 50 per cent could assimilate the correct KAP even after repeated sessions of nutrition education delivered to them. This could be attributed to their illiteracy and absence of formal education in the tribal areas. However, it is encouraging that nearly 40 -50 per cent of women could assimilate nutrition concepts in a short duration of six months.