

SUMMARY AND CONCLUSION

The present study titled, “**Effect of Interventions on Vitamin A and Iron Nutritional Status among Primitive Tribal Children in Nilgiris District**” was conducted among the six PTG’s in Nilgiris District. Four thousand three hundred and seventy six PTG children in the age group of 1 - 14 years were screened for clinical symptoms of VAD and IDA. From among them 317 PTG children showing moderate to severe clinical symptoms of VAD and IDA were selected for socioeconomic, dietary and anthropometry assessments. From the parameters namely standing height, body weight, BMI, MUAC, Head Circumference and Chest Circumference, indices such as HZA, WZA, Weight for Height, MUAC for Age and BMI for Age were computed. Two food supplements, namely, spirulina candies and a Spirulina Incorporated Food Supplement (SIFS) were administered. The candies were procured from Antenna Nutritech Foundation, Madurai and contained 1g of spirulina. SIFS was prepared using the same quantity of spirulina (1g) as in the Spirulina candies and tested for acceptability using a child friendly scale. Then nutrients and storage stability were analysed. One hundred and sixty seven children in the age group of 7-14 years were included for supplementation and divided into four groups, constituting two experimental groups (E I- Supplemented with Spirulina Candies and E II with SIFS) and two placebo groups (P I- supplemented with ordinary candies and P II - supplemented with Food Supplement without spirulina powder), for a period of 180 days. The children were examined clinically and their nutritional anthropometry was assessed before and after supplementation. Biochemical tests namely blood haemoglobin and serum retinol were performed on a sub group of 60 children. Tribal mothers were divided into three groups of 50 each and the first group was given only nutrition education, the second group was taught to lay, cultivate and harvest Kitchen Gardens and the third group was given both interventions (nutrition education and Kitchen garden). Nutrition education was given in the local dialects (Paniya language and Tamil), to 100 mothers drawn from ten different tribal hamlets using various educational methods like audio- visual aids, exhibition, Positive Deviance Hearth (PD Hearth). A total of 25 sessions were conducted for groups of primitive tribal women, for a period of six months with an interval of seven days. The

concept of kitchen garden was new to them and was adopted by 100 willing families with small land holdings around their houses from 10 different tribal hamlets. One kitchen garden was laid by the investigator in one area as a model from each tribal hamlet involving all the participants. Thereafter Kitchen garden seeds were distributed to them. Impact was assessed using KAP questionnaire from the mothers before and after interventions.

The results of the present study are summarized below

Phase I

Prevalence of VAD and IDA among PTG Children in Nilgiris District

Clinical Symptoms of VAD and IDA among PTG Children

- The prevalence rate of Bitot's spot reported in the present study is 0.7 per cent which 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.
- Koilonychia, the most visible symptom of IDA was observed among Thoda Kota, Irula, Paniya and Kattunaicker children ranged from 0.5 to 3.1per cent in 1-5 years age group and 0.5 to 1.3per cent in 6-14 years age group.
- The highest prevalence of emaciation, was observed among Kattunaicker children (0.9- 3.1 per cent). Overall prevalence of B- complex deficiencies such as glossitis was 1.8 per cent and angular stomatitis was 2.9 per cent, while cheilosis was observed among 1.4 per cent of Irula children and 3.7 per cent of Paniya children
- 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).
- 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.

Socio Economic Background of PTG Children

- On the whole, 23.3 per cent of the children were from joint and 76.7 per cent were from nuclear families.
- Totally, 12 per cent were single children in their homes, 19 and 30.3 per cent belonged to two and three children families, 21.1, 12, 4.7 and 0.9 per cent were from four, five, six and seven children families respectively.
- 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.
- On the whole, 99.7 per cent of the families belonged to EWS and only 0.3 per cent were from LIG with the average monthly income of ₹ 3,033/.
- All the families spent a major part of their income (62.5 per cent) on food. It was shocking to note that, the next sizeable expenditure (19.9 per cent) was on paan, betel nut and alcoholic drinks and both the parents in the families were addicted to these habits which caused a major Socio, Economic, psychological and drain on the families.
- Crippling was observed due to these habits which caused a major Social, economic, physical and psychological drain on the families.

Nutritional Anthropometry of PTG Children

- 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.
- The heights of boys was compared statistically with WHO standards and it was observed that most of boys and girls were significantly ($p < 0.01$; $p < 0.05$) shorter than their WHO counterparts.
- Similarly PTG children were much lighter than both their standard counterparts (WHO and ICMR). Weight of boys and girls in all the age groups were significantly ($p < 0.01$; $p < 0.05$) less than the respective standard values.
- 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.
- Mean chest and head circumference of 1- 5 years children was significantly ($p < 0.01$) below the standard values of respective age groups.

- The overall prevalence of underweight (Weight for age < Median -2SD) among under 5 year boys and girls was about 32.5 and 40 per cent.
- The overall prevalence of stunting (Height for age < Median -2SD) among boys and girls under five years was 37.5 and 44.3 per cent.
- The overall prevalence of wasting (Weight for height < Median -2SD) among under 5 year boys and girls was 12.5 and 12.8 per cent.
- The overall prevalence of moderate (MUAC for age < Median -2SD) category of MUAC among under five year boys and girls was 13 and 14 per cent respectively. Severe (MUAC for age < Median -3SD) category of MUAC was two per cent each.
- The overall prevalence of thinness (BMI < -2SD) among 6-14 years was about 14.2 per cent, with 7.1 per cent severe thinness in boys and 12.5 per cent with 1.2 per cent severe thinness in girls. This could be because of hyper activity observed among boys and adolescent growth spurt among girls.
- Morbidity over the past three months, episodes of diarrhoea were 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 are 5. Total of the scores is 45, which shows II degree morbidity among PTG children.

Dietary Pattern of PTG Children

- All the families were non-vegetarians and consumed three meals a day.
- All the children right from one year of age consumed black tea. On the whole, 6.6 and 93.4 per cent of the children drank black tea, three and four times each day respectively.
- The predominant method adopted for cooking food items was boiling. None of the families used steaming and pressure cooking methods.
- Sixty per cent consumed raw rice every month and 40 per cent consumed occasionally. All the families used refined wheat flour (maida) on a weekly basis.
- Pulses were not included in their daily diet. Bengal gram dhal and black gram dhal were used once a week.
- 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 were included daily in all the families. Other green leafy vegetables were consumed once a week or on monthly basis.
- Other vegetables were consumed 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. While non-vegetarian foods like chicken, egg, fish, mutton were consumed by 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.
- Refined oil was used for cooking and hence consumed daily and coconut oil weekly. Sugar was used daily, while honey and jaggery were used occasionally.
- The mean intake of foodstuffs was below the recommended dietary intakes, cereals and millets constituting (83.3 to 92.6 per cent), pulses (53.3 to 64 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 52.4 per cent of the ICMR (2009) suggested allowances.
- intake of almost all the nutrients was below the Recommended Allowances (ICMR, 2010), energy (91.1 to 92 per cent), protein (59.7 to 64.5 per cent), fat (50 to 60 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 75 per cent).

Phase II

Background Information and Nutritional Status of PTG Children included for Supplementation

Socio Economic Background of Supplementation Group Children

- On the whole, 24.6 per cent of the tribal children lived in joint and 75.4 per cent were from nuclear families. Thus it is evident that even among tribals, joint family system of life is fast changing.
- Totally, 31.7, 32.3 and 35.9 per cent of children belonged to Kurumba, Paniya and Kattunaicker community respectively, on the whole, 47.9 per cent were boys and 52.1 per cent were girls.
- About 99.4 per cent of the families belonged to EWS and only 0.6 per cent were in LIG.

- About 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.

Nutritional status of Children

- The mean height of boys and girls in the age group of 7-14 years ranged from 117.61 cm to 157.49 cm and 112.05 cm to 150.52 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 mean weight of children in the age group of 7-14 years boys and girls was 17.10 kg to 43.59 kg, which were all below the standard values of the respective age groups.
- The mean MUAC of 7- 14 years boys and girls ranged from 15.05 cm to 22.58 cm and 14.04 cm to 22.58 cm and all the values were above the standard values of the respective age groups.
- The haemoglobin values were below the threshold level in all the age groups, indicating the presence of anaemia. Hence, according to WHO (2001), IDA is a problem of public health significance among the PTG children.
- According to the degree of anemia, 8.3 per cent of the children were normal, 20, 65, 6.7 per cent were mildly, moderately and severely anaemic. 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 among the PTG children surveyed in the study.
- Iron intake and haemoglobin have a statistically significant linear relationship ($p < 0.001$) and ($p < 0.005$). The direction of the relationship is positive (i.e., Iron intake and haemoglobin are positively correlated), these variables tend to increase together.
- The mean values of serum retinol of all age groups were significantly ($p < 0.01$) below the standard values of the respective age groups.
- Beta- carotene and serum retinol showed a statistically significant linear relationship ($p < 0.001$), the direction of the relationship being highly positive (i.e., Beta- carotene and serum retinol were positively correlated). This drives home the

fact that vitamin A nutritional status can be improved by increasing the intake of food sources of the vitamin.

- Serum retinol and haemoglobin showed a positive and statistically significant linear relationship ($p < 0.001$).
- Emaciation 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 spots were observed 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.
- 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.
- B complex deficiency symptoms such as glossitis were seen in 15.6 to 29.4 per cent, Angular stomatitis among 31.3 to 67.3 per cent, Cheilosis in 25 to 39.2 per cent of children respectively. Vitamin C deficiency symptoms like gingivitis were observed among 15.6 to 34.6 per cent children.
- Dental caries were observed among 3.1 to 5.9 per cent children. Iodine deficiency symptom, namely, palpable thyroid gland was seen in 1.9 per cent. Dermatitis was observed among 9.4 to 19.2 per cent of children.

Phase III

Composition, Acceptability and Nutritive value of Spirulina supplement

Composition of Spirulina Incorporated Food supplement

- In one serving (30g based on acceptability trials) the composition of wheat flour, corn flour, jowar flour, Bengal gram flour, ragi flour, jaggery powder and Spirulina were 5.4g, 4.8 g, 4.8 g, 3.6g, 1.5g, 9g and 1 g respectively.
- One serving of SIFS provided 6.2, 9, 0.8, 18.7, and 25.6 per cent of suggested allowance of energy, protein, Vitamin A, vitamin C, iron and calcium.
- Among the three different variations of SIFS, 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.

Nutritive value and Storage Stability of SIFS

- Each serving (30g) contained 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.
- 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.
- 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.

Phase IV

Impact of Interventions on Nutritional Status of Children and KAP of Mothers

Impact of Supplementation

Nutritional Anthropometry

- In the E I and E II group, the mean initial heights of boys and girls were below the standard values and the mean final heights had significantly ($p < 0.01$; $p < 0.05$) increased and still the final height was less than the standard WHO (2007).
- The range in height increase in boys was 3.32 to 5.98 cm in E I and 3.46 to 5.33 cm in E II. In the placebo group there was no marked improvement or normal pattern of growth throughout the study period (the range of increase being, 0.08 to 3.29 cm), which shows the absence of even discernible height increments in the absence of spirulina supplementation.
- Among girls in E I and E II, the range in height increase is 3.32 to 5.48 cm and 2.70 to 5.80 cm. The increase in height in the placebo group was only marginal with the range of 0.80 to 2.96 cm in P I and 0.90 to 1.96 cm in P II in which was significant at one and five per cent level and non significant at certain age groups, which reiterates the status of height increase in the absence of supplementation.
- The range in weight increase of boys is 0.61 to 2.84 kg in E I and 1.54 to 4.54 kg in E II which was statistically significant ($p < 0.01$; $p < 0.05$) near normal pattern 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 cm in P I and 0.70 to 2.19 cm in P II which was statistically non significant.

- In E I the range of weight increase was 1.00 to 5.28 kg and 1.19 to 4.34 kg in E II which was statistically significant at 1 per cent and 5 per cent level when compared with the initial values. The range of weight increase in P I was 0.24 to 2.13 kg and 1.10 to 3.44 kg in P II (significant at five per cent level in all age groups except for 9 years). 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.
- The mean MUAC measurements of the tribal children per se were much higher than the standards at all age points.
- As among boys, the final mean MUAC values in the E I were significant at 1 and 5 per cent level with the range of 0.43 to 1.90 cm and in E II 0.27 to 1.18 cm. In P I the range of MUAC Increase is 0.23 to 0.80 cm and in P II 0.12 to 0.92 cm which was statistically non significant.
- In E I the range in MUAC increase is 0.50 to 1.28 cm and in E II 0.76 to 1.84 cm which was statistically significant at one and five per cent level. 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 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.
- The mean initial haemoglobin values of children were below the standard values initially and after supplementation the mean final haemoglobin values had increased significantly at five per cent level in E I and E II the increase in range is 0.15 to 0.69 mg/dl and 0.40 to 1.34 mg/dl and reached near the standard values of the respective age groups.
- The range of increase between the mean initial and final values was higher among the E II when compared with the E I. In Placebo groups the range of haemoglobin increase is 0.01 to 0.90 mg/dl which was statistically not significant.
- Before 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, two in mild, 11 in moderate and two in severe anaemic group in E I and E II respectively. After six months of supplementation 6 children were in mild anaemic group and 9 in moderate in E I, one in normal, 7 children each in mild and moderate anaemic group in E II, but in

placebo group the shifting over from moderate to mild was very less when compared with the experimental groups.

- The increase in serum retinol value in E I and E II ranged from 0.04 to 0.07 mg/L which was statistically significant at five per cent level. The difference between the mean initial and final group was higher in E II when compared with E I. In P I the range of increase in serum retinol was 0.01 to 0.06 mg/L and in PII 0.00 to 0.04 which was not significant statistically.
- Prevalence of emaciation reduced from 7.7 and 5.9 to 1.9 per cent each in EI and EII. The mean prevalence of Bitot's spots was 15.4, 13.7 and 4.7 per cent before supplementation and it come down to 11.7 per cent in E II. Prevalence of Conjunctival 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 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 and 9.8 per cent in E II.
- Koilonychia was observed among 9.6, 5.9 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.
- The adequacy percentage of cereals and millets, 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 2.5, 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 jaggery, fats and oil. Thus, food intake has increased in the

groups where spirulina was supplemented and no change was recorded in the placebo groups.

- Energy, protein, fat, calcium, iron, vitamin A, β -Carotene, thiamine and vitamin C intakes had increased after supplementation in EI and EII with the range of 2.3 to 2.4, 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 when spirulina was supplemented and there was no change in the placebo groups.

B. Impact of Kitchen garden and Nutrition Education

1. Impact of Kitchen Garden and Nutrition Education on KAP

- In group I where only nutrition education was given, the scores for Knowledge and attitude had increased with the difference of 8.24 and practice with the difference of 7.33. In group II where the only intervention was kitchen garden, Knowledge had increased by 7.33, attitude by 7.41 and practice by 8.34. In group III where both kitchen garden and nutrition education was given, Knowledge had increased by a difference of 8.08, attitude by 8.21 and practice by 8.05.
- All the final scores for knowledge, attitude and practice had increased significantly (P-value <0.01) than the respective initial scores.
- The scores for knowledge and attitude had increased more than scores for practice in group I where only Nutrition Education was given, the scores for attitude and practice had increased more than scores for knowledge in group II where only Kitchen Garden was given. In the group III, where mothers were given nutrition education and kitchen garden, their scores for knowledge, attitude and practice had increased.

From the foregoing results, it can be concluded that VAD and IDA is a problem of public health significance among PTG children. Angular stomatitis, bleeding gums, glossitis and cheilosis were observed especially among Kattunaicken and Paniyas. According to HUDCO (2010) Classification, about 99 per cent of the families belonged to Economically Weaker Section and less than one per cent were in Low Income Group. Sixty six per cent of the monthly income was spent on food and 18.6 per cent on alcoholic drinks, smoking, paan and betel leaves. Crippling was observed due to these habits. All were non vegetarians, consumed three meals and black tea daily. Food intake pattern was dismal. Most of the foods cooked by boiling, Parboiled rice was consumed

daily, pulses and fleshy foods were not included daily; roots and tubers, green leafy vegetables and other vegetables consumed only once a week; fruits and milk intake was very rare. Supplementation of both SC and SIFS showed a significant impact on food and nutrient intakes and consequently on clinical symptoms, nutritional anthropometry, serum retinol and blood haemoglobin when compared to the respective placebos. As a supplement, SIFS showed better effect than SC on the nutritional status. Nutrition Education cum Kitchen Garden was more effective on KAP of mothers than any of them singly.

Recommendations

- Organise large scale, long term and widespread intervention programmes, to enhance the nutritional status of tribal children.
- Conduct in depth longitudinal studies, following up tribal girl children from foetal stages through adolescence assessing their health, nutritional status and functional performance through pregnancy and lactation
- Study the impact of feasible/sustainable interventions on tribal vulnerable groups
- Identify and bring out sports talents and improve nutritional status and sports performance of tribal athletes
- Improve the lot of differently-abled tribal individuals
- Provide special deaddiction programmes, health and nutritional interventions to tribal smokers and alcoholics
- Address need based programmes to tribals with specific communicable and non communicable diseases