SUMMARY AND CONCLUSION

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Malnutrition has been wide spread throughout the developing world including India. It is identified as a third ranking global problem. Malnutrition predominates among the underserved rural as well as urban poor affecting the vulnerable groups. Micronutrient deficiency is one of the most critical factors, which needs to be dealt immediately along with overall control of malnutrition. To combat these deficiencies the Government has initiated several intervention programmes.

Over the years it has been a common practice to evaluate the epidemiology of micronutrient deficiencies separately for each micronutrient and to develop individual strategies for their prevention. Supplementation with single micronutrient has led to highly variable out comes, making the evaluation of the relative efficiency of each type of intervention difficult. Thus the synergistic effect of providing more micronutrient in combination needs to be studied in depth.

The present study on the "Impact of Nutritious Supplement on the Selected Anaemic Adolescents in Coimbatore City, Tamil Nadu" was carried out among the selected adolescents in three Government and seven private schools located in semi urban areas of Coimbatore City namely Kavudampalayam, Ashokapuram and Vellakinaru. These schools were selected by convenience sampling technique. The selected adolescents were in the age group of 10 to 18 years, from the class 6^{th} to 12^{th} standards. Among the selected 3166 adolescents, 1823 (57.5%) were boys and 1343(42.5%) were girls.

Using an interview schedule, background information, life style pattern and dietary pattern were elicited from the selected 3166 adolescents. Anthropometry measurements, clinical examination, dietary and biochemical assessment formed basis for assessing the nutritional status of the selected adolescents.

Out of 3166 adolescents, 1331 were found to be underweight (boys 819, girls 512). The school authorities gave permission only to assess blood haemoglobin for the underweight adolescents. On the basis of blood haemoglobin values, the underweight adolescents were classified as moderate anaemic (N=371), mild anaemic (N=603) and non anaemic (N=357) or normal. A nutritious supplement was formulated in the form of biscuits, 100g of biscuits (8no) and was supplemented for 90 days to the anaemic underweight (N= 114 moderate and N=181 mild). During supplementation normal home diet was followed. In addition, an educational tool namely Health Oriented Education Programme (HOEP) imparted for a period of two months to the supplemented group (underweight moderate and mild anaemic adolescents N=295) and non supplemented group (192 underweight anaemic adolescents, 179 underweight adolescents, 285 risk of underweight adolescents N=656).

The major findings of the study are summarized as follows:

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

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

• It was noted that among 3166 selected adolescents, 10 percent parents were illiterate, 40 percent parents had completed 12^{th} standard and 50 percent parents had college degree.

•With the less educational background, 30 percent of boy's and 18 percent girl's parents were employed in private companies. Twenty four percent boy's and 23 percent girl's parents were coolie workers and they were employed on daily wages. Only less percentage of the parents were doing business and agriculture.

• Around 39 percent boys and 21 percent girls belong to low income group (Rs 2100 - 4500). Fourteen percent boys and 15 percent girls come from middle income families (Rs 4501-7500). Negligible number was in the high income category.

•Among the 3166 adolescents interviewed, 47 percent of boys and 36 percent of girls were in nuclear family system. Majority of adolescent families have five members in their family.

• Out of 1331 underweight adolescents, 15 percent boys and eight percent girls were in the age group of 13 to 15 years. Among the 569 risk of underweight adolescents, 10 percent and eight percent were boys and girls respectively. In the case of selected 1158 normal weight adolescents, 20 percent were boys and 17 percent were girls. Only 78 selected adolescents were overweight and 30 selected adolescents were obese.

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

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

•It was observed that the food preferences after viewing television coincided with adolescents favourite foods. Seventy three to 88 percent of the adolescents had an unhealthy eating environment, they dine while watching television.

•Analysis of data collected revealed that 2371 of the selected adolescents were non vegetarians dominated by constituting 21 percent and 12 percent boy's and girl's population respectively in underweight category, whereas in normal weight category, 16 percent boys and 12 percent girls were non vegetarians. Among the risk of underweight category, five percent boys and six percent girls, in the case of overweight and obese adolescents only two percent and one percent had the habit of taking fleshy food. Only 10 percent boys and six percent girls were pure vegetarians, remaining five percent boys and four percent girls were ova vegetarians.

•Among the 3166 adolescents, none of them skipped their lunch at school. Majority of the selected adolescents, 13 percent boys and 11 percent girls skipped their breakfast often.

•Thirty eight percent boys and 34 percent girls had the habit of consuming fast foods like bhel puri, pani puri, masala puri, chilly gobi and gobi manchurian as snack items; sometimes this itself constituted their main meal. Biscuits still remain the favourite for 23 percent boys and 19 percent girls and they reported to consume them every day because it is very cheap in price. Chips was taken by 23 percent boys and 19 percent girls from the entire BMI category. Sixteen percent selected boys and girls respectively consumed fruits in between meals. Fruits commonly consumed were amla, mango, papaya, guava and some seasonal fruits like sapota, watermelon, pineapple and pears which were sold near school premises.

•Among the selected adolescents, 23 percent boy's and 16 percent girl's occasionally went out to have their food, whereas only nine percent girls and eight percent boys have the habit of taking food outside atleast once in a month. Ice cream was the most favourite item consumed by 48 percent of boys and 32 percent girls, which was followed by snacks like puffs, pastries, pizza and sambar vadai which was taken by 35 percent boys and 29 percent girls. Majority of the selected boys (34 %) and girls (30 %) from all the BMI category group dined outside with their families for evening snacks/dinner. More number

of underweight and overweight boys (17 %) respectively dined outside with their peer group which was followed by normal weight and obese boys.

•Among the selected adolescents, 17 percent boys and 12 percent girls had the habit of taking tea daily. Nine percent boys and eight percent girls consumed coffee regularly. Ten percent boys and girls respectively consumed 75ml to 100ml of milk and coffee respectively. Only less percentage (7% boys and 6% girls) drank health drinks.

•Thirty three percent boys and 22 percent girls had the habit of consuming one to three eggs per week. Only six percent boys and four percent girls consumed four to six eggs per week. In the case of underweight and risk of underweight adolescents very less percentage consumed one to three eggs per week.

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

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

•Totally 28 percent of selected boys and 22 percent girls used refined oil for cooking. Thirteen percent boys and 9 percent girls used gingelly and groundnut oil respectively. Only two percent boys and one percent girls switched over to use corn oil from other oils because of the awareness on cholesterol levels and its health benefits.

•The mean BMI before and after supplementation among the selected underweight moderate anaemic adolescents showed a significant difference at one percent level in the age group of 13 to 18 years in boys and girls but in the age group of 10 to12 years no

statistical significance was obtained. Whereas in mild anaemic underweight adolescents the mean difference values showed a significant difference at one percent level in 10 to12 years,16 to 18 years boys and girls respectively. But in boys from 13 to 15 years there was meager increment in BMI values and was not statistically significant.

•The mean fluctuation of haemoglobin levels in underweight moderate anaemic adolescents was higher among the selected boys (10 to 18years) with the uniform gradual increment and was statistically significant at one percent level when compared with the girls'. At the end of the study only 16 to 18 year old boys had 12.1 g/dl of haemoglobin indicating normal haemoglobin level, which was significant at one percent level. The mean initial haemoglobin levels of underweight mild anaemic sub sample were 10.8 to 11.1 g/dl. After supplementation there was an increase in haemoglobin levels and the 't' values showed one percent level of significance. This revealed that these adolescents showed a better haemoglobin picture.

•Mean increment in the serum iron levels registered by the underweight adolescents in moderate anaemic group was noticed. At the end of the supplementation one percent level of significance was observed in boys (10 to 15 years) and girls (10 to 18 years). Whereas 16 to 18 year old boys did not show appreciable improvement in their serum iron levels and hence it was not statistically significant. The mean differences between the initial and final values of serum iron within underweight mild groups were found to be highly significant at one percent level.

• The initial and final values of serum ferritin in underweight moderate anaemic boys from the age group of 10 to 18 years and for girls 13 to 18 years were significant at one percent level. Whereas the selected 10 to 12 year old girls did not show appreciable improvement in the serum ferritin levels and it was not statistically significant. At the same time mild anaemic boys and girls, showed a significant difference in their serum ferritin values from at one percent level of significance and they had normal serum ferritin level 12 μg /dl.

•In 10 to 15 year old boys and 13 to 15 year old girls sub sample in moderate anaemic underweight group showed a significant difference in initial and final TIBC values at one percent level respectively. In the case of 10 to12 year old girls five percent level of significance was obtained. Whereas in 16 to 18 year old boys, final values were not statistically significant. In the case of mild anaemic underweight group maximum difference was noted in 13 to 15 year old boys, 16 to 18 year old girls and it was significant at one percent level .Whereas in 10 to 12 year old boys five percent level of significance was obtained but for girls in the same age TIBC values were not statistically significant. TIBC values will decrease when iron nutritional status improves and hence the mean values indicated a greater reduction after supplementation.

•Changes in the mean transferrin saturation levels were found to be significant at one percent level in the moderate anaemic boys in 10 to 15 years and girls in13 to 18 years. Whereas five percent significance was seen in 10 to 12 years girls. No statistical difference was seen in 16 to 18 years boys. In the case of mild anaemic underweight sub sample in all the age one percent level of significance was observed.

•The increase in mean serum total protein levels of the moderate anaemic underweight group which was significant at one percent level in all the ages and both sex after supplementation. An appreciable increment in serum total protein levels of mild anaemic underweight boys in 10 to 12 year olds was compared with other age and was found to be significant at one percent level. Among the girls serum protein value was increased to normal level (6.8 to 8.3g/dl) and significant at one percent level.

•It was interesting to note that the selected moderate anaemic underweight boys and girls had low serum albumin levels before supplementation. After supplementation there was an appreciable increment in albumin values of the boys and girls and it was found to be significant at one percent level. In the case of mild anaemic underweight boys and girls (10 to 18 years) serum albumin showed significant increment at one percent level and their values was similar to the normal values 3.7 to 5.8g/dl.

•The mean differences in initial and final serum globulin levels of the moderate anaemic underweight were found to be significant at one percent level in 16 to 18 year old boys and 13 to 18 year old girls. But 13 to 15 years boys' and 10 to 12 years girls', serum globulin values were significant at five percent level, whereas no significance result was seen in 10 to 12 year old boys. In mild anaemic underweight boys and girls from all the age group one percent significance was obtained. After supplementation study, two groups (moderate and mild anaemic underweight sub sample) showed better changes in various blood parameters.

• Fatigued was observed as a clinical symptoms among 33 percent boys and 36 percent girls in moderate anaemic group. Whereas general weakness was reported by 41 percent boys and 40 percent girls. Dental caries was a common problem seen among adolescents (32 % boys and 20 % percent girls) while angular stomatitis was found in 25 percent boys and 12 percent girls and 15 percent girls had bleeding gums. Occurrence of pale conjunctiva in 24 percent boys and 15 percent girls was also noted.

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

•Nutrition knowledge of the selected adolescents receiving the nutritious supplement showed significant increase ($P<0.01$) in the mean scores when compared with the non supplemented group.

•The attitude of the selected adolescents in supplemented and non supplemented group before HOEP was very poor and they simply copy their peers. Post testing scores when compared with non supplemented group, supplemented group adolescents showed significant change in their attitude.

•After HOEP, there was change in the food selection and consumption practiced by the supplemented and non supplemented group. They changed their habit of taking junk foods and it was noticed among 39 percent and 17 percent sub sample in the supplemented and non supplemented group. The selected 80 percent and 77 percent adolescents in the supplemented and non supplemented group respectively understood certain nutritional aspects that combination of food groups is nutritionally good.

• KAP scores of the selected sub sample in supplemented group had scored more when compared with non supplemented group. For nutrition knowledge supplemented and non supplemented group had one percent level of significance. However for changes in attitude of the selected adolescents in supplemented group showed five percent level of significance. Whereas in non supplemented group no statistical significance was observed. Incase of adoption of desirable practices in nutrition and health aspects five percent level of significance was achieved by the both group. Nutrition counselling based on dietary modifications can be used to the adolescents on the basis of prevention and general strategy to overcome nutritional deficiency diseases in coming years.

•The mean nutrient intake was lower in the both supplemented and non supplemented groups. When compared with non supplemented group, supplemented group had an improvement in the intake of nutrients but they did not meet the RDA.

To conclude, supplementation of a nutritious supplement has improved the nutritional status of the selected underweight anaemic adolescents and **Hypothesis I** set for the present study was accepted. Also there was gain in knowledge, attitude and practice among the selected sub sample in the supplemented and non supplemented group; hence the **Hypothesis II** "Health Oriented Education Programme (HOEP)" has improve the selected adolescents and was accepted.

RECOMMENDATION.

This study is a drop in the ocean, in order to improve the nutritional status of the adolescents, similar studies should be undertaken to create awareness and to change the life style and food habits. It is recommended that future research along the following lines be undertaken to bring out more community based strategies on a sustainable basis especially among adolescents.

•Supplementation studies with larger population for longer period.
•Explore other under exploited and less expensive foods rich in micronutrients that can form a regular item of menu
•Formulation and popularization of micronutrient rich food snacks which can makeup the micronutrient deficiencies
•Studies on iron, vitamin A and zinc nurtures among the school going adolescents
•Imparting sound nutrition knowledge not only to children but also to whole family emphasizing the importance of foods and hygienic practices in order to bring about change in the health and nutritional status thereby reducing the incidence of illness and infection.

LIMITATIONS

1. School authorities gave permission to estimate the blood haemoglobin only for the selected adolescents who had poor nutritional status.
2. Only 114 underweight mild anaemic and 181 underweight moderate anaemic adolescents were willing to participate in the supplementation study, so these adolescents were selected as a sub sample.
3. Out 295 selected underweight anaemic sub sample in the supplementation study only103 selected underweight anaemic sub sample were willing to give serum , so blood estimation like serum iron, serum ferritin, total iron binding capacity, transferrin saturation, serum total protein, serum albumin and serum globulin were estimated only for these sub sample.