SUMMARY

& CONCLUSIONS

Developing countries are undergoing nutritional transition, due to globalization and urbanization, leading to faulty dietary and lifestyle behaviors. Both adults and children of all age groups are being affected by this changing scenario. Hence, unhealthy dietary and lifestyle behaviors, not only leads to malnutrition (overweight including obesity and under weight) but also leads to micronutrient deficiencies, especially iron deficiency (anemia). Children and adolescents are the most vulnerable age group to be malnourished and anemic, hence their basic dietary and lifestyle behaviors need to be corrected at this age only. Adolescents being the last stage of opportunity when their behaviors can be influenced , should be targeted to help them improve their dietary and lifestyle behaviors, to enter healthy adulthood. Hence, schools are the best settings to target adolescents along with their caretakers (parents and teachers), to help them prevent the development of NCD risk factors. Therefore, the school authorities also need to be made aware about their roles and responsibilities in the school nutrition and health promotion and prevention of NCDs.

Hence, the present study was undertaken to study the prevalence of malnutrition (overweight including obesity, underweight and anemia), among the adolescents, aged 10-13 years, and subsequently plan a need based nutrition health promotion program and study its effectiveness in a school setting, with the following objectives:

BROAD OBJECTIVE

To study the impact of a nutrition and health promotion program in adolescents (10-12 years) in a school setting.

SPECIFIC OBJECTIVES

1. To review National Curriculum Framework (NCF, 2005) and Gujarat board curriculum being followed by Central Board of Secondary Education (CBSE) and Gujarat Secondary & Higher Secondary Education Board (GSEB) respectively, with regards to essential topics on health and nutrition.
2. To assess the school ethos and environment with respect to nutrition and health services in the school with the help of Nutrition Friendly School Health Index (NFSHI) adapted from Nutrition Friendly School Initiative (NFSI), and School Health Index (SHI).

3. To assess the canteen services in the school for the nutritional quality of the items being sold in it.
4. To assess the knowledge of the science and physical activity teachers regarding nutrition and health aspects with the help of a pretested questionnaire.
5. To conduct situational analysis of the adolescents with respect to their anthropometric, biophysical, biochemical, dietary and lifestyle practices, and meal pattern with the help of a pretested questionnaire adapted from Global School Health Initiative (GSHI).
6. To create enabling environment in the school, by building capacities of the teachers for tiffin auditing, of parents to provide healthy tiffin and by improving the available nutrition services (canteen) in the school.
7. To improve parents' knowledge attitude and practice, by conducting awareness and capacity building sessions pertaining to understanding various aspects of adolescents and building their capacity to manage underweight and overweight problems faced by their children.
8. To improve anemia status of adolescents by necessary IFA supplementation (60mg elemental iron+ 0.5 mg folic acid) for 3 months.
9. To improve knowledge, attitude and practices of the adolescents regarding healthy dietary and lifestyle practices by nutrition health education and capacity building sessions.
10. To assess the impact of one and a half year "nutrition health promotion programme" on the anthropometric, biophysical, biochemical, dietary and lifestyle practices of the children by comparing the results with a control school.

Methodology

A prospective study was undertaken after the ethical approval from the Department of Foods and Nutrition ethical committee prior to commencement of the research study (Ethical committee no. F.C.Sc./FND/ME/80). The two schools (experimental and control) with comparable fee structure were randomly selected and the permission to conduct the study in the respective schools was taken from the principal. The fee structure of the intervention and control school for classes Vth, VIth and VIIth was in the range of 12,000/- to 13,000 /- per annum. The intervention in the form of need based nutrition health promotion program based on situational analysis at baseline

was conducted in the experimental school, while control school was only used to compare nutritional health status and dietary and lifestyle behaviors at baseline and after intervention. The study was conducted only in classes V-VII, with adolescents aged 10-13 years. The consent form (Annexure 1), explaining the purpose and methodology of data collection, were distributed to all the children of the selected classes by the researcher. The study subjects whose parents consented for their child's participation in the study were enrolled in the study. Also informed consent was taken from the study subjects as well (Annexure 1). There was no specific inclusion criteria as all the children from classes Vth – VIIth were being enrolled after their parent's consent. The exclusion criteria was that the child should not be suffering from any disease.

The whole study was divided into 3 phases, namely:

I. Situational analysis
II. Intervention for creating enabling environment in the experimental school
III. Impact of need based nutrition health promotion program (intervention) in the experimental school and comparison of impact indicators between the experimental and control school

All these three phases were carried out during 1 ½ years school academic calendar, including months when no activities could be carried out due to examinations, annual functions and holidays. The study design (Figure 3.1), shows the various steps (20 in number) undertaken in the 3 phases. The 3 phases of the study operated separately or simultaneously as a need based program was evolved step by step. These steps could be from different phases carried out simultaneously in a given time period. Hence, the time framework (Table 3.1) details out the continuous implementation of these 20 steps (as seen from the study design) during a given time period.

Major highlights of the study

Background information of the study subjects

The two study schools were co-educational. The experimental school, had both English and Gujarati as teaching medium, however, the subjects belonging to only English medium were enrolled in the study. While the control school had only English as teaching medium, hence all the subjects from English medium class from standard Vth – VIIth were included in the study. The total number of subjects from the experimental school enrolled in the study were 273, while from the control school were 92. Both the schools were under Gujarat Secondary & Higher Secondary Education Board (GSEB) and therefore the GSEB curriculum was also reviewed to compare the topics covered in Central Board of Secondary Education (CBSE) & guidelines given by Center for disease control, Atlanta to also compare the same with International standards.

Regarding the study subjects, majority (94.8%) of the study subjects from both the schools (experimental school: 95.6% & control school: 92.4%) were in their pre adolescent stage (10-13 years). Looking into the gender distribution of the study subjects (Table 4.1.1), boys were almost double (66.3%) in proportion than girls (33.7%) in both the schools. The same trend of boys being more than girls, was observed in the experimental school (boys: 68.9% vs girls: 31.1%) and control school (boys: 58.7% vs girls: 41.3%) also. The overall distribution of the study subjects, with respect to religion showed (Table 4.1.1), three quarters (75.9%) of the subjects belonged to Hindu religion, while 15.3% and 8.2% belonged to Christian and Muslim religions respectively.

Phase I: Situational analysis

Reviewing National Curriculum Framework (NCF, 2005) for CBSE, State Board Curriculum for GSEB and international curriculum (CDC, USA)

National Curriculum Framework (2005) is the latest curriculum framework for making syllabi, textbooks and teaching practices within the school education programs in India. It is framed and implemented by National Council of Educational Research and Training (NCERT), by the Government of India (GOI), to assist and

advise the central and state governments on academic matters related to school education. Understanding the importance of health education in schools, CBSE launched its Comprehensive School Health Programme (CSHP) in 1940s, which advocated that schools become Health Promoting Schools displaying and supporting the commitment to enhance the emotional, social, physical and moral well being of the school community (principal, teachers, students and family). National Curriculum Framework (2005) also categorically states that health is a critical input for the overall development of the child and it influences significantly student enrolment, retention and completion of school.

The CSHP of India is similar to Comprehensive School Health Program (CSHP) of America which was initiated in late 1980s, later changed to "Coordinated School Health Program" (CSHP) in 2007, to better describe the inter disciplinary and interagency collaboration required between the eight components, namely: health education, physical education, health services, nutrition services, counseling psychology & social services, staff health promotion, family& community involvement and healthy environment. Thus, a collaborative effort of CBSE with WHO was initiated in 2007 with an overall goal to strengthen the CSHP of India more effectively by delivering it's interventions in the form of recommending:

- Four comprehensive school health manuals
- Promotion of school health and wellness clubs

Hence, these manuals along with chapters related to nutrition and health were reviewed with the following highlights:

- The NCF 2005, framed by NCERT for CBSE affiliated schools, updated its Comprehensive School Health Program in collaboration with WHO in 2007 to include formal and informal approaches in the curricular pedagogy by developing teacher's training module and establishment of school wellness clubs. However, many gaps were observed in the module and services provided by the school wellness clubs when compared to CDC recommendations.
- The state board (GSEB) however, did not have any such recommendations regarding setting up of school health & wellness clubs.

- The text books of national (CBSE) and state board (GSEB), covered very few essential topics on healthy eating (NCERT: 13.6% vs GSEB: 9.1%) and physical activity (NCERT: 37.5% vs GSEB: 18.8%). When compared with CDC recommendations. The National Curriculum was slightly better than the state (Gujarat) Curriculum, though both need improvements.

Assessment of school ethos and environment

As recommended by Center for Disease Control (CDC), the schools should take up self assessment activity, with the help of SHI to understand their own school's strengths and weaknesses in terms of policies and practices to improve their nutrition and health services. This activity is carried out with NHT members of the school, comprising of the representatives of different members (school administration, teachers, students and parents). However, no representative school health committee was in place to review the policies and practices related to nutrition and health in both the schools.

The results of the SHI, for the four related modules, with the newly formed NHT members, showed that according module 1 (school health policies), no written policies related to nutrition and health were found in both the schools. Further, according to module 3 (physical education and physical activity program), more weaknesses (experimental: 50% vs control: 70%) were observed than the strengths (experimental: 40% vs control: 30%) in both the schools. However, it was observed with the help of module 2 (health education imparted) and module 4 (nutrition services) that no policies related to the modules were being practiced in both the schools.

The canteen services were not nutrition friendly, as depicted by figures 4.1.1 & 4.1.2. The canteen service providers had no knowledge about nutrition. Also the menus of the canteens were not nutritionally planned. Besides, the teachers teaching science and physical activity also did not have technical nutrition and health knowledge to impart evidence based knowledge to students and act as role models for them by demonstrating healthy dietary and life style behaviours.

Assessment of anthropometric (nutritional status, central obesity), sub optimal blood pressure, biochemical (haemoglobin, lipid and glucose) parameters and

dietary and lifestyle behaviors of the study subjects from the selected two schools catering to Middle to High socio economic strata (MHSES)at baseline.

It was very surprising to note that, in schools where students come from middle to high income socio economic groups, only 12% were healthy, i.e., free from any malnutrition (overweight including obesity, underweight or anemic), while 88.0% were either over weight, obese, underweight or anemic (Figure 5.1). More than half of them (53.7%) were found to be under weight with 49.3% of the study subjects being anemic,irrespective of their nutritional status (Figure 5.2), a trend similar to what is seen in under privileged or low income population.

However, contrary to the hypothesis, that children from MHSES are more over weight and obese, a quarter (25.2%) of them were found to be overweight and obese, with 21.4% of the study subjects were having sub optimal blood pressures, indicating an emergence of one of the major NCD risk factors in adolescents also (Figure 5.2). Therefore, it can be seen that triple burden of malnutrition is also the problem in this socio economic strata, with high prevalence of underweight, over weight and micronutrient (anemia) deficiencies.

Central obesity was as high as 37.0% according to high WHtR and 9.0% according to high waist circumference, posing a need for the researchers to explore the validity of WHtR, over waist circumference, which is a proven risk factor for NCDs. The present study also revealed an association between central obesity and sub optimal blood pressure levels with subjects with high WC (OR: 6.28) or high WHtR (OR: 6.18) having six times increased risk of developing sub optimal blood pressures.

Fasting lipid and glucose estimations were carried out only on overweight and obese subjects, with 46.5% and 28.2% identified to be dyslipidemics, according to ATP III and AHA classifications respectively, while 5.6% were identified as having Glucose intolerance. Among five dietary and lifestyle behaviors considered important for maintaining healthy nutritional status of the adolescents, low intake of fruits and vegetable (≤ 400 gm/day) was observed in more than half (56.7%) of the study subjects. TV watching /computer playing was practiced by 41.4% of the study subjects, while 36.7% of the study subjects had frequent fast food (2 or more than 2 days per week). Physical inactivity was present in 31.8% of the study subjects, while

only 15.3% consumed carbonated (sweetened) beverages for two or mor than two days per week.

More boys had highly significant ($p \leq 0.01$) central obesity than girls as indicated by high WHtR (42.6% vs 26.0%). Similarly, highly significant ($p \leq 0.01$) percentage of boys consumed more carbonated beverages than girls (19.0% vs 8.1%). While highly significant ($p \leq 0.01$) percentage of girls were irregular in consuming breakfast (36.6% vs 20.7%).

Phase II: Intervention for creating enabling environment in the experimental school

Multipronged need based efforts were made to create enabling environment in the experimental school to deal with triple burden of malnutrition among the study subjects to design and implement a nutrition health promotion program in the experimental school setting. Hence, various initiatives were made with the help of school administration, teachers, students and parents. The various initiatives were:

- Improving the tiffin menus brought by the study subjects.
- Change the unhealthy menus of the canteen by promoting availability of healthy snacks and beverages in the canteen.
- Conducting NHE sessions for parents to help them improve their knowledge regarding management of triple burden of malnutrition.

Immediately after the situational analysis in phase I, an orientation meeting was held for school administration and parents, to discuss the results of phase I and nutrition health promotion program to be initiated in the school. However, a very poor (0.04%) participation of parents was seen in the first meeting. Though, with very few parents and school administration, a consensus was reached to change the tiffin menus instead of starting a school meal program.

As an alternative strategy to involve parents in the nutrition health promotion program, a duly signed letter by the principal, mentioning the various components of the program were sent to the parents through the study subjects. This initiative was taken to make parents especially those who did not attend the earlier orientation meetings to make them aware about the nutrition health promotion program to be

initiated in the school. Also another effort was made to involve parents in the decision making process, to decide which component of the program they would want to be initiated in the school for the betterment of their own child.

The response of this activity was better as compared to the orientation meeting, as 47.3% of the parents responded to the letters sent to them. The results showed that most (82.2%) of the parents who responded to the letter wanted a change in the canteen menus, while 71.3% were in favour of a school meal program.

Since, in the first orientation meeting the school administration had shown unwillingness to start a school meal program, and urged mothers to send healthy tiffin from home, a 6 days cyclic menus (Annexure 14) was planned by the researchers to provide 1/3rd of the RDA with iron rich recipes and sent to the mothers. While on the other hand an effort was made with the school canteen contractor to help him change the canteen menus to provide healthier options to students of the school.

The tiffin auditing results either done by researcher or the class teachers showed that the percentage of the study subjects bringing healthy tiffin increased from 49.9% at baseline to almost 100.0%, after the introduction of two sets of 6 days cyclic menus (providing 1/3rd of the RDA and iron rich) as an alternative to school meal program.

An effort was also made to build the capacities of class teachers to help them do the tiffin auditing with the help of checklist (Annexure 18) developed by the researchers. However, they could do it only for one month and were unable to audit tiffin menus of the study subjects due to overload of their own teaching schedules.

An effort was also taken up to improve the school canteen menus. However, the canteen contractor was unwilling to start low fat milk beverages in the canteen, therefore, to convince him a five days pilot trial was initiated to study the sale trend of the proposed product by the students. In all the five days of the trial, there was a consistent demand for butter milk and flavoured milk as compared to the sweetened beverages (Figure 5.3). On looking at the response the canteen contractor made arrangements for providing the healthy beverages in the school canteen.

Besides, all the efforts taken to involve parents, in the nutrition health promotion program in a school setting, improving the knowledge of parents regarding the

management of triple burden of malnutrition for their own children is very essential. Hence, two NHE sessions with the help of power point presentations during the whole one and a half years nutrition health promotion program were conducted for the parents. The results showed significant improvements in the knowledge of parents regarding prevention and control of triple burden of malnutrition (overweight including obesity, underweight and anemia).

The parent's participation throughout the program was not 100%, though it improved gradually at every occasion. From 0.04% participation of parents in the first orientation meeting, it improved to 47. 3% as seen by the response of parents to the letters sent to them, briefing about the nutrition health promotion program initiated in the school. However, only 22.0% actually attended the first NHE session, while it increased to 33.0% in the second NHE session.

Hence it can be concluded that greater efforts are required to involve parents in the nutrition health promotion program initiated in the school setting by making them aware about their roles and responsibilities to make the program effective and improving their own child's health.

PHASE III: Interventions for the study subjects from experimental school

Anemia was found to be present in 49.3% of the study subjects, hence IFA supplementation was immediately initiated, which was also supported by 57.4% of the parents (Table 4.2.1). Later four NHE and capacity building sessions were conducted for the study subjects according to the availability of free periods during one and a half years academic school years. These sessions were conducted to enhance the knowledge of the study subjects about prevention and management of triple burden of malnutrition. Hence the impact of these sessions was seen on their knowledge levels at the end of each session as compare with their knowledge before the session. The impact of full one and a half years nutrition health promotion program was seen on the selected few outcome indicators (anthropometric profile, biophysical and dietary and lifestyle behaviors) of the study subjects from the experimental school and compared with the control school.

Impact of weekly IFA supplementation of 60 mg elemental iron and 0.5 mg folic acid for a period of 3 to 4 months (12 doses) on the prevalence of anaemia

After 3 to 4 months of nutrition health promotion program activities and IFA supplementation (combined interventions), a mild reduction in anaemia prevalence (49.3 to 48.7) in the study population (though not significant) was seen . To study the impact of intervention among the study subjects on haemoglobin and anemia levels, further analysis was done according to the compliance of the tablets taken by the study subjects. Therefore the subjects were categorized according to the compliance of IFA tablets into 4 groups namely : very good, good, average and poor compliance groups respectively (11- 12 tablets, 9-10 tablets, 8 tablets and < 8 tablets).

Overall girls had better compliance than boys. Majority of the girls (74.1%) as compared to the boys (65.9%) had taken ≥9 doses ie. equal to or more than 75% of the required dose of total 12 doses. On looking at the prevalence of anaemia, a reduction was seen in very good (11 – 12 tablets) compliance group (56.6 Vs. 40.8) followed by average compliance group (50 Vs. 40) and good compliance group (59.3 to 52.5). On the contrary a very highly significant increase in anaemia prevalence (18.7 Vs. 68.7) was seen in poor compliance group (Figure 5.4).

Similarly on looking at the mean haemoglobin levels with respect to compliance, a highly significant ($p<0.001$) increase (11.30± 1.9 gm/dl Vs. 11.91±1.2 gm/dl) in the haemoglobin levels was seen in the subjects who had very good compliance (11-12 tablets), and also in good compliance group (11.28±1.7 gm/dl to 11.49±1.0 gm/dl) and average compliance (11.59±1.6 gm/dl to 11.74±0.9 gm/dl) categories. However in the subjects with poor compliance (<8 tablets) a significant decrease in haemoglobin levels (12.97±1.7 gm/dl to 11.3±0.92 gm/dl) was seen (Table 4.3.4). An increase (though not significantly) in haemoglobin levels from base line were seen anemic subjects after the IFA supplementation give little more detail(Table 4.3.5).

Shift in severity of anaemia

Shift in the severity of anaemia was also analyzed with respect to compliance of the total tablets consumed. Moderate anaemia decreased in all the compliance categories (36.8 Vs. 3.9 in 11-12 tablets group), (38.9 Vs. 8.4 in 9-10 tablets group), 13.3 Vs.3.3 in 8 tablets group) and (9.3 Vs. 6.2 in <8 tablets group). Similarly in subjects with

very good (38.1 Vs.57.8), good (28.8 Vs. 35.5) and average (36.6 Vs. 46.6) compliance, a higher percentage of subjects were present in normal categories after intervention as compared to their base line values, except for subjects with poor compliance (81.2 Vs. 25), who registered a highly significant ($p<0.001$) decrease in mean haemoglobin levels after intervention from baseline (Figure 5.5, 5.6, 5.7, 5.8).

Impact of weekly IFA supplementation of 60 mg elemental iron and 0.5 mg folic acid for a period of 3 to 4 months (12 doses) on the academic performance of the study subjects

A significant improvement (from baseline) was seen in the academic scores obtained by the study subjects in the supplemented group (IFA) as compared to the non-supplemented group (191.2±45.20 Vs. 169.86±48.53). Similarly, when comparisons were made in the academic scores obtained between anaemic (174.38±45.46 Vs. 179.57±45.56) and non anaemic (187.87±82 Vs. 190.6±82) subjects the data clearly demonstrated highly significant ($p \leq 0.01$) improvement in anemic group than the non anemic group after the IFA supplementation.

Nutrition health education and capacity building session with students

To improve knowledge of the students, nutrition health education (NHE) and capacity building sessions were conducted, after which marked improvement in knowledge was shown. More than 90% of the study subjects became aware about various nutritional aspects of adolescence like under nutrition, overweight including obese, anaemia. After the capacity building session regarding BMI plotting, 84.6% of the study subjects were able to correctly plot their own BMI on the charts.

Impact of nutrition and health promotion program on few selected outcome indicators (BMI for age, biophysical parameter, biochemical parameter, and dietary and lifestyle behaviors), in comparison to the control school.

After one and a half years of nutrition health promotion program, no significant difference was seen between the experimental and control schools in the prevalence of malnutrition (77.9% vs 82.6%). Though looking at the malnutrition prevalence in the experimental school after the nutrition health promotion program, a decrease in the prevalence of malnutrition was observed from its baseline values (78.8% vs 77.9%),

though it failed to reach significant levels. In the control school after the nutrition health promotion program the prevalence of malnutrition increased from its baseline values (79.3% vs 82.6%).

Regarding central obesity, after nutrition health promotion program, no significant difference existed between the experimental and control school, as indicated by high WC (4.5% vs 9.8%) and high WHtR (31.5% vs 38.0%) with control school having higher prevalence of central obesity than the experimental school.

The prevalence of central obesity within the two schools also did not show any significant decrease as compared to their respective baseline values irrespective of the indicators (WC and WHtR) used.

The prevalence of sub optimal blood pressures, after the nutrition health promotion program was very highly significantly ($p \leq 0.001$) high in control school than in the experimental school (4.1% vs 35.9%). In the experimental school, after the nutrition health promotion program a very highly significant ($p \leq 0.001$) fall was also observed in the prevalence of sub optimal blood pressures from their baseline values (23.8% vs 4.1%). However, a reverse trend was observed in the control school, where very highly significant ($p \leq 0.001$) rise was observed from its baseline values (14.1% vs 35.9%) after nutrition health promotion program.

The impact of one and a half years nutrition health promotion program was also observed on biochemical profile (fasting lipid and glucose) which was taken only for overweight and obese subjects to assess the prevalence of dyslipidimea and glucose Intolerance. After the nutrition health promotion program (intervention), the control school was found to have significantly higher ($p \leq 0.05$) prevalence of dyslipidimea (according to ATP III) than the experimental school (46.4% vs 19.5%). Similarly, the prevalence of dylipidimea according to AHA also, after the intervention, was found to be highly significantly ($p \leq 0.01$) more in the control school than the experimental school (42.9% vs 9.8%). Similarly, looking at the changes in the prevalence in the schools from their respective baseline values, the experimental school showed significant ($p \leq 0.05$) reduction from the baseline prevalence of dyslipidimea according to ATP III (37.2% VS 19.5%) or AHA classification (20.9% vs 9.3%). While in the control group, dyslipidimea decreased, though not significantly from

baseline by ATP III classification (60.7% vs 46.4%) and increased non significantly by AHA classification (39.3% vs 42.9%).

Looking into the prevalence of glucose intolerance (GI), after the nutrition health promotion program (intervention), the control school (17.9%) was found to have higher prevalence of GI than the experimental school (4.9%), though the difference was non significant, while a significant difference existed at baseline between the two schools. However, in the experimental school, the prevalence of GI reduced from baseline (9.3% vs 4.9%), while the prevalence emerged in the control school.

It was also observed that unhealthy dietary and lifestyle behaviors were more in the experimental school than in the control school before the nutrition health promotion program, while after the intervention, these behaviors were found to be very highly significantly ($p \leq 0.001$) high in the control school than in the experimental school.

On looking at the changes in the prevalence of unhealthy behaviors in the experimental school, very highly significant ($p \leq 0.001$) decrease was observed from their baseline values for (carbonated/ sweetened beverage intake, fast food intake, Low fruits and vegetable intake, physical inactivity) While high significant ($p \leq 0.01$) decrease from its baseline values, in the experimental school was observed in TV watching/ computer playing. On the contrary, in the control school, after one and half years nutrition health promotion program (intervention) very highly significant ($p \leq 0.001$) increase was observed in percent prevalence of study subjects who consumed carbonated (sweetened) beverages, became physically inactive. While significant increase ($p \leq 0.05$) was observed in the percent prevalence of the study subjects from the control school who consumed fruits and vegetable less than 400 gm/day. Similarly, with respect to fast food intake and TV watching / computer playing, non significant increase was observed in the control school from their respective baseline values.

After the nutrition health promotion program (intervention), the percent prevalence of more than or equal to 3 cumulative unhealthy behaviors was very highly significantly ($p \leq 0.001$) lower in the experimental school subjects as compared to those in control school subjects (4.1% vs 52.2%).

Within the schools also, a very highly significant ($p \leq 0.001$) drop, in the percentage of subjects, having cumulative unhealthy behaviors was seen in the experimental school (30.0% vs 4.1%), while the reverse trend was seen in the subjects of the control school (9.8% vs 52.2%).

Conclusions

The present study aimed to initiate a nutrition and health promotion program in a school setting where students from middle to high socio economic strata come. The assessment of nutritional status of the study subjects showed that, adolescents from middle to high socio economic status are not only at risk of overweight and obesity, but are more at risk of being under nourished (under weight and anemic). The rapid nutritional transition in the developing countries, like India due to economic growth and globalization and women joining the work force has led to replacement of traditional healthy food with more unhealthy energy dense, low nutrient foods. This unhealthy nutrition transition is also supported by food processing industries, who market their processed products with great advertising skills, without thinking on the nutritional aspects of the product.

However, this transition, is also largely accepted by the society as there has been a shift in female's role also. The females are now more taking up jobs outside home, and find it difficult to spend more time in the kitchen. Hence, these processed foods and ready to eat foods are well accepted by the society, without the realization of the unhealthy dietary habits it perpetuates and its role in the rising burden of non communicable diseases and its risk factors in the population.This rising burden of NCD risk factors can be controlled at the early ages. These modifiable NCD risk factors are overweight including obesity, high blood pressure, unhealthy dietary and lifestyle behaviors. Hence, to control these modifiable risk factors among children and adolescents is much easier than in adulthood where behavior patterns are set and often difficult to change. Also if these NCD risk factors are left unrecognized and uncontrolled in this age group, then these at risk adolescents enter unhealthy adulthood, with risk of earlier manifestations of developing NCDs. Therefore, adolescents, being the age of opportunity to develop healthy dietary and lifestyle behaviors, should be targeted as adolescent overweight and obesity is rising in the developing countries also.

To capture this age group at one time, for their nutritional assessments and to help them modify their dietary and lifestyle behaviors, schools are the best settings. Therefore, school administration of the schools should be made aware of the recommendations regarding nutrition and health policies to be implemented in the schools for the students. They should also be made aware of the fact that schools hold immense potential to change an individual's life. With the help of teachers and parents, they should take initiative to make their school nutrition friendly. Also to make any nutrition and health promotion program sustainable, policies need to be made so that it becomes mandatory for the schools to follow nutrition recommendations. Hence, a monitoring committee should be there to monitor the various eight aspects of school health, namely, health education, physical education, health services, nutrition services, counseling, psychological and social services, healthy school environment, health promotion for staff and family/community involvement. Also science teacher's knowledge about nutrition health being poor and parent's apathy towards attending school health promotion program needs to be improved by discussing results of nutrition assessment during Parents Teachers Meetings.

The school's curriculum and environment should be made in such a way to help children practice healthy dietary and lifestyle behaviors. The curriculum of the school besides other subjects should contain chapters, providing technically correct information about nutrition to the students. The curriculum should be in line with the national recommendations for children and adolescents. Therefore, these chapters should be framed with the help of a person who is technically sound in nutrition aspects. In the school also, to teach nutrition and health, a nutrition expert trained to impart evidence based knowledge and skills to children of various age groups should be employed, and the other subject teachers should not be given this job.

Nutritious meal program is essential in schools as tiffin auditing is much more cumbersome and time consuming activity which can be avoided if nutritious meals are served in schools. This will also ease parents/ mothers pressure of making healthy meals in the mornings and giving tiffins, especially when more and more mothers are now doing jobs or doing some business etc. Teacher's participation and supervision of

nutritious meal program with peer influence will promote healthy eating and teachers can be effective role models for promoting healthy eating.

Also regarding the meal services to be provided in the school campus, school authorities should have a say in the food products sold in the school campus and should frame a healthy canteen policy to be adopted by the contractor and should be a part of nutrition and health committee of the school, so that she/he is made aware of the recommendations regarding the nutritious food services in the school campus. Besides, the nutrition aspect of the food being served in the school for students, they should also be trained in food safety measures and healthy cooking practices.

A school nutrition health promotion program is always incomplete without the participation of parents, hence, more of parents participation should be encouraged to reinforce the knowledge of students outside school. Involvement of parents also enables them to gain knowledge about their own child's nutritional status and nutrition and lifestyle behaviors that need to be promoted during adolescence period. Therefore various strategies should be adopted to involve parents as much as they can be, because it is the parents who will help children to sustain these healthy dietary and lifestyle behaviors lifelong.

As is seen in the underprivileged or low income population, it was surprising and worrisome to note that in the present middle to high income schools also the burden of under nutrition is highest with more than 50.0% of the pre adolescents being under weight. Similarly anemia (49.3%) in the population was also a public health problem in the selected school. The results of the study indicate that governments and school authorities need to give importance to this aspect. At present government of India runs National Programs (school health program, Anemia control program, SABLA etc) to tackle the problem of under nutrition and anemia in government or corporation schools. However, in private non government schools there is no mandatory provision of identifying under nutrition and anemia. Consequences of under nutrition and anemia in this age group can cause intergenerational cycle of malnutrition and can have both short term and long term consequences. Therefore, it is important that all schools government or private should have mandatory requirement for assessment of nutritional status and identifying anemia as anemia is a universal phenomenon in

India and there is a need to tackle this problem in this age group due to its adverse consequences in reducing cognitive performance and physical work capacity.

Till now many of the school nutrition and health promotion programs have been planned to prevent overweight and obesity among school going children and adolescents, however, looking at the triple burden of malnutrition among the adolescents age group from the present age and income group, the schools should plan to tackle the triple burden of malnutrition in this socio economic strata also. Therefore, nutrition and health promotion programs after development of a comprehensive school health policy for all the schools of India, needs to be institutionalized.

RECOMMENDATIONS OF THE STUDY

For the government (national and state)

- Advocacy to the government is needed to give due importance to school health or school as a setting for nutrition health promotion in all sections of society, this can play a significant role in curbing the rising trend of NCDs.
- National level / state level steering committee on school health needs to be formed consisting of school administration, teachers, nutrition experts/ specialists, educationists, parents, behavior change experts, health experts, physical activity experts and psychologists (counselors) etc, and they should oversee the curriculum development and school health promotion strategies.
- National data base for nutrition and health status of school children needs to be created which will help in guiding the school authorities and national governments, the steps that need to be taken to promote school health.
- National and state school policies related to healthy eating and physical activity should be mandatory for all the schools (public and private).
- School meal programs should be initiated in MHSES schools, preferable school breakfast programs providing 1/3rd of the RDAs.
- The records of the nutritional status of all the students nationally, should be decentralized so that the data is available as and when required. These records should be analyzed and discussed at national level to make changes in the national recommendations if required.

For Research

- Nationwide and state wide mapping of all the schools for nutritional status is required using uniform standards for comparisons.
- Newer markers for assessing at risk adolescents for NCD need to be identified like (Waist to height ratio, neck circumference, blood pressure etc).
- Efficacy of blood pressure assessment and monitoring needs to be validated in adolescent population in view of controversies regarding its use as screening tool in this population.
- The role of blood pressure monitoring as an indicator for practicing healthy behave iours in population as shown in the present study also need to be validated by larger trials.

Figure 5.1: Percent prevalence of healthy and malnourished study subjects in the selected two schools

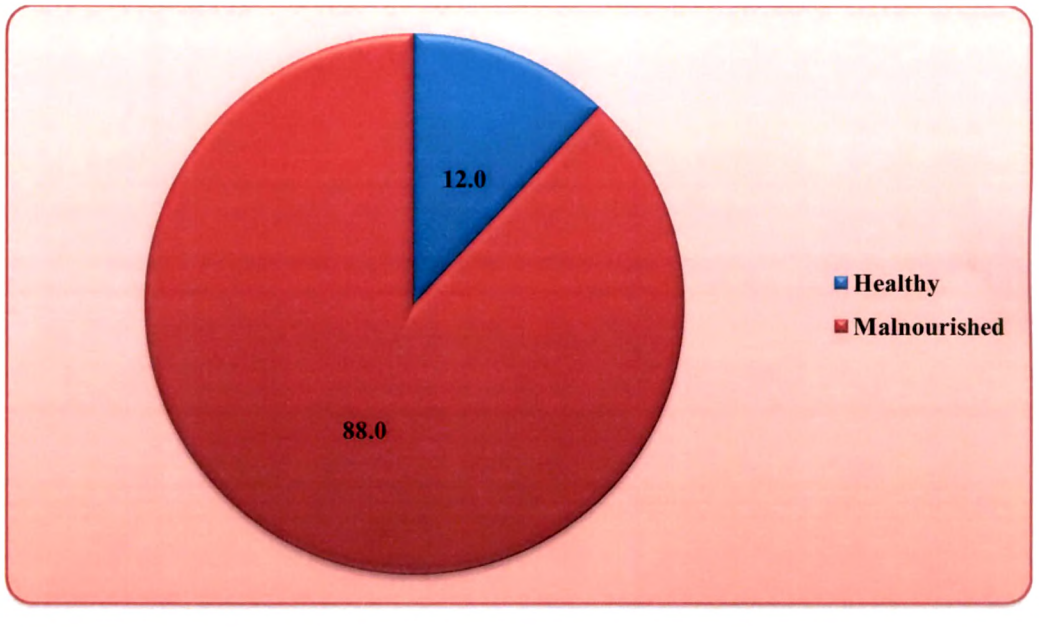

Figure 5.2: Percent prevalence of malnutrition, central obesity and high blood pressure among the study subjects

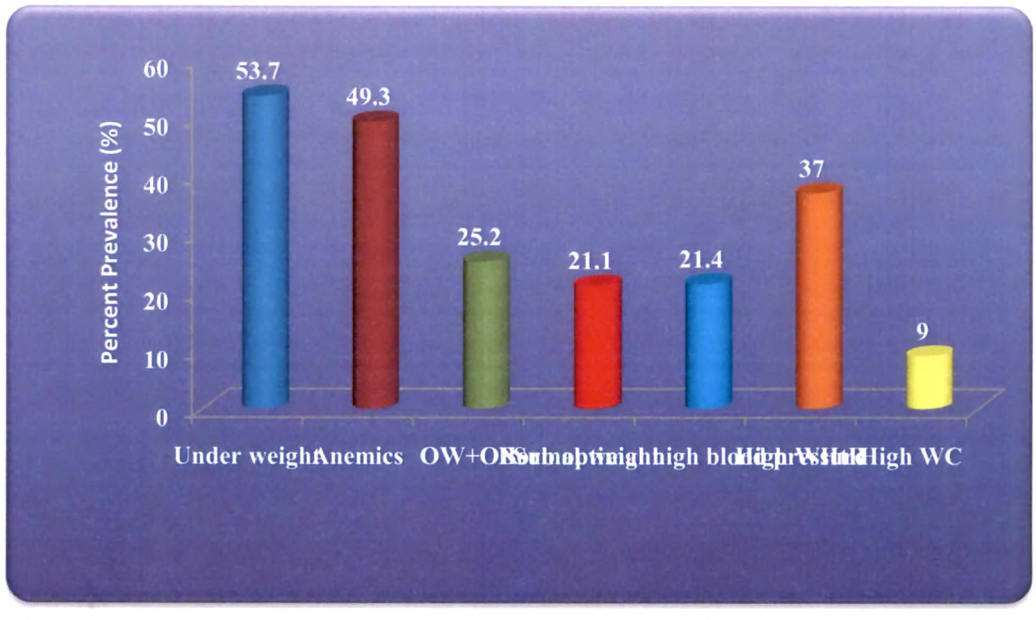

Figure 5.3: Mean number of products sold in five days pilot trial

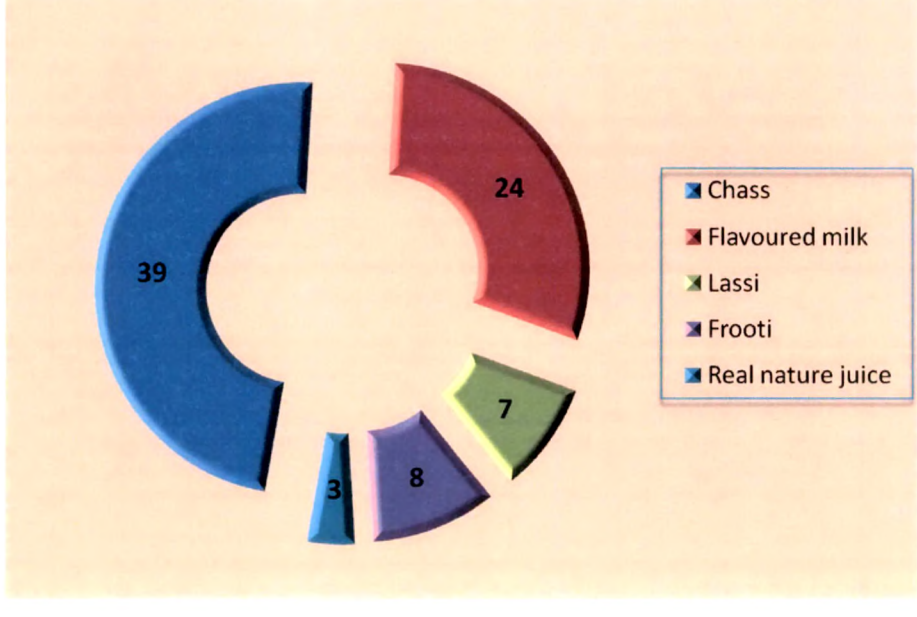

Figure 5.4: Changes in prevalence of anaemia in the study subjects before and after intervention in relation to compliance of IFA tablets

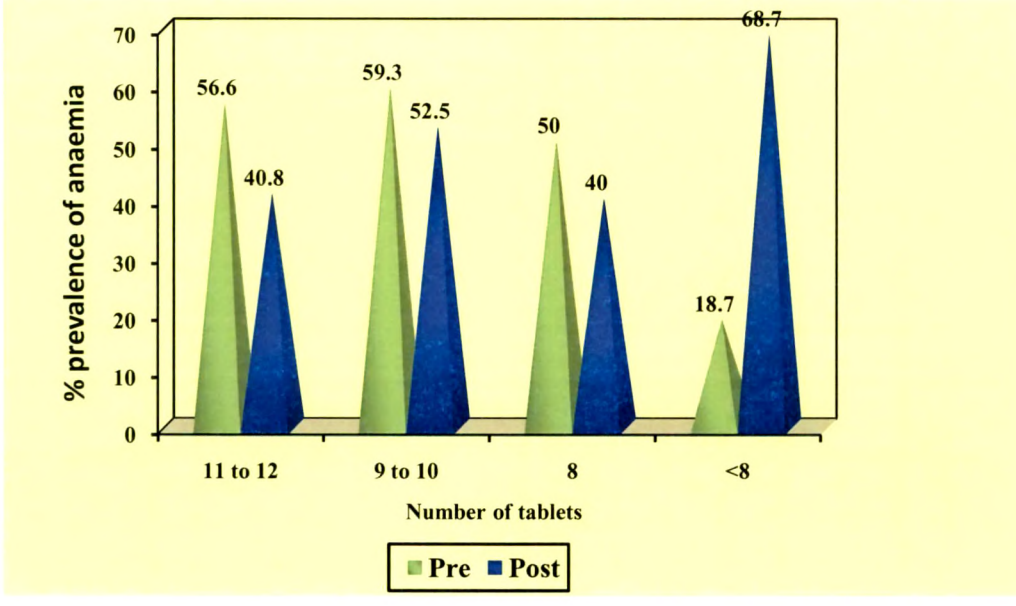

Figure 5.5: Percent change in prevalence of anaemia in relation to compliance of IFA tablets (11-12 tablets) among the study subjects (N=197)

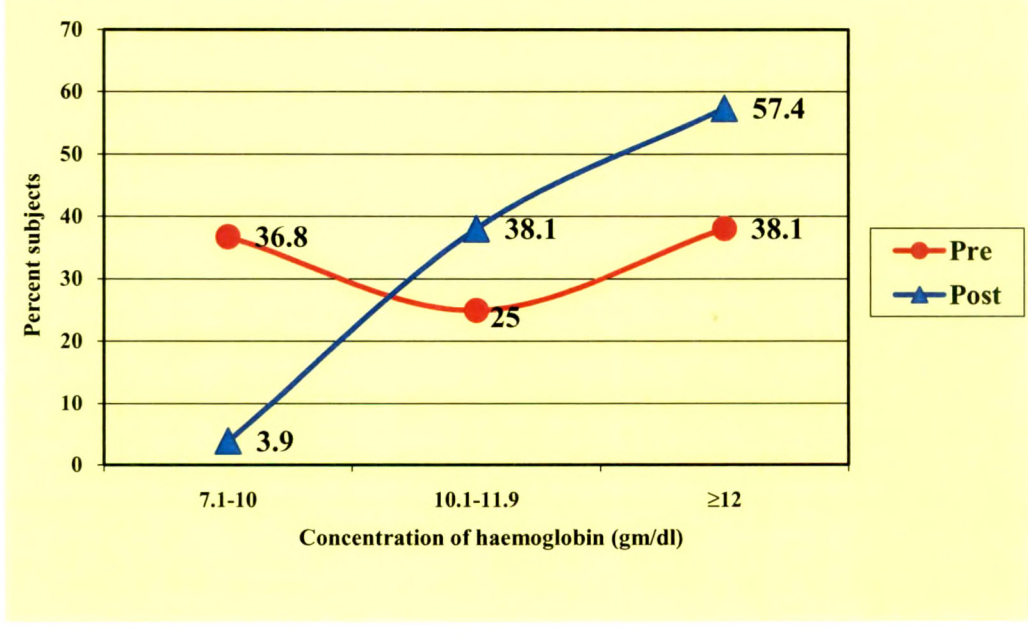

Figure 5.6: Percent change in prevalence of anaemia in relation to compliance of IFA tablets (9-10 tablets) among the study subjects (N=197)

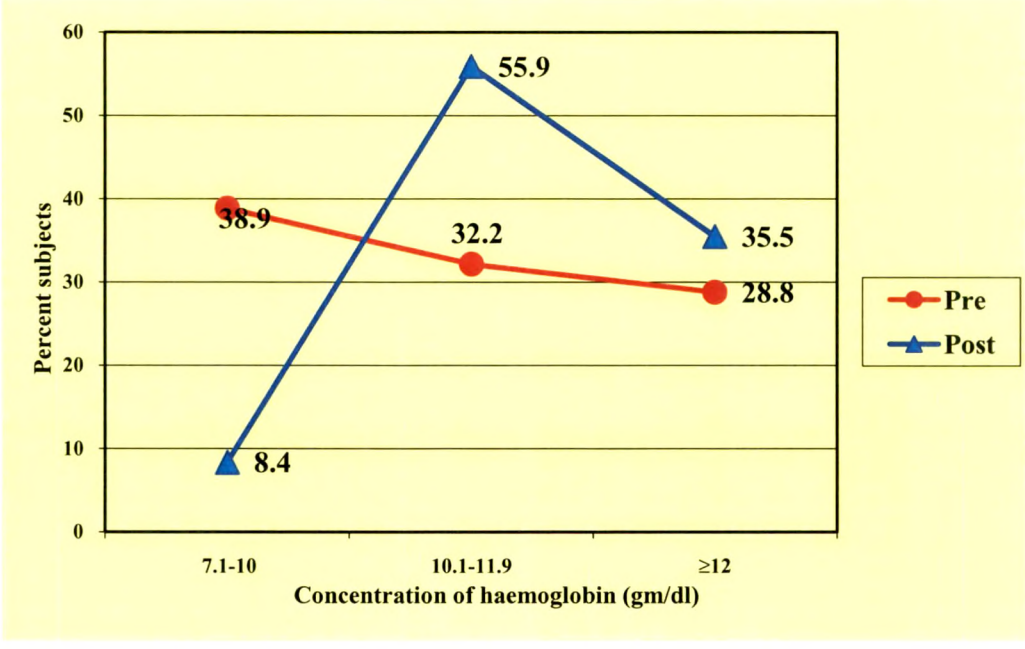

Figure 5.7: Percent change in prevalence of anaemia in relation to compliance of IFA tablets (8 tablets) among the study subjects (N=197)

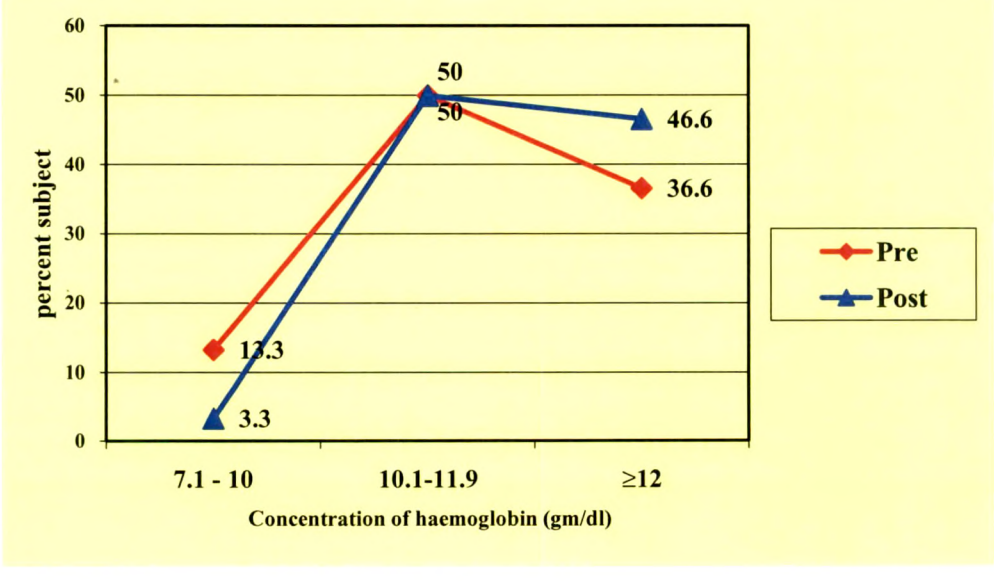

Figure 5.8: Percent change in prevalence of anaemia in relation to compliance of IFA tablets (< 8 tablets) among the study subjects (N=197)