RESULTS & DISCUSSION

This chapter presents the results of the following study conducted in two schools with the study subjects belonging to middle to high economic strata (MHSES). The study involved adolescents aged 10-12 years, the last window of opportunity to attain growth and development and influence healthy dietary and lifestyle behaviours in school setting where teachers and parents can play a significant role. Hence, the study was conducted in Three phases. The first phase included situational analysis in terms of reviewing national and state school curriculum related to nutrition and health education, understanding school ethos and environment of the selected schools and screening of the study subjects from classes Vth to VIIth, to assess the burden of malnutrition (under weight, over weight and anemia). Then based on the results of the prevalence of malnutrition among the study subjects of the selected schools, nutrition health promotion program was planned in the next three phases, to be implemented in the school setting, where all the study subjects could be targeted at one time. The intervention aimed at creating enabling environment in the school using various approaches (capacity building of teachers & parents and efforts to improve canteen services) and improving student's knowledge, attitude and practices by various forms of Nutrition Health Education (NHE) materials (health cards, power points, posters, and book marks), and IFA supplementation.

Therefore, the three phases of the study were:

PHASE I: Situational analysis in terms of school curriculum, school ethos and environment of the two selected schools and assessment of the burden of malnutrition among the study subjects from the selected two schools.

PHASE II: Interventions for creating enabling environment in the experimental school

PHASE III: Interventions for the students from experimental school & Post intervention data collection from experimental and control school to assess the impact of one and a half years nutrition and health promotion program in a school setting

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 class 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 and compared with the topics covered in Central Board of Secondary Education (CBSE). Also efforts were made to review guidelines given by center for disease control Atlanta USA to compare it with International standards.

Before elaborating the results of the above mentioned three phases, table 4.1.1 describes the profile of the study subjects from the two selected schools. The table clearly shows that majority (94.8%) of the study subjects from both the schools were in their pre adolescent phase (10-13 years). In the experimental and control school 95.6% and 92.4% of the study subjects respectively, were in the age group of 10-13 years, the pre adolescent 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 (68.9% vs 31.1%) and control school (58.7% vs 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.

The results of the following phases are as follows:

Table 4.1.1: Age, gender and religion profile of the study subjects from the selected two schools

Variables	Experimental School (N=273)	Control School (N=92)	Total (N=365)
	% (n)	% (n)	% (n)
AGE (years)			
< 10	2.2 (6)	0 (0)	1.6 (6)
10 – 13	95.6 (261)	92,4 (85)	94.8 (34.6)
14 - 16	2.2 (6)	7.6 (7)	3.6 (13)
GENDER			
Girls	31.1 (85)	41.3 (38)	33.7 (123)
Boys	68.9 (188)	58.7 (54)	66.3 (242)
RELIGION			
Hindu	68.9 (188)	96.7 (89)	75.9 (277)
Muslim	10.6 (29)	1.1 (1)	8.2 (30)
Christian	19.8 (54)	2.2 (2)	15.3 (56)
Sikh	0.7 (2)	-	0.5 (2)

PHASE I

SITUATIONAL ANALYSIS

4.1.1Reviewing National Curriculum Framework (NCF, 2005) for CBSE and State Board Curriculum for GSEB

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. NCERT publishes textbooks, for classes 1 to XII, used by government and private schools across India following Central Board of Secondary Education (CBSE) board.

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

4.1.1a Comprehensive school health manuals

Till recent years aspect of school health was somehow relegated to sporadic health checkups or in some cases a few hours of health instructions in the curriculum. However, the four manuals, developed by CBSE in collaboration with WHO in 2007 addresses this gap in schooling, where it aims to view health holistically, utilize all the educational opportunities for health promotion including formal and informal approaches in curricular pedagogy. The four modules developed were:

- Volume I: Addressed to all stakeholders concerned with school health.
- Volume II: Teachers activity manual for Primary Level (classes I to V)
- Volume III: Teachers activity manual for Upper Primary Level (classes VI to VIII)
- Volume IV: Teachers activity manual for Secondary and Higher Secondary Level (classes IX to XII)

The activities to be conducted by the teachers revolve around six different themes. They are:

1. Knowing your body
2. Foods and Nutrition
3. Personal, environmental hygiene and sanitation
4. Physical fitness
5. Being safe and responsible
6. Behaviour and life skills

As can be seen from tables 4.1.2 and 4.1.3, the topics in national (CBSE) Teachers Training manuals were reviewed and they revealed that 81.8% of the essential topics on healthy eating and 87.5% on physical activity respectively were covered, as described by Center for Disease Control (CDC) curriculum, however, the state (GSEB) board being currently followed in the selected schools, did not have any teachers training module at all.

Looking at the important topics recommended by CDC & its relevance in our context as well, the national (NCERT) curriculum had certain gaps which were as under:

Table 4.1.2: Comparison of essential topics to be addressed for healthy eating curriculum in national and state

S. No.	Essential topics for healthy eating recommended by CDC	Whether or not covered by NCERT					Whether or not covered by GSBST
		Teacher's training manuals- Vol II (classes I - V)		Teacher's training manuals- Vol III (VI - VIII)		Text Books (V to VIIth)	
		2007	2010	2007	2010		
1	Benefits of healthy eating	√	√	√	√	√	√
2	Importance of eating a healthy breakfast	X	X	X	X	X	X
3	Importance of making healthy choices when eating out	√	√	√	√	X	X
4	Importance of making healthy choices when snacking	√	√	√	√	X	X
5	The relationship of unhealthy eating to chronic diseases such as heart disease, cancer, diabetes, hypertension, and osteoporosis	-	-	√	√	X	X
6	The Dietary Guidelines for Indians	-	-	√	√	X	X
7	The Food Guide Pyramid and nutritious choices for each group	√	√	√	√	X	X
8	Using food labels	-	-	√	√	√	X
9	Importance of moderation in a person's eating habits	-	-	√	√	X	X
10	Identifying key nutrients (e.g., water, vitamins, minerals, protein, carbohydrates, and fiber) and major food sources of each	√	√	√	√	√	√
11	Identifying foods that are low in fat, saturated fat, cholesterol, sodium, and added sugars	-	-	X	X	X	X
12	Preparing a variety of healthy meals and snacks	-	-	√	√	X	X
13	Influence of personal preferences, family, peers, culture, and media on dietary behavior	-	-	√	√	X	X
14	Finding valid information and services related to healthy eating	-	-	√	√	X	X
15	Goal-setting and decision-making skills for healthy eating	√	√	√	√	X	X
16	How students can influence and support others to engage in healthy eating	-	-	√	√	X	X
17	Balancing food intake and physical activity	X	X	√	√	X	X
18	Healthy weight management	-	-	√	√	X	X
19	Accepting body size differences	-	-	√	√	X	X
20	Risks of unhealthy weight control practices, such as crash or fad diets, purging, diet pills, and tobacco use	-	-	X	X	X	X
21	Eating disorders (e.g., anorexia, bulimia)	X	X	X	X	X	X
22	Food safety, including handwashing and safe food purchasing, preparation, and storage	√	√	√	√	X	X

- Topics not for the respective age group

Table 4.1.3: Comparison of essential topics of to be addressed for physical activity curriculum in national and state

S. No.	Essential topics for physical activity recommended by CDC	Whether or not covered by NCERT					Whether or not covered by GSBST
		Teacher's training manuals (Vol II)		Teacher's training manuals (Vol III)		Text Books (V to VIIth)	
		2007	2010	2007	2010		
1	Meaning of physical activity, exercise, and health-related fitness sunburn, heat stroke, and hypothermia	√	√	√	√	√	X
2	Physical, mental, and social benefits of physical activity	√	√	√	√	√	X
3	Role of physical activity in controlling body weight	√	√	√	√	√	√
4	Recommended amounts and types of physical activity for adolescents and adults	-	-	√	√	√	√ (but not correct)
5	Role of a sedentary lifestyle in development of chronic diseases	X	X	√	√	√	√
6	Ways to increase daily physical activity	√	√	√	√	√	X
7	Physical activities that contribute to maintaining or improving the components of health related fitness	√	√	√	√	X	X
8	Influence of culture and media on physical activity	-	-	√	√	X	X
9	Finding valid information and services related to physical activity and fitness	-	-	X	X	X	X
10	Interpersonal communication skills related to physical activity	√	√	√	√	X	X
11	Behavioral skills related to physical activity (e.g., goal-setting, decision-making, self monitoring)	√	√	√	√	X	X
12	Planning a personal physical activity program	√	√	√	√	X	X
13	Methods for avoiding and responding to physical conditions such as physical exhaustion,	√	√	√	√	X	X
14	Proper wear and use of safety equipment for specific physical activities	√	√	√	√	X	X
15	Importance of hydration in physical activity	√	√	√	√	X	X
16	Effects of and legal issues related to using performance-enhancing drugs	X	X	-	-	X	X

1. Dietary guidelines were given only for energy and not for other nutrients like protein or fats or essential vitamins and minerals.
2. Children were taught to identify healthy (fruits & vegetables and home cooked foods) and unhealthy (processed foods from market) foods without mentioning the exact reason for them being healthy or unhealthy.
3. BMI calculation and WHO 2007 growth charts were not introduced to enable students to calculate their own nutritional status.

There were few topics (recommended by CDC) which were not at all discussed, namely:

- Identifying foods that are low in fat, saturated fat, cholesterol, sodium, and added sugars
- Risks of unhealthy weight control practices, such as crash or fad diets, purging, diet pills, and tobacco use.
- Eating disorders (e.g., anorexia, bulimia)
- Recommended duration of physical activity according to age.

4.1.1b Course text books

The chapters pertaining to nutrition and health were also reviewed of national (CBSE) and state (GSEB) board compared with CDC recommended essential topics to be covered in the curriculum for healthy eating and physical activity. The results are presented in table 4.1.2 and 4.1.3. Out of 22 essential topics for healthy eating, only 3 topics (13.6%) were covered in the text books of national (CBSE), while only 2 topics (9.1%) were covered in the state (GSEB) board text books.

Regarding essential topics for physical activity (table 4.1.3), 6 topics (37.5%) were covered in national (CBSE) books, while only 3 topics (18.8%) were covered by the state (GSEB) books.

It was also observed that the Gujarat (GSEB) board text books had information on RDAs (table 4.1.4) and exchange list (table 4.1.5). On reviewing the information from table 4.1.4, it clearly showed that the information provided in the text books appeared to be incorrect or incomplete as compared to National Institute of Nutrition (NIN) RDA applicable in 2005 and revised RDAs for Indians in 2010 **(NIN 2011).** The

exchange list (table 4.1.5) in the text book was also inappropriate and not very clear in terms of the portion sizes commonly consumed by the populations.

Table 4.1.4: Comparison of the Recommended Dietary Allowances (RDA) given in state curriculum (GSEB) books and National standards given by National Institute of Nutrition (NIN) for Indians

RDA as in Gujarat board (GSEB) text books		Standard RDA as recommended by National Institute of Nutrition for Indians *					
Individual	Daily Requirement (calories)	Group	Category/ age (in years)	2005		2010	
				Net energy (kcal)	Protein (g/d)	Net energy (kcal)	Protein (g/d)
10-12 years old child	2000	Boys Girls	10-12 10-12	2190 1970	54 57	2190 2010	39.9 40.4
12-14 years old boy	2200	Boys	13-15	2450	70	2750	54.3
14-16 years old girl	2600	Girls Boys	13- 15 16-17	2060 2640	65 78	2330 3010	51.9 61.9
15-18 years old girl	2600	Girls	16-17	2060	63	2440	55.5
15-18 years old youth	3000						
Labourer	2500-4000	Man	Sedentary Moderate Heavy	2425 2875 3800	60.0	2320 2730 3490	60.0
		Woman	Sedentary Moderate Heavy	1875 2225 2925	50	1900 2230 2850	55.0

Reference: * National Institute of Nutrition (2004), Hyderabad

Table 4.1.5: Review of the exchange list given in state text books (GSEB)

Food	Amount	Calorie available	Review Comments
Chapati	One	150	Serving size of chapatti not mentioned
Bread	One big slice	70	
Apple	One big piece	100	Amount of serving not mentioned
Rice	100 gms	500-600	Cooked or raw not mentioned. 100 gms of raw rice gives 350 kcal, hence cooked will give lesser calories
Butter	1 spoonfull	100	Tea spoon (tsp)or table spoon (tbsp), not mentioned. 1 tsp= 5gms & tbsp= 15 gms.1 tsp gives 45 kcal, 1 tbsp gives 135kcal
Milk	1 cup	150	Skimmed or full fat not mentioned. Measurement of the cup also not mentioned.
Mutton	50 gms	100	1 piece of mutton or two not mentioned. 2 pieces are 40 gms and provides 70 kcal.
Egg	1 big	100	Average egg in market weight between 60-80 gms-
Spinach	100	26	Raw or cooked – not mentioned
Banana	1 banana (Big)	104	Big= 100gms, medium= 80 gms or small= < 80 gms.
Grapes	100gms	17	100 gms of grapes (pale green variety) provide 71 kcal.

For example, in table 4.1.5, it is given that one chapati gives 150 kcals. However, when comparing with the standard exchange list, one exchange of cereal is 20 gms which provides 70 kcal of energy. Therefore, from the table 4.1.5, it is not clear that one chapatti is how many grams of wheat flour, and the amount of energy provided by one exchange thus cannot be calculated. Likewise, the information provided for other foods in the table 4.1.5, was incomplete in terms of amounts or calories, when details about the amounts taken to derive at the values was not given.

4.1.1c School health and wellness clubs

At National level (NCERT) institutionalization of School health wellness clubs in all the schools as an integral part of comprehensive school health promotion was recommended because they can act:

- As organizer of all the health relevant activities (at least 8-10 activities in the year at each level)
- Resource center for the overall well being of the students.
- Screen, diagnose and impart health counseling services to the students.

They have the following objectives:

- To create health cards for each student.
- To create a health newspaper at least twice a year/ poster competition related to health issues.
- To conduct surveys on health related concerns.
- To organize health walks as part of social campaigns.
- To organize health fairs and immunization projects.
- To tap the local resources in the community to arrange health talks.
- To render service in any area affected by a disaster or a calamity.
- To create health help- line within the school to de-stress, cope with emotional and social behaviours and to clarify misconceptions regarding sexual and reproductive health.
- To teach the students techniques of yoga and meditation from an early age.
- To inculcate in the students healthy and positive way of living.
- To teach health songs on various health topics.
- Celebration of important days (World Health Day- April 7).
- Creating awareness regarding World No Tobacco Day (May 31), World AIDS day (December 1), etc.

These activities were further classified to be carried class wise (1-V, VI-VIII, and IX-XII), under the six areas (knowing your body, food and nutrition, personal, environmental hygiene and sanitation, physical fitness, being responsible and safe, and behavior and life skills).

In view of the rising trend of over weight/ obesity among adolescents and its risks of developing high blood pressure, dyslipidemia, poor school performance with problems of undernutrition and anemia still affecting large sections of the population, it is imperative that the monitoring of these indicators become a part of school health

assessment. Keeping these points in mind the health cards given by national curriculum (NCERT) were reviewed and the following gaps were noted:

- Biochemical estimations (haemoglobin level, fasting glucose and lipid profiles) were not included.
- The school health card I (health history) did not have any information on haemoglobin levels, fasting and lipid profiles.
- School health card II (results of the examinations done in the wellness clubs) did not include weight information (classification based on different categories of Body Mass Index) and biochemical profile (stool examination, haemoglobin levels and glucose and lipid profile).
- The health card II, also did not have the WHO 2007 growth charts (different for girls and boys) so that the growth of the child could be monitored regularly in the wellness clubs.
- Blood pressure measurement was also not incorporated in school health card II, indicating that no provision is made to measure blood pressure of children's in the wellness clubs.

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 to CDC recommendations. The National Curriculum was slightly better than the state (Gujarat) Curriculum, though both need improvement.

4.1.2 Assessment of school ethos and environment

Center for Disease Control (CDC), recommends that schools should take up self assessment activities to understand their strengths and weaknesses in terms of policies and practices to improve their nutrition and health services. Therefore, to conduct this activity a representative team of school community (administrators, students, teachers) and parents is required. However, both the experimental as well as the control schools did not have any such team, hence, a Nutrition Health Team (NHT) was formed, comprising of 2 administrators (principal and vice principal), 1 teacher, 2 students, and 1 parent who volunteered to be a part of the NHT and nutrition health promotion program to be implemented in the school.

4.1.2b Assessing School Policies and Practices

School Health Index (SHI) of CDC (CDC 2005) and Nutrition Friendly School Initiative (NFSI) of WHO (WHO 2006) was used to develop framework to assess the strengths and weaknesses of the study schools with respect to various components of Coordinated School Health Program (CSHP), namely, health education, physical education, health services, nutrition services, counseling, psychological & social services, healthy school environment, health promotion for staff, family & community involvement. All these components of CSHP, are important for the holistic development of the students in a school setting. Therefore, Nutrition Friendly School Health Index (NFSHI) adapted from SHI (CDC) and NFSI (WHO), was used to assess strengths and weaknesses of the two selected schools with the help of only four modules pertaining to health and nutrition policies and practices (school health policies, health education, physical education & physical activity program and nutrition services).

The strengths and weaknesses of the respective schools are shown in Table 4.1.6, four modules pertaining to health and nutrition were assessed. These results were the responses of the NHT members (principal, vice principal, teachers, counselor, student representatives, and one parent representative).

Table 4.1.6: Strengths and weaknesses of the selected two schools with respect to health and nutrition policies and practices as assessed by NFSHI

MODULES	STRENGTHS		WEAKNESSES		PARTIALLY IN PLACE	
	Experimental School	Control School	Experimental School	Control School	Experimental School	Control School
Module 1: **School Health Policies**	Access to physical activity facilities outside school hours Overcoming barriers to learning Enrichment experiences Adequate physical activity facilities		No representative school health committee No written school health policies Complete access to foods of minimal nutritional value No communication of school health policies to Students, parents, staff, and visitors	Access to physical activity facilities outside school hours Overcoming barriers to learning Adequate physical activity facilities No representative school health committee No written school health policies No communication of school health policies to Students, parents, staff, and visitors	Connectedness to school	Enrichment experiences Complete access to foods of minimal nutritional value
MODULE 2: Health Education	• Nil	Nil	Nil	Nil	Active learning strategies	Active learning strategies
MODULE 3: Physical Education and Physical Activity program	225 minutes of physical education per week Students active for at least 50% of class time Physical education is enjoyable Participation in extracurricular physical activity programs	225 minutes of physical education per week Students active for at least 50% of class time Participation in extracurricular physical activity programs	Sequential physical education curriculum consistent with standards Physical education grading Promote community physical activities *(class room discussions and assignments)* Prohibit substitution for physical education Adequate teacher/student ratio (ratio similar to other subject taught)	Physical education is enjoyable Sequential physical education curriculum consistent with standards Physical education grading Promote community physical activities *(class room discussions and assignments)* Prohibit substitution for physical education Adequate teacher/student ratio (ratio similar to other subject taught)	Individualized physical activity/ fitness plans	
MODULE 4: Nutrition Services	• Nil		Nil		Nil	Promote healthy food and beverage choices

Looking at the results of the module 1, which is related to school's policies, for the experimental school, out of the points considered to assess policies of the schools, strengths and weaknesses were found to be in the same proportion (44.4%) while only one point (11.1%) was considered to be partially in place, i.e., connectedness to school. However, no strengths were observed in the control school regarding policies and 66.7% of the considered points were taken as weaknesses and 33.3% were partially in place. Therefore, the results indicate that school administration needs to be sensitized on the importance of incorporating health and nutrition policies along with policies related to other issues.

The results of module 2, related to health education imparted in the schools, showed similar results for both the experimental and control schools. No strengths and weaknesses were found in terms of health education, while only active learning strategies were found to be partially in place in both the schools. Hence, as observed before also, the whole education curriculum of the state (Gujarat) board needs revision based on the national standards (CBSE), if not international standards (CDC).

Module 3, based on physical education and physical activity program also shows, similar results for both the selected schools. More weaknesses (experimental: 50% vs control: 70%) were observed than the strengths (experimental: 40% vs control: 30%) in both the schools. The results show that, though children were active for the recommended time (1 hour per day), other aspects (student teacher ratio, education curriculum, prohibit substitution for physical activity, etc) need to be considered to improve physical activity and education in the schools. Lastly, module 4, pertaining to nutrition services showed no policies in place for both the schools. However, only in the control school, sale of unhealthy snacks and beverages was prohibited, though it was not included in the school policy.

4.1.2c Assessing Canteen services

Canteen is a place where children access food in the school campus. Hence, it is an important aspect of the nutrition service for the students in the school. Therefore, the canteen of the two selected schools was assessed for their services. In both the schools, canteen was the only source of food besides their tiffin during the schools hours. Further results revealed that the experimental school, offered precooked and pre packed snacks, high in trans fats, and sugars. The study of sales trends of these

snacks showed high sales of unhealthy, high calorie, trans-fat containing snack items such as puff, samosa and vegetable roll (figure 4.1.1) as well as sweetened beverages such as pepsi, fruity and appy fizz (figure 4.1.2). School authorities had no role in planning canteen menu (or other foods available in the canteen) and the nutritional aspect of the foods being sold on the school campus was not taken into consideration.

In the control school, permanent canteen did not exist. Two volunteer mothers of the students were given the contract to provide the snack items. The recipes (ragda patties, vada pau, vegetable rice, poha etc) were decided by the volunteer mothers themselves. The food was cooked at home, and provided to students in the recess time only. Before and after the recess, no snack or any other item was available to the students in the control school. However, sale of unhealthy snacks (puff, frankys, samosas etc) and carbonated beverages was prohibited in the school campus, although no written policy was in place for the same.

Figure 4.1.1: Sales trend of popular snacks (average pieces/day) at baseline in experimental school

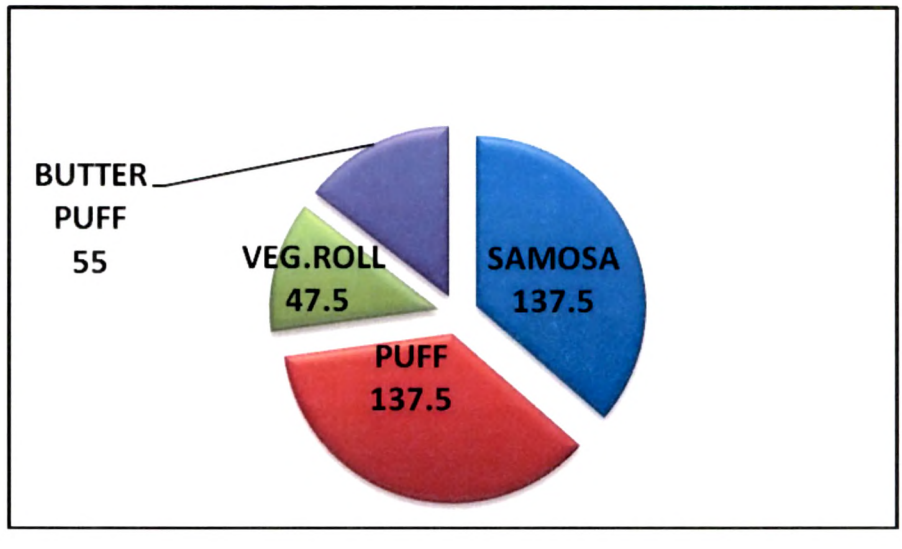
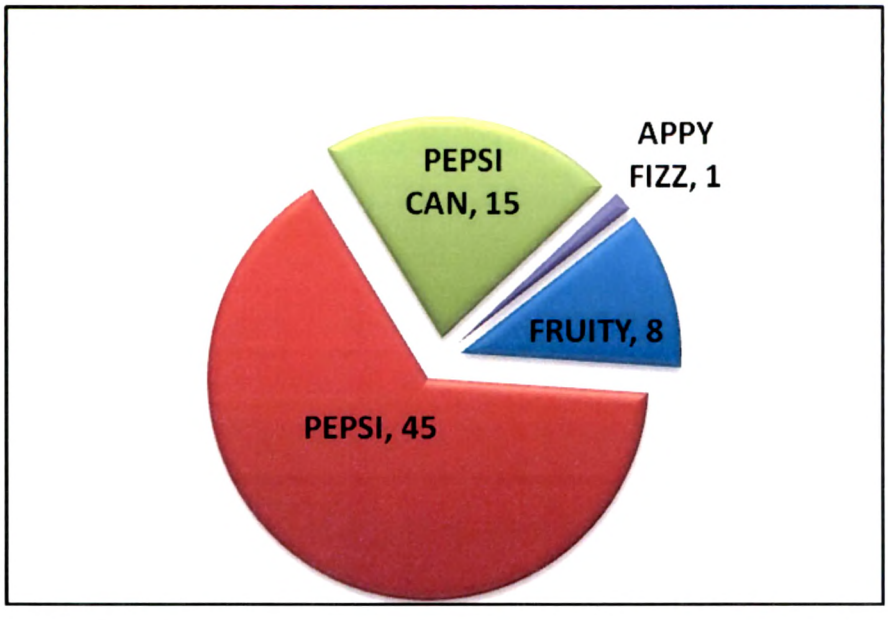


Figure 4.1.2: Daily sales trend of beverages (glasses or tetra packs) at baseline in experimental school



4.1.2d Assessing Nutrition Health knowledge of science and physical activity teachers of classes V-VII

Knowledge of teachers, from the two schools pertaining to 'healthy diet' was found to be in appropriate. They could correctly identify faulty behavior patterns leading to malnutrition in children and also supported teaching about these in school, their outlook regarding the same was however limited. Their main concern was on scholastic performance of children with no thought about the health consequences. It was also found that in spite of teachers being able to distinguish unhealthy behaviors from healthy ones, they depicted insufficient knowledge about their reasons. For example, though all the teachers agreed that sweetened carbonated beverages did not impart any health benefit, none were able to give an explanation for the same other than suggest that, they were 'chemicals' and 'toxins'. It was also found that experimental school did not have any technically qualified physical activity teachers, while the control school had one.

Highlights:

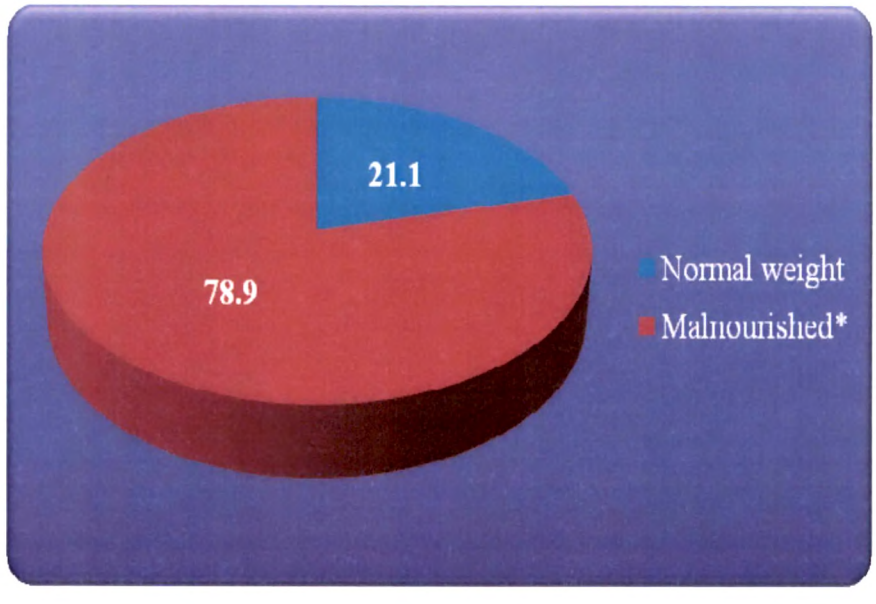
- No representative school health committee was in place to review the policies and practices related to health and nutrition in both the schools.
- According to SHI, module 1 pertaining to school health policies, no written policies related to nutrition and health were found in both the schools. However, in both the schools, various related activities were being followed (access to physical activity facilities was better in the experimental school than in the control school while better enabling environment in terms of selling of nutritious food was found in the control school than in the experimental school).
- 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.
- According to module 2 (health education imparted) and module 4 (nutrition services) showed no policies in place for both the schools.
- The canteen services were not nutrition friendly. The canteen service providers had no knowledge about nutrition aspect. Also the menus of the canteens were not nutritionally planned.
- Teachers teaching science and physical activity did not have technical knowledge about nutrition and physical activity.

4.1.3 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)

According to figure 4.1.3, more than three quarters (78.9%) of the study subjects from MHSES were malnourished (overweight including obese, and underweight), while only 21.1% were having normal weight, as indicated by BMI for age WHO 2007 growth standards. Furthermore, from figure 4.1.4, it was very surprising to note that more than half (53.7%) of the study subjects from MHSES, were identified as underweight, while a quarter (25.2%) of them were overweight (including obesity). The prevalence of anemia, was 49.3% in the study subjects. Hence, prevalence of

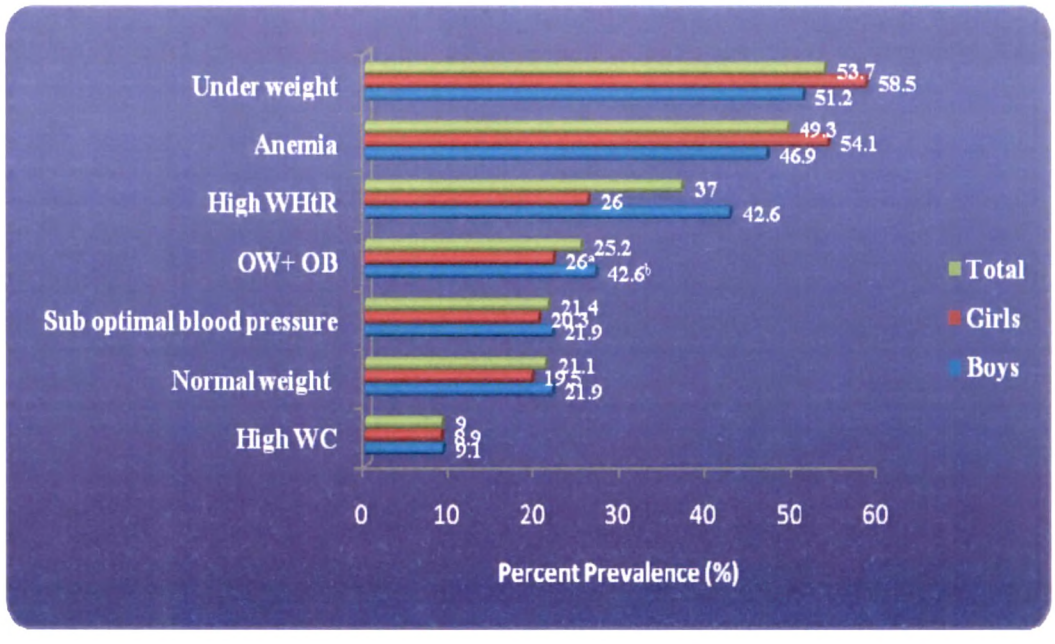
overweight (including obese), underweight along with anemia indicated the presence of triple burden of malnutrition among this age group from MHSES also. Central obesity measurements as seen from figure 4.1.4, also revealed that 1/3rd (37.0%) of the study subjects had central obesity when measured by high WHtR, while 9% subjects could be classified as centrally obese by taking the criteria of high waist circumference. Similarly, about 1/5th (21.4%) of the study subjects had suboptimal blood pressures (Figure 4.1.4).

Figure 4.1.3: Percent prevalence of nutritional status of the study subjects from the selected two schools



****Malnourished (overweight including obese and under weight)***

Figure 4.1.4: Prevalence of anemia, malnutrition, sub optimal blood pressure and central obesity among the study subjects from the selected two schools



Nutritional status according to WHO 2007 (de Onis et al. (2007)**:** Normal weight: (-1 to +1 z score), Over weight: (> + 2 to +3 z score), Obese: (> +3 z score), MIUW: (< -1 to – 2 z score), MOUW: (< -2 to -3 z score), SUW: (< - 3 z score).

Central Obesity (Ferna´ndez et al.2004, McCarthy and Ashwell. 2006)**:** Waist Circumference (WC): High WC: ≥ 90th percentile; Waist to Height Ratio (WHtR): High WHtR: (Normal: < 0.5, High: ≥ 0.5)

Hypertension (NIH 2005)**:** Normal: <90th percentile, Pre hypertension: ≥ 90th to <95th percentile, Stage I: ≥95th to 99th percentile, Stage II: >99th percentile

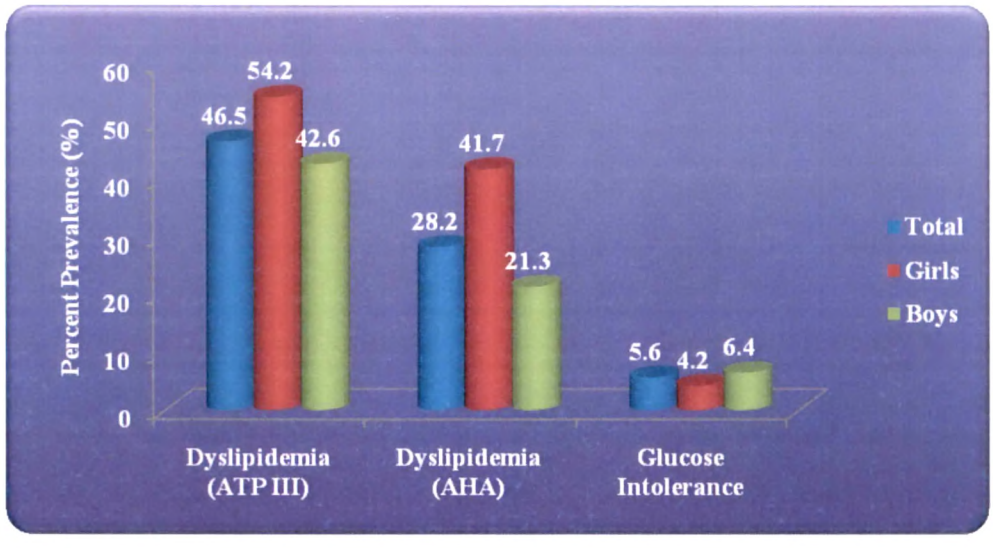
Anemia status (age wise classification, WHO 2007)**:** 5-11 years: >11.0g/dl, 12-14 Years: ≥ 11.5 g/dl, Boys (15 or above): ≥ 12.0 g/dl; Girls (15 or above): ≥ 13.0 g/dl

a vs b***

The biochemical parameters of only overweight (including obese) subjects, showed that (figure 4.1.5), dyslipidemia was present in 46.5% and 28.2% of the study subjects according to ATP III and AHA classifications respectively. Glucose intolerance was observed in 5.6% of overweight and obese subjects.

Looking into the dietary and lifestyle behaviors of the study subjects, figure 4.1.6 indicated that more than half (56.7%) of the study subjects did not fulfill their daily recommended intake of fruits and vegetables (≥ 400 grams), which was followed by 41.4% of the study subjects watching TV/ playing on computer for more than two hours a day. Having fast food, 2 or more than 2 days was practiced by 36.7% of the study subjects. Moreover, 31.8% of the study subjects were physically inactive, and high intake of carbonated beverages (≥ 2 days / week) was reported by 15.3% of the subjects.

Figure 4.1.5: Percent prevalence of Dyslipidemia (ATP III & AHA classifications) and Glucose Intolerance (IDF Classifications) in over weight and obese subjects from the selected two schools



ATP III: Adult Treatment Panel, AHA: American Heart Association, IDF: International Diabetes Federation

Cut off for Lipid profiles,:

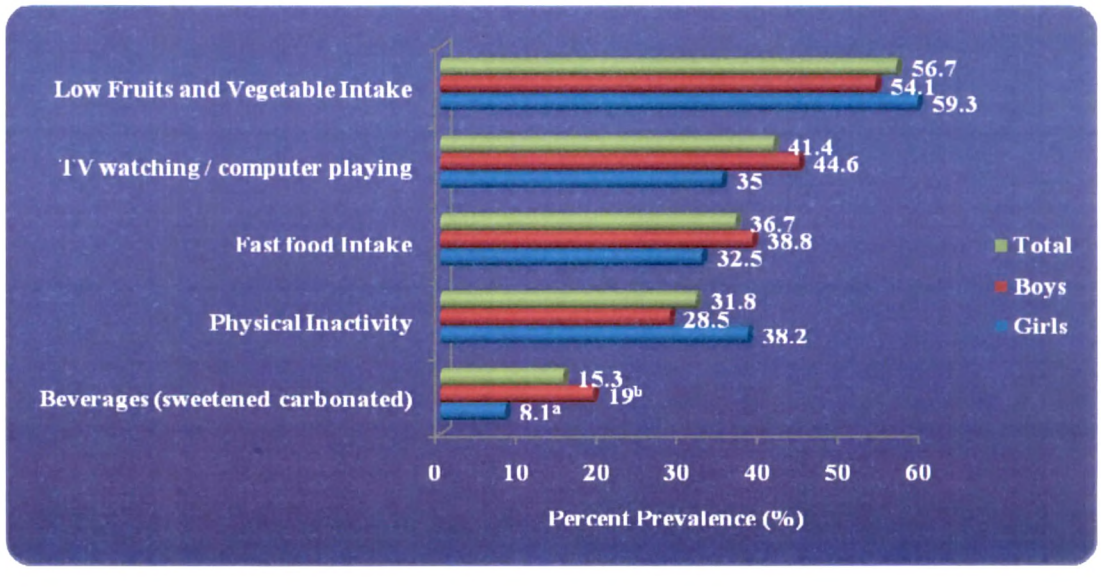
ATP III Classification (NIH 2002): TC:> 200gm/dl
LDL: >100 gm/dl
TG: >150 gm/dl
HDL: < 40 gm/dl

AHA Classification: TC: > 200gm/dl
LDL: > 130 gm/dl
TG: ≥ 150 gm/dl
HDL: ≤ 35 gm/dl

Cut off for glucose profiles :

IDF guidelines (IDF 2007): < 100gm/dl

Figure 4.1.6: Percent prevalence of modifiable risk factors among the study subjects from the selected two schools



a vs b **: X^2= 7.43, p= 0.006

The breakfast patterns of the study subjects (Table 4.1.7) revealed that most (65.8%) of the study subjects consumed breakfast regularly while about a quarter (26.0%) of them were not regular breakfast eaters. Table 4.1.8, shows the reasons, given by the study subjects for their irregularity in having breakfast. The results revealed that, most (32.9%) of them mentioned other reasons (completing homework in the morning, do not feel hungry in the morning, tuitions early in the morning) for not being able to take breakfast, besides not having enough time (26.6%) and not able to eat early in the morning (8.8%). Regarding the breakfast pattern of the study subjects, table 4.1.9, revealed that most (82.7%) of the subjects were having unhealthy breakfast at home.

Table 4.1.10, showed that most (89.9%) of the study subjects brought their lunch boxes to school, and about half (48.8%) of the study subjects consumed the food from their lunch box only in the school campus while another half (44.9%) of the study subjects had their lunch box as well as bought snacks from the canteen also (Table 4.1.11).

Table 4.1.7: Breakfast consumption pattern in terms of number of days consumed by the study subjects from the selected two schools

		Girls (n=123)	Boys (n=242)	Total (N=365)
		% (n)	% (n)	% (n)
Breakfast pattern	**Regular (> 3 days / week)**	52.8 (65)	72.3 (175)	65.8 (240)
	Irregular (≤ 3 days / week)	36.6 (45)	20.7 (50)	26.0 (95)
	No breakfast	10.6 (13)	7.0 (17)	8.2 (30)

X^2= 13.89***

Table 4.1.8: Reasons for skipping breakfast in the morning before coming to school as given by the study subjects from the selected two schools

	Responses	Girls (n=123)	Boys (n=242)	Total (N=365)
		% (n)	% (n)	% (n)
Reasons for not having breakfast	No response	26.8 (33)	34.3 (83)	31.8 (116)
	Do not have time	35.0 (43)	22.3 (54)	26.6 (97)
	Cannot eat early in the morning	15.4 (19)	5.4 (13)	8.8 (32)
	Other reasons	22.8 (28)	38.0 (92)	32.9 (120)

X^2= 21.551***

Table 4.1.9: Breakfast pattern of the study subjects from the selected two schools

		Girls (n=123)	Boys (n=242)	Total (N=365)
		% (n)	% (n)	% (n)
Breakfast pattern	Unhealthy breakfast	81.3 (100)	83.5 (202)	82.7 (302)
	Healthy breakfast	12.2 (15)	12.0 (29)	12.1 (44)
	Nothing	6.5 (8)	4.5 (11)	5.2 (19)

Table 4.1.10: Percentage of the study subjects from the selected two schools bringing lunch box to the school

Responses	Girls (n=123)	Boys (n=242)	Total (N=365)
	% (n)	% (n)	% (n)
Yes	95.1 (117)	87.2 (211)	89.9 (328)
No	4.9 (6)	12.8 (31)	10.1 (37)

X^2= 5.632*

Gender wise distribution

While assessing the association between the various indicators (malnutrition, central obesity, suboptimal blood pressure, anemia, dyslipidemia and glucose intolerance) and gender, no significant associations were found (Figure 4.1.4, Figure 4.1.5). However, more girls were found to be under weight (58.5% vs 51.2%) and anemic (54.1% vs 46.9%) as compared to boys , while boys were found to be more over weight and obese than girls (26.9% vs 22.0%). A highly significant association ($p<0.01$) was observed between high WHtR and gender, with boys having more high WHtR than girls (42.6% vs 26.0%). The prevalence of sub optimal blood pressure between the two genders was found to be almost similar (21.9% vs 20.3%). Central obesity as indicated by high WC was almost same in both the genders (9.1% vs 8.9%).

According to figure 4.1.5, no significant gender difference existed in the prevalence of dyslipidemia and glucose intolerance in overweight and obese subjects between the genders. However, girls were found to be more dyslipidemic than boys (ATP III: 54.2% vs 42.6%, AHA: 41.7% vs 21.3%), while boys had higher levels of glucose intolerance (6.4% vs 4.2%).

Also no significant gender differences were observed between the gender and unhealthy behaviors, except for consumption of carbonated beverages, which was consumed more by boys (19.0%) than girls (8.1%), and the difference was highly significant ($p=0.002^{**}$). However, looking into the gender differences for other behaviors, more girls (59.3% vs 54.1%) were found to consume less fruits and vegetables (< 400gm), than boys. Girls were also found to be more (38.2%) physically inactive than boys (28.5%). While, boys were found to be involved more in watching TV/ playing on computer more than 2 hours a day (44.6% vs 35.0%), consuming fast food, 2 or more than 2 days (38.8% vs 32.5%).

Table 4.1.7, showed that there is a highly significant association between the breakfast pattern and gender ($p=001^{**}$). It shows that more proportion of girls (36.6%) were irregular (≤ 3days/week) in their consumption of breakfast than boys (26.0%), indicating highly significant difference between the genders ($p\leq 0.01^{**}$). Also very highly significant association between reasons and the gender was seen

(table 4.1.8). More proportion of the girls as compared to boys (35.0% vs 22.3%) reported that they did not have time followed by expressing their inability to have breakfast in the morning (15.4% vs 5.4). However, more proportion of boys were found to give no response (34.3% vs 26.8%) and giving other reasons (38.0% vs 22.8%) for not consuming breakfast.

From table 4.1.10, demonstrated an association between bringing lunch box to school and gender, with significantly higher (p=0.018*) proportion of boys not bringing lunch box than girls (12.8% vs 4.9%).

Similarly, from table 4.1.11, an association was also observed between eating pattern of the study subjects in the recess and gender. High significant difference ($p \leq 0.01$**) was observed between the genders, with more girls (56.9%) eating only the food brought in their lunch box than boys (44.6%), while more proportion of boys (8.7%) were found to be using only canteen in the recess than girls (1.6%).

Table 4.1.12, shows the relation of sub optimal blood pressure with different parameters (nutritional status and central obesity). No association was found between the sub optimal blood pressure levels of the subjects and nutritional status as measured by BMI. However, an association was found between suboptimal blood pressure and central obesity. There was very highly significant difference in the prevalence of sub optimal blood pressure between the subjects with high waist circumference as compared to subjects with normal waist circumference (57.6% vs 17.8%). Similarly, 49.4% of the study subjects with high WHtR had sub optimal blood pressures, than the study subjects having normal WHtR (13.6%), showing very highly significant association . The result also indicated that the subjects with high WC (OR: 6.28) and high WHtR (OR: 6.18) were six times at risk of developing sub optimal blood pressures.

Table 4.1.11: Eating pattern of the study subjects from the selected two schools during the recess time

Responses	Girls (n=123)	Boys (n=242)	Total (N=365)
	% (n)	% (n)	% (n)
Eat the food only from the lunch box	56.9 (70)	44.6 (108)	48.8 (178)
Buy from the canteen	1.6 (2)	8.7 (21)	6.3 (23)
Both	41.5 (51)	46.7 (113)	44.9 (164)

X^2= 9.455**

Table 4.1.12 Relationship of sub optimal blood pressure with nutritional status and central obesity of the study subjects from the selected two schools

	Normotensives	Sub optimal blood pressure
	% (n)	% (n)
Normal weight (n=77)	83.1 (64)	16.9 (13)
Malnutrition (n= 288)	77.4 (223)	22.6 (65)
Normal WC (n=332)	82.2 (273)	17.8 (59)[a]
High WC (n= 33)	42.4 (14)	57.6 (19)[b]
Normal WHtR (n=286)	86.4 (247)	13.6 (39)[c]
High WHtR (79)	50.6 (40)	49.4 (39)[d]

a VS b*** (OR: 6.28); c VS d*** (OR: 6.18)

Highlights:

- Presence of triple burden of malnutrition in the present study subjects from MHSES (under weight: 53.7%, overweight including obesity: 25.2% and anemia: 46.3%) is alarmimg.
- Only 21.1% of the study subjects from middle to high income schools were having normal BMI for age.
- Central obesity as indicated by high WHtR and High WC was present in 37.0% and 9.0% of the study subjects respectively.
- Sub optimal high blood pressure was present in 21.4% of the study subjects.
- In overweight and obese subjects, 46.5% and 28.2% were identified to be dyslipidemics according to ATP III and AHA classifications respectively.
- In overweight and obese subjects, 5.6% were identified as having Glucose intolerance.
- Among five dietary and lifestyle behaviors, low intake of fruits and vegetable (≤ 400 gm/day) was observed in more than half (56.7%) of the study subjects.
- More boys (42.6%) had central obesity than girls (26.0%) as indicated by high WHtR, with the difference being highly significant ($p \leq 0.01$**).
- More girls (36.6%) were irregular than boys (20.7%) in consuming breakfast, with the difference being highly significant ($p \leq 0.01$**).
- More proportion of boys (19.0%) consumed carbonated beverages than girls (8.1%), indicating highly significant difference ($p \leq 0.01$**).
- Regarding breakfast pattern, more girls (36.6%) were irregular in having breakfast than boys (20.7%), indicating high significant difference (($p \leq 0.01$**) between the two genders.
- The study subjects having high WC and high WHtR were six times at risk of developing sub optimal blood pressures.

Discussion

Adolescents form the largest cohort of young population worldwide, i.e., 1.8 billion, of which 1.5 billion live in developing countries. According to Lancet series on adolescents in 2012, young people are referred to people aged between 10-24 years (Patton et al 2012). They are often thought of as a healthy group and hence are the

neglected ones. Also this age group is considered the last window of opportunity to set the stage for a healthy and productive adulthood (WHO 2012).

Therefore, with the rising epidemic of childhood obesity (Wang and Lobstein, 2006), all the countries started mapping the prevalence of obesity among the school going children and adolescents from MHSES groups, worldwide (Jazayeri 2005, Lobstein et al 2004, Hedley et al 2004,) as well as in India ((Marwah et al 2012, Aggarwal et al 2008, Sharma et al 2007, Kumar et al 2007, Sidhu et al 2005, Sharma et al 2004, Bhave et al 2004, Sethi & Kapoor 2003, Kapil et al 2002, Ramchandran et al 2002) to control the expanding prevalence of overweight and obesity in school going children and adolescents (6-18 years), to prevent the rising burden of adulthood NCDs. But, the prevalence of under nutrition in the aforesaid population is not well known, as it was considered to be the problem of under privileged segments of the society. Further departmental studies also depicted similar scenario of estimating only over weight and obesity among children and adolescents in urban Vadodara. Studies carried out over the years by Akolkar, Shah, Gandhi and Munshi in 2003, 2004, 2005, 2012 respectively reported the prevalence of overweight and obesity in young children and adolescents (6-18 years) ranging from 7- 25.0%, irrespective of the standards used.

It has recently been estimated that adolescent obesity prevalence is increasing in the developing countries also where under nutrition used to be the major nutritional disorder (Poskitt 2009, Önera et al 2004). Hence the present study was undertaken to assess the nutritional status of adolescents, aged 10- 13 years from MHSES, and their dietary and lifestyle behaviors in the school campus and outside school hours. The data showed that more than half of the study subjects were under weight (53.7%), a quarter (25.2%) were overweight and obese, while 46.3% of the study subjects were found to be anemic. This indicated the presence of triple burden of malnutrition in the adolescents from MHSES. However, no study could be retrieved worldwide or in India which reported the presence of triple burden of malnutrition among the same adolescent population in MHSES.

Very few studies from developing countries facing double burden of malnutrition due to nutritional transition have reported an increasing incidence of overweight and obesity along with under nutrition (Özgüven et al 2010, Opara et al 2010, Aboshkair et al 2009, Montazerifar et al 2009, Tang et al 2007, Thiam *et al* 2006, Gales-Camus et al 2006, Eggal and Lopriore 2006, Shrimpton 2006, Bener and Abdulbari 2006,

WHO 2004, Önera et al 2004, Hooshyar et al 2001). In India also, two review studies for the school going children and adolescents from MHSES of different regions reported coexistence of over nutrition (over weight and obesity) and under nutrition (under weight) in this age group of 6 - 19 years (Srihari et al 2007, Jeemon et al 2009). While two studies from Gujarat, conducted on the same study subjects (adolescents aged 12-14 years) indicated coexistence of double burden of malnutrition (Iyer et al 2011, Shah et al 2008).

The prevalence of overweight and obesity reported by the current study as 25.2%, which is much higher than the reported prevalence world wide, i.e., 11.1% in Nigeria, 9.1% in Vietnam, and 10.1% in Baluchistan (Opara et al 2010, Montazerifar et al 2009, Tang et al 2007), while it is similar to 25.6% and 24.0% reported in urban Turkey and Malaysia respectively (Aboshkair et al 2011, Önera et al 2004). In India also, the reported prevalence (25.2%) was much higher than 13.4% reported in a study conducted for school going children and adolescents of MHSES workers of industries from 10 cities (Jeemone et al 2009) and 14.8% to 17.5% reported in two cities of Gujarat (Iyer et al 2011, Shah et al 2008). All the above studies referred, reported over nutrition and under nutrition in the same study population.

The present study also reported a high prevalence of underweight (53.7%) in the study subjects from MHSES, which was found to be higher than the estimated prevalence of underweight worldwide between 9.4% to 27.3% (Aboshkair et al 2011, Opara et al 2010, Montazerifar et al 2009, Tang et al 2007, Önera et al 2004) while it was within the estimated range in India, between 36.3% to 70.4%, indicating a rising trend of underweight among the school going children and adolescents from MHESE (Iyer et al 2011, Jeemone et al 2009, Shah et al 2008).

The present study also reported 46.3% of the study subjects from MHSES, to be anemic. It was very surprising to note that no study was done in the developed countries or in developing countries to estimate the prevalence of anemia among school going children and adolescents from MHSES. However, in India, few studies estimated the prevalence of anemia between the range of 14% to 88% in the school going children and adolescents (6-18 years) from MHSES indicating that besides under privileged children and adolescents being anemic, the MHSES children and adolescents are also vulnerable to iron deficiency anemia (Srihari et al 2007).

Addressing central obesity issues to prevent the occurrence of NCD risk factors so early in life is also extremely important as, it was present in 9.0 % to 37.0% of the study subjects as indicated by WC and WHtR respectively in the present study. A high central obesity in school children has earlier been reported (7.1%) by Mishra, 2011.

A very high percentage of sub optimal high blood pressure (21.4%) in the study subjects as shown in the present study is disheartening, although bigger trials on assessing the burden of sub optimal blood pressure in school children, especially adolescents is required. However, high burden of sub optimal blood pressure in the adolescent subjects has been reported earlier though at lower levels (3-10%) than in the present study (Narayanappa et al 2012, Verma and Singh 2012, Durrani and Wasim 2011, Khan et al 2010).

Developing countries are undergoing nutrition transition due to increased economic development and market globalization leading to rapid changes in lifestyle and dietary habits. Poor dietary and lifestyle behaviours have led to an increase in overweight and obesity among adults and children. Hence, besides the double burden of underweight and micronutrient deficiencies (folate, vitamin D, calcium, magnesium and vitamin E), the developing countries are also facing triple burden of malnutrition (under weight, micronutrient deficiencies and overweight and obesity) in MHSES as indicated by data of the the review of studies (Jeemone et al 2009, Li et al 2005, Gills 2005, Elmadfa and Weichselbaum 2004, De Benoist et al 2004, Nead et al 2004, WHO 2003, Thane et al 2003, Pinhas-Hamiel et al 2003, Halterman et al 2001, Schaff et al 2000,).

This trend of triple burden of malnutrition among children and adolescents is of great concern as unhealthy children and adolescents are likely to become unhealthy adults and develop non communicable diseases (NCDs), like type II diabetes, hypertension and cardiovascular diseases (Field 2006, Nader et al 2006, Whitaker et al 2006, Monteiro et al 2003). Also under nutrition adversely influence growth and development, cognitive performance and increase susceptibility to infections (Srihari et al 2007). Hence, according to 2008- 2013 action plan for the global strategy for the prevention and control of NCDs, targeting children in the school has been identified as the best buys for the prevention of childhood malnutrition (WHO 2008).

Preventing unhealthy behaviors during childhood and adolescents is easier and more effective than trying to change unhealthy behaviors during adulthood. As schools have direct contact with the nation's young people aged 5–17 years, for about six hours a day, and for up to 13 years of their social, psychological, physical, and intellectual development, schools play a critical role in promoting the health and safety of young people and helping them establish lifelong healthy behavior patterns (CDC 2012).

Therefore the National Health Education Standards (NHES) of America are developed to establish, promote and support health-enhancing behaviors for students in all grade levels—from pre-Kindergarten through grade 12. The NHES provide a framework for teachers, administrators, and policy makers in designing or selecting curricula, allocating instructional resources, and assessing student achievement and progress. Importantly, the standards provide students, families and communities with concrete expectations for health education (CDC 2013a).

Hence, according to CDC, health education curriculum should emphasize on:

- Teaching functional health information (essential knowledge)
- Shaping personal values and beliefs that support healthy behaviors
- Shaping group norms that value a healthy lifestyle
- Developing the essential health skills necessary to adopt, practice, and maintain health-enhancing behaviors.

Likewise NCF 2005, in India provides a framework for all CBSE affiliated schools, the framework for making syllabi, textbooks and teaching materials for all the grades (pre Kindergarten through 12) within the school education programs. CBSE in collaboration with WHO, made an effort to make teaching and learning more participatory for both teachers and students, by developing skill based training modules and introducing school wellness clubs in the schools.

It is very surprising to note that, the review of literature on this aspect did not reveal any reported studies in India till now. Therefore the results of the present study could not be compared with reported literature which looks into the national recommended standards for education.

As can be seen from tables 4.1.2 and 4.1.3, the topics in NCERT Teachers Training manuals were elaborated and covered 81.8% of the essential topics on healthy eating and 87.5% of physical activity respectively, as described Center for Disease Control (CDC) curriculum, however, GSEB board being currently followed in the selected schools did not have any teachers training module or did not sufficiently cover essential topics for nutrition health promotion.

The results of this study showed that the chapters from the text books of NCERT & 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%).

Thus it can be concluded that nutrition and health focus to prevent malnutrition in all its forms is missing in both National as well as Gujarat state curriculum, though National curriculum was better than state curriculum. Therefore, it is a need to improve school curriculum if we want to seriously curb the rising burden of NCDs and promote health amongst adolescents.

Hence, more studies need to be conducted to evaluate the existing school curriculum to improve them or incorporate the required curriculum in school based intervention programs which addresses the problem of childhood and adolescent malnutrition.

The observations made in the present study showed that, the school authorities did not have a say in the canteen menu, resulting in rampant and unchecked consumption of unhealthy, high energy dense foods and beverages as corroborated by the sales trend data in results section of the school canteen. Consumption of unhealthy, energy dense foods by the school children on the school campus was also reported by various studies (Marwah et al 2012, Laxmaiah et al 2007). Considering that a school canteen is one of the first places outside home which largely influences a child's food choices, a healthier approach here might become a primary step towards eliminating the danger of children getting used to high trans-fat, sugary and pre packed foods – the main pre disposers to malnutrition in this age group. Also since teachers and peers can influence adolescent food choices, probably a planned nutritious school meal program may help adolescents to follow healthy food choices.

Teachers remain the primary providers of information to children who can effectively impart nutritional education. In the present study, knowledge of teachers, pertaining to "healthy diet" particularly, was found to be inadequate and hence they were likely to

pass-on incorrect information or model unhealthy dietary behaviours probably unintentionally. However, since their own knowledge about healthy dietary and lifestyle behaviours is limited, it will be prudent to build the capacity of teachers in these areas or have these included in the science curriculum for them to become role model for students (Evans, et.al., 2005). However, since their own knowledge about healthy dietary and lifestyle behaviours was very limited, it will be necessary to build capacity of both teachers and parents in the area of prevention and control of malnutrition or have them included in the science curriculum.

It is an alarm bell for school authorities and parents as unhealthy diets and stress of achieving high grades probably take a toll on young minds who find it difficult to cope up with school pressure, parental & teacher expectations etc. Also the study showed that overweight and obesity was a significant risk factor for developing sub optimal high blood pressures, it is important that low salt and higher intake of fruits and vegetables with promotion of physical activity is promoted in all settings including schools and has been recommended by WHO 2012 for controlling NCD in populations (Mehan, et.al., 2012). The role of teachers and parents in shaping healthy behaviours in their children especially adolescents can not be undermined, their sensitization and modeling of healthy behaviours is also necessary. For this it is important to initiate media programs and probably include health and nutrition guidelines in all teaching curriculums of schools and universities as it is important to make our population as a whole nutrition & health literate, if we want to tackle the huge burden of non communicable diseases affecting our nation.

PHASE II

INTERVENTIONS FOR CREATING ENABLING ENVIRONMENT IN THE EXPERIMENTAL SCHOOL

In order to create enabling environment in the experimental school, interventions like understanding school ethos and environment, nutrition health promotion in the form of nutrition health education of school teachers, parents and finally students was done. Also efforts were made to improve the quality of meals students brought to school, and improve the existing food services (canteen menus) in the school campus.

4.2.1 Planning nutrition health promotion program in school with participation of teachers, parents, and researcher

4.2.1a Orientation meeting with NHT members along with parents

In order to make the nutrition health promotion program participatory and sustainable, as a first step nutrition health team consisting of teachers/ students/ administrators and parents was made. An orientation meeting was organized for the NHT members along with parents. The meeting aimed to discuss the results of the NFSHI and the triple burden of malnutrition among the study subjects from phase I, and plan a nutrition health promotion program in consultation with the NHT members and parents. Roles and responsibilities of NHT, teachers and parents were also discussed. However, the participation of the parents in the first meeting was disheartening as out of the parents of 273 study subjects, only 12 (0.04%) came for the meeting.

Looking at the very poor response of the parent's participation in the first orientation meeting, an alternative methodology was adopted to involve parents in planning the intervention program. The letters duly signed by the principal through the study subjects (students) were sent to all parents, where parents had to tick on the programs they felt should be initiated in the school from the various given options for the programs (table 4.2.1). However, only 47.3% of the parents responded. The results of parent's response from table 4.2.1, showed that most (82.2%) of the parents of those who responded, wanted a change in the canteen menus to restrict the sale of unhealthy food items, followed by many (71.3%) wanting a school feeding program. It can be thus understood that only 47.3% of the parents were willing to get involved in a

nutrition health promotion program. However, the school authorities were hesitant to initiate any new program, thus alternatively parents were urged to take initiative in providing healthy tiffin to their children. Hence, an effort was made to provide a 6 days cyclic menus to the parents (of all the children irrespective of their participation in the program) and introduce healthy menus in the canteen, with the aim of helping all school children to have an enabling environment in the school campus with respect to healthy eating.

Table 4.2.1: Responses of parents to the components of the nutrition health promotion program to be initiated in the experimental school

Components of nutrition and health promotion program	TOTAL (n=129) % (n)
Starting a "School Feeding Programme"	71.3 (92)
In the Canteen: Restricting the sale of unhealthy food items and providing healthy snacks and milk beverages.	82.2 (106)
Iron Folic Acid Supplementation for all.	57.4 (74)
Presentations on how family members can influence the development of healthy dietary and lifestyle practices of children.	62.8 (81)
Demonstrations of healthy menus.	66.7 (86)
Talks by eminent personalities to build the capacities of the family members.	41.9 (54)

4.2.1b Support given by NHT members to implement the nutrition health promotion program

As the NHT consisted of the representatives from administration, children and parents, it facilitated the planning of the capacity building sessions and nutrition health education sessions for teachers, parents and students. The planning schedules included, deciding the dates, periods that could be engaged for nutrition health education for students and parents who consented for their participation in the school program.

4.2.1c Awareness and Capacity building of Class teachers

The awareness of the class teachers regarding nutrition and health issues was assessed along with the sessions conducted for the study subjects (students). No separate session was conducted for the teachers due to unavailability of all the teachers at one time.

Since, six days cyclic menus were distributed, a 60 minutes capacity building session was conducted for teachers to train them for tiffin auditing with the help of a check list both at baseline (before giving menus) and 3 months after giving menus to understand if parents had improved the quality of tiffins they made for their children (Annexure 18).

4.2.2 Parent's engagement in the school nutrition health promotion program in the management of malnutrition

To make parents understand their roles and responsibilities, towards their child's nutrition and health, nutrition health education (NHE) was conducted including awareness and capacity building sessions, which were planned to make them understand the importance of adolescent age group and how to prevent and control triple burden of malnutrition (overnutrition, undernutrition and anemia) in this age group. Further, as suggested by the school authorities in the orientation meeting that parents should take initiative by providing healthy tiffin to their children, two sets of 6 days planned cyclic menus (Annexure 14 & 26), providing 1/3rd of the child's RDA and iron rich, were given to the mothers to help them plan healthy tiffin for their child (explained further). .

4.2.2a Awareness and capacity building sessions for parents

Two NHE sessions were conducted for parents separately. The first session was related to improve their knowledge regarding prevention and control of underweight and anemia among adolescents , and build capacities of parents to enable them monitor their own child's growth regularly with the help of WHO 2007 growth charts. Hence they were taught to calculate BMI, plot on growth chart and then interpret the result. The second session was conducted to improve their knowledge regarding prevention and control of overweight and obesity in adolescents.

The first session was conducted on the following topics:

- What is adolescent age?
- Why adolescent period is important.
- Consequences of malnutrition (under nutrition & over nutrition)
- Why nutrition is important for adolescents

- Causes and consequences of under weight and anemia
- Preventive measures (dietary and lifestyle) for under nutrition
- Sources of iron and vitamin C rich foods
- Planning and Preparation of healthy meals.

Table 4.2.2, presents the results of the first NHE session, in which only 22.0% of the parents participated. The results demonstrated that before the session, though more than half (55.0%) of the parents knew about the correct age to define adolescence and importance of nutrition during adolescence (81.7%), after the session the proportion of parents significantly increased who could identify correct age of adolescence (98.3%) and could understand the importance of nutrition during adolescence (100.0%). It was very surprising to note that before the session only a quarter (25.0%) of the parents were aware about the term malnutrition, while after the session 100.0% parents could understand the exact meaning of malnutrition.

Looking at the responses for the steps that should be undertaken to address the nutritional requirements of the child, At baseline 0.04 % of parents understood the importance of providing healthy meals & monitoring dietary intakes of their children, however, majority (80.0%) of the parents after the session understood the same importance of providing healthy tiffin meal and monitoring the dietary intake of the child at home (76.7%). Further, the proportion of parents before the session who agreed that addressing malnutrition during adolescence is important was very less (33.3%) which increased to 91.7% after the session.

Coming to the awareness of parents regarding the nutritional status of adolescents, none of the parents were aware about the method of assessing nutritional status and BMI before the NHE session. However, after the session, 100.0% of the parents were aware about the assessment of nutritional status of adolescents and were able to identify BMI as a method to assess the nutritional status of the adolescents.

The awareness level of parents about the causes of under nutrition at baseline was low (38.3%), While, after the session majority (71.7%) of them could identify unhealthy dietary practices followed by unhealthy home tiffin (63.3%), consumption of aerated drinks (61.7%) and skipping breakfast (55.0%) as causes of under nutrition.

The first NHE session also gave knowledge about control and prevention of anemia. Table 4.2.3, shows the improvement levels in the knowledge of parents related to key issues of anemia prevention and control. Before the session, only 13.3% were aware about anemia while after the session the percentage of parents significantly increased to 86.7% , who were able to understand anemia. While, assessing the knowledge of parents regarding sources of haem and non haem iron, it was seen from the table 4.2.3, that only 13.3% (correct: 5.0%, partially correct: 8.3%) and 30.0% (partially correct: 30.0%) of parents could identify correct sources of haem and non haem iron respectively. However, the percentage of parents significantly increased to 95.6% and 100.0%, after session who could correctly identify the sources of haem amd non haem iron respectively.

Furthermore from table 4.2.3, looking into the knowledge of parents regarding enhancers and inhibitors of iron bioavailability, before the session, only 23.3% (partially correct: 23.3%) and 15.0% (correct: 5.0%, partially correct: 10.0%) of parents were able to correctly identify enhancers and inhibitors respectively. While after the session, 100% of the parents were able to identify the enhancers (correctly 70.0%, partially correct: 30.0%) and inhibitors (correctly 80.0%, partially correct: 20.0%). Similarly, an increase in knowledge about healthy cooking practices to improve nutritional quality of meals was also observed (table 4.2.3).

Table 4.2.2: Impact of nutrition health education sessions to parents on improvement in knowledge about key issues related to under nutrition

Key issues related to under nutrition	Before the session (N=60)	After the session (N=60)
	% (n)	% (n)
Correct age of adolescence 10-19 years	55.0 (33)	98.3 (59)
Importance of nutrition during adolescence	81.7 (49)	100.0 (60)
Awareness of malnutrition	25.0 (15)	100.0 (60)
Most frequent responses for the steps that should be undertaken to address the nutritional requirements of the child • Monitoring the dietary intake of the child at home • Giving healthy tiffin meal to child • Health check ups	65.0 (39) 48.3 (29) 28.3 (17)	76.7 (46) 80 (48) 50.0 (30)
Importance of addressing malnutrition during adolescence	33.3 (20)	91.7 (55)
Method assessing the nutritional status of adolescents	0 (0)	100 (60)
Importance of assessing nutritional status regularly	80.0 (48)	100 (60)
Awareness about Body Mass Index (BMI)	0 (0)	96.7 (58)
Assessing their child's nutritional status • Yes (Once a month, Twice a year, Thrice a year) • Never	50.0 (30) 48.3 (29)	
Causes of under nutrition • Unhealthy dietary practices • Unhealthy home tiffin • Skipping breakfast • consumption of aerated drinks Don't Know	 36.7 (22) 33.3 (20) 26.7 (16) 25.0 (15) 38.3 (23)	 71.7 (43) 63.3 (38) 55.0 (33) 61.7 (37) 0 (0)

Table 4.2.3: Impact of nutrition health education sessions to parents on improvement in knowledge about key issues related to anaemia

Key issues related to anaemia	Before the session (N=60)	After the session (N=60)
	%(n)	% (n)
Awareness about anaemia	13.3 (8)	86.7 (52)
Sources of haem iron		
• Correct answer (meat, poultry, fish)	5.0 (3)	50.0 (30)
• Partially correct	8.3 (5)	45.0 (27)
• Wrong	70.0 (42)	3.3 (2)
• Don't know	16.7 (10)	1.7 (1)
Sources of non haem iron		
• Correct answer (pulses, cereals, vegetables, legumes)	0 (0)	16.7 (10)
• Partially correct	30.0 (18)	83.3(50)
• Wrong	28.3 (17)	0 (0)
• Don't know	41.7 (25)	0 (0)
Enhancers		
• Correct answer (Vitamin C rich fruits, meat, fish and other sea foods)	0 (0)	70 (42)
• Partially correct	23.3 (14)	30.0 (18)
• Wrong	43.3 (26)	0 (0)
• Don't know	33.3 (20)	0 (0)
Inhibitors		
• Correct answer (Coffee, Tea)	5.0 (3)	80 (48)
• Partially correct	10 (6)	20 (12)
• Wrong	38.3 (23)	0 (0)
• Don't know	46.7 (28)	0 (0)
Watermelon seeds are very rich in iron	35.0 (21)	96.7 (58)
Use of boiled water of green leafy vegetables for using it in other preparations	53.3 (32)	96.7 (58)
Incorporation of green leafy vegetables to add the iron content of various food products	45.0 (27)	6.7 (58)
Usage of left over iron rich vegetables or dal to knead the flour	26.7 (16)	93.3 (56)
Cauliflower greens are rich source of iron	33.3 (20)	95.0 (57)
Preparation of iron rich snacks with lemon topping.	43.3 (26)	96.7 (58)
Preparation of fruits just before having them	43.3 (26)	96.7 (58)

The second NHE session for parents was related to management and control of over nutrition (overweight including obesity). The topics covered were:

- Importance of including five food groups for healthy diet
- Consequences of high intake of salt, sugar and saturated fats.
- Recommendations for physical activity, TV/computer playing, and fruits and vegetable intake.

Table 4.2.4, shows the results of the second NHE session on parent's knowledge before and after the session. The percentage of parents participating in the second NHE session increased from 22.0% in the first NHE session to 33.0% in the second NHE session. The table showed that before the session, more (61.1%) parents knew the cereals, bread and potatoes are the constituent of five food groups followed by very few parents identifying pulses & legumes (11.1%) and fruits & vegetables (11.1%) also to be the constituent of five food groups. None of the parents knew that milk and milk products and oil, salt & sugar also form the five food groups, before the session. However, after the session all (100.0%) could understand that all food items categorized into various groups forms the five food groups.

Regarding the adverse consequences of high salt intake, before the session, majority (83.3%) of the parents identified high blood pressure as a major health problem, while very few (16.7%) of the parents reported heart problem as major ill consequence of high salt intake. However, after the session, 100.0% of the parents were able to understand that high salt intake leads to both high blood pressure and heart problems (table 4.2.4).

From table 4.2.4, it was very clear before the session that, majority (88.9%) of the parents knew that high intake of sugar leads to diabetes, while only 11.1% of parents reported that it can lead to increased weight gain. However, after the session all the (100.0%) parents knew that besides diabetes, high sugar intake also leads to increased weight gain.

The table 4.2.4, revealed that majority (83.3%) of the parents considered heart diseases the major adverse consequence of high saturated fat intake, followed by 11.1% and 5.6% of parents identifying high blood pressure and increased blood cholesterol respectively, to be the major health risks of high saturated fat intake.

Nevertheless, after the session, all (100.0%) of the parents understood that high saturated fat intake also leads to high blood pressure and increased blood cholesterol leading to heart diseases.

It was very surprising to note that, the knowledge of parents regarding recommended levels of physical activity per day (≥ 60 minutes /day) of their children was low, as majority (74.4%) of them reported that children should be less active than the recommended hours (≥ 60 minutes /day), while only a quarter (25.6%) of parents reported that the children should be active for 60 minutes or more. However, after the NHE session, all (100.0%) parents knew about the recommended level of physical activity to be performed by their children daily.

Regarding the hours spent by the children watching TV or sitting on computer, parents themselves wanted that their children should spend less time in front of the TV or sit on computer, Therefore, before the session, majority (80.0%) of the parents surprisingly could correctly identify the recommended levels of TV watching/ computer playing. However, after the session all (100.0%) were able to identify the recommended levels of TVwatching / sitting on computer (table 4.2.4).

Regarding the recommended levels of fruits and vegetable intake (≥ 400 gm/day), table 4.2.4 revealed that 63.3% of the parents were not knowing about the correct amount of fruits and vegetable to be consumed daily (≥ 400 gm/day), while after the session the percentage of parents increased significantly to 100.0%, who knew about the recommended levels of fruits and vegetable (≥ 400 gm/day) to be consumed daily by their children.

Table 4.2.4: Impact of nutrition health education sessions to parents on improvement in knowledge about key issues related to over nutrition

Responses	Before the session (N=90) % (n)	After the session (N=90) % (n)
Five food groups contain		
• Cereals, bread and potatoes	61.1 (55)	-
• Pulses and Legumes	11.1 (10)	-
• Milk and milk products	-	-
• Fruits and vegetables	11.1 (10)	-
• Oil Salt and sugar	-	-
• All of the above	16.7 (15)	100.0 (90)
High intake of salt leads to:		
• High blood pressure	83.3 (75)	-
• Heart problems	16.7 (15)	-
• Both	-	100.0 (90)
High Intake of sugar leads to		
• Diabetes	88.9 (80)	-
• Increased weight gain	11.1 (10)	-
• Both	-	100.0 (90)
High intake of saturated fat leads to		
• Increased blood cholesterol	5.6 (5)	-
• Heart diseases	83.3 (75)	-
• High blood pressure	11.1 (10)	-
• All of the above	-	100.0 (90)
How much time daily your child should be physically active vigorously?		
• Less than 60 minutes	74.4 (67)	-
• Equal to or more than 60 minutes	25.6 (23)	100.0 (90)
How long daily your child should watch T.V or sit on computer?		
• More than 2 hours	20.0 (18)	-
• Equal to or less than 2 hours	80.0 (72)	100.0 (90)
How much (in grams) your child should consume fruits and vegetables daily?	63.3 (57)	-
• Less than 400 grams	36.7 (33)	100.0 (90)
• Equal to or more than 400 grams		

4.2.3 Creating enabling environment in the school to promote healthy eating during school hours

4.2.3a Improving quality of tiffin menus brought by the study subjects to school

The baseline assessment of tiffin, was done by categorizing the tiffin menus as healthy (cooked: paratha sabji, thepla, sabudana khichdi etc or uncooked: bread jam, bread butter, cheese sandwhich, khakra etc) and unhealthy (cooked: magi, noodles, franky, veg roll, muthiaetc or uncooked: mamra, fryms, biscuits etc). Therefore, table 4.2.5, showed that almost equal percentage of the study subjects brought unhealthy (50.1%) and healthy tiffin (49.9%) whether cooked or uncooked. Hence, an effort was made to improve the tiffin menus by planning 6 days cyclic menus. These tiffin menus were then given to parents, helping them to plan healthy tiffin on their own. Two sets of 6 days cyclic menus were planned to provide 1/3rd of the RDAs with special emphasis given to make food items iron rich (Annexure 14 & 26). The items in the first set were decided after observing the maximum frequency of items (home cooked and healthy) brought by the students at the baseline. These items were then modified to provide 1/3rd of the RDA and make it iron rich. The two items in the second set of 6 days cyclic menu were replaced by the recipes provided by the student (made by their mother). Further, these two recipes were again modified to provide 1/3rd of the RDA and make it iron rich.

The acceptability of the 6 days cyclic menus (two sets) were observed by tiffin auditing done by either class teachers (for one month) or the researchers (two months for Ist set and for three months for IInd set of menus).

4.2.3b Tiffin auditing

Table 4.2.5, shows the acceptability of planned tiffin menus (providing 1/3rd of the RDA and iron rich) through tiffin auditing. The table indicates a significant increase from 49.9% to 80.3% in healthy tiffins, after the distribution of Ist set of 6 days cyclic menus. The tiffin auditing was done for 2 months. One month it was done by the teachers with the help of a checklist (Annexure 18) and the second month by the researchers again, after teachers expressed their inability to complete the checklist on time.

The tiffin auditing was discontinued for four months due to exams and summer vacation and again resumed by the researchers to observe the trend of tiffin menus after the reopening of the school for one month. The results indicated that healthy tiffins were reduced from 80.3% to 75.6%, though the decrease was not significant. After the second session of the parents again a 2nd set of tiffin menus was given to the mothers. Tiffin auditing was continued for 3 months by the researchers and now it was observed that almost all (99.5%) of the study subjects were bringing healthy tiffin (table 4.2.5).

Table 4.2.5: Change in tiffin meal pattern brought by the study subjects before and after the distribution of two sets of 6 days cyclic menus

Type of tiffin meal	Baseline (2 months) N*=1053	Tiffin meals after giving Ist set of planned 6 days tiffin menu, after the first parent's NHE session (after 2 months) N*=7564	Tiffin meals after reopening of the school (after summer vacation for 1 month) N*= 6700	Tiffin meals after giving IInd set of planned 6 days tiffin menu, after the second parent's NHE session (after 3 months) N*=20,636
	% (n)	% (n)	% (n)	% (n)
Healthy (cooked + uncooked)	49.9 (525)	80.3 (6076)	75.6 (5060)	99.5 (20525)
Unhealthy (cooked + uncooked)	50.1 (528)	15.5 (1169)	18.6 (1245)	0.1 (36)
Healthy + unhealthy (cooked+ uncooked)	-	4.2 (319)	5.9 (395)	0.4 (75)

*Number of observations made (N)= Number of days X number of students)

4.2.3c Facilitating the delivery of healthy food options in the school canteen

The baseline assessment of the canteen menus as demonstrated by figures 4.1.1 and 4.1.2, showed high sale of precooked and reheated unhealthy snacks like puff, samosa, vegetable roll, carbonated beverages which were high in saturated, trans fat and sugar. Therefore, a meeting was conducted with the principal and the canteen contractor to discuss how canteen services can be improved by changing the existing canteen menus. The healthy snacks suggested were: Methi thepla, uttapa, chilla, dhokla, sprouts bhel, ragda patties, sev usal, subudana khichdi, idli sambhar, sambhar wada, soyabean patties, etc. However, the canteen contractor showed difficulty in serving the healthy snacks, because he neither had any facility for cooking in the premises nor the expertise to cook the menus as mostly pre- packaged or out sourced snacks were sold in the premises.

Regarding serving of healthy beverages in the canteen, efforts were made by the researcher to promote only those beverages which were having a comparable cost to the beverages that were sold in the canteen (Table 4.2.6). The selected beverages were, low fat milk beverages (butter milk, flavoured milk etc.) and sweetened fruit juices, like: real nature fresh juice, frooti etc (Table 4.2.7). It was not considered feasible, to promote the consumption of unsweetened fruit juices due to higher costs (Table 4.2.8). Hence, in order to promote the sale of healthy beverages a five day pilot trial was initiated by the researchers to study the response of the study subjects.

4.2.3d Five days pilot trial to promote healthy beverages in the school canteen

In this Five Day Pilot Trial, coupons were sold to the study subjects (students) according to their preferences for the products mentioned in table 4.2.7. This trial was also undertaken to assess the acceptability of healthy beverages among the study subjects and promote the consumption of healthy beverages by making them available in the school canteen. Figure 4.2.1, showed the popularity for butter milk and flavoured milk also. On looking at the response of the pilot trial, and knowing that 82.2% of the parents (table 4.2.1) wanted a change in canteen menus, the canteen contractor made arrangements for providing the healthy beverages in the school canteen.

Table 4.2.6: Comparison between the cost of proposed healthy beverages and available beverages in the canteen

Cost of healthy milk beverages and juices proposed for the change in the canteen		Cost of unhealthy carbonated beverages already being sold in the canteen	
Beverages	**Cost (Rs.)**	**Cost (Rs.)**	**Beverages**
Butter milk (200 ml)	3.00	18.00	Pepsi Can
Flavoured Milk (200 ml)	7.00	5.00-10.00	Pepsi
Lassi (200 ml)	9.00	10.00	Appy fizz, etc
Frooti (200ml)	10.00		
Real Nature Fresh (200ml)	15.00		

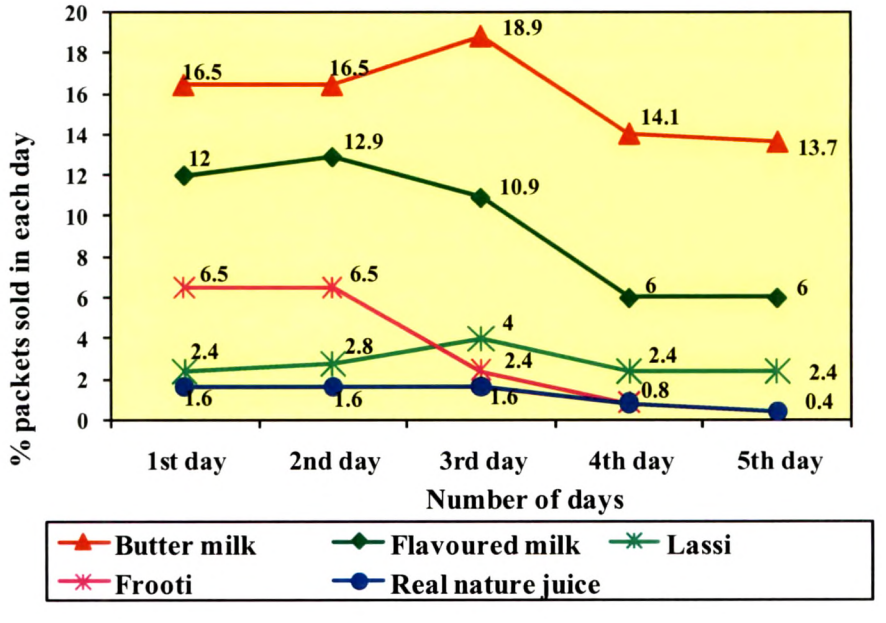
Table 4.2.7: Selected low fat milk beverages and fruit juices proposed to be sold in the school canteen

Beverages	Cost (Rs.)
Butter milk	@ 3.00
Flavoured milk	@ 7.00
Lassi	@ 9.00
Frooti	@ 10.00
Real nature	@ 15.00

Table 4.2.8: Cost of unsweetened fruit juices in the market which could not be proposed in the school canteen due to higher costs

Fruit juices labeled as "No added sugar"	Cost of tetra pack of 200 ml (Rs.)
Active	20.00
Ceres	25.00

Figure 4.2.1 Sale trend of proposed milk beverages and fruit juices in the five days trial period



Highlights

- High (82.2%) percentage of the parents who participated wanted a change in the existing school canteen, followed by 71.3% agreeing to initiate a school meal program.
- Parent's participation was very poor (0.04%) during the first orientation meeting which improved slightly to 22.0% in the first NHE session to 33.0% in the second session NHE session.
- The knowledge of parents who attended the NHE sessions improved significantly after the NHE session conducted to provide information about prevention and control of triple burden of malnutrition (overweight including obesity, underweight and anemia).
- The percentage of study subjects brining 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.
- Teachers were unable to audit tiffin menus of the study subjects due to due to overload of their own teaching schedule.
- Low fat milk beverages like butter milk and flavoured milk were proposed to be sold in the school canteen as they were well accepted by the study subjects, shown by A Five Day Pilot Trial.

Discussions

The second phase of the study was conducted to engage teachers and parents in the school nutrition and health promotion program. It also aimed to create enabling environment in the school by improving tiffin menus brought by the study subjects and improving the existing nutrition services in the school to offer ample opportunity for the children to adopt healthy dietary behaviors.

Since there was no school meal program in the school, an initiative was made to improve the tiffin menus of the study subjects they brought from home and had it in the school interval. Two sets of 6 days cyclic menus, providing 1/3rd of the RDA and iron rich recipes were given to mothers, helping them to plan healthy tiffin for their child. With the help of tiffin auditing (by teachers and researchers) positive change

was observed, with percentage of the study subjects bringing healthy tiffin increased from 49.9% to almost 100.0%. In the United States (U.S) school meal programs are in place, comprising school breakfast program or school lunch programs (CDC 2011). The review of literature also shows that students who participated in school meal programs consumed more milk, fruits, and vegetables and have better nutrient intake than those who do not participate (Condon and Crepinsek 2009, Gordon et al 2009). In addition, regular participation in the School Breakfast Program is associated with lower BMI, improved student functioning on a broad range of psychosocial and academic measures and significant decrease in the rates of school absence and tardiness compared with the students whose participation remained the same or decreased (Gleason and Dodd 2009, Murphy et al 2005, Murphy et al 2001, Powell et al 1998, Murphy et al 1998). However, no data on school meal program from MHSES could be retrieved from India to support our result. Thus based on experiences from USA and parents willingness to initiate nutritious meal programmes in the present study, It will be worthwhile if school authorities of private schools are given some recognition such as accreditation as nutrition friendly school or incentives such as providing kitchen space if they start a nutritious school meal programme. It is also important that school management is sensitized about the need to focus on nutrition assessment and adverse implications of micronutrient deficiencies especially anemia and malnutrition on scholastic achievements and development of non communicable diseases in future. In the present study, an effort was also made to improve the existing canteen services. According to the U. S. School Health Guidelines, foods or beverages sold or served outside of the school meal program, are the principal source of low- nutrient, energy dense foods that students consume at school **(CDC 2011)**. The most commonly available competitive foods are high in sugar, fat, and calories, including high fat salty snacks, high fat baked goods, and high calorie sweetened beverages, such as soft drinks, sports drinks, and fruit drinks (CDC 2008, O'Toole et al 2007, US GAO 2005).

While it was not feasible in the study school setting to improve canteen menus because of lack of infrastructure available to the contractor or his willingness or motivation to make a change, in the absence of school authorities having no say in the running of the canteen, therefore, a five day pilot trial conducted to promote low fat milk beverages and juices among the students proved to be quite successful as

given the choice of selecting healthy foods students were willing the change and prefer low fat and healthy alternatives such as butter milk, flavoured milk and fruit juices. This clearly demonstrates that students are willing to change their eating habits provided they get an enabling environment, therefore the onus of improving adolescent or school health lies with the school authorities and informed & supportive parents. This result was supported by Briefel et al 2009. Who showed that children attending schools without stores or snack bars that sell foods or beverages is estimated to significantly reduce sugar-sweetened beverage consumption by 22 kcal per school day for middle school students and 28 kcal per school day for high school students. In addition, restricting access to snack foods is associated with more frequent fruit and vegetable consumption (Gonzalez et al 2009). Government of India (GOI) has also recognized the importance of healthy canteens in school premises, especially banning the sale of aerated drinks, however, it needs to go further and ban all other unhealthy items such as high salt savory items, trans fat laden bakery items etc in the school premises with some monitoring mechanism in place.

Though in India, international schools are running school meal programs or restricting the sale of unhealthy snacks and beverages in their schools, no scientific data could be found to support the results of the present nutrition and health promotion program or the implementation of GOI guidelines in schools. These initiatives by the international schools are generally based on commercial gains and not nutritional considerations.

The nutrition and health promotion programs also in the present study aimed to involve parent's participation. The participation rate of parents in the present program was not very satisfactory, however, it increased from 22.0% to 33.0% from first NHE session to second NHE session. According to CDC's School health guidelines, parents contribute to the academic success of the students and are key stakeholders in healthy eating and physical activity policies and practices in schools (Epstein et al 2009, Henderson and Mara 2002, Epstein 2001). Family involvement in nutrition and health can increase children's as well as parent's knowledge and attitude about healthy lifestyle (Nader et al 1996), influence behavior change (Trevino et al 2005, McGarvey et al 2004, Beech et al 2003, Golan and Crow 2003, McLean et al 2003), and provide social support for being healthy.

Therefore it is imperative that parents involvement and sensitization is routinely done to make them aware of the healthy dietary and life style behaviours to be promoted in children, this can be effectively done by inviting experts on nutrition, health, physical activity, yoga etc in parent teachers (PTA) meeting who can guide them on healthy life style habits to be promoted in children.

Studies that have assessed strategies to prevent and treat childhood obesity or promote physical activity and healthy eating have demonstrated more success when focusing on both the family and the child rather than the child alone (Bharati et al 2008, Shah et al 2008, Golan and Crow 2004, Ransdell et al 2003). However, in Indian scenario this concept of parent's participation in nutrition and health issues has largely remained unexplored.

In the present study, parents who participated in nutrition health promotion program also wanted a change in canteen menus (82.2 %) and initiating school meal program (71.3%) in the school. Hence, the results of the present study revealed that those parents who participated were keen on initiating healthy nutrition practices, thus it is important that schools make efforts to engage parents in these activities. However, it can be hypothesized that those who participated were more aware of the nutrition health issues and thus wanted to be more informed, while those (majority) who did not participate were those who were totally unaware and thus all the more it is important that schools become a medium to sensitize and educate parents to focus on improving not only their child's scholastic performance but also immediate and future health of their children.

Teachers are also an important part of nutrition and health promotion programs in schools. In the present study, teachers showed willingness to participate in the program, however due to their own overload of teaching schedules, could not conduct the activities required by them (tiffin auditing, participation in NHE sessions etc). Hence to ensure effective implementation of nutrition and health promotion programs in school qualified professionals are required who should be employed by the school for the program only with parental financial support. The United State Department of Education has recommended that schools should develop and adopt policies that require certified physical and nutrition education teachers, rather than teachers who are certified to teach other subjects areas, to ensure that students receive quality

instructions. Certified teachers teach longer lessons, spend more time developing motor and movement skills, impart more knowledge, and provide better guidance (Davis et al 2005, McKenzie et al 2000, Sallis et al 1997, McKenzie et al 1995,). These technically qualified teachers should be aware of the recommended national standards to help school comply with the recommendations (NASPE 2009, Cater and Carr 2004, Rainville and Carr 2000). Later, these specifically qualified teachers should also be provided annual professional development opportunities (Bauer ET AL 2006, O'Toole et al 2006, Davis et al 2005, McKenzie et al 2004, Kelder et al 2003, ADA 2003, Sullivan et al 2000, McKenzie et al 1997,). Professional development can enhance teachers' instructional strategies for increasing student physical activity during physical education classes, and can help implement changes within the school meal program leading to reduction in calories from total fat, saturated fat, and sodium (Fairclough and Stratton 2005, Kelder et al 2003, McKenzie et al 2000, McKenzie et al 1997, Osganian et al 1996,). In addition, professional development also help the teachers to positively influence children's choices for healthy dietary and lifestyle behaviours (Fulkerson et al 2002).

Therefore, the second phase of the study helps us to understand the importance of participation of school community (administration, teachers and nutrition service providers) and parents, for effective implementation of nutrition and health promotion program for the growth and development of school aged children and adolescents.

PHASE III

IMPACT OF NUTRITION HEALTH PROMOTION PROGRAM (INTERVENTION) IN THE EXPERIMENTAL SCHOOL AND COMPARISION OF IMAPCT INDICATORS BETWEEN THE EXPERIMENTAL AND CONTROL SCHOOL

Before planning the nutrition health promotion program, the situational analysis of the study subjects regarding anthropometry (BMI for age, central obesity), biophysical (blood pressure), biochemical parameters (haemoglobin and lipid and glucose) and dietary and lifestyle behaviors was done in the Experimental & control schools. Since, anemia was found to be present in 49.3% of the study subjects, IFA supplementation was immediately initiated among the student as blanket cover in the Experimental school. Later depending on the availability of free classes, NHE sessions were conducted for the study subjects in the experimental school. The nutrition health promotion program besides creating enabling environment in the experimental school as described in Phase II also included:

- 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 and improvement in haemoglobin levels.
- Nutrition Health Education (NHE) and capacity building sessions with the study subjects, with the help of power point presentations were conducted for prevention and management of malnutrition (in all its forms).

Later, the impact of the nutrition health promotion program was seen on:

- The prevalence of anemia after weekly supplementation of 60 mg elemental iron and 0.5 mg folic acid for a period of 3 to 4 months (12 doses).
- The change in the knowledge, attitude and practices of study subjects after nutrition health education for the prevention and management of malnutrition (in all its forms) and capacity building for assessing their own nutritional status.
- The selected outcome indicators (BMI for age, biophysical parameter, biochemical parameters, and dietary and lifestyle behaviors), after one and half years of nutrition health promotion were compared with the subjects from the control school.

4.3.1 Impact of nutrition health promotion program including weekly 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

Table 4.3.1, demonstrates that there was a slight decrease (though not significantly) in the prevalence of anaemia after nutrition health promotion program (intervention) including IFA supplementation from base line (49.3% vs 48.7%). Mean haemoglobin levels also increased slightly from its respective base line values (11.61±1.9 gm/dl vs 11.66±1.0 gm/dl).

Table 4.3.2 presents overall and sex wise compliance of IFA tablets. Among the study subjects, the overall compliance was very good (38.6%) and good (30.5%) suggesting that 68.5% of the study subjects had no problems with compliance. Overall the girls had better compliance(≥9 doses) than boys (74.1% vs 65.9%) comprising of subjects who took more than 75% of the given 12 doses (Figure 4.3.1).

Initial and final prevalence and severity of anaemia between the 4 groups (groups A: 11-12 tablets, group B: 9-10 tablets, group C: 8 tablets, group D: < 8 tablets) were compared in the table 4.3.3. In order to observe the efficacy of nutrition health promotion programme including weekly IFA supplementation on anaemia control, the table reveals that 27.9% reduction in the prevalence of anaemia was seen in 'A' group (11 – 12 tablets) followed by Group 'C' (20.0%) and Group 'B' (11.4%). On the contrary, a very highly significant increase (267%) was seen in Group 'D' although their initial prevalence was lower at baseline (18.7%).

Similarly on looking at the mean haemoglobin levels with respect to compliance, table 4.3.4 demonstrates that a highly significant ($p<0.01$) increase in haemoglobin levels (11.30 ± 1.9 to 11.91 ± 1.2) was seen in the subjects who had very good compliance (11-12 tablets). Similarly in good (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 also an increase (though not significantly) in haemoglobin levels from base line was seen after nutrition health promotion program including IFA supplementation. However in subjects with poor compliance (1-7 tablets) a significant ($p \leq 0.05$) decrease in haemoglobin levels (12.97±1.7 to 11.3±0.92) was seen.

Table 4.3.5 presents a significant fall in mean haemoglobin level among non anaemic subjects from baseline to end line (13.20±1.15 Vs. 12.0±0.99) in all supplemented groups where as, a significant increase in haemoglobin levels was seen in anaemic subjects from baseline value (10.04±0.97 vs 11.29±1.04). A linear relationship in improving the anaemic status from baseline was seen with the compliance of the tablets. Those who had good and very good compliance had higher increase in haemoglobin levels (very good: 9.83 ± 0.99 to 11.34 ± 1.0; good: 10.14 ± 1.0 to 11.32 ± 1.0) as compared to poor compliers (poor: 10.05 ± 0.5 to 10.41 ± 1.06). However, no consistent trend was observed in reduction of haemoglobin levels in the non-anaemic subjects.

Table 4.3.6 presents at baseline academic scores of the supplemented subjects as compared to non-supplemented subjects. At baseline, in the supplemented subjects a significant improvement in the academic performance of the study subjects after nutrition health promotion programme (combined interventions) from the baseline (186.7 ± 46.64 Vs. 191.20 ± 45.20***, p≤ 0.001) as compared to non supplemented group (177.24 ± 48.34 Vs.169.86 ± 48.53***, p≤ 0.001) was seen. Similarly, significantly (p<0.01) higher improvement in the marks obtained by subjects after supplementation from baseline in anaemic subjects as compared to counter parts was observed (Table 4.3.7).

Table 4.3.1: Percent change in prevalence of anaemia and change in mean haemoglobin levels of the study subjects before and after the intervention including weekly IFA supplementation

	prevalence of anaemia (n=197)	Mean Haemoglobin levels (gm/dl)
	% (n)	Mean ± S.D
Initial	49.3 [a] (99)	11.61±1.9 [c] (197)
Final	48.7 [b] (96)	11.66±1.0 [d] (197)
p value	p = 0.09	p = -0.37

Table 4.3.2: Compliance of 12 doses of Iron Folic Acid supplementation among all (anaemic + non-anaemic) study subjects

	Girls (n=62)	**Boys (n=135)**	**Total (N=197)**
	% (n)	**% (n)**	**% (n)**
Very good compliance (11-12 tablets)	43.5 (27)	36.3 (49)	38.6 (76)
Good compliance (9-10 tablets)	30.6 (19)	29.6 (40)	30.5 (59)
Average compliance (8 tablets)	12.9 (8)	16.2 (22)	14.7 (29)
Poor compliance (1-7 tablets)	12.9 (8)	17.8 (24)	16.2 (32)

Figure 4.3.1: Compliance of IFA supplementation among study subjects (≥75%)

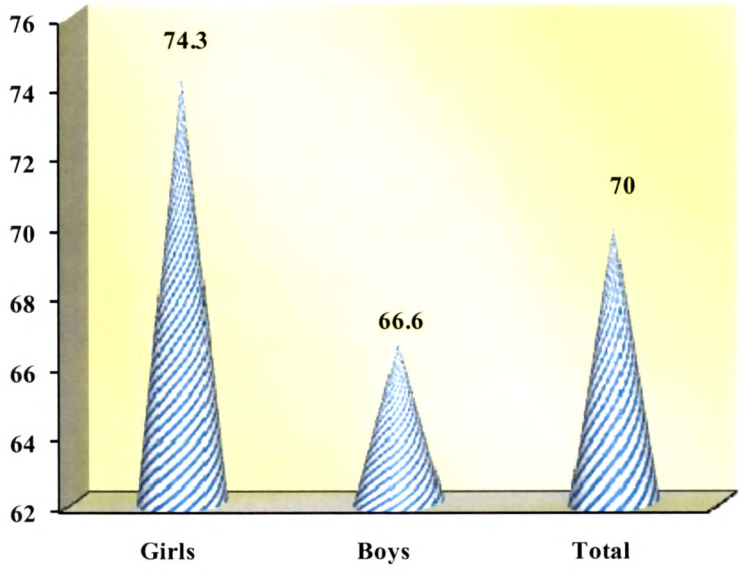


Table 4.3.3: Changes in the severity of the Anaemia among the study subjects before and after the intervention in relation to compliance

	Group A (11-12 tablets) (n= 76)		Group B (9-10 tablets) (n=59)		Group C (8 tablets) (n=30)		Group D (<8 tablets) (n=32)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Non anaemics	38.1 [a] (29)	57.8 [b] (44)	28.8 (17)	35.5 (21)	36.6 (11)	46.6 (14)	81.2[c] (26)	25.0[d] (8)
Mild anaemia 10.1 – 11.9 gm/dl	25.0 (19)	38.1 (29)	32.2 (19)	55.9 (33)	50.0 (15)	50.0 (15)	9.3 (3)	68.7 (22)
Moderate anaemia 7.1 – 10 gm/dl	36.8 (28)	3.9 (3)	38.9 (23)	8.4 (5)	13.3 (4)	3.3 (1)	9.3 (3)	6.2 (2)
Severe anaemia ≤ 7 gm/dl	-	-	-	-	-	-	-	-

a Vs. b = 5.17*
c Vs. d = 18.13 ***
*p < 0.05, *** p < 0.001

Table 4.3.4: Relations between compliance of Iron Folic Acid tablets and mean change in haemoglobin level in the study subjects

Number of doses	Changes in Haemoglobin level		Mean difference	Paired 't' test
	Base line Hb Mean±SD (gm/dl)	End line Hb Mean±SD (gm/dl)		
11-12 (n=76)	11.30±1.9	11.91±1.2	0.6±0.4	3.0 **
9-10 (n=59)	11.28±1.7	11.49±1.0	0.2±0.2	0.72
8 (n=30)	11.59±1.6	11.74±0.9	0.1±0.1	.77
<8 (n=32)	12.97±1.7	11.3±0.92	-1.66±1.1	5.6*
Total (N=197)	11.61±1.9	11.66±1.0	0.05±0.03	0.37

* p < 0.05
** p < 0.01

Table 4.3.5: Impact of IFA supplementation in relation to the compliance and anaemic status of the study subjects

	11-12 tablets		9- 10 tablets		8 tablets		<8tablets		Total	
	Non Anaemic (n=33) (gm/dl)	Anaemic (n=43) (gm/dl)	Non Anaemic (n=24) (gm/dl)	Anaemic (n=35) (gm/dl)	Non Anaemic (n=15) (gm/dl)	Anaemic (n=15) (gm/dl)	Non Anaemic (n=26) (gm/dl)	Anaemic (n=6) (gm/dl)	Non Anaemic (n=98) (gm/dl)	Anaemic (n=99) (gm/dl)
Initial	13.23±1.13	9.83±0.99	12.94±1.2	10.14±1.0	12.78±1.2	10.4±0.97	13.65±1.01	10.05±0.5	13.20±1.15	10.04±0.97
Final	12.65±1.04	11.34±1.0	11.74±0.89	11.32±1.0	12.04±0.66	11.4±1.0	11.51±0.77	10.41±1.06	12.0±0.99	11.29±1.04
Change in Hb from baseline	-0.58	1.51	-1.2	1.18	-0.73	1.0	-2.13	0.36	-1.16	1.25
Paired t test	2.35*	-7.55 ***	39.07***	-4.84***	2.92*	-2.50*	7.678***	-.788^{NS}	7.63***	-8.86***

* $p < 0.05$,** $p < 0.01$, ***$p<0.001$, NS= Non significant

Table 4.3.6: Comparison of the mean academic scores of the supplemented Vs. non supplemented study subjects

	Scores before intervention Mean ± S.D	Scores after intervention Mean± S.D	Paired t Test
Supplemented (151)	186.7 ± 46.64	191.20 ± 45.20	-3.3***
Non-supplemented (72)	177.24 ± 48.34	169.86 ± 48.53	4.8***

*** p< 0.001

Table 4.3.7 Impact of combined intervention on the academic scores of the Study Subjects

	Scores before intervention Mean ± S.D	Scores after intervention Mean± S.D	Paired t Test
Anemic (69)	174.38 ± 45.46	179.57 ± 45.56	-2.7**
Non-anemic (82)	187.87 ± 82	190.6 ± 82	-2.0*

* p<0.05; ** p< 0.01

4.3.2: Impact of nutrition health education given to study subjects for the prevention and management of malnutrition (in all its forms) as a component of nutrition health promotion programme and their capacity building for assessing their own nutritional status on change in knowledge, attitude and practices of the study subjects.

In order to assess the impact of nutrition health education on knowledge pertaining to different aspects of adolescent health, under nutrition, anaemia and over nutrition, Nutrition health education was given to all the study subjects of class VI and VII. Two major sessions were conducted for under nutrition management and over nutrition management with the help of power point presentations. Under nutrition management session consisted of three sessions, which were as follows:

i. Session 1: Under weight management (60 minutes)
ii. Session 2: Skill building to calculate BMI (30 minutes)
iii. Session 3: Capacity building to plot and interpret BMI for age WHO (2007) growth charts (30 minutes)

Another session was conducted for over nutrition control and management for the study subjects for 60 minutes.

Hence, table 4.3.8, presents the results of NHE sessions pertaining to adolescent health and under nutrition.

The first session was conducted on the following topics:

- Age group of adolescent and importance of nutrition in these years
- Definition of Mal nutrition
- Methods of Nutritional status assessment by BMI calculation
- Causes of under nutrition etc.
- What is anaemia
- Sources of heam and non-heam iron
- Enhancers and inhibitors of iron etc.

According to Table 4.3.8, before the session, less than half (47.8%) of the study subjects knew the correct age of adolescence, which significantly increased to 98.2% after the session. Though more than half (58.2%) of the study subjects at baseline understood the importance of nutrition during adolescence, the percentage significantly increased to 100% after the session. Very few (8.0%) of the study subjects, before the session, were aware about the term malnutrition, however, after the session percentage increased to 94.7%. Less than a quarter (21.3%) of the study subjects, before the session understood that it is important to address the malnutrition during adolescence, which increased significantly to 93.8% after the session. Though before the session, 64.9% of the study subjects reported that they understand the importance of assessing the nutritional status regularly, nevertheless only 4.0% of them could mention the methods of assessing the same. However, almost all subjects (98.2%) after the session were able to understand the importance of assessing nutritional status and identifying the methods to assess the nutritional status. Before

the session, table 4.3.8, reported that 31.6% of the study subjects, were aware about their own nutritional status which increased to 86.2%. From table 4.3.8, it is very clear that none of the study subjects were aware about the term Body Mass Index (BMI), which significantly increased to 94.2% in the study subjects, after the session, who could identify BMI as a method to assess their nutritional status. Regarding the causes of under nutrition, more than half (52.9%) of the study subjects were not knowing the exact causes of under nutrition at baseline while after the session 92.0% of them could correctly identify the causes of under nutrition. The table 4.3.8, does not indicate any gender difference in the knowledge of the study subjects.

Table 4.3.9 shows the response of the study subjects related to key issues of anaemia, which shows that the percentage of the study subjects increased from 12.0% to 87.1% regarding their awareness about anemia before and after the session. Regarding the sources of haem iron only 6.7% of the study subjects before the session could identify the sources which were partially correct, however, this proportion of the study subjects increased significantly to 93.9% (Correct: 79.1%, partially correct: 14.2%) after the session. Similarly, only 11.1% of the study subjects before the session, could identify the sources of non haem iron which was partially correct, which after the session increased to 92.8% of the study subjects who correctly identified the sources (Correct: 72.4%, partially correct: 20.4%). Regarding the enhancers and inhibitors of the iron bioavailability of iron, though more than a quarter (26.3%) could identify the sources of enhancers, 19.6% of the study subjects were partially correct and only 6.7% were absolutely correct in identifying the sources of enhancers. This percentage increased significantly to 94.2%, with more (74.2%) identifying correctly all the sources of enhancers, while only 20.0% being partially correct. Regarding, identification of inhibitors, before the session, almost same percentage of the study subjects could correctly (11.6%) and partially (10.7%) identify it. However, after the session, 95.1% of the study subjects could identify the sources, of which 81.8% correctly identified while only 13.3% partially identified the sources of inhibitors.

Later, two skill building sessions were carried out for 30 minutes for each section. In this session capacity of the students were built regarding BMI calculation, BMI chart plotting and interpretation. After the capacity building session, 84.6% students were able to correctly plot and interpret the BMI chart (Figure 4.3.2).

The second NHE session conducted for students was on control and prevention of over weight and obesity. Table 4.3.10, shows the knowledge level of the students for various aspects on control and prevention of overweight and obesity before and after the NHE session. Regarding the knowledge of including five food groups for making healthy diet, as expected at baseline nobody knew the concept of five food groups, instead 74.5% of the study subjects could identify cereals, bread and potato as five food groups. However, after the NHE session, 100.0% of the subjects could identify all the five food groups. It was very surprising to note that the study subjects were unaware of the fact that high salt/ sugar/fat intake could lead to any health problems before the session, while after the session 100% could identify the respective health problems due to high intake of salt/sugar/fat intake. Regarding the recommended levels of various dietary and lifestyle behaviors, before the NHE session, 77.3% of the students correctly identified the level of physical activity they should be engaged in, with more proportion of boys (89.4%) responding correctly than girls (52.9%). However, after the session, this percentage became 100.0%. While coming to the knowledge of the students regarding duration of screen time (TV watching and sitting on computer), at baseline the knowledge was good with majority (92.2%) of the students identifying more than two hours, as the recommended level, which further improved to 100% after the session. Regarding the daily consumption of fruits and vegetables, before the session, only a quarter (25.5%) of the students reported that they should consume less than 400 gm/day fruits and vegetable, while majority (74.5%) of them reported that it should be consumed equal to or more than 400gm/day, which after the session 100.0% of the students were clear about the recommended levels of fruits and vegetable daily.

Table 4.3.8: Impact of nutrition health education sessions to students on improvement in knowledge about key issues related to under nutrition

Key issues related to Adolescent health and under nutrition	Before the session			After the session		
	Girls (n = 63)	Boys (n = 162)	Total (N=225)	Girls (n = 63)	Boys (n = 62)	Total (N=225)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Correct age of adolescence 10-19 YEARS	46.0 (29)	48.1 (78)	47.8 (107)	98.4 (62)	98.1 (159)	98.2 (221)
Importance of nutrition during adolescence	57.1 (36)	58.6 (95)	58.2 (131)	100 (63)	98.8 (160)	99.1 (223)
Awareness of malnutrition	4.8 (3)	9.3 (15)	8.0 (18)	93.7 (59)	95.1 (154)	94.7 (213)
Importance of addressing malnutrition during adolescence	12.7 (8)	24.7 (40)	21.3 (48)	93.7 (59)	93.8 (152)	93.8 (211)
Method assessing the nutritional status of adolescents	9.5% (6)	1.9 (3)	4.0 (9)	96.8 (61)	98.8 (160)	98.2 (221)
Importance of assessing nutritional status regularly	65.1 (41)	64.8 (105)	64.9 (146)	100 (63)	97.5 (158)	98.2 (221)
Awareness of their own nutritional status	31.7 (20)	31.5 (51)	31.6 (71)	88.9 (56)	85.2 (138)	86.2 (194)
Awareness about Body Mass Index (BMI)	0 (0)	0 (0)	0 (0)	95.2 (60)	93.8 (152)	94.2 (212)
CAUSES OF UNDERNUTRITION						
• All correct responses (Total four)	34.9 (22)	44.4 (72)	41.8 (94)	90.5 (57)	92.6 (150)	92.0 (207)
• Don't know	60.3 (38)	50 (81)	52.9 (119)	3.2 (2)	3.7 (6)	3.6 (8)

Table 4.3.9: Impact of nutrition health education sessions to students on improvement in knowledge about key issues related to anaemia

Key issues related to anaemia	Before the session			After the session		
	Girls (n = 63)	Boys (n = 62)	Total (N=225)	Girls (n = 63)	Boys (n =162)	Total (N=225)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Awareness about anaemia	19.0 (12)	9.3 (15)	12.0 (27)	92.1 (58)	85.2 (138)	87.1 (196)
Sources of haem iron						
• Correct answer (meat, poultry, fish)	0 (0)	0 (0)	0 (0)	77.8 (49)	79.6 (129)	79.1 (178)
• Partially correct	6.3 (4)	6.8 (11)	6.7 (15)	14.3 (9)	14.2 (23)	14.2 (32)
• Wrong	25.4 (16)	24.1 (39)	24.4 (55)	3.2 (2)	3.7 (6)	3.6 (8)
• Don't know	68.3 (43)	69.1 (112)	68.9 (155)	4.8 (3)	2.5 (4)	3.1 (7)
Sources of non haem iron						
• Correct answer (pulses, cereals, vegetables, legumes)	0 (0)	0 (0)	0 (0)	74.6 (47)	71.6 (116)	72.4 (163)
• Partially correct	7.9 (5)	12.3 (20)	11.1 (25)	14.3 (9)	22.8 (37)	20.4 (46)
• Wrong	14.3 (9)	18.5 (30)	17.3 (39)	3.2 (2)	1.2 (3)	2.2 (5)
• Don't know	77.8 (49)	69.1 (112)	71.6 (161)	8.0 (5)	3.7 (6)	4.9 (11)
Enhancers						
• Correct answer (Vitamin C rich fruits, meat, fish and other sea foods)	7.9 (5)	6.2 (10)	6.7 (15)	82.5 (52)	71.0 (115)	74.2 (167)
• Partially correct	9.5 (6)	23.5 (38)	19.6 (44)	14.3 (9)	22.2 (36)	20.0 (45)
• Wrong	19.0 (12)	13.6 (22)	15.1 (34)	1.3 (1)	4.3 (7)	3.6 (8)
• Don't know	63.5 (40)	56.8 (92)	58.7 (132)	1.3 (1)	2.5 (4)	2.2 (5)
Inhibitors						
• Correct answer (Coffee, Tea)	6.3 (4)	13.6 (22)	11.6 (26)	93.7 (59)	77.2 (125)	81.8 (184)
• Partially correct	6.3 (4)	12.3 (20)	10.7 (24)	6.3 (4)	16.0 (26)	13.3 (30)
• Wrong	25.4 (16)	18.5 (30)	20.4 (46)	0 (0)	3.7 (6)	2.7 (6)
• Don't know	61.9 (39)	55.6 (90)	57.3 (129)	0 (0)	3.1 (5)	2.2 (5)

Figure in parenthesis indicates number of subjects

Figure 4.3.2: BMI chart plotting by the students after capacity building session

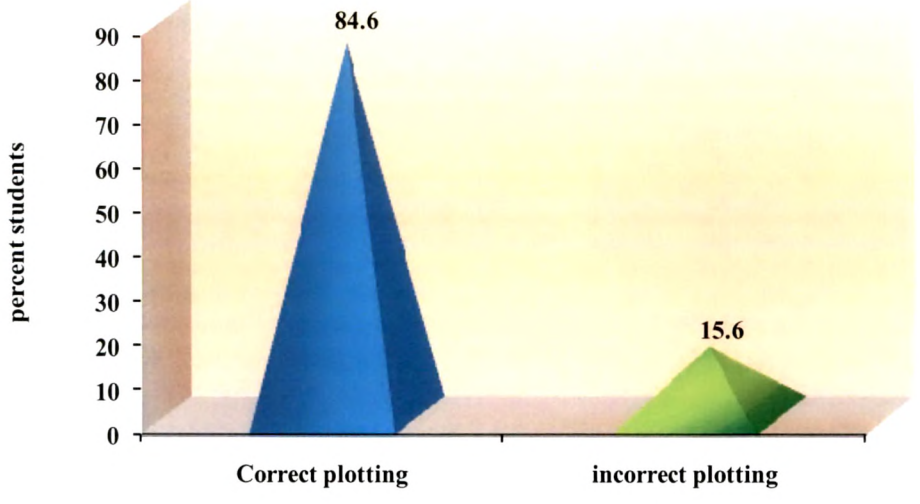


Table 4.3.10: Impact of nutrition health education sessions to the students on improvement in knowledge about key issues related to over nutrition

Responses	Before the session			After the session		
	Girls (n=85) % (n)	Boys (n=170) % (n)	Total (N= 255) % (n)	Girls (n=85) % (n)	Boys (n=170) % (n)	Total (N= 255) % (n)
Five food groups contain						
• Cereals, bread and potatoes	70.6 (60)	76.5 (130)	74.5 (190)	-	-	-
• Pulses and Legumes	11.8 (10)	8.8 (15)	9.8 (25)	-	-	-
• Milk and milk products	5.9 (5)	2.9 (5)	3.9 (10)	-	-	-
• Fruits and vegetables	5.9 (5)	5.9 (10)	5.9 (15)	-	-	-
• Oil Salt and sugar	-	2.9 (5)	2.0 (5)	-	-	-
• All of the above	5.9 (5)	2.9 (5)	3.9 (10)	100.0 (85)	100.0 (170)	100.0 (255)
High intake of salt leads to:						
• High blood pressure	85.9 (73)	89.4 (152)	88.2 (225)			-
• Heart problems	14.1 (12)	10.6 (18)	11.8 (30)			-
• Both				100.0 (85)	100.0 (170)	100.0 (255)
High Intake of sugar leads to						
• Diabetes	90.6 (77)	95.9 (163)	94.1 (240)			
• Increased weight gain	9.4 (8)	4.1 (7)	5.9 (15)			
• Both				100.0 (85)	100.0 (170)	100.0 (255)
High intake of fat leads to						
• Increased blood cholesterol	82.4 (70)	97.1 (165)	92.2 (235)			
• Heart diseases	17.6 (15)	2.9 (5)	7.8 (20)			
• High blood pressure						
• All of the above				100.0 (85)	100.0 (170)	100.0 (255)
How much time daily you should be physically active vigorously?						
• Less than 60 minutes	47.1 (40)	10.6 (18)	22.7 (58)			
• Equal to or more than 60 minutes	52.9 (45)	89.4 (152)	77.3 (197)	100.0 (85)	100.0 (170)	100.0 (255)
How long daily you should watch T.V or sit on computer?						
• More than 2 hours	82.4 (70)	97.1 (165)	92.2 (235)			-
• Equal to or less than 2 hours	17.6 (15)	2.9 (5)	7.8 (20)	100.0 (85)	100.0 (170)	100.0 (255)
How much (in grams) you should consume fruits and vegetables daily?						
• Less than 400 grams	11.8 (10)	32.4 (55)	25.5 (65)			-
• Equal to or more than 400 grams	88.2 (75)	67.6 (115)	74.5 (190)	100.0 (85)	100.0 (170)	100.0 (255)

4.3.3: Impact of one and half years of nutrition and health promotion program on few selected outcome indicators (BMI for age, biophysical parameter, biochemical parameter, and dietary and lifestyle behaviors), as compared to subjects of the control school.

From table 4.3.11, it was observed that both the schools had almost similar prevalence of malnutrition (experimental: 78.8% vs control: 79.3%) at baseline. However, after the intervention period, control school was found to have higher prevalence of malnutrition (82.6%) than the experimental school (77.9%), though no significantly different.

While looking at the results of experimental school from baseline, the decrease in percent prevalence in the malnutrition (in all its forms) was 3.3%, as compared to the percent increase of 4.1% in the control school. This indicates, that the nutrition health promotion programme with combined intervention (creating enabling environment, and providing NHE to the study subjects and parents) had little effect on the BMI status of the study subjects from the experimental school in one and a half years of school nutrition and health promotion program, although a trend towards reduction in malnutrition was seen.

On the other hand (Table 4.3.12), regarding central obesity, at baseline, the control school had higher prevalence compared to experimental school irrespective of the indicators used (WC or WHtR). At baseline, significantly higher ($p \leq 0.01$) high WC existed in the control school subjects, at baseline than the experimental school (17.4% vs 6.2%). Similarly, with respect to high WHtR also, at baseline, the control school subjects had higher prevalence, though not significantly different, than experimental school subjects (41.3% vs 35.5%).

Similarly, after the nutrition health promotion program (intervention) also, the control school had higher prevalence rates of central obesity (WC: 9.8%; WHtR: 38.0%) than the experimental school (WC: 4.5%; WHtR: 31.5%), however, after the intervention non significant differences existed between the schools, thereby suggesting that nutrition health promotion program did not have any impact on central obesity from their respective baseline values.

Coming to the changes in the prevalence of central obesity in experimental and control school, the results from table 4.3.12, showed non significant decrease in both the schools from their baseline values according to WC (experimental: 6.2% vs 4.5%; control: 17.4% vs 9.8%) and WHtR (experimental: 35.5% vs 31.5%; control: 41.3% vs 38.0%).

With respect to the prevalence of suboptimal blood pressure in the study subjects (Table 4.3.13), at baseline, higher prevalence, though not significant, was observed in the experimental school than the control school (23.8% vs 14.1%). However, after the nutrition health promotion program (intervention), the prevalence of sub optimal blood pressure, decreased very highly significantly ($p \leq 0.001$) in the experimental school as compared to control school (4.1% vs 35.9%).

Similarly, on looking at the changes in the sub optimal blood pressure in both the schools from their respective baseline values, the table 4.3.13 demonstrates that in the experimental school a highly significant ($p \leq 0.001$) fall in the sub optimal blood pressure was observed from baseline (23.8% vs 4.1%) while in the control school, the percent prevalence of sub optimal blood pressure, very highly significantly ($p \leq 0.001$) increased from baseline (14.1% vs 35.9%). Hence, showing an impact of nutrition health promotion program on sub optimal blood pressures of the study subjects from the experimental school.

Biochemical profile (fasting lipid and glucose) was taken only for overweight and obese subjects to assess the prevalence of dyslipidimea and glucose Intolerance. Looking at the results from table 4.3.14, for dyslipidimea, irrespective of the classifications used, the prevalence was higher in the control school than in the experimental school, with the difference being non significant between the two schools at baseline (ATP III: 60.7% vs 37.2%; AHA: 39.35 vs 20.9%). However 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 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 (Table 4.3.14), 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 non 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), from table 4.3.14, before the intervention, 9.3% of the subjects were found to have glucose intolerance in the experimental school than in the control school (0.0%). While after the nutrition health promotion program (intervention), control school (17.9%) was found to have higher prevalence of GI than the experimental school (4.9%), though the difference was statistically non significant. 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 (0% vs)

The impact of the intervention in the school was also seen on dietary and lifestyle behaviors of the study subjects from both the schools **(Table 4.3.15).** Looking at the prevalence of the study subjects practicing unhealthy behaviors of consuming carbonated (sweetened) beverages for 2 or more than two days, at base line, the experimental school had significantly higher ($p \leq 0.05$) prevalence than the control school (17.6% vs 8.7%). However, after the nutrition health promotion program (intervention), it was found that the percentage of study subjects practicing this unhealthy behavior of consuming carbonated beverages for 2 or more than 2 days were more in the control school than in the experimental school (13.0% vs 7.1%) though the difference was non significant (Table 4.3.15).

Coming to the changes in the prevalence of this unhealthy behavior in the experimental and control schools from its baseline values, very highly significant ($p \leq 0.001$) reduction was observed in the experimental school (17.6% vs 7.1%), while in the control school very high significant ($p \leq 0.001$) increase was observed in the control school from its baseline prevalence (8.7% vs 13.0%).

On looking at the unhealthy dietary habit of frequent fast food intake (2 or more than two days per week) in the study subjects from table 4.3.15, at baseline, the experimental school subjects had highly significant ($p \leq 0.001$) higher percentage

prevalence of unhealthy habit of taking fast food frequently than in the control school subjects (42.9% vs 18.5%). However, after the nutrition health promotion program, (intervention), non significant difference in the percentage of study subjects practicing this unhealthy behavior was noticed between the two schools. However, the control school subjects had higher percentage of the subjects practicing unhealthy behavior than in the experimental school subjects (22.8% vs 17.2%).

the experimental school the fast food intake decreased very highly significantly ($p \leq 0.001$) from its respective baseline values (42.9% vs 17.2%). On the contrary, in the control group, the intake of fast food in the study subjects increased from 18.5% at baseline to 22.8% after intervention, though it failed to reach statistical significance (Table 4.3.15).

Regarding another unhealthy habit of consuming low fruits and vegetable intake (< 400 gm/day) in the study subjects, table 4.3.15, data revealed that at baseline, more subjects from the experimental school had low fruit and vegetable intake than in the control school (59.0% vs 50.0%), the difference being non significant. However, after the nutrition health promotion program (intervention), the percentage of the study subjects having low fruit and vegetable intake, was very highly significantly ($p \leq 0.001$) higher in the experimental school as compared to the control school (67.4% vs 15.4%).

On comparing the percentages of the study subjects from the two schools with their respective baseline values, table 4.4.5 showed that in the experimental school, the percentage of study subjects consuming low fruits and vegetable (< 400 gm/day) reduced very highly significantly ($p \leq 0.001$) from the baseline (59.0% vs 15.4%). However, in the control school, the percentage of study subjects practicing this unhealthy dietary behavior of low fruit and vegetable intake (< 400 gm/day) significantly ($p \leq 0.05$) increased from the baseline prevalence (50.0% vs 67.4%).

Looking at the physical inactivity pattern of the study subjects, at baseline in the experimental and control schools, the data from **table 4.3.15** revealed that significantly higher ($p \leq 0.05$) percentage of the study subjects were physically inactive in the experimental school as compared to the control school (34.8% vs 22.8%). After the nutrition health promotion program (intervention), the physical

inactivity in the study subjects in the experimental school was very highly significantly ($p \leq 0.001$) lower in the experimental school as compared to the control school (6.0% vs 88.0%).

The change in the physical inactivity pattern from baseline in the experimental school also showed a very highly significant ($p \leq 0.001$) fall in physical inactivity levels (34.8% vs 6.0%), while in the control group, physical inactivity increased very highly significantly ($p \leq 0.001$) from its respective baseline prevalence (22.8% vs 88.0%).

More than or equal to 120 minutes of TV / computer / video games per day is considered as an unhealthy habit, and the data at baseline, from table 4.3.15, revealed that in the experimental school and control school, this unhealthy habit was similarly prevalent in both the schools (41.8% vs 40.2%). However, after the nutrition health promotion program (intervention) the unhealthy habit of higher exposure to TV/ computer / video games was very highly significantly ($p \leq 0.001$) more prevalent in the control school as compared to the experimental school (58.7% vs 38.2%).

Similarly, the comparisons, between the status of this practice, within the experimental and control schools from their baseline values showed that in the experimental school, there was a highly significant ($p \leq 0.01$) drop in the percent of subjects having the unhealthy habit of TV/ computer viewing / video (41.8% vs 32.2%) while in the control group there was a rise in the percent prevalence of the subjects reporting this unhealthy practice (40.2% vs 58.7%), though it did not reach statistical significance (Table 4.3.15).

The data in the literature reveals that accumulation of three or more than three of the unhealthy behaviors enlisted above can have a significant association with overweight and obesity. In the study subjects also, the change in the cumulative unhealthy patterns was also seen in the experimental and control school subjects.

At baseline (Table 4.3.15), very highly significant ($p \leq 0.001$) percentage of the subjects in the experimental school had cumulative unhealthy behaviors as compared to subjects in the control school (30.0% vs 9.8%). 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 subject as compared to control school subjects (4.1% vs 52.2%).

Within the schools also (Table 4.3.15), a very highly significant ($p \leq 0.001$) drop, in the percentage of the 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%).

Table 4.3.11: Total percent prevalence of malnutrition in both the schools before and after the intervention

Malnutrition	Experimental % (n)	Control % (n)
Pre	78.8 (215)	79.3 (73)
Post	77.9 (208)	82.6 (76)

Table 4.3.12: Total percent prevalence of central obesity in both the schools before and after the intervention

Central obesity		Experimental % (n)	Control % (n)	Significance level (p value)
Waist circumference (WC)	**Pre**	6.2 (17)[a]	17.4 (16)[b]	a vs b ** (p=0.001)
	Post	4.5 (12)	9.8 (9)	-
Waist to height ratio (WHtR)	**Pre**	35.5 (97)	41.3 (38)	-
	Post	31.5 (84)	38.0 (35)	-

Table 4.3.13: Total percent prevalence of sub optimal blood pressure in both the schools before and after the intervention

Sub optimal blood pressure	Experimental % (n)	Control % (n)	Significance level (p value)
Pre	23.8 (65)[a]	14.1 (13)[b]	a vs b [NS]
Post	4.1 (11)[c]	35.9 (33)[d]	c vs d*** (p= 0.000)
Significance level (p value)	a vs c*** (p=0.000)	b vs d*** (p=0.000)	

Table 4.3.14: Total percent prevalence of dyslipidimea and glucose intolerance in both the schools before and after the intervention

		Experimental (n=43) % (n)	Control (n=28) % (n)	Significance level (p value)
Dyslipidimea (ATP III)	**Pre**	37.2[a] (16)	60.7[b] (17)	a vs b[NS] (p= 0.088)
	Post	19.5[c] (5)	46.4[d] (13)	c vs d* (p=0.032)
Significance level (p value)		a vs c* (p=0.021)	b vs d [NS]	
Dyslipidimea (AHA)	**Pre**	20.9[e] (9)	39.3[f] (11)	e vs f [NS]
	Post	9.8[g] (4)	42.9[h] (12)	g vs h** (p=0.001)
Significance level (p value)		e vs g* (p=0.04)	f vs h[NS]	
Glucose Intolerance	**Pre**	9.3 (4)	0 (0)	NA
	Post	4.9 (2)	17.9 (5)	NA
Significance level (p value)		NA	NA	

NS: Non significant; NA: Not applicable

Table 4.3.15: Total percent prevalence of unhealthy dietary and lifestyle behaviours in both the schools before and after the intervention

Unhealthy dietary and lifestyle behaviours		Experimental (n=273) % (n)	Control (n=92) % (n)	Significance level (p value)
Carbonated (sweetened) beverages Unhealthy (≥ 2days/ week)	Pre	17.6[a] (48)	8.7[b] (8)	a vs b* (p= 0.045)
	Post	7.1[c] (19)	13.0[d] (12)	c vs dNS
Significance level (p value)		a vs c*** (p=0.000)	b vs d*** (p=0.000)	
Fast food Intake Unhealthy (≥ 2days/ week)	Pre	42.9[e] (117)	18.5[f] (17)	e vs f*** (p=0.000)
	Post	17.2[g] (46)	22.8[h] (21)	g vs h[NS]
Significance level (p value)		e vs g*** (p=0.000)	f vs h[NS]	
Low fruits & vegetable Intake Unhealthy (<400 gms/day)	Pre	59.0[i] (161)	50.0[j] (46)	i vs j[NS]
	Post	15.4[k] (41)	67.4[l] (62)	k vs l*** (p=0.000)
Significance level (p value)		i vs k*** (p= 0.000)	j vs l* (p= 0.020)	
Physical Inactivity Unhealthy (< 3days/ week)	Pre	34.8[m] (95)	22.8[n] (21)	m vs n* (p= 0.033)
	Post	6.0[o] (16)	88.0[p] (81)	o vs p*** (p= 0.000)
Significance level (p value)		m vs o*** (p= 0.000)	n vs p*** (p= 0.000)	
TV/computer playing Unhealthy (≥ 120 min/day)	Pre	41.8[q] (114)	40.2[r] (37)	q vs r[NS]
	Post	32.2[s] (86)	58.7[t] (54)	s vs t*** (p= 0.000)
Significance level (p value)		q vs s** (p= 0.005)	r vs t[NS]	
Cumulative unhealthy behaviors ≥ 3 unhealthy behaviors	Pre	30.0[u] (82)	9.8[v] (9)	u vs v*** (p= 0.000)
	Post	4.1[w] (11)	52.2[x] (48)	w vs x*** (p= 0.000)
Significance level (p value)		u vs w*** (p= 0.000)	v vs x*** (p= 0.000)	

NS: Non significant

Highlights

- Highly significant improvement in knowledge of the students after the NHE sessions regarding control and management of triple burden of malnutrition (under weight, anemia and over weight including obesity) was observed.
- Nutrition health promotion program, very highly significantly reduced the percent prevalence of study subjects practicing unhealthy dietary and lifestyle behaviors in the experimental school as compared to the control schools.
- Nutrition health promotion program had a very highly significant impact in reduction of sub optimal blood pressures in the study subjects belonging to the experimental school, while in the control school, the sub optimal blood pressures appeared to be rising from their baseline values.
- Nutrition health promotion program could significantly reduce the prevalence of dyslipidimea in the overweight and obese subjects of the experimental school, both by ATP III as well as AHA classification.
- A linear compliance dependent improvement was observed with weekly IFA supplementation in the study subjects on anemia reduction, subjects having very good and good compliance of weekly IFA supplementation significantly improved their anemia status, haemoglobin and academic performance levels after three months of supplementation.
- Anaemic subjects showed significant improvements in mean haemoglobin levels and reduction in anaemia prevalence than non-anaemic subjects after weekly IFA supplementation.
- Impact of nutrition health promotion program in the school setting was seen in the trends towards reduction in malnutrition status of the subjects (BMI for age)
- No impact of nutrition health promotion program was noticed on central obesity level of the subjects by both the indicators, namely, high waist circumference (WC) or high waist to height ratio (WHtR) or central obesity.

Discussion

Education and health are interdependent and there is a critical synergistic relationship between learning and the health status of a child .Education is a preparation for life. Childhood, particularly during the period of adolescence is full of demands, conflicts and stress. Life-skills equip children with the ability to cope with challenges which

are increasingly faced by them in a rapidly changing environment. The core life skills that have been identified by WHO include self-awareness, empathy, effective communication, social skills, ability to cope with emotions, creativity critical thinking, problem-solving and decision making. These life-skills have to be integrated to the total curricula and imparted through activity based learning **(Ory et al 2002)**. Looking at the emerging issues about childhood malnutrition and its relationship with adulthood non communicable disease burden it is now more important and relevant that children are equipped with the knowledge and skills required to maintain their health and nutritional status in a school setting.

The improvement in knowledge and practice of following healthy dietary and lifestyle practices by students of the experimental school in the present study clearly demonstrates that a school nutrition health promotion program needs to be based on this concept of life skill building of the adolescents, so that the adolescents themselves realize the importance of healthy dietary and lifestyle behaviors they should adopt to lead a healthy life. Thus nutrition health promotion program, besides emphasizing on the parent's participation, should also focus on building the child's capacities and improving their knowledge to make them the change agents for themselves as well as for the families and communities. Their knowledge and skills should be enhanced so much that they start demanding for healthy food choices in the school as well as in their own family and outside homes to stay healthy.

The present nutrition health promotion program was planned with the same objective to create enabling environment in the school as well as build their capacities and enhance knowledge of adolescents regarding healthy dietary and lifestyle behaviors, enabling them to understand about the healthy behavior they should adopt to be healthy.

The results of the NHE sessions in the present program, showed highly significant improvements in the knowledge levels after the NHE sessions, indicating that besides the other efforts to improve students health through a school program, nutrition health education should be an important component of it, as it is imperative to first educate people about the behaviors they need to practice. The results of this study are in line with other studies also which have shown significant improvement in knowledge levels after the NHE sessions or after the introduction of nutrition health curriculum

(Rajalakshmi et al 2010, Gorely et al 2009, Foster et al 2008, Bayne-Smith et al 2004, Warren et al 2003, Caballero et al 2003, Morris and Zidenberg-Cherr 2002, Baranowski et al 2000).

The results also demonstrated significant decrease in the unhealthy dietary and lifestyle behaviors after one and a half years nutrition health promotion program. The results clearly show that if the students are given healthy choices in the school by providing healthy food and beverages in the school canteen and or make them aware about the ill consequences of unhealthy behaviors, they show inclination towards adapting healthy behaviors. Other studies have also shown improvements in changing the behaviors of students by creating enabling environment, or through introducing kitchen garden concept in the school (Rajalakshmi et al 2010, Gorely et al 2009, Angelopoulos et al 2009, Rachaelet al 2007, Warren et al 2003).

Surprisingly in the present study, the prevalence of suboptimal blood pressure was found to be as high as 21.4% among the adolescents which is a cause of worry. The literature has shown increased levels of blood pressure in this population (Noronha et al 2012, Pande et al 2012, Madhusudan et al 2012, Mogra and Kaur 2012). Blood pressure has been associated with high BMI and stress levels (Kaur et al 2013, Sundar et al 2013). However, the results of the present study, showed that after one and a half years of intervention there was a significant decrease in the prevalence of suboptimal blood pressures among the adolescents in the intervened group. This indicates, that if the healthy dietary and lifestyle behaviors are practiced, the blood pressure can be controlled, even though no change in BMI is achieved. Hence, blood pressure could be taken as a good indicator to study the impact of nutrition health promotion programs in a school settings by changes in behaviors of the students.

Though, presently, the reason of occurrence of suboptimal blood pressure among the adolescents is supposed to be high BMI, or the high academic stress levels, the present study demonstrates that promoting healthy diet and lifestyle are the core components of a school nutrition health promotion programme to control blood pressure, a leading risk factor for non communicable disease control..

Therefore it is important to encourage promotion of healthy dietary and lifestyle behaviors through nutrition health promotion programs. Also improvement in parental

knowledge regarding control and management of blood pressures, could have also helped in improving the healthy dietary and lifestyle behaviors of their own children on outside the school setting as well. The studies (Davis-Kean and Pamela 2005, CDC 2012) has shown that uninformed parents indulge in spoiling their own children by promoting unhealthy behaviors (treating in fast food joints, eating out frequently as an incentive for better school performance). Another, major reasons for the development of unhealthy behaviors among the adolescents could be women joining the formal workforce leaving them little time to do household chores including cooking. Thus working mothers who do not have much time to spend in the kitchen, may allow their children and themselves go out for having meals in the restaurants, thereby increasing the frequency of eating food outside home.

It was surprising to note in the present study that though there was a significant fall in the dyslipidimea prevalence in overweight and obese subjects, there was no significant fall in the central obesity among the subjects. The reason may be, that dyslipidimea is also associated with unhealthy dietary and lifestyle behaviors. Hence, due to one and a half years nutrition health promotion program, which focused more on healthy dietary behaviors, the children had controlled their dietary and lifestyle behavior resulting in lower dyslipidimea prevalence.

On the other hand, studies (Mcmurray et al 2002, *Caballero et al 2003, Williamson* et al 2007, Foster et al 2008) shown that reducing anthropometric profiles (BMI for age and central obesity) are not only difficult to change but also require sustained intervention. Since, the present nutrition and health promotion program, focused only on diet and lifestyle behaviors, the reduction was seen more on behaviors rather than on BMI for age or in central obesity. Reductions in over nutrition (over weight including obesity and central obesity) status, needs both diet and physical activity which was not a focus of our study. Hence, nutrition health promotion program in a school should focus both on diet as well as on physical activity promotion in and outside the school.

The results of nutrition health promotion program in the present study demonstrate that schools are a good settings for laying the foundation for controlling and managing NCDs in adults and malnutrition control in children and adolescents. Hence, nutrition health promotion programs in a school settings needs to be promoted,

if we want to curtail the rising trends of NCDs in school going children and adolescents which are going to be productive adults and have lower disability adjusted life years (DALYs).

It was also very surprising to note that 49.3% of the study subjects form middle to high income schools were anemic, irrespective of their nutritional status. Hence, weekly IFA supplementation was an urgent need to start. Therefore the results of the weekly IFA supplementation showed improved haemoglobin levels in the subjects having good compliance than the subjects with poor compliance. The results also showed significant improvement in haemoglobin levels and scholastic performance in the subjects who were anemic before the supplementation than the nonanemics. Hence, blanket supplementation may not be advisable and should not be given to all the students and assessment of anemia status should be important in a school setting before initiating IFA supplementation in both government and non government schools. Anemia control should also be an integral part of nutrition health promotion program in schools, and IFA compliance is likely to improve if IT technology of sending reminders on mobile phones is used to remind students to consume their weekly dose and involving parents to ensure regular IFA intake may further improve the results as in a school setting due to examinations, vacations etc it is difficult to give supervised IFA supplementation in school for 3 months.

Finally, the results of the present study clearly demonstrate that comprehensive multi component (curriculum, food service, school staff and parental involvement) nutrition health promotion program works & helps in controlling malnutrition in all its forms.