MATERIALS AND METHODS

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The present study was undertaken to assess the nutritional status of school going adolescent children (10-17y) in 3 schools of urban Vadodara also to develop a Healthy Eating Index and Food Behaviour Checklist for them along with assessing the impact of a Nutrition Communication Programme to improve their dietary practices.

Study Design

Sample selection

Three schools of urban Vadodara were purposively selected for the present study. Consent was obtained from the Directors, Principals of all the schools and parents of the subjects. All the students from standard V to XI standard were enrolled for the study. In all there were 1041 subjects from the 3 schools comprising 613 boys and 428 girls. Anthropometric data was obtained on all the subjects. Students of std X, XI and XII were later dropped from the study due to excess load of studies.

Socio- economic status and food and physical activity behavior data was collected for 631 subjects studying in std. V to std. IX.

Two schools (comprising 478 subjects) were randomly selected and randomly allocated as Experimental group and Control Group. In all there were 212 subjects in the experimental group, comprising 134 boys and 78 girls, whereas the control group included a total of 266 subjects, including 166 boys and 100 girls. Information was collected on anthropometric measurements, Socio-Economic status, Knowledge attitudes and practices, Cognitive development, Food behaviour, Morbidity Profile and Diet history of all the subjects from Std. V to Std. IX.

Due to a dropout of 38 students, by the end of the intervention period there were 191 subjects in Experimental group and 245 subjects in Control group. Post intervention data was collected on 436 subjects.

Biochemical estimations were carried out for a subsample of 61subjects.

Inclusion exclusion criteria

All the subjects studying in Std. V to std. XII were enrolled for the anthropometric data collection. Due to excess workload of studies standards X, XI and XII were excluded from the study thereafter. Data was collected for all the students except those who were transferred to other schools. Students admitted in the school after the initiation of the study were not included in the study but were allowed to attend the Nutrition Communication Programme sessions.

Ethical committee approval

Consent of the ethical committee was taken prior to conducting the study. A written consent was taken from the parents of the subjects. Consent was also taken from the Teachers, Principals and Directors of the schools. Biochemical tests were performed only on the students whose parents consented for the same. (Ethical clearance no. F.C.Sc/ FND/ME/90).

The study was conducted in five phases:

Phase I: Assessment of the Nutritional status of the subjects

Phase II: Healthy Eating Index and Food Behaviour Checklist – Development, assessment for subjects and validation

Phase III: Development of Nutrition Communication programme and its implementation

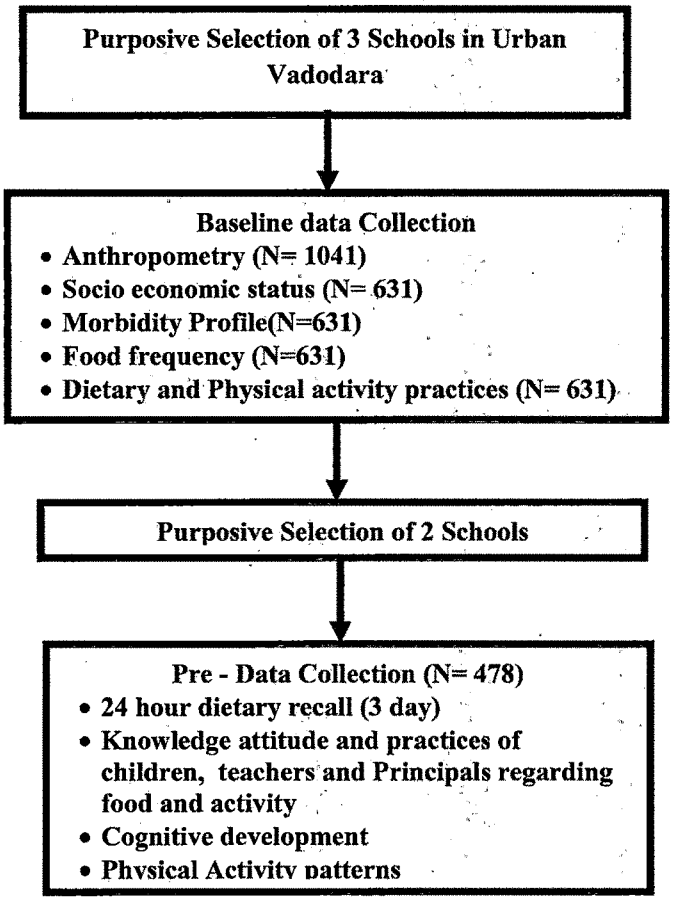
Phase IV: Assessing the impact of Nutrition Communication on the Subjects

Phase V: Data analysis, report writing and dissemination of results

Phase I: Assessment of the Nutritional status of the subjects

The main purpose of this phase was to assess the magnitude of malnutrition among school going adolescents. Figure 3.1.1 shows the experimental design of Phase I.

Figure 3.1. 1: Formative research – Enrollment profile of the study subjects



The major variables/parameters included in formative research were

Socio Economic Status

Information on the socio economic profile of the subjects was collected using a pre-tested structured questionnaire. Information regarding date of birth, sex, religion, family composition, parent's education and occupation, per capita income, dietary habits etc. was collected (Appendix- I)

Anthropometric measurements

To assess the prevalence of malnutrition, indices namely, BMI for age, Height for age (WHO 2007 standard) and Weight for age (CDC, 2000) were calculated.

Weight **(Principle)**

Weight is a key anthropometric measurement of body mass. It is a sensitive indicator of malnutrition and can be useful for diagnosing acute protein calorie malnutrition in children of all age groups.

Procedure

Weight measurement was done for all the subjects using a calibrated digital weighing scale. It is portable and can be conveniently used in the field. The subject was asked to stand erect on the scale without touching anything, with no heavy clothing or foot wear and looking straight ahead. It was ensured that the children were not wearing any heavy jewellery while taking the weight. The weight was then taken twice in order to ensure accuracy.

Height **(Principle)**

Height is a linear measurement made up of the sum of four components: legs, pelvis, spine, and skull (Jelliffe, 1966). A given deficit in height may represent a period of growth failure in a person's life.

Procedure

Height measurements of all the subjects were taken using a flexible, non-stretchable fiberglass tape. The tape was fixed vertically on a smooth wall of the school perpendicular to the ground, ensuring that the floor was smooth. The subject was asked to stand erect with the shoulders, hips and heels touching the wall and with no footwear, heels together and looking straight ahead. The head was held comfortably erect, arms hanging loosely by the sides. A thin smooth scale was

held on top of the subject's head in the center, crushing the hair at the right angles to the tape and the height of the subject was read from the lower edge of the ruler to the nearest 0.1 cm.

Body Mass Index (BMI)

BMI or the Quetelet's index was calculated using the following formula

$$BMI = \frac{\text{Weight (Kg.)}}{\text{Height (m)}^2}$$

Waist and Hip measurements

Each child stood with weight evenly balanced on both the feet and the feet about 25-30 cms apart. The child was asked to breathe normally and at the time of making measurement was asked to breathe out gently. This prevented them from contracting their muscles or from holding their breath.

Waist

The measurements were obtained by measuring the distance around the smallest area below the rib cage and above the umbilicus (belly button) with the use of a non stretchable tape measure. The reading was taken to the nearest 0.1 cm.

Hip

The measurement was done at the point yielding the maximum circumference over the buttocks with the tape held horizontally.The reading was taken to the nearest 0.1 cm.

Waist Hip Ratio (WHR)

WHR was calculated using the given formula

$$WHR = \frac{\text{Waist (cm)}}{\text{Hip (cm)}}$$

Mid Upper Arm Circumference (MUAC)

Mid upper arm circumference was measured halfway between the acromian process of the scapula and the olecranon process of the ulna. A non stretchable fiber glass tape was used for the measurements which were taken to the nearest 0.1 cm.

Morbidity Profile

Information pertaining to coughs and colds, diarrhea, fever, malaria etc was elicited using a morbidity checklist using a reference period of 15 days (Appendix II). Haemoglobin levels are known to be sensitive to certain infections and thus morbidity data was collected for correct interpretation of the change in the levels of these parameters.

The terms for infectious episodic morbidities were explained if not understood as follows

Diarrhea	Defined as passing of more than three loose stools in a day.
Cold	Characterized by running nose or blocked nose.
Cough	Based on subject's history.
Malaria	Characterized by the high fever, shivering and pain in the abdomen and as diagnosed by the physician.

Biochemical Indicators

Haemoglobin and Red cell morphology was assessed to map the prevalence and severity of anaemia along with the red cell morphology.

Haemoglobin Levels

The most feasible quantitative measure for iron deficiency anaemia is estimation of haemoglobin levels (Gillespie 1998). Cyanmethaemoglobin method, the international reference method to determine the total haemoglobin concentration in blood, is considered as a Gold standard for assessing haemoglobin levels.

Principle

On treating haemoglobin with Drabkin's reagent, haemoglobin present in blood reacts with potassium ferricyanide forms methaemoglobin and this compound is reduced by potassium cyanide to form cyanmethaemoglobin a rust colored compound, which is estimated spectrophotometrically at 540 nm.

Standardization

Cyanmethaemoglobin reference standard was obtained from "Qualigens Pvt Ltd". Spectrophotometer was calibrated using this method.

Procedure

Suitable aliquot of 0.75 ml, 2.25 ml and 3.75 ml haemoglobin standard was taken in separate test tubes and the volume was made up to 5ml by Drabkin's solution. In one test tube undiluted aliquot of 5 ml was taken as top standard. These were read at 540 nm on a spectrophotometer after 30 minutes after adjusting the instrument to zero with blank solution (Drabkin's reagent). A factor for estimation of haemoglobin was calculated from the optical density obtained.

The estimation of haemoglobin was done according to the following steps:

1. Any one finger of the hand was selected specifically the middle one. It was then wiped with a cotton swab dipped in ethanol and was allowed to dry.
2. Then with a disposable lancet a bold prick was made.
3. The first drop of blood was wiped off.
4. Then a big drop of blood was allowed to form on the finger and then 20 mcl of blood was pipetted using a calibrated micropipette. 20 µl
5. The blood sample was added to 5 ml Drabkin's reagent and mixed thoroughly.
6. This solution was allowed to stand (away from sunlight) for 30 minutes before being read on a spectrophotometer at 540 nm.
7. Duplicate samples were collected from each subject.

Calculation

The haemoglobin concentration was calculated using the optical density of the samples as follows

OD x Factor = Haemoglobin Concentration (g/dl)

Serum Total Protein

Serum Total protein, as the name implies, represents the sum total of numerous proteins, many of which vary independently of each other.

Principle

Proteins form a purple coloured complex with cupric ions in alkaline solution. The reaction takes its name from the simple compound biuret which reacts in the same way. The intensity of the purple colour is measured at 540 nm / yellow green filter and compared with a standard serum of known protein concentration.

Procedure

1. Pipette 2.5 ml Sodium Chloride diluents in the blank tube.
2. Pipette 2.45ml, 2.4ml and 2.35ml of the sodium chloride diluent in S1, S2, and S3 tubes respectively.
3. Add 0.05ml, 0.1 ml and 0.15 ml of bovine serum standard to S1,S2 and S3 tubes respectively.
4. For the test sample take 2.4ml of sodium chloride diluent and 0.1 ml of test sample in the tube marked test.
5. Add 3 ml of Biuret reagent to all the tubes.
6. Incubate at room temperature (25-35°C) for 15 minutes.
7. Set the spectrophotometer to zero using blank at 540 nm and measure the absorbance of standards and test .

Calculation

Plot the absorbance values of standards against their respective concentrations. The measurable range with this graph is from 0.5 to 10 g/dl. Plot the absorbance values of test on the calibration graph and read off the concentrations.

Results are calculated using the formula:

$$\frac{\text{Test absorbance}}{\text{Standard Absorbance}} \times \text{Concentration of standard} = \text{d/dl}$$

Peripheral Blood Smear

Principle

A peripheral blood smear (peripheral blood film) is a glass microscope slide coated on one side with a thin layer of venous blood. The slide is stained with a dye, Leishman's stain, and examined under a microscope

Peripheral Blood Smear Preparation

The wedge slide ("push slide") technique developed by Maxwell Myer Wintrobe (1974) remains the standard method for the preparation of peripheral blood smears (films). Figure () shows the steps involved in the preparation of peripheral blood smears. Figure 3.1.2

Procedure

1. A 1" x 3" glass microscope slide with a frosted end on a flat surface was used.
2. A label on the slide, specimen identification number, and date of preparation was attached on the frosted surface.
3. Any one finger of the hand was selected, especially the middle one. It was wiped with cotton swab, dipped in ethanol and allowed to dry.
4. Then with a disposable lancet a bold prick was made.
5. The first drop was wiped off and the second drop (a 2 - 3 mm drop of blood) was placed approximately 1/4" from the frosted slide, using a wooden applicator stick or glass capillary tube.
6. The slide was held by the narrow side between the thumb and forefinger of one hand at the end farthest from the frosted end.
7. A second slide ("spreader slide") was grasped between the thumb and forefinger of the other hand at the frosted end. The spreader slide was pushed forward at a 30^{o} angle with a rapid, even motion.
8. The edge of the spreader slide was placed on the lower slide in front of the drop of blood (side farthest from the frosted end).
9. The spreader slide was pulled toward the frosted end until it touched the drop of blood. The blood was permitted to spread by capillary motion until it almost reached the edges of the spreader slide.
10. The smear was dried quickly by waving it in air.

Figure 3.1. 2: Wedge slide technique for preparation of a peripheral blood smear

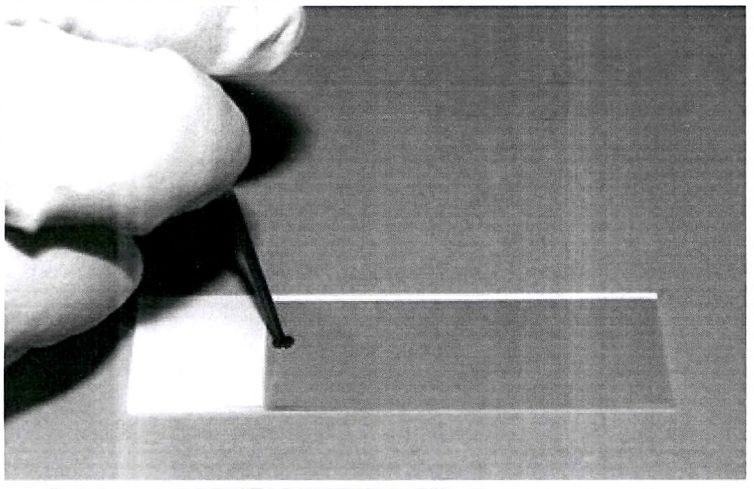
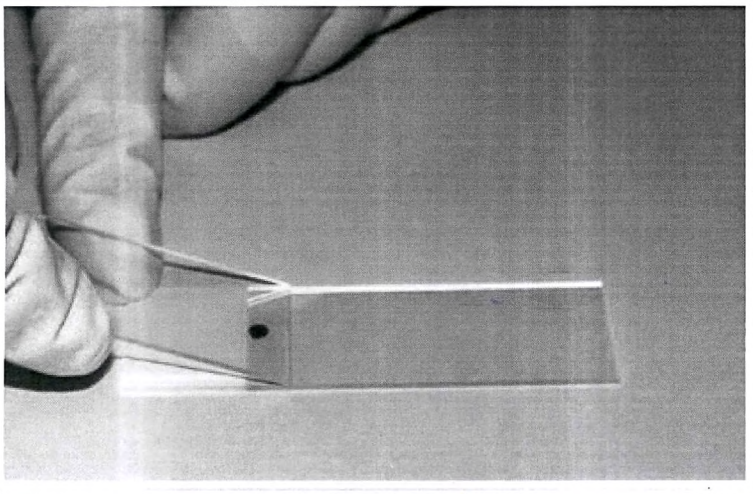
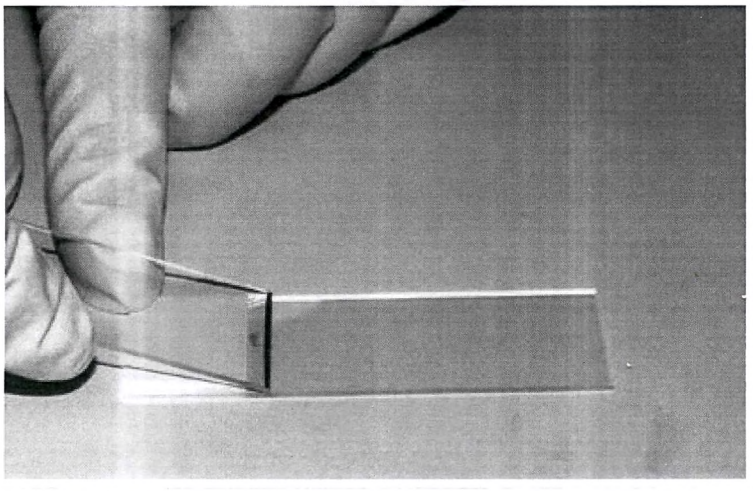
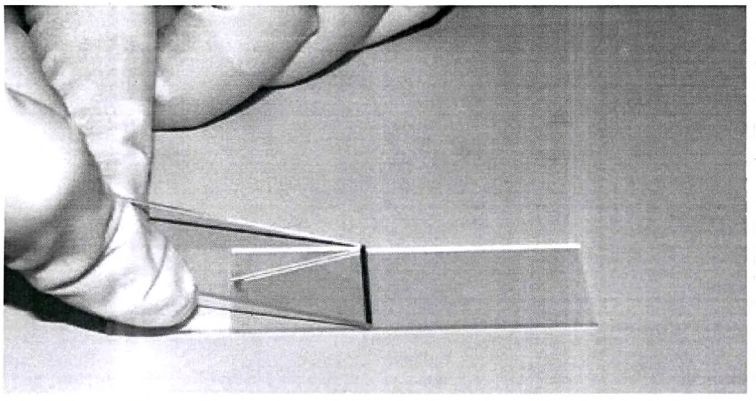
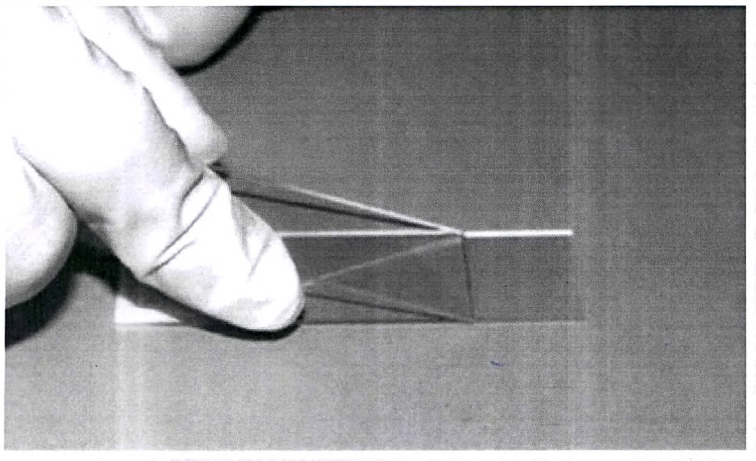
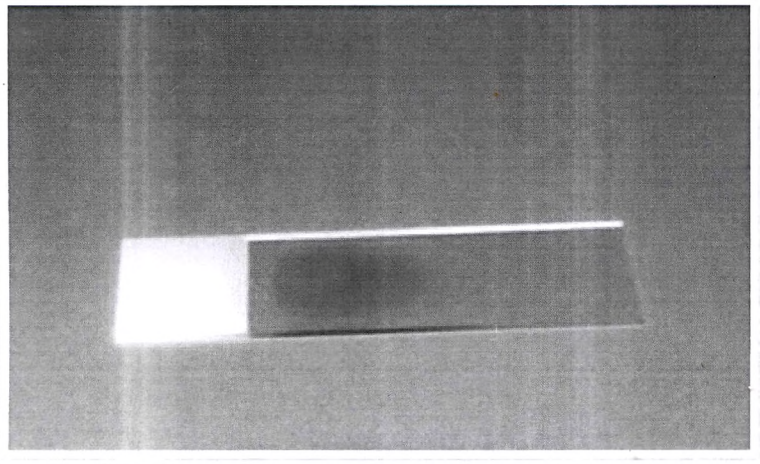
	Step 1. Placing a small drop of venous blood on a glass microscope slide, using a glass capillary pipette. A wooden applicator stick can also be used for this purpose.
	Step 2. A spreader slide has been positioned at an angle and slowly drawn toward the drop of blood.
	Step 3. The spreader slide has been brought in contact with the drop of blood and is being drawn away. Note layer of blood at the edge of the spreader slide.

Fig.3.1.2: Wedge slide technique for preparation of a peripheral blood smear (contd.)

	Step 4. The spreader slide is further pulled out, leaving a thin layer of blood behind.
	Step 5. The blood smear is nearly complete.
	Step 6. End result. A glass slide with a well-formed blood film. After drying for about 10 minutes, the slide can be stained manually or placed on an automated slide stainer.

1. The slide was stained with 8-10 drops of Leishman's stain till the stain got fixed.
2. The slide was washed with buffered water and dried.
3. The fixed stain slide was then read under the microscope for identification of size and shape of the red blood cells.

Diet History

Food frequency, dietary pattern (6 days), nutrient intake (one day 24 hour dietary recall) were collected. The dietary pattern was used to develop the Food behaviour checklist and the dietary intake was used to arrive at the Healthy eating Index scores for adolescent children.

Diet Habits and Practices

Dietary habits and practices data was obtained from the adolescent subjects regarding frequency of meals, breakfast consumption, fruits intake, consumption of accessories with meals, fast foods and soft drink intakes, frequency of eating out etc.

24-Hour Dietary Recall

The diet surveys were done to have an estimate about the subject's intake of energy, protein, fat, calcium and iron. Information on dietary intake was collected for 3 days (1 holiday and 2 working days) before and after the period of intervention for all the subjects in the control and experimental groups.

Principle

According to Rivera et al (1985) 24-hour dietary recall is a simple and valid method for assessing food and nutrient intakes of populations, the method is based on the process of recall of food consumption over a specified period of time (24 Hrs) prior to the survey. It is one of the most common methods used for the diet survey.

Procedure

The respondents were questioned about the foods eaten for different meals as well as the amount of food consumed. Their mothers or the cooks were then asked about the raw ingredients used for the preparation of each food item for the entire household and were asked to show the amount of raw ingredients taken in terms of household measures and this was then recorded in terms of the standard volumetric measures. This was later converted into grams. The volume of

the cooked food was also recorded. This was also done in the terms of household measures and then was converted in terms of standard measures.

Then the subject's consumption of the cooked food in terms of household measures was taken and then converted in standard volumetric measures. Using this information the subject's intake of raw ingredients was calculated (Appendix-II). Nutritive value of the foods consumed by the children were calculated based on the value given in the food consumption tables of the Nutritive Value of Indian Foods (NIN 1998).

Food Frequency

Food frequency method is used to assess habitual food intake of the subjects, qualitatively. An exhaustive list of the commonly consumed foods was prepared and the respondent was asked as to how frequently each of the listed food was consumed by him/her. The frequency was daily, alternate days, twice a week, once a week, twice a month, once a month, rarely and never (Appendix- III)

Dietary pattern

For the Food Behaviour Checklist information on the dietary pattern of the subjects was collected (Appendix IV). A checklist was prepared with the common patterns like:

- Breakfast consumption, frequency and items
- Mid morning food consumption
- Vegetable especially Green leafy vegetable and yellow and orange vegetable consumption
- Evening snack consumption, items and frequency.
- Outside food consumption etc.
- Different activities carried out and their duration

Physical activity

The general activity information was obtained using a pretested structured questionnaire. An exhaustive list, which was representative of the physical activities of children of the present study, was made (Appendix). These activities were then classified into light, moderate and heavy activities as per the description of FAO/WHO expert committee's report on energy requirements (FAO/WHO 1985); light activity which involved 75% sitting and 25% standing and moving,

Moderate activity mainly involving standing and walking but no other physical activity and Heavy activity which included heavy physical activity.

Cognitive development

Malnutrition adversely affects the ability of adolescents to learn. The mental functions of the subjects were assessed by using a set of selected tests from the Wechsler Intelligence Scale for children (WISC IV) and other standard methods used previously in the department (Bhardwaj and Gopaldas, 1986 and Bhatt M C 1973). WISC IV is a battery of tests for 6-17 year olds that evaluates intellectual abilities. The various tests used were Digit Span (Forward and backward), Visual memory test and maze test. As class performance is also considered as cognitive development therefore the marks obtained by the subjects in the examinations were also noted down.

Digit Span

It is a measure of short term auditory memory for non- meaningful information, concentration and ability to remember a sequence of numbers both forwards and backwards.

Procedure:

1. **Digit Span Forward:** A series of numbers were read out which gradually increased in length. Each list of numbers was presented once and the subjects were asked to recall and writs each set of the numbers in the same sequence
2. **Digit Span Backward:** Another set of numbers were called out and the subjects were asked to recall and write it down in reverse sequence.

Different series of numbers were presented for forward and backward recall. Each set of numbers were called out once only and the subjects were previously instructed to be attentive. They were instructed to write only after the whole set of numbers was read out completely (Appendix-V).

Scoring: The written series were checked for the correct order and scores were given separately for forward and backward recall as per the method of description. Both the scores were added and a total score was given. Seventeen was the maximum score.

Visual Memory Test

Visual memory test is a test to measure short term memory of the subjects.

Procedure: Fifteen commonly used items are placed on a table such as toothbrush, pen , eraser etc.(Appendix-VI). The subjects were allowed to observe the objects for one minute and then the objects were covered with a cloth. Subjects were then asked to recall and list down the items which they had seen within 2 minutes.

Scoring: One point was given for each item listed correctly. The scores were calculated as the ratio of the total number of items correctly listed to the total number of itemsi.e.15. the highest score was one.

Maze Test

It is used to measure psychomotor coordination; planning, visual motor coordination and speed; and fine motor coordination, planning, following directions. Performance is also based on time.

Procedure: The maze tests have complex pathways having blind alleys. Papers containing seven mazes were given and the subjects were asked to find their way out of the mazes using a pencil, without making any errors within specific time given for completion of each maze. There were seven mazes increasing in complexity (AppendixVII). The subjects were not allowed to draw lines approaching from outside to inside. They were asked not to lift their pencils.

Scoring: Each maze was checked for the number of errors and accordingly scores were given (AppendixVIII)

Error:

1. If the line of the maze was touched it was counted as one error
2. Crossing the imaginary line into a major blind alley is one error
3. Crossing lines (walls of the maze) is one error. A line is crossed if any white space can be seen between the printed line and pencil line on the wrong side of the printed line.

Knowledge Attitude and Practice

Data was collected by interviewer administered method using a pre tested semi- structured questionnaire. Information regarding Diet, healthy eating habits, meal consumption pattern, Food Pyramid, etc. was obtained from the subjects (Appendix-IX). Also data was obtained on the Knowledge and attitudes of the teachers regarding adolescents (Appendix-X)

Table 3.1.1 shows the sample size for all the parameters studied.

Table 3.1. 1: Sample size and parameters studied in the present study

Indicators	Pre intervention (N)	Post intervention (N)
Anthropometric measurements • Height • Weight • Waist • Hip • MUAC • Wrist	1041	436
Socio economic status	631	----
Morbidity profile	478	436
Biochemical estimations	61	----
Physical activity	478	436
Dietary data • 24 hour dietary recall • Food Frequency • Food behaviour pattern	 478 631 631	 436 436 436
KAP • Children • Teachers and Principals	478 15	436 ----
Cognitive development	478	436

Phase II: Healthy Eating Index and Food Behaviour Checklist – Development, Assessment for subjects and Validation

Healthy Eating Index (HEI)

U.S. Department of Agriculture (USDA) has developed a healthy Eating Index (HEI), to find out how well the Americans follow the recommended healthy eating patterns.

The overall index has a total possible score ranging from zero to 100. Each of the 10 dietary components has a scoring range of zero to 10. Individuals with an intake at the recommended level received a maximum score of 10 points. A score of zero was assigned when no foods in a particular group were eaten. Intermediate scores were calculated proportionately. The healthy eating index was applied to the 1989 and 1990 USDA data from the continuing Survey of Food Intake by individuals.

Food Group Components of the Healthy Eating Index (1989)

The healthy eating index examines dietary intake in relation to the five major groups in the Food guide pyramid. For each of the five food group components of the index, individuals who consumed the recommended levels of the servings received a maximum score of 10. A score of zero was assigned to any food group where no items from the category were consumed. Intermediate scores were calculated proportionately to the number of servings consumed. For example, if the recommended level of serving was eight and an individual consumed four servings, the component score for the individual was 5 points. A score of 7.5 points was assigned if six servings were eaten.

Other Components of the Healthy Eating Index

Total Fat

Fat intakes less than and equal to 30 percent of the total calories were assigned a score of 10 points. The scored declined to zero when the proportion of fat to total calories reached 45 percent. Intakes between 30 percent and 45 percent were scored proportionately.

Saturated fat

A score of 10 points was assigned to saturated fat intakes at less than 10 percent of total calories. Zero points were assigned when the saturated fat intake reached a level of 15 percent of the total calories. Scores between the two cutoff values were calculated proportionately.

Cholesterol

A maximum point value for cholesterol was assigned when intake was at the level of 300 milligrams or less. Zero points were assigned when intake reached a level of 450 milligrams or more. Values between the two cutoff points were scored proportionately.

Sodium

A maximum score for sodium was assigned at an intake level of 2,400 milligrams or less. Zero points were assigned at a level of 4,800 milligrams or more. Scores between the two levels of intake were scored proportionately.

Variety

Dietary variety was assessed by totaling the number of "different" foods eaten by an individual in amounts sufficient to contribute at least one-half of a serving in a food group. Similar foods were grouped together and counted only once in measuring variety. Food mixtures were broken down into their component ingredients and assigned to the relevant food groups. Index scores for variety were calculated in a manner analogous to the method used for the other index components. Cutoff scores for variety were defined based on 3 days of recorded data. A maximum score was given if 16 or more different food items were consumed over a 3-day period. A score of zero was given if six or less different items were eaten. When based on 1 day of reported data, the cutoff scores for variety were reduced by a factor of two. Intermediate intakes were calculated proportionately.

Development of the HEI – 2005

CNPP (Center for Nutrition Policy and Promotion) USDA convened an interagency Working Group to begin the process of revising the HEI. The working group reviewed the original HEI and its uses.

The Working Group decided to base the revised index on the food patterns found in USDA's food guidance system, which was then called My Pyramid, which translates key recommendations in the 2005 Dietary Guidelines for Americans into specific, quantified dietary recommendations (Britten, Marcoe, Yamini, & Davis, 2006). Collectively, these documents specify amounts to consume from each of the major food groups and from oils and provide recommended limits for sodium, saturated fat, and discretionary calories. In addition, they advise that at least half of grain intake should be whole grain, recommend specific amounts of several vegetable subgroups, and suggest that less than half the fruit consumed should be juice. A subgroup of the HEI Working Group further developed the components of the index, constructed the scoring and weighting protocol, developed the evaluation plan, conducted the analyses, presented findings to the full Working Group, and held briefings for wider audiences (Guenther et al, 2007).

The components of the HEI-2005 were considered to be of two types. The food-group and Oils components were the "adequacy components" because the recommendations on which they were based were established to ensure adequacy of nutrient intake. The "moderation components" were Saturated Fat, Sodium, and Calories from SoFAAS. The components of HEI- 2005 are shown in Table 3.2.1 with their maximum scores. The minimum score for all the components was zero. Intermediate scores were calculated proportionately. A total score of more than 80 points implied that the dietary quality was 'good'. A score between 51 to 80 suggested that the diet quality 'needed improvement' and a score of 50or less implied that the diet was of a 'poor quality'.

Table 3.2. 1: Components of HEI -2005 with maximum and minimum scores

Components	Max Score	Min Score
Total Fruit	5	0
Whole Fruit	5	0
Total Vegetables	5	0
Dark Green and Orange Vegetables and Legumes	5	0
Total Grains	5	0
Whole Grains	5	0
Milk	10	0
Meat and Beans	10	0
Oils	10	0
Saturated Fat	10	0
Sodium	10	0
Calories from SoFAAS	20	0
Total HEI Score	**100**	**0**

Healthy Eating Index for Adolescents (HEIA) Development and Assessment – Present Study

The Healthy Eating Index for Adolescents had a total score of 100. It consisted of 10 dietary components. If the diet scored above 80 points then it was considered as a good quality diet. If the score ranged between 51 and 80 then the diet needed improvement and if the score was less than or equal to 50 then it was considered to be of poor dietary quality. Each component had been allotted a maximum score. Based on the dietary guidelines, the intakes at different levels were given scores. The most desirable intake of a component was given the maximum score. Minimum score was allotted to the most undesirable intakes. Intermediate scores were calculated proportionately to the amounts consumed. The maximum and minimum scores according to age and sex are shown in Table 3.2.2.

Food Behaviour Checklist

A short food behavior checklist (FBC) was developed to evaluate the impact of nutrition education on fruit and vegetable intake among ethnically diverse women in the Food Stamp Nutrition Education Program (FSNEP) and the Expanded Food and Nutrition Education Program (EFNEP (Blackburn et. al, 2006). This short, culturally neutral FBC is a valid and reliable indicator of fruit and vegetable consumption. Compared with the 24-hour dietary recall, it is also less time-consuming to administer, code and analyze, with a reduced respondent burden.

Food Behaviour and Activity Checklist for Adolescents (FBACA) – Present Study

Food Behaviour and Activity Checklist for Adolescents (FBACA) was developed to assess the quality of diet and activity patterns of the adolescent children according to frequency. The FBACA checklist was administered for 6 days to ascertain the trend. Frequencies for breakfast, mid morning, vegetables, fruits, local fruits, intake of processed foods, fried foods, water intake, and for activity patterns according to playtime, leisure time and study time were seen. The frequencies were given scores of 0 to 5. Zero was given to the most undesirable action for any dietary component or activity pattern and a maximum score of 5 was given to the most desirable frequency of food item consumption or activity pattern (Table 3.2.3). Different components of foods and activity patterns were included in the checklist and scores were allotted accordingly. The score guide for FBACA is given in (Appendix-XII)

Table 3.2. 2: Healthy Eating Index for Adolescents - Scoring system

S.no.	Individual Component	Age (y)/ Sex	Cut Off Value	Max Score	Min. Score
1	% of RDA consumed from Total Grains	< 9-9.11	≥ 180 g	10	0
		10-12.11 G	≥ 240g		
		10-12.11 B	≥ 300g		
		13-15.11 G	≥ 330g		
		13-15.11 B	≥ 420g		
2	% of RDA consumed from Pulses(P) or Egg/ Meat/ Chicken/ Fish (M)	<9-9.11	≥ 60 g of P OR 30g of P and 50 g of M OR 100g of M	10	0
		10-12.11 G			
		10-12.11 B			
		13-15.11 G			
		13-15.11 B	≥ 75 g of **P** OR 38g of **P** and 75 g of **M** OR 150g of **M**		
3	% of RDA consumed from Total Vegetables	< 9-9.11	≥ 300 g	5	0
		10-12.11 G			
		10-12.11 B			
		13-15.11 G			
		13-15.11 B	≥ 350 g		
4	% of RDA consumed from Green, Yellow & Orange Vegetables	< 9-9.11	≥100 g	5	0
		10-12.11 G			
		10-12.11 B			
		13-15.11 G			
		13-15.11 B			
5	% of RDA consumed from Fruits	< 9-9.11	≥ 100 g	10	0
		10-12.11 G			
		10-12.11 B			
		13-15.11 G			
		13-15.11 B			
6	% of RDA consumed from Milk	< 9-9.11	≥ 500 ml	10	0
		10-12.11 G			
		10-12.11 B			
		13-15.11 G			
		13-15.11 B			

Table 3.2.2: Healthy Eating Index for Adolescents - Scoring system (Contd.)

S. No	Individual Component	Age (y)/ Sex	Cut Off Value	Max. Score	Min. Score
7	% of RDA consumed from Edible Oil	< 9-9.11	≤ 30g[1]	10	0
		10-12.11 G	≤ 35g[1]		
		10-12.11 B	≤ 35g[1]		
		13-15.11 G	≤ 40g[1]		
		13-15.11 B	≤ 45g[1]		
8	% of RDA consumed from Sugars	< 9-9.11	≤ 20g	10	0
		10-12.11 G	≤ 30g		
		10-12.11 B	≤ 30 g		
		13-15.11 G	≤ 25g		
		13-15.11 B	≤ 20g		
9	Variety	< 9-9.11	≥8 items/ day – ≥3 items/day	10	0
		10-12.11 G			
		10-12.11 B			
		13-15.11 G			
		13-15.11 B			
10	Calories from Sofaas[2]	< 9-9.11	≤ 20% of energy	20	0
		10-12.11 G			
		10-12.11 B			
		13-15.11 G			
		13-15.11 B			
	Total			100	0

[1]A score of 8 is given to the diets having the maximum required RDA for oils. Even if the RDA is 30 g yet maximum score is given for 24gms.

[2]SOFAAS -Solid fats and added sugars.

Table 3.2. 3: Food Behaviour and Activity checklist scoring system

S.No.	Food Behaviour and Activity Checklist For Adolescents (Components)	Max Scores
1	Breakfast Consumption Y/N	5
2	Breakfast Food Item	5
3	Mid Morning Y/N	5
4	Mid Morning Food Item	5
5	Carry Lunch To School	5
6	Vegetable Consumption Y/N	5
7	Green Leafy Vegetables	5
8	Roots & Tubers	5
9	Yellow & Orange Vegetables	5
10	Other Vegetables	5
11	Fruit Consumption	5
12	Any Fruit	5
13	Local Fruits Consumption	5
14	Evening Snacks	5
15	Evening Snacks Food Item	5
16	Outside Food	5
17	Water Intake	5
18	Activity (Playtime Outdoor In School And Home)	5
19	Activity (Leisure Time Watching TV, Computer Or Video Games, Etc.)	5
20	Activity (Study Time)	5
	Overall Score	**100**

Evaluation Psychometric properties of HEIA and FBACA

HEIA and FBACA were evaluated by assessing several types of validity and one type of reliability. To do this 3 day dietary intakes were obtained from the sample and several sets of exemplary menus.

Data sources

For analysis data was obtained from 478 subjects. A 3 day intake in the form of 24 hour recall was obtained from each subject. Sample menus for assessing validity were used from the 'Dietary guidelines for Indians – A manual' published by National Institute of Nutrition.

Validity

Content Validity

It examines qualitatively the extent to which an index represents the variety of attributes that make up the diet quality as specified the 'Dietary guidelines for Indians- 2010'.

The main question in evaluating content validity is whether the index is able to capture the various key aspects of diet quality in 'Dietary Guidelines for Indians-2010'? For this purpose the set of components were checked against the key recommendations of 'Dietary Guidelines for Indians-2010'.

Construct and criterion Validity

It evaluates how well the index measures the diet quality. It was done in 4 ways.

Firstly, to evaluate construct validity the first and foremost important question that needs to be answered is whether the index gives maximum scores to menus developed by nutrition experts to illustrate high diet quality? For this sample diet menus given by experts were used.

Another important question is whether the index has concurrent criterion validity i.e. does HEIA distinguish between groups with known differences in diet quality for example under nourished and well nourished?

Thirdly, HEIA should be able to assess diet quality independent of diet quantity, as measured by diet's energy value. Because nutrient intake is positively correlated with energy intake, a diet quality index could lead to an overrating of high calorie diets. To evaluate this independence,

Pearson correlations of the HEIA and FBACA total and components cores with the energy intake were seen.

Fourthly, the underlying structure of the index was examined through principal component analysis (PCA). On the basis of the correlations among the components, the PCA was used to determine the number of independent factors that compromise the HEIA and FBACA. The main objective of PCA was to find out whether one or more than one factor accounted for the systematic variation observed in the data.

Reliability

HEIA and FBACA were checked for one form of reliability, internal consistency, the degree to which multiple components within an index measure the same underlying, unidimensional, latent construct, by using Cronbach's coefficient alpha. This statistic is mathematically equivalent to the average of the correlations among all possible split-half combinations of the 10 components of HEIA, and thus captures any systematic variation underlying the dietary components that are measured.

Also to get an understanding of the inter component relationships among components, inter component correlations were observed.

Phase III: Development of Nutrition Communication programme and its implementation

Creating **H**ealthy **A**ctive **L**earning **K**ids (**CHALK** Programme)

A nutrition communication programme was developed using PowerPoint presentations, charts posters, video clips etc. to increase awareness among kids regarding Healthy foods, healthy eating habits, junk foods, physical activity etc. The key concepts from phase I and Phase II were

taken and 7 sessions were developed accordingly. Table 3.3.1 shows the key messages involved in the development of CHALK programme.

The sessions were conducted on a weekly basis for boys and girls separately over a period of 3- 4 months. The information provided was reinforced by sessions conducted fortnightly for a period of 2 months. These reinforcement sessions were mainly a recap of the above mentioned sessions along with questions answer session.

Phase IV: Assessing the impact of Nutrition Communication on the Subjects

Final data of the subjects were assessed at the end of six months of nutrition communication program. The anthropometric measurements i.e. weight, height, waist, hip and mid upper arm circumference were taken. Data on morbidity profile was collected using a reference period of 15 days. Dietary intake data was collected using 24 hour dietary recall (3 day recall) and food frequency questionnaire for all the subjects. Data on knowledge, attitudes and practices regarding food and activity was collected using the same questionnaire as was used for baseline. Subjects were asked to fill the food behavior checklist also at the end of nutrition communication program. Cognitive development data was also collected using the same procedure as the baseline.

Table 3.3. 1: Key Messages for the Development of CHALK programme

Key concepts for Nutrition Communication
• Correct concept of Growth and Development of Adolescents
• Healthy food (Balanced diet) and Healthy Eating Behaviours
• Functions of foods and various food groups
• Meal Patterns and Breakfast consumption
• Dietary guidelines and Food Pyramid
• Healthy food choices (outside as well as at home)
• Fruit consumption
• Fast foods and soft drinks consumption
• Physical Activity
• Appropriate weight
• Self perception

Phase V: Data analysis, report writing and dissemination of results

The data was entered and then analyzed using Microsoft excel (2007), Epi info version and Spss 16 and above.

- Frequency distribution and percentages were calculated for all parameters that were expressed in a rank order fashion.
- Means and standard errors were calculated for all parameters that were expressed numerically.
- Analysis of variance and independent't' test was used to compare differences between the means in different groups.
- Paired't' test was used to assess the differences between the means of the same group before and after the Intervention period.
- Chi-square test was used to assess the differences between the frequency distribution of the groups.
- Correlation Coefficients were computed between indicators of nutritional status and other parameters of interest.
- Stepwise multiple regression analysis was done to identify independent variables that had a significant role in influencing the dependent variables like Height for age, Weight for Age, BMI for age, HEIA scores etc.