SUMMARY
AND
CONCLUSION

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'Adolescence is an age of opportunity for children, and a pivotal time to build on their development in the first decade of life, to help them navigate risks and vulnerabilities, and to set them on a path to fulfilling their potential' (UNICEF, 2011).

Healthy eating patterns in childhood and adolescence promote optimal health, growth, and intellectual development (SCN, 2006).

Most of the countries have developed or are developing National Food Based Dietary Guidelines (FBDG). In addition to the dietary guidelines, there has also been a call in the research and policy communities to develop simple indicators to measure diet quality. Simple dietary assessment tools like Healthy Eating Index (Kennedy et al, 1995) and Food Behaviour Checklist (Blackburn et al, 2006) can be used by the adolescents to assess their dietary intakes.

Additionally nutrition education should be provided to adolescents as 'Nutrition education is an important measure to improve dietary habits and food choices of the adolescents, as poor dietary habits and ignorance are the main reasons for poor nutritional status of the adolescents'- (Gupta and Kochar, 2009).

Thus, in view of the above the present study was planned with the **Major Objective** of developing a Healthy Eating Index and Food Behavior Checklist for adolescents in Indian context and to implement a Nutrition Communication Programme to improve their dietary practices from three schools of urban Vadodara.

Methodology

The present study was conducted in 3 schools of urban Vadodara. The enrolled sample constituted of 1041 subjects between 7 to 18 years of age. Anthropometric data was obtained for all the subjects. Socio economic status; Food frequency; Food and Physical activity behaviour data was collected for 631 subjects studying in Std. V to Std. IX.

Data on Knowledge, Attitudes and Practices (KAP); Dietary intakes using 3- day 24 hour recall and Food frequency; Morbidity Profile; Cognitive development was obtained on 478 subjects from two schools. Biochemical estimations were carried out on a subsample of 61 subjects.

Two schools were allotted to the Experimental and Control group for the Nutrition Communication Program. The experimental group consisted of 212 subjects and in the Control group there were 266 subjects. However, due to dropouts from the study, Pre and Post data for impact evaluation was analyzed on KAP; Dietary intakes; Food and Physical activity behaviour for the 191 subjects in the Experimental group and 245 subjects in the Control group, who completed the study.

Data was analyzed using Microsoft excel (2010), Epiinfo Version 7 and Statistical Package for Social Sciences (SPSS) Version 17.

The salient findings of the present study are summarized below:

Phase I Formative Research

Socio Economic Status

Most (91%) of the subjects were Hindus and belonged to nuclear families (73%) with a mean family size of 4.71 ± 1.56 members. Per capita income was between Rs 600-50,000 per month while mean per capita income was Rs. 5873.1 ± 4.75. Most of the fathers (80%) were in service while 90% of the mothers were housewives. More than half of the subjects were vegetarians (57%).

Age and Sex Profile of the subjects

Mean age of the study subjects was 12.45 ± 0.07 years. The study population consisted of 59% boys and 41% girls. Around 66% boys and 61% girls were between 10-13 years of age.

Growth Patterns among the study subjects

Mean Height of boys and girls was 153.53 and 150.76 cm respectively. Peak height velocity was observed in boys at 12 years and in girls at 11 years of age with an increment of 7 cm and 5.9 cm in boys and girls respectively. The difference in height amongst boys and girls were thus evident from 13 years onwards.

Mean weight of the subjects was 42.3 kg irrespective of the sex. Peak weight velocity was observed in girls at 11 years of age and in boys at 15 years with an increment of 5.04 kg and 7.98 kg in girls and boys respectively.

Overall scenario shows that girls had higher height and weight during pre-adolescent years as compared to boys, but by late adolescence, boys had better heights and higher weights as compared to girls.Girls had significantly higher mean BMI than boys (18.38 and 17.63 kg/m^2). Girls had higher values for BMI at all ages when compared to boys except between 15 to 19 years of age.

Comparison with other reference standards revealed that Height for age amongst boys in the present study was higher than the NCHS, WHO and Agarwal standards till 14 years of age, while for girls it was higher till 12 years of age. In case of weight for age the subjects had higher values for initial years till 11 years of age when compared to NCHS and Agarwal standards. BMI for age was lower than the NCHS and WHO standards at almost all ages. This clearly indicates the failure of the subjects to grow to their full potential.

Mean waist circumference was 65.5 and 64.2 cm in boys and girls respectively. Boys and Girls had lower values for WC at all ages when compared to NHANES III subjects. While boys had higher WC values till the age of 13 years, girls had lower WC values at all ages, when compared to an Indian study – The PEACH study.Mean Waist Hip Ratio (WHR) was 0.83 and 0.80 in boys and girls respectively. Mean Mid Upper Arm Circumference (MUAC) values were found to be 21.9 cm and 21.7 cm in boys and girls respectively. MUAC values at all ages were higher as compared to Agarwal standards in both boys and girls except at 17.5 years in boys and 15.5 to 16 years in girls. Mean waist stature ratio was found to be 0.43 in both the sexes.

Prevalence of Malnutrition

Prevalence of underweight (weight for age< -1 SD) was found to be 24.6%. Prevalence of moderate (WAZ <-2 SD) and severe (WAZ<-3SD) underweight was 4.8% and 0.9% respectively. Prevalence of stunting Height for age <-1 SD) was 14.3%. Moderate (HAZ<-2 SD) and severe (HAZ <-3 SD) stunting were 2.2% and 0.3% respectively. Prevalence of thinness (BMI for Age < -1 SD) was 33%. Moderate (BAZ <-2SD) and Severe (BAZ< -3SD) thinness

were 7.9% and 2.2% respectively. Prevalence of overweight (>1 SD BAZ) and Obesity (BAZ> 2 SD) were 13.4% and 3.5% respectively.

Prevalence of dual burden of malnutrition (under and over) was highest during early and mid-adolescence.

Dietary and Nutrient Intakes

Mean intakes of all the food groups, except edible oil, was below 75% of the recommended dietary allowances (RDA). Boys had higher intakes of all the food groups, except grains and pulses, as compared to girls. Amongst boys, the youngest age group had highest consumption for grains and oil, while the eldest had highest consumption of milk and sugar. Girls showed a similar pattern, except the fact that milk consumption was lower among the oldest age group of girls.

Mean nutrient intakes of boys were significantly higher than girls. As age increased above 13 years a decline was observed in the mean nutrient intakes. Consumption of all the nutrients, except protein and fat, was below 84% of the RDA. Mean intakes of all the nutrients was lowest in the oldest age group irrespective of sex. More than half and one-third of the subjects reported intakes between 26% to 50% of the RDA for iron and calcium respectively.

A comparison of mean nutrient intakes with the nutritional status revealed that subjects with WAZ scores <-3, HAZ scores -2.99 to -2 and BAZ scores -2.99 to -2 had the lowest mean nutrient intakes.

Cereal consumption on a daily basis was reported by all the subjects, while 64% of the subjects consumed pulses on a daily basis. Daily milk consumption was reported by 84% of the subjects. Green leafy vegetables/ roots and Tubers / other vegetables like brinjal, ladyfinger, cauliflower etc. were consumed by around 50% of the subjects on a daily basis. Nearly 55% subjects consumed fruits daily.

Amongst unhealthy foods the most frequent consumption was observed for baked foods (42.5%) followed by accessories (42.3%) like jams, murabbas, pickle, papad etc. with meals on a daily basis.

Biochemical Estimations

Mean Hemoglobin level of the subjects was 11.9 g/dl. Forty one percent girls and 47% boys had hemoglobin levels between 11-11.9 g/dl and 12-12.9 g/dl respectively. Lowest hemoglobin levels in boys and girls were 8.6g/dl and 7.4g/dl respectively. Prevalence of anemia was found to be 42.6%,with most of the subjects having either mild anemia (65.5) or moderate anemia (30.8).Highest prevalence of anemia was seen among early adolescents. BAZ scores were found to be significantly associated with anemia.

Red cell morphology results revealed that 58% of the anemic subjects showed normocytic red cells. Microcytic hypochromic anemia was seen in 23% of the subjects.

Mean values of all the hematological indices were less than the International references. Hemoglobin showed a positive correlation with all the hematological indices (p<0.01). Serum total proteins and albumin levels of the subjects were found to be normal.

Morbidity Profile

Almost two thirds of the subjects reported to have experienced some or the other form of morbidity (ies). Nearly one-third of the subjects reported of experiencing cold, headache, stomachache and cough which were the most common morbidities. Most of the morbidities were experienced by early–adolescence group. One-fifth of the subjects had dental caries.

Physical Activity Profile

Boys were more active than girls in relation to previous day's physical activity pattern. Reported playtime in school, during recess and at home was similar in both the sexes. Two-third of the subjects reportedly slept forless than 8.5 hours daily. By the age of 10 years, number of subjects with sleep time of less than 8.5 hours started increasing. Most of the subjects spent less than an hour on leisure activities. Boys as compared to girls spent less time on leisure activities apart from their school time. One-third of the subjects reported a study time of >5 hours. Subjects spending more than 5 hours on studies started increasing from the age of 10 years. As age increased the duration of physical activity, playtime, leisure time and sleep time reduced.

Cognitive Abilities

Mean cognitive scores for girls in Digit span, Maze test and Overall class performance were higher than boys. Cognitive function test scores were positively correlated to age while class performance was negatively correlated with age. Undernourished subjects had lowest overall score in the cognitive tests performed by them.

Knowledge Attitude and Practices of the Subjects regarding Healthy Eating, Dietary Habits and Physical Activity

Lack of knowledge regarding healthy foods, healthy eating, food groups, functions of foods, benefits of eating fruits and vegetables, food pyramid, physical activity etc. was observed amongst the subjects. Half or more subjects failed to make healthy choices from the options given to them.

Around two-third (63%) of the subjects could not correctly respond on being asked about functions of food. A mere 7% could correctly state the functions of food. Almost all (94%) of the subjects did not know the names of food groups. Majority (95%) of the subjects were unable to define appropriate weight. Only 36% of the subjects were able to correctly perceive their body types when shown a picture with figures of three body types. Almost all of them (93%) stated that physical activity was important for them.

Although 71% subjects reported of consuming breakfast regularly, only 56% of the subjects actually consumed breakfast on all days in the past week. While eating out a majority of them had unhealthy choices. Half of the children spent their pocket money, fully or partly, on food. Apart from their pocket the subjects received money to eat out at times, half (49%) of the subjects spent it on purchasing bakery items from the shop near the school or tuition classes.Most of the subjects (84%) got packed lunch boxes (tiffins) from home while 8% of them bought food from the canteen.

Around half of them (47%) undertook some form of physical activity for more than an hour every day. Most common physical activity was playing outdoors (75%). Around 20% of children who were overweight or obese felt that they were ectomorphic (thin), while 36% of the subjects who were thin, reported themselves as mesomorphic (healthy person with healthy muscle mass).Two thirds of the subjects (64%) had incorrect perception regarding their body image.

Knowledge, Attitude and Perception of Teachers and Principals

Majority (80%) of the teachers were females. Sixty percent of the teachers had Grade I obesity. All of them stated that adolescents are children between 10-19 years of age, but they believed that age range of adolescent comes somewhere between 10-19 years. Some responded to 13-18 years or 12-16 years as range of adolescence. More than half (57%) did not know about BMI and only 7% could give the formula for same. Majority of them (93%) gave incorrect or partially incorrect responses regarding functions of food and food groups. Lack of awareness regarding health, foods to be given under various conditions etc. was observed amongst the teachers.

PhaseII Healthy Eating Index for Adolescents (HEIA)and Food Behaviour and Activity Checklist (FBACA) – Development, Assessment for Subjects and Validation

No tools to measure the dietary quality of adolescents have been developed in India. Indians have their own dietary guidelines and recommendations. It is time now to assess whether these guidelines are followed or not. New tools like Healthy Eating Index (Kennedy et al, 1995) and Food Behaviour checklist (Balckburn et al, 2006) have been developed in the United States of America and have been in use since 1989 (HEI was developed by USDA in 1989).

The present study aimed at developing new tools to assess dietary quality and also to evaluate the level to which the adolescent in urban Vadodara conform to the dietary guidelines for Indians.The new tools developed were named as Healthy Eating Index for Adolescents (HEIA) and Food Behaviour and Activity Checklist for Adolescents (FBACA).

Healthy Eating Index for Adolescents (HEIA) was developed in the present study to assess the dietary quality of the subjects. Except total vegetables, green/yellow/orange vegetables and Solid fat and added sugars (SOFAAS) each of the 7 components had scoring range of 0 to 10. SOFAAS had a maximum score of 20 while total vegetables and green/yellow/orange vegetables had a score range of 0 to 5. The overall HEIA score is a sum of the scores of each component. A total score of 80 indicated a "good" diet while a score between 51 and 80 implied "need for improvement" in the dietary quality. A score of ≤ 50 indicated a "poor" quality diet.

Total HEIA scores

Mean Overall HEIA scores were 63.34 ± 5.2 and were higher for boys as compared to girls. Oldest age group had lowest scores indicating a lower diet quality than the rest of the subjects.

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Mean overall HEIA scores were significantly affected by religion and dietary habits. Christians had highest mean HEIA scores and vegetarians and non-vegetarians had significantly higher scores as compared to ovo-vegetarians.

HEIA increased with the increase in per capita income and years of education of both the parents, although the difference was not significant. Family size showed a negative association with HEIA scores. Assessment of the dietary quality of the subjects based on HEIA scores revealed that almost all the subjects (99%) needed improvement in their diets. Mean HEIA scores were significantly affected by the nutritional status of the subjects (WAZ and HAZ scores).

There was no significant difference between the HEIA scores for anemic and non-anemics. A possibility could be the small size of the subsample (n=61) on which biochemical estimations were conducted.

Individual HEIA Component Scores
Subjects received maximum scores for SOFAAS (19.8/20) followed by Total sugar (9.8/10) and Total oil (9.48/10). The lowest mean scores were of Total green/ yellow/ orange vegetables (0.5/5) and Total fruit (1.01/10) indicating lack of Variety in the diet and low intake of protective foods.Mean components scores were similar amongst boys and girls except Total Grains (Score higher in girls) and Variety (Score higher in boys). All the components except Total Oil, Total Sugar and SOFAAS showed significant positive correlation with overall HEIA scores.

Religion had a significant effect on mean Total Grains and Total Pulses/Meat/ Fish/ Poultry scores while type of family had significant effect on the total milk scores. Family size also had a significant effect on Total Milk scores. Education of parents had no significant effect on mean component scores. Mean scores for variety were significantly higher in subjects whose fathers were more educated. Children of well-educated mothers had significantly higher scores for SOFAAS.

Significantly higher scores for Total Grains and Total Milk were seen among vegetarians on comparison with ovo-vegetarians. Similarly, non-vegetarians had significantly higher scores for Total Green/Yellow/Orange vegetables and Total milk as compared to ovo-vegetarians.

A Food Behavior Checklist (FBC) was developed by Blackburn et al (2006)to evaluate the impact of nutrition education on fruit and vegetable intake in the Food Stamp Nutrition Education Program (FSNEP) and the Expanded Food and Nutrition Education Program (EFNEP). FBC was found to be a valid and reliable indicator of fruit and vegetable consumption.

For the present study a Food Behaviour and Activity Checklist for Adolescents was developed to assess the dietary and physical activity practice of the subjects. The maximum total FBACA score was 100. FBACA consisted of 20 practices related to diet and physical activity. Each FBACA component was allotted a maximum score of 5 and a minimum score of zero. 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 (Appendix). A mean FBACA total of 80 points implied that the practices being followed are of a good quality. If the score ranged between 51 and 80 then the practices needed improvement and if the score was less than or equal to 50 then practices being followed were considered to be of a poor quality.

Total FBACA Scores

Mean Total FBACA scores were found to be higher for girls as compared to boys. An agewise analysis showed that the lowest mean FBACA score for girls was seen between 16-17 years of age while for boys it was seen between 9-10 years.However, there was no significant effect of age on Total FBACA scores. According to FBACA scores

Subjects with per capita income less than Rs 5000 had significantly lower mean Total FBACA scores as compared to those who had PCI above Rs 5000. Subjects with smaller family size, well-educated parents and working mothers had higher mean Total FBACA score as compared to others. However, these differences were not significant among the groups.

More females than males had 'good' dietary and physical activity practices (13% v/s 8%). Most of the subjects (89%) needed improvement in the practices. None of the subjects above 16 years had good quality of practice according to FBACA scores. There was no significant difference between the FBACA scores of well-nourished or undernourished subjects.

Individual FBACA Component Scores

The highest mean FBACA score was observed for vegetables (4.9), which indicates almost all the subjects consumed vegetables regularly. A further look into the type of vegetables revealed that the highest score was of roots and tubers indicating the highest consumption of roots and tubers among all the vegetables. The lowest scores were for evening snack item (0.97) indicating higher intakes of unhealthy foods as evening snacks.

Christians had significantly higher scores (p<0.05) for other vegetables and playtime. Scores for roots and tubers were significantly higher in nuclear families as compared to joint or extended families. Smaller families (< 5 members) had significantly higher scores for roots and tubers and evening snack.

Per capita income showed a significant positive association with mid-morning item, yellow orange vegetables and study scores of the subjects. A significant difference was observed amongst the subjects in relation to mid-morning item and parent's education. Children of well-educated parents had higher mid-morning scores in comparison to the others. Outside food score was significantly higher in vegetarians as compared to non-vegetarians.

Psychometric Properties of HEIA and FBACA (Validity and Reliability)

Content validity examines qualitatively the extent to which an index or scoring system represents the variety of attributes that make up diet quality in case of HEIA and the quality of practices in case of FBACA. All the components that relate to diet quality are reflected in HEIA. FBACA also covers the healthy dietary and the physical activity practices as given by the dietary guidelines of India. Thus, content validity was established for HEIA and FBACA in the present study.

Construct and criterion validity measures how well the index measures diet quality. This was done in four ways.

Four sets of menus for adolescents were chosen and scored according to HEIA. All the diets ranked as good quality, thus establishing construct validity for HEIA. Validity can also be established if the index is able to differentiate between groups of known differences, in this case undernourished and well-nourished. Mean total HEIA scores for undernourished subjects was

significantly lower (p<0.005) as compared to well-nourished subjects (60.4 v/s 63.5). Total vegetables, Total fruits and Total milk scores were significantly higher in well-nourished subjects.

Correlations of Total HEIA, FBACA and their components were established in relation to energy intakes. It was observed that both HEIA and FBACA showed low correlations with energy indicating independence from FBACA intakes. Thus, it can be stated that both HEIA and FBACA were able to predict diet quality without being affected by the diet quantity.

Principal component analysis revealed that no single linear combination of components of HEIA or FBACA accounted for a significant proportion of variation in the dietary and Physical activity patterns of the subjects in the present study.

Thus, Content construct and criterion validity were established for both HEIA and FBACA.

Test retest reliability was already established as HEIA and FBACA were developed to be identical for identical diets or practices that are executed (recalled, recorded and coded) the same way. Inter rater reliability was not needed as there was no judgment required for scoring of the diets or practices.

Another form of reliability known as internal consistency was observed using Cronbach's coefficient alpha. For HEIA alpha was -0.17 and for FBACA it was 0.17. It was low as expected because diet quality or quality of practices is known to be multidimensional. As well there is no consistency in individuals meeting the standards which are used for assessing the diet or physical activity quality. Thus, internal consistency was not a necessary characteristic of HEIA or FBACA.

Phase III Planning, Development and Implementation of the Nutrition Communication Program for Adolescents - Creating Healthy and Active Learning Kids (CHALK) Programme

Phase I revealed a dual burden of malnutrition amongst subjects and a closer look into the practices showed unhealthy practices regarding diet and physical activity. Phase II showed that most of the subjects needed improvements in the diet quality and also in the quality of practices being followed. Subjects from two schools were allotted to two groups namely, Experimental Group (EG) and Control Group (CG).

Assessment of knowledge and practices was carried out in order to extract key messages for the development of the Nutrition Communication Programme (NCP) and was named as Creating Healthy and Active Learning Kids program – the CHALK Program.

Formative Research for the Development of CHALK Programme

Experimental group (EG) consisted of 212 subjects, comprising 134 boys and 78 girls while a total of 266 subjects constituted the Control Group with 166 boys and 100 girls. Most of the subjects were between 10-14 years of age.

Assessment of the knowledge levels regarding healthy eating and physical activity practices, followed dietary practices and food and nutrient intakes of the subjects

Subjects in EG had higher knowledge regarding healthy eating as compared to CG, while subjects in CG had higher knowledge regarding requirements of healthy growth and development. Around half of the subjects in both the groups considered breakfast as a very important meal. Although knowledge regarding functions of food, food groups, benefit of eating fruits / vegetables and appropriate weight was significantly higher in the experimental subjects, yet the number of correct responses was very low. Subjects in EG chose the most healthy choices out of the three options given, while, a significantly higher number in cg reported soft drinks and fast foods to be unhealthy. Subjects in both the groups had a very low knowledge level regarding healthy foods, healthy diet, food groups, food pyramid, number of complete meals, appropriate weight etc.

Assessment of the dietary practices followed by the study subjects in the two groups

A recall of the past 7 days showed that although many subjects reported of breakfast consumption on a daily basis yet the items consumed were not satisfactory. Almost half of the subjects consumed only milk for breakfast. A significant difference was observed in the mid-morning consumption between the two groups (EG 68% and CG 56%). The main reason for this was the canteen facility which was offered in the control group. A local vendor in the experimental group sold bakery items like vegetable puffs and muffins during recess. Possibly this was the reason why 30% of the subjects in EG reported irregular mid-morning food consumption. Daily vegetable consumption was reportedly high in both the groups but consumption of green leafy vegetables and yellow orange vegetables was very low.

Regular evening snack consumption was very high in CG. Consumption of unhealthy foods like Namkeen and farsan (both are deep fried dry salty snacks) was higher in EG. Around half of the subjects reported outside food consumption for >2 days in the past week.

Assessment of the daily physical activity practices of the study subjects

Playtime was significantly higher in CG with about 66% subjects in CG spending 60 minutes or more per day on playtime as against only 57% subjects in the EG.More than half of the subjects in both the groups reported > 180 minutes a day as their study time apart from the 5 hours of school time. Ninety percent subjects in both the groups spent < 2 hours on leisurely activities.

Assessment of the self-perception of the study subjects in the two groups

On showing a picture of three figures and asking the subjects to mark the figure that resembled them, the response showed that 72% in EG and 38% in CG had incorrect self-perception. Half of the subjects in EG who perceived themselves as underweight were normal, while out of the 36% subjects in CG who thought of themselves as underweight none were underweight. One fourth of the subjects in EG who thought they were normal, were actually underweight. None of the subject in CG thought of themselves as overweight and obese though 13% of them were overweight.

Assessment of the food and nutrient intakes of the subjects in the experimental and control group

Mean intakes of fruits was very low in both the groups. Mean intakes for energy, protein and iron were higher in CG while mean intakes for fat and calcium was higher in EG. However, there was no significant difference observed in the mean nutrient intakes of the subjects in both the groups. Around 85% subjects in both the groups reported consumption of milk daily although as observed by the mean food group intakes it was less than 40% of the recommended amount. Consumption of aerated drinks was significantly higher in CG (7.9%) as against 2.4% in EG. High consumption of various accessories like jams, murabbas, chutneys, pickles, papadetc.along with food was reported in the control group.

Selection of Key Messages and Development of the CHALK Programme

An assessment of knowledge and practices led to the selection of the following key messages for the NCP:

- 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

Based on the above concepts, a nutrition communication programme was developed. Seven sessions were conducted, which covered the concepts behind all the key messages for the subjects in the experimental group. The subjects in the control group received no intervention. The sessions were conducted on a weekly basis for boys and girls separately over a period of 3-4

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months. Different communication methods like power-point presentations, posters, puzzles and video clips were used to communicate the information to the study subjects. Each session was planned for 45 minutes. These were followed by reinforcement sessions, which were conducted fortnightly for a period of 2 months. These reinforcement sessions were mainly a revision of the main sessions along with questions answer session.Average attendance for each session was 12 - 16 girls and 25-28 boys.

Phase IV Assessing the Impact of Nutrition Communication Programme (CHALK Programme) on the Dietary Practices of the Subjects

At the end of intervention data was collected on the knowledge, attitudes and practices followed (past 7 days), food and nutrient intakes for all the subjects excluding the dropouts. At the end there were 191 subjects in EG and 245 subjects in CG. There were 121 boys and 70 girls in the experimental group while the control group consisted of 154 boys and 91 girls. Therefore, assessment of the impact of the CHALK programme was limited to the subjects who completed the study.

Impact of the CHALK Programme on Knowledge Levels of the study subjects

Subjects in EG had significantly higher knowledge than the control group, before the intervention, regarding functions of foods, food groups, constituents of healthy breakfast, benefits of eating fruits and vegetables, healthy food choices, effect of TV viewing on growth and development, physical education and meaning of appropriate weight. The control group had significantly higher knowledge regarding the requirement of a healthy growth and development, importance of breakfast, unhealthy foods like soft drinks and fast foods prior to the intervention period.

Impact on knowledge regarding growth and development, healthy foods and healthy eating behaviours

Figure 5.4.1 shows a visual representation of changes in the knowledge and attitudes regarding growth and development, healthy foods and healthy eating behaviours after the intervention period. There was a significant difference in the understanding related to healthy growth and

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development between EG and CG (EG 39% and CG 19%). Prior to intervention CG had significantly higher knowledge regarding growth and development (EG 10% and CG 17%).

Knowledge regarding the concept of healthy foods was almost same between the two groups prior to intervention. A significant improvement in the experimental group was seen as compared to the control group (EG 58% and CG 6%) as well as in comparison with the knowledge levels prior to intervention in EG with regard to healthy food (EG pre 8% and EG post 58%).

Initially there was no significant difference between the two groups regarding healthy eating behaviours, while after the intervention, EG showed a ten times increase in knowledge while CG remained the same. The difference in both the groups after intervention was found to be significant regarding healthy eating behaviours.

Impact on knowledge regarding food groups, number of complete meals and breakfast consumption

EG subjects showed a 15 times increase in the understanding of food groups after the intervention. This was a significant increase in the knowledge in EG after the intervention. None of the subjects in CG could correctly respond on being asked about food groups. EG was significantly higher than CG before and after the intervention .

A significant difference between in the experimental group in relation to the concept of meals was observed post intervention (EG pre 7% and EG post 26%). There was no significant change in the control group (CG pre 9.4% and CG post 9.8%) after the intervention period. Initially there was no difference between the two groups regarding the concept of number of meals in a day but after the intervention EG was significantly higher than CG in the number of correct responses.

The number of subjects who reported breakfast as a very important meal was significantly higher in the experimental group after intervention (EG pre 50% and EG post 70%). CG was significantly higher than EG before intervention regarding the responses on importance of breakfast (EG 47% and CG 58%), while after intervention CG had significantly lower number of correct responses as compared to EG (EG 69% and CG 60%). There was no significant change

regarding constituents of healthy breakfast among the subjects in EG before and after the intervention (Figure 5.4.2).

Impact on knowledge regarding healthy food choices, food pyramid and appropriate weight

There was no significant difference in EG regarding healthy food choices before and after the intervention.

No difference was observed in the two groups regarding correct response for food pyramid after the intervention. However, the number of partially correct responses related to food pyramid were significantly higher in the experimental group after the intervention (3.7% EG and 0.8% CG; $p<0.05$).

A significant three fold rise was observed in the number of subjects (31%) stating that appropriate weight is the weight according to age and sex, in the experimental group after the intervention (EG pre 11% and EG post 31%).

Impact of the CHALK Programme on the Dietary Practices of the Subjects – Post Intervention

Daily breakfast consumption showed a rise of 6% among the experimental group subjects. Daily consumption of only milk decreased while subjects consuming a combination of milk and cereals increased significantly in the experimental group. In the control group there was no significant difference observed related to breakfast consumption before and after the intervention.

Experimental group showed a significant rise in daily mid-morning food consumption after the intervention. However, there was no significant change observed in the control group. This positive change in the dietary practice of the subjects can be attributed to the CHALK intervention (Figure 5.4.3).

Daily vegetable consumption improved significantly in the experimental group after the intervention and could be attributed to the increase in the consumption of a cereal vegetable combination for mid mornings, while there was no significant change in the control group. There was no significant change in both groups regarding fruit intake.

There was no significant change in the consumption of evening snacks, outside food and water intake in both the groups before and after the intervention.

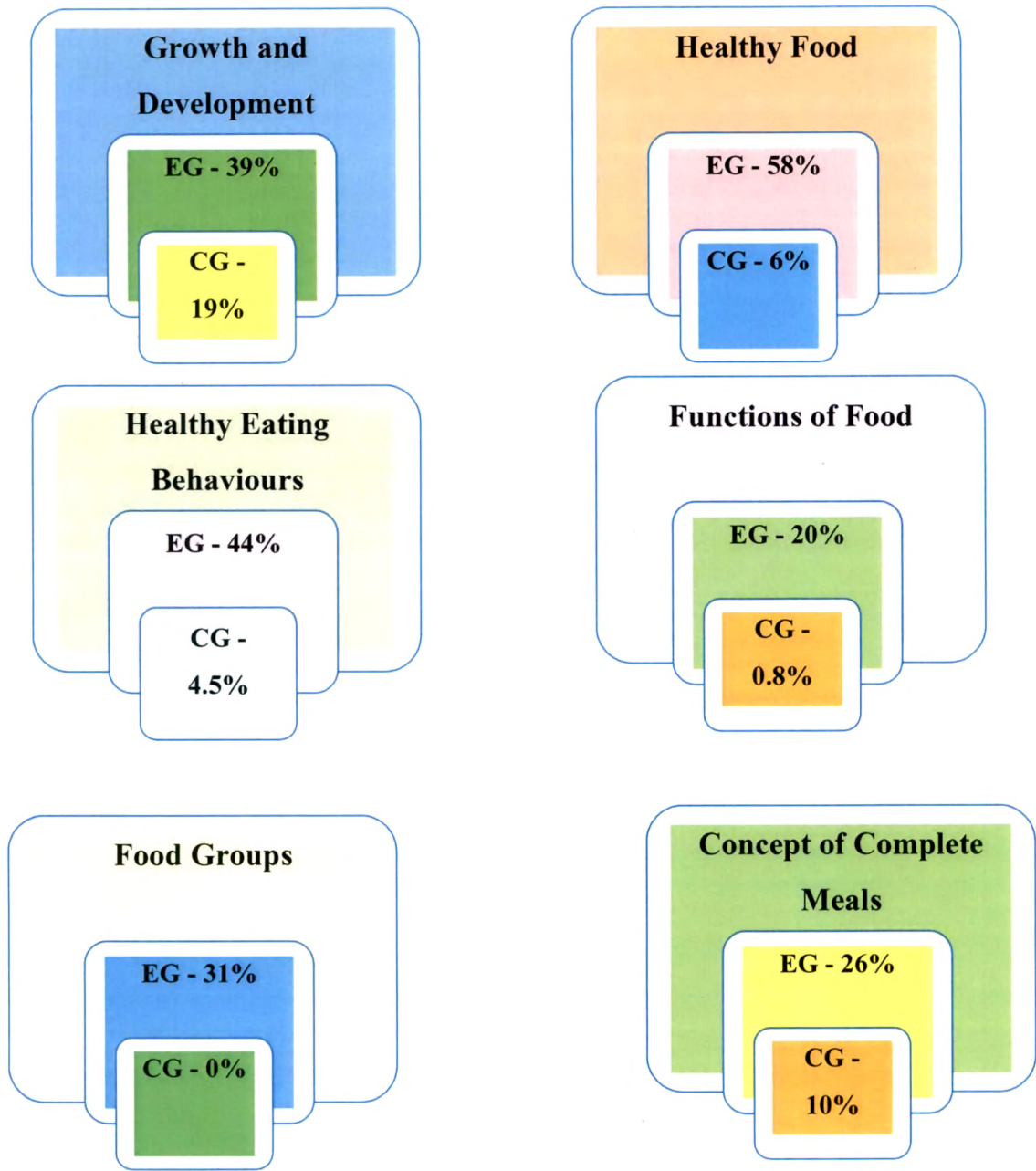**Impact of the CHALK Programme on the Physical Activity Practices of the Subjects– Post Intervention**

Playtime (>60 minutes / day) was significantly higher in the subjects of control group before intervention. However, after intervention there was no significant difference found between the playtime of the subjects in the two groups.

A very small positive change was observed in the physical activity levels though these changes were not significant among the subjects of the experimental group.

Impact of CHALK Programme on the Self-perception of the subjects in the two groups– Post Intervention
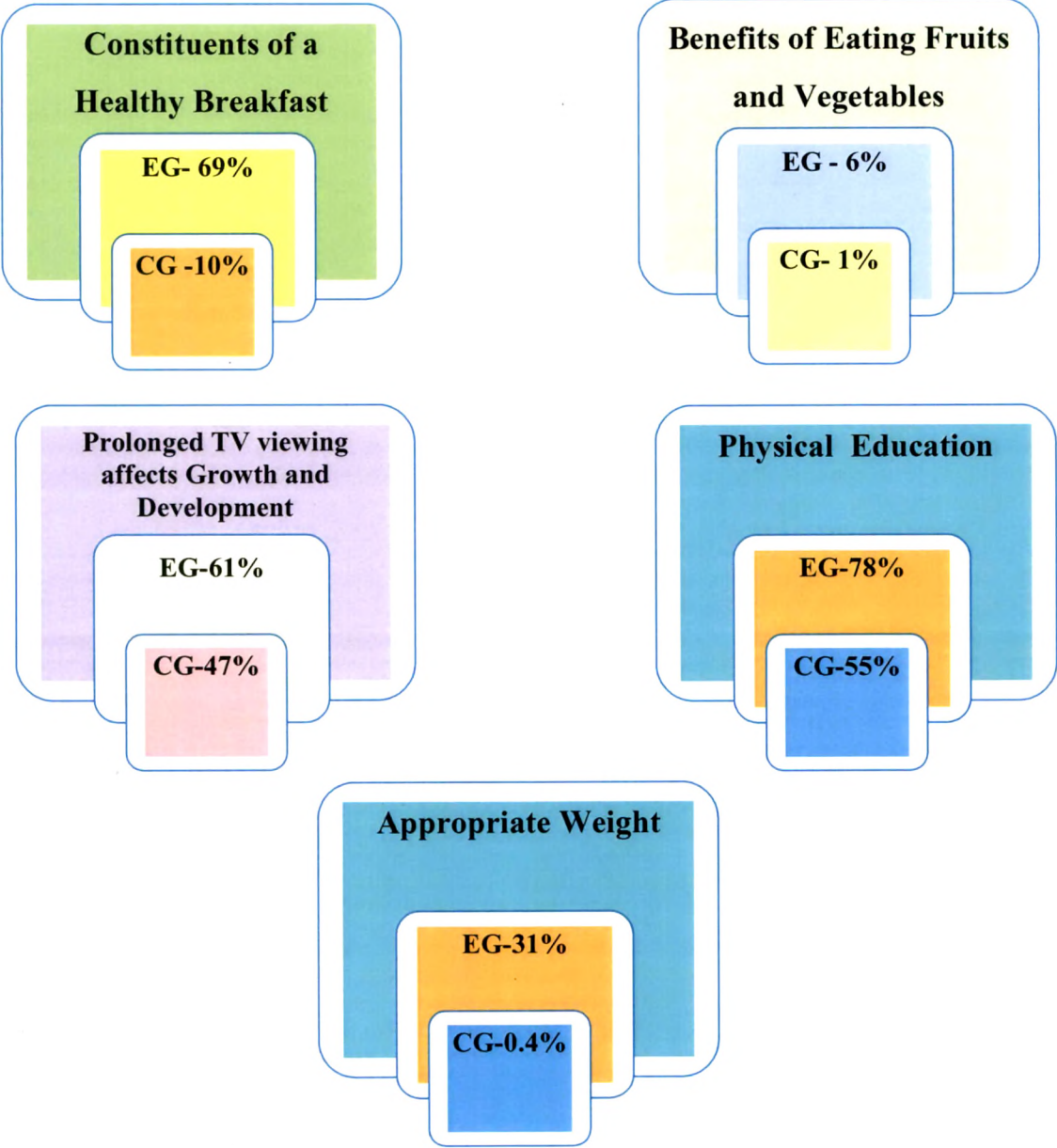
Around 72% of the subjects in the experimental group showed incorrect self-perception prior to the intervention, while after intervention 53% subjects had incorrect perception regarding themselves, this was a significant change in the group. Control group on the other side did not show any significant change in self-perception of the subjects after the intervention period (CG pre57% and CG post 58%).

Figure 5.4. 1: Overview of the Impact of the CHALK Programme on increase in Knowledge levels of the study subjects*

Growth and Development
EG - 39%
CG - 19%

Healthy Food
EG - 58%
CG - 6%

Healthy Eating Behaviours
EG - 44%
CG - 4.5%

Functions of Food
EG - 20%
CG - 0.8%

Food Groups
EG - 31%
CG - 0%

Concept of Complete Meals
EG - 26%
CG - 10%

*Visual Representation (Not to Scale)
EG – Experimental Group
CG - Control Group

Figure 5.4. 2: Overview of the Impact of the CHALK Programme on the Knowledge Levels of the study subjects*

Constituents of a Healthy Breakfast
EG- 69%
CG -10%

Benefits of Eating Fruits and Vegetables
EG - 6%
CG- 1%

Prolonged TV viewing affects Growth and Development
EG-61%
CG-47%

Physical Education
EG-78%
CG-55%

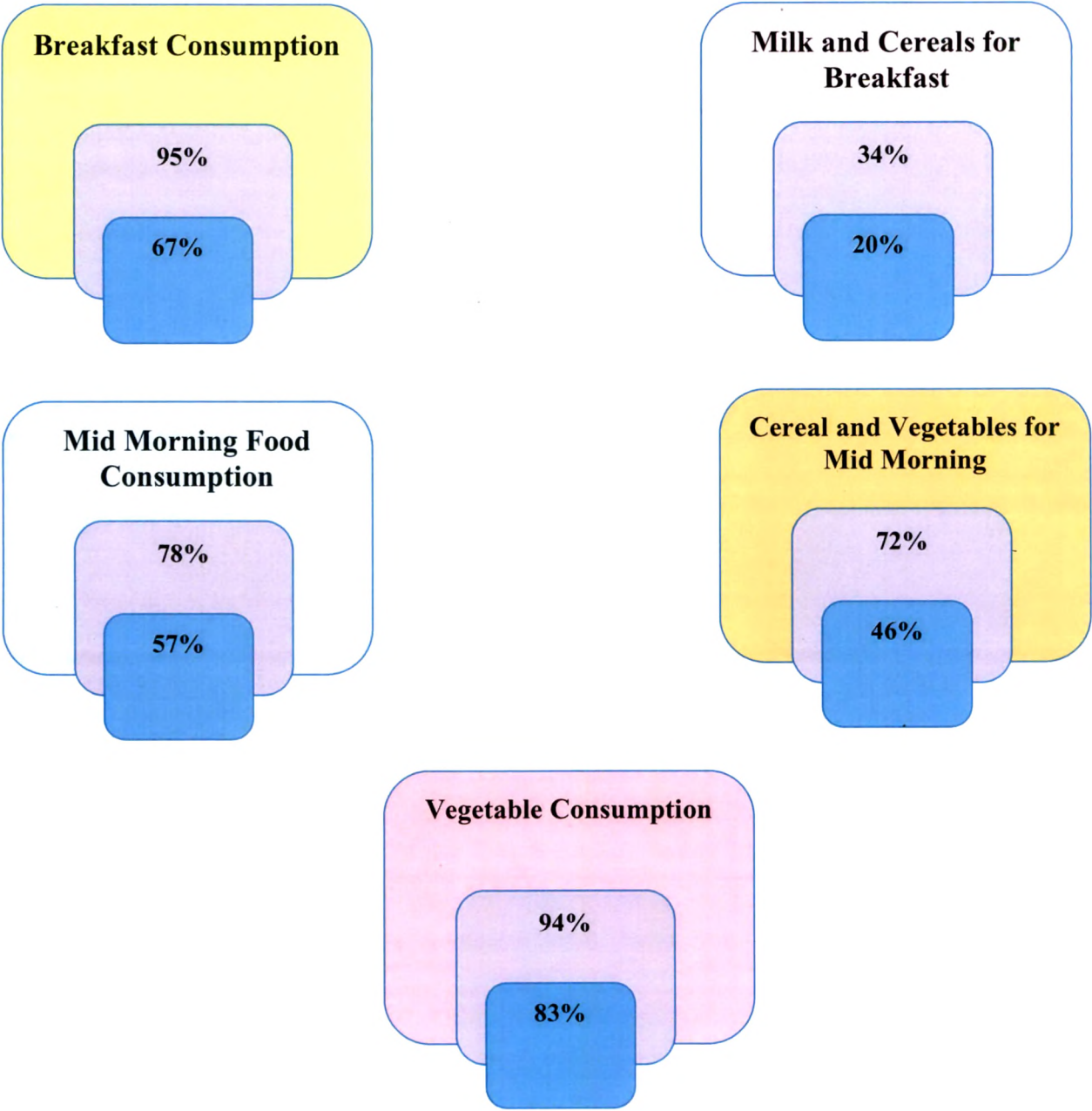**Appropriate Weight**
EG-31%
CG-0.4%

*Visual Representation (Not to Scale)
EG – Experimental Group
CG - Control Group

Figure 5.4. 3: Overview of the Impact of the CHALK Programme on the Dietary Practices of the study subjects

Breakfast Consumption
95%
67%

Milk and Cereals for Breakfast
34%
20%

Mid Morning Food Consumption
78%
57%

Cereal and Vegetables for Mid Morning
72%
46%

Vegetable Consumption
94%
83%

*Visual Representation (Not to Scale)
Represents – Experimental Group
Represents - Control Group

Impact of CHALK programme on the Food and Nutrient intake of the subjects

There was a significant increase in the mean food group intakes of grains, vegetables and edible oil in EG after the intervention while, a significant decrease in the mean intakes of grains, pulses and milk was observed in the control group. After the CHALK programme intervention the experimental group had significantly higher intakes of grains, vegetables and edible oil as compared to the control group.

A 4% increase was observed in the energy intakes in EG while there was a 0.4% increase observed in CG after the intervention. Mean protein intakes increased by 2g in EG which accounts for a 5% increase which was significant. A significant increase of 0.9 g in fat intakes was seen in the experimental group after the intervention.Although there was no significant difference between the two groups before the intervention, a significant difference was observed in the mean energy and iron intakes of the subjects in the two groups, post intervention.

Mean increments in the nutrient intakes were significantly higher in the experimental group as compared to the control group.The mean increment for all the nutrients was highest in girls as compared to boys in the experimental group, while in the control group the mean increments were higher in boys as compared to girls.Mean increments in the intakes for all the nutrients in the experimental group were significantly higher than the control group amongst both the sexes.The youngest age group showed the maximum positive change in the experimental group. Analysis of variance showed that being in the experimental group had a significant effect on the mean increments of the nutrients (p<0.001).

Analysis according to the stage of adolescence showed that pre-adolescents in EG had significantly higher mean increments, as compared to early adolescents, followed by mid-adolescents. Mid-adolescents, in the control group, showed negative increments in the mean intakes for energy fat and iron. These increments were found to be significantly lower as compared to the experimental group.

The difference in the mean RDA before and after intervention was found to be significant in case of the experimental group for all the nutrients. A 5% rise was seen in the experimental subjects, consuming >75% of RDA for energy, against 1% increase in the control group. A drop of 8% was observed in the experimental group subjects consuming <75% of the RDA for protein, resulting in an equivalent rise in the protein intakes of >75% of the RDA for protein. An increase

of 1% subjects in the control group, consuming <75 % of the RDA for protein after intervention. An increase of 3.6% was observed in experimental subjects consuming >100% RDA for fat after the intervention, while the control group showed no changes before or after the intervention. A significant improvement in the iron intakes was observed with an increase of 5% in the subjects in the experimental group while the control group subjects showed an increase of 0.5% in the subjects consuming >50% of the RDA for iron post intervention.

Impact of the CHALK Programme on the Frequency of Consumption of Healthy and Unhealthy Foods

An analysis of the frequency of food consumed showed a significant improvement in daily consumption of other vegetables like lady finger, cauliflower, brinjaletc in the experimental group. Daily consumption of fried foods went down significantly from 13.1% to 6.8% in the experimental group while a non-significant rise of 2% was observed in the control group after the intervention programme. A 6% reduction was observed in the experimental group as against a 2% increase in the control group regarding daily consumption of baked foods after the intervention.

Consumption of sugary foods like sweets chocolates, candies, ice creams, accessories like jams, murabbas, pickle, chutneys, papads and aerated soft drinks remained significantly higher in the control group than the experimental group while consumption of fruits was significantly lower in the control group as compared to the experimental group after the intervention.

Conclusion

Several major conclusions emerge from the present study. Firstly, the study clearly demonstrates that in middle income group urban school going children (Pre-adolescents and Adolescents), dual burden of malnutrition exists. However, the problem of undernutrition is higher than overnutrition. Two out of three schools used to check height and weight of the subjects once a year, still prevalence of undernutrition was very high in these schools, as it was done only for the school records. Therefore, growth monitoring and promotion should be a regular practice in all the schools, the students should be taught to read and prepare their own growth charts and also to calculate their BMI (A point to note here is that almost all the subjects in the present study

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except the V standard students were able to calculate their BMI). Parents should be informed regarding the nutritional status of their child.

Secondly, self-perception of the child leads to a healthy or unhealthy behaviour. Many subjects in the present study had incorrect perception about their body types. An increase in the awareness regarding 'healthy weight and unhealthy weight' would help adolescents to perceive themselves more clearly which in turn, would lead to improved healthy behaviours.

Thirdly, Healthy Eating Index for Adolescents (HEIA) was found to be a valid and reliable tool in assessing the dietary quality of the subjects. Similarly, Food Behaviour and Activity Checklist for Adolescents (FBACA), was a short, valid and reliable tool for assessing the quality of practices being followed by the school children. Tools like HEIA and FBACA should be developed for other age groups.

Fourthly, simple Behaviour Change Communication (BCC) messages can be designed and imparted to adolescents and their parents, especially mothers in order to bring about long term changes in their behaviour.

Policy Implications for Healthier Dietary and Physical Activity Practices

Advocacy is required at all levels right from the students, their parents, teachers and even the Principals, regarding health and healthy eating behaviours. There is a need to change the existing policies in schools regarding health of the school children. Schools can be accredited for initiating healthy canteen facilities, health education, growth monitoring etc. This would motivate the school authorities to generate new ways of health improvement amongst the students.

Also there is need to develop new tools like HEIA and FBACA for all age groups and implement it at population levels, to see the degree of conformation to the dietary guidelines. These tools are simple, yet valid and reliable for populations.

Another implication to be drawn from the present study is that with a little information general population can also be trained to evaluate the quality of their own diets using HEIA and FBACA. Steps should be made in this regard as to make these tools more accessible to the population.

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Thus, to conclude simple dietary tools like HEIA - to assess the diet quality and FBACA - to assess quality of dietary and physical activity practices, should be used in conjunction with simple BCC messages to bring about positive behavioural changes amongst populations.