Chapter 6 Summary and Conclusions

Adolescence is the transition period between childhood and adulthood characterised by rapid physical, cognitive and psychosocial growth. Malnutrition among adolescents is high. Addressing the problem of malnutrition in this age group is crucial. Thinness in children is associated with higher risk of infectious diseases, which is one of the leading causes of mortality among adolescents. (WHO 2019, UNICEF 2020) Providing optimum nutrition and inculcating appropriate dietary practices in school age children and adolescents is important to prepare them for a better future. (UNICEF 2011)

Early adolescence is the phase when individuals experience growth spurt. (UNICEF 2011) It is the second and last phase of growth spurt in human lifespan. This provides an opportunity to address malnutrition in this age group. This is also the age where majority of children are in primary or upper primary schools. Hence, they can be benefitted from the school feeding programmes.

India's Mid Day Meal programme is World's largest schools feeding programme under which children from all the Government and Government aided primary schools children are given hot cooked meals on school days. Despite this programme being implemented, prevalence of undernutrition among school age children and adolescents is still very high in India as reported by national databases and various research studies. (NFHS 3, NFHS 4, CNNS 2019)

Primary schools are considered a potential strategic place to foster healthy lifestyle in this age group. Imparting Nutrition Health Education can make them aware about healthy choices related to diet as well as hygiene. This may translate into practice and influence their nutritional status on a long run.

In view of this, present study was planned "to evaluate the Mid Day Meal programme in rural Vadodara and to study the impact of nutrition health education on the nutritional status of moderate and severely thin children of Rural Vadodara."

Rural areas of Vadodara near the petrochemicals industries were selected for the study. There were total 47 Government run primary schools in this area, out

of which 30 schools were coeducational and had both primary as well as upper primary sections. Since the study focused on children of upper primary section, sample in the study was drawn from these 30 schools.

The study was carried out in 2 phases:

Phase 1: Evaluation of Mid Day Meal Programme in Rural Vadodara

Phase 2: Impact of Nutrition Health Education on the Nutritional Status of Moderate and Severely Undernourished Upper Primary School Children of Rural Vadodara

Phase 1: Evaluation of Mid Day Meal Programme in Rural Vadodara

This phase was a cross sectional phase. The study area was divided into three geographical regions in a way that each region 10 schools from the 30 coeducational schools with primary and upper primary sections. Two schools from each area were randomly selected for this phase. Specific objectives of this phase were:

1. To study the implementation of Mid Day Meal Programme at the school level in the industrial area of rural block of Vadodara
2. To investigate the storage, food handling and cooking practices in the centralised kitchen of TAPF
3. To study the nutrient composition, quality and safety attributes of MDM provided by TAPF in the rural block of Vadodara

Phase one was divided into three phase to address these three objectives.

Phase 1 A: Evaluation of MDM at school level

This phase was conducted at schools level in the selected six schools. All the children studying in 5^{th} to 8^{th} standard were enrolled in the study after obtaining a written consent. Data on anthropometry, socio economic status as well as practices and perceptions regarding MDM, sanitation and hygiene were collected. Implementation of MDM at school level was also studied through spot observations. Data on nutrient intake was collected through 3 days 24 hours diet recall on a subsample. One school from each cluster was randomly

selected in the sub sample. Every fifth child from children studying in 5th to 8th standard was randomly selected for dietary assessment.

Major findings of Phase 1 A are presented below:

Nutritional Status Assessment using Anthropometry

- A total of 984 children were enrolled for anthropometric assessment, out of which 513 were boys and 471 were girls.
- Mean weight of boys and girls was 26.8±6.8 Kg and 27.5±7.3 Kg respectively. Mean weight of girls was significantly ($p<0.01$) higher than boys in 13-14 years age group (34.2±5.6 Kg for girls vs 31.9±4.2 Kg for boys). Mean weight across the stages of adolescence showed that girls had significantly higher mean weight (28.5±7 Kg) in early-adolescence phase compared to boys (27.4±6.8 Kg).
- Mean height was higher in girls (136±9.6 cm) as compared to boys (135.4±8.7 cm). It was significantly higher in the age groups of 11-12 years (134.6±6.5 cm vs 136.7±7.5 cm, $p<0.05$) and 12-13 years (139.1±7.4 cm vs 142.4±6.3 cm, $p<0.001$). Girls in early adolescence had significantly higher mean height than boys.
- Girls had a higher BMI (14.7±2.5 Kg/m^2) than boys (14.5±2.4 Kg/m^2) with a significantly ($p<0.01$) higher BMI (16.1±2.2 Kg/m^2) than boys (14.8±2.0 Kg/m^2) in 13-14 years age group.
- A total of 365 children of 8-10 years of age were enrolled in the study. Mean WAZ of children was -2.3±1.1. Prevalence of underweight was 66.1% with 31.1% severe underweight.
- Mean HAZ was higher for boys (-1.6±1.0) than girls (-1.7±0.8). More than one third (38.4%) of the children were stunted. Severe stunting was reported in 7.4% children and was higher among girls (8.1%) than boys (6.8%).
- Mean BAZ was higher among girls (-1.9±1.4) than boys (-2.2±1.5). More than half (55.7%) of the children were found to be thin (BAZ<-2SD) out of which 25.9% were severely thin. Prevalence of thinness was higher among boys as compared to girls.

Socio Economic Status

- Majority of the children were Hindu (97.3%) and only 2.7% were Muslim.
- With respect to castes, majority (61.6%) were from general category, followed by OBC (20.5%), SC (13.3%) and (4.6%) ST category.
- Data on educational status of parents showed that one third (34.9%) of the fathers had studied up to 10th standard while 63.4% of the mothers had left studies while they were in primary section.
- With respect to occupation of parents, Majority of the fathers were occupied in service (57.7%) and mothers were housewives (82.8%).
- One fourth (43.9%) children were from nuclear families followed by joint (29.1%) and extended nuclear (26.8%) families.
- Majority of the children belonged to lower income class and lower middle income class as per revised B G Prasad classification.

Practices and Perceptions regarding Mid Day Meal

- Most (93%) of the children consumed MDM in schools with nearly one third (70.1%) consuming MDM for 5-6 days a week.
- Main reason for not consuming MDM was not liking the taste among those who reported that they didn't eat MDM at school.
- Khichadi was the most liked item (28.7%) and Aloo subji (24.6%) was the most disliked item served under MDM, among children.
- Three fourth of the children (74.9%) opined that MDM is beneficial for them. The main perceived benefit of MDM as reported by the children, was improvement in health (28.7%).

Practices and Perceptions regarding Sanitation and Hygiene

- Almost all the children (99.7%) opined that hand washing is an important hygiene practice and majority (96.1%) said that it can prevent illnesses.
- All the children reported to be washing their hands before handling or consuming food, after eating and after using toilet.
- Only 43.2% children were washing hands after going home from outside followed by 31.5% washing their hands after doing household chores.

- Almost all the children reported that they used soap for hand washing when at home. Only around two third (67.2%) children reported washing hands with soap in school.
- Most of the children (96.9%) said that they keep their nails clean and trimmed with 61.1% reported to be cutting their nails once a week. However, only one third (32.8%) of the children were observed having clean and trimmed nails at the time of interview.

Dietary Assessment

- Boys had significantly ($p<0.05$) higher mean dietary intake of energy (1418±483 vs 1150±397 Kcal), carbohydrates (183±58 vs 149±52 gm), protein (40.9±15.7 vs 31.8±13.9 gm) and fat (54.2±20.9 vs 44.5±17.1 gm) as compared to girls.
- Comparison of mean nutrient intakes with recommended allowances showed that mean intake of energy and protein met 2/3rd (62.4±22.1%) and 93.4±41.5% of the RDA (2010) respectively. The diets were meeting less than one third of the RDA of calcium (31.0±18.5% RDA) and iron (28.6±18.2% RDA). The mean percent RDA met though the dietary intake were higher in boys as compared to girls.
- Comparison with newer guidelines (EER/EAR 2020) showed that children's diets met 61.5±22 % EAR for energy, half of the EAR for iron (48.6±30.7) and one fifth of the EAR for calcium (37.2±21.5). Mean protein intake was higher among children in terms of percent EAR (2020) for both boys (160.7±66.4) and girls (125.6±57.4) in comparison with RDA 2010.
- Children were consuming 515±204 Kcal energy,18±7.5 gm protein and 28.6±11.8 gm fat through MDM. MDM contributed to only 47±21 mg calcium and 0.9±0.6 mg iron on an average to the children's daily diets. Boys had significantly higher intake of protein, fat and iron though MDM than girls. (($p<0.05$)
- Comparison with dietary requirements (RDA 2010 and EAR 2020) showed that MDM contributed around one fourth of the daily energy requirements and around half of the RDA 2010 and two third of the EAR of protein among children.

- Only 38.9% and 48.2% of the children met the nutrient norms of energy and protein. More boys consumed amount of MDM that met nutrient norms as compared to girls.

Spot Observations of MDM at School

- Regular supply of safe drinking water in the schools was recorded in most of the observations.
- Soap was available at the time of 66.7% visits and children were observed to be washing their hands with soap before meals but only 33.3% observations reported majority of the children washing their hands with soap before consuming MDM in school.
- Supervision of hand-washing was observed in only 16.7% observations, where hand-washing was supervised by student members of *'Bal-Sansad'.*
- Children were asked to wash their hands before meal but no dedicated time for hand-washing was given in the schools.
- Open spaces like corridors, play grounds and open shaded dining areas were used for serving MDM in the schools. Cleaning of floor was not done satisfactorily.
- Serving was done by MDM helpers and senior students in the schools.
- Serving spoons being used in the schools were of different sizes. Jugs and other utensils were also used in some schools for serving.
- Plates for consuming MDM were provided from school as seen in one third observations. Children were bringing plates from home in two third observations.
- It was observed that teachers were present at the time when meals were started being served. However, presence of teachers for monitoring throughout MDM serving as well as motivation by teachers were lacking.
- Waste-bins for collecting plate waste, were present in all the schools.

Phase 1 B: Evaluation of MDM at centralised kitchen

This phase comprised of process observations for a period of one week and monthly spot observations for six months, carried out at the NGO run centralised kitchen of Vadodara.

Major findings of the observations are given below:

- The centralised kitchen was run by The Akshaya Patra Foundation (TAPF) in Vadodara.
- The kitchen was divided into different sections dedicated to specific functions such as storage, cold storage room, vegetable processing section, cooking area, vessel washing area, vessel store, dispatch/ loading area, vessel unloading area, boiler section, van washing area etc.
- Various machinery and equipment such as rice cleaning machine, rice silos, flour sieving machine, dough kneading machines, vegetable cutter, potato peeling machine, wet grinder, roti making machines, rice cauldrons, dal cauldrons, idly making machine as well as flour fryer machines were being used for various processes in food production in the centralised kitchen.
- The centralised kitchen had steam boilers and biogas plant. LPG, steam and bio-gas were used as fuels in the kitchen.
- Reverse Osmosis (RO) Plant was available in the kitchen to ensure usage of clean water for preparation of the meals.
- All the staff members were provided with uniforms, head-gears, aprons, gloves and rubber boots. They were following optimum personal hygiene practices.
- Good cleanliness and hygiene were maintained in kitchen and storage area of the centralised kitchen.
- Cereal grains under Mid Day Meal programme were provided through the nearest FCI godowns in both centralised as well as school level kitchens. All the other food items were purchased by the NGO from local vendors.
- Raw food items were systematically stored in close packets on raised platforms that were kept away from the walls, as recommended in the programme guidelines.
- Kitchen floors were kept clean throughout cooking. Floors and all the machineries were thoroughly cleaned after cooking. All the utensils were

cleaned using three bucket method and steam sterilised before storing in the vessel storing area.

- Raw food items were cleaned before cooking. Vegetables, pulses and rice were thoroughly washed before using.
- A well planned dispatch process was followed in order to ensure error free deliveries of meals to the schools.
- Pest-control was done by a company hired on a contract basis everyday.

Phase 1 C: Nutrient Composition and Quality Attributes of MDM

Nutrient and microbial analysis of food samples was carried out to study the quality attributes of food items served by the centralised kitchen in study area. Food samples were collected in sterile containers using sterile ladles. Samples were collected from the kitchen for nutrient analysis. Microbial analysis was carried out on food samples collected from the kitchen at the time of production and from the school while MDM was being served. This was done to understand the changes in microbial profile of food from production to serving. Analysis was done in an NABL accredited laboratory.

Major findings of the analysis are given below:

- The MDM lunch menu provided by the centralised kitchen included curry based items (dal and subji), rice based items (jeera rice, chana rice, vegetable pulao, peas pulao and khichadi) as well as roti and thepla.
- In addition to this, snack items such as fried grounduts, sukhadi, bataka poha, idli were served in breakfast at 11 AM.
- Energy content of rice based items ranged from 65 Kcal/100 gm for khichadi to 173 Kcal/100 gm for chana rice. Curry based items had lower calories per 100 gm as compared to rice based items and rotis. Aloo subji had the lowest caloric content (37 Kcal/100 gm). All the snacks served as MDM breakfast were high calorie foods, except for idlis (159 Kcal/100 gm). Fried groundnuts had the highest calorie content (whole groundnuts-643 Kcal/100 gm and split grounduts-597 Kcal/100 gm).
- Chana rice provided highest amount of protein (7.38 gm/100 gm) among all the food items served in lunch. Fried groundnuts had the highest amount of protein (whole groundnuts- 23.89 gm/ 100 gm and split

groundnuts 22.59 gm/ 100 gm) among all the food items served in breakfast and lunch items.

- Breakfast items had higher fat content per 100 gm (except for idli) as compared to food items served in lunch.
- Fried ground nuts and peas pulao had the highest content of calcium among all the food items of breakfast and lunch respectively.
- The food items were not found to be providing good amount of iron.
- Results of microbial analysis showed that roti, thepla and dal dhokali had higher TPC (total plate count) in general as compared to other food items. These involved some human handling at the time of cooking and packing.
- Rice based food had the least TPC count except for khichadi.
- Food items containing vegetables such as dal and subji had higher TPC than rice items.
- TPC count of all the analysed samples were well within the safe limits at the time of production as well as while serving.
- Coliforms (<10 cfu/gm), E. coli (0 MNP/gm), yeast (<10 cfu/gm) and mould (<10 cfu/gm) were within the safe limits for human consumption; both at the time of production and consumption in all the samples.

Phase 2: Impact of Nutrition Health Education on the Nutritional Status of Moderate and Severely Undernourished Upper Primary School Children of Rural Vadodara

Phase 2 of the study was an intervention phase carried out using quasi experimental research design. Six out of 30 coeducational schools having primary and upper primary sections were selected for the study. Specific objectives of this phase were:

1. To assess the magnitude of under nutrition in rural upper primary school children. (WHO 2007 standards)
2. To assess the prevalence of anaemia amongst moderate and severely undernourished rural upper primary school children.
3. To develop NHE material for moderate and severely undernourished upper primary school children.

4. To assess the impact of NHE on growth, hemoglobin levels, morbidity profile, cognitive development, physical work capacity, practices and perceptions- MDM, sanitation & hygiene, MDM compliance and nutrient intakes among thin children.

This phase was divided into two sub-phases:

Phase 2 A: Screening of Students for Thinness

Baseline data on anthropometric measurements of all children in the 5th through 8th standards of the selected six schools were obtained in this phase. The children were classified into categories of thinness using to the World Health Organization (WHO) Growth Standards (2007).

A pre-tested semi-structured questionnaire was used to collect socio economic status data from the students. Blood sample was collected only on those children who gave consent for the same. For children whose blood sample was collected, dietary pattern information was elicited using the 24-hour dietary recall method.

Major findings of Phase 2 A are as below:

Anthropometric Assessment of all the Screened Children and Thin Children

- Mean weight, height and BMI of children were 29.6±7.6 Kg, 138.1±10.2 cm and 15.3±2.4 Kg/m^2. Prevalence of underweight (WAZ< -2 SD), stunting (HAZ< -2 SD) and thinness (BAZ< -2SD) among children was 43%, 31.9% and 34% respectively.
- Mean weight (25.5±4.9 Kg) of thin children was slightly higher among boys than girls but this difference was not statistically significant. Age wise data also showed no significant difference in the mean weights of boys and girls.
- Mean height (137.1±9.7 cm) among subjects did not show any gender wise difference.
- Body Mass Index was 13.4±1 Kg/m^2 for the thin children. Boys (13.5±0.7 Kg/m^2) had significantly ($p<0.05$) higher BMI than girls (13.1±0.6 Kg/m^2) at 11 years of age.

- Majority of the thin children were underweight (88.1%) and 41% were stunted.

Socio Economic Status of Thin Children

- Majority of thin children enrolled in the study were Hindus (90.6%) with only 9.1% and 0.3% being Muslim and Christian respectively.
- Majority (41.6%) were from general category, followed by OBC (25.0%), SC (18.8%) and ST (14.6%) categories.
- Half of the children (51.9%) were from nuclear family followed by extended nuclear family (28.6%).
- Data on education of parents showed that majority (42.2%) of the fathers had studied till primary level followed by one fourth (25.3%) who had studied upto secondary section (8^{th}-9^{th} standards).
- Half of the mothers (51.3%) had studied left studies while or after primary schooling (1^{st} to 7^{th} standard).
- Majority (42.2%) of the fathers were working as salaried employees and mothers were home makers (53.9%).
- Majority of the children belonged to lower income class (43.8%) and lower middle income class (36.7%) families based on per capita income according to the revised B G Prasad classification for 2019.
- Almost half of them had monthly family income of 2555-7587 INR.

Hemoglobin Status and Anemia among Thin Children

- Mean hemoglobin levels among subjects were 11.5±1.4 g/dl.
- No difference was reported in the mean hemoglobin of boys (11.7±1.3 g/dl) and girls (11.3±11.5 g/dl).
- Nearly half (49.7%) of the children were anemic with higher prevalence (63%) among girls than boys (46.1%).
- Almost one fourth of the children were mildly anemic (23.9%) and moderately anemic (23.9%). Severe anemia was reported in 1.9% children.

Dietary Intakes among Children

- Mean dietary intake among children were, 1009 ±338.2 Kcal energy, 141.0±50.8 gm carbohydrates, 26.9±9.7 gm protein, 33.2±14.7 gm fat, 178.2±102.1 mg calcium and 4.4±3.2 mg iron.
- Dietary intakes were higher among boys than girls.
- Diet of children met nearly half of the RDA (2010) of energy (46.4±15.4), more than two third RDA (2010) of protein (63.8±23.9) and nearly one fourth RDA of calcium (22.3±12.8) and iron (18.2±14.7).

Phase 2 B: Impact evaluation of Nutrition Health Education

This was an intervention phase where Nutrition Health Education with planned reinforcement sessions were given to upper primary school children. Main session of NHE was given in schools enrolled in experimental group, using a PowerPoint presentation in local language. Reinforcement sessions were held every 15 days. Total duration of the NHE was two months. Post data was collected after the intervention. Data was again collected after a period of two months washout period.

Data on anthropometry, haemoglobin and dietary intake were collected. In addition to that, data was also collected on practices and perceptions regarding MDM, sanitation and hygiene, morbidity profile, cognitive scores and physical work capacity. A pre-tested open-ended questionnaire was used to collect data on practices and perceptions about MDM, sanitation and hygiene. Data on morbidity profile for a reference period of 15 days was collected using a pre-tested questionnaire. Step test was used to assess physical work capacity. A combination of two cognitive tests, RAVEN's Progressive Matrices and the Clerical test, was used to collect information on cognitive growth.

Major results of this intervention phase are:

- Mean anthropometric measurements and indices increased in both the groups after intervention. Prevalence of underweight and stunting did not change post intervention.

- All the children enrolled in this phase were thin. A higher shift to normal BAZ category was reported in experimental group (13.7%) than control group (5.6%) after intervention.
- Majority of the children reported to be consuming MDM in school both pre and post intervention.
- Data on preference for food served under MDM showed that majority of the children liked the food. More number of children in experimental group reported that they liked the food served in MDM, post intervention vs. no change in control group.
- Three fourth children (75.7%) in experimental group and 82.1% children in control group before intervention, considered MDM to be beneficial. Experimental group showed a higher number of children who identified MDM to be beneficial for them post intervention than control group.
- Improvement in health and nutrition were the most commonly identified benefits of MDM by children in both the groups.
- Most of the children considered hand-washing to be an important hygiene practice.
- Majority said that hand-washing practices ensure hygiene and nearly one third of the children opined that following proper hand-washing practices can prevent illnesses. A significantly ($p<0.05$) higher number of children in experimental group reported that hand-washing ensures hygiene, whereas no change was seen in control group.
- An increase (8.3%) in number of children reported to be practicing hand-washing before eating in experimental group was reported post intervention, whereas this number decreased by 3.8% in control group.
- A significantly higher increase (5.3% to 55.4%) in number of children washing hands with soap in school was reported in experimental group vs. no change in control group (35.8% to 36.2%).
- Most (97.5%) of the children regarded keeping nails trimmed and clean as an important hygiene practice. Despite of majority reported that they followed good nails hygiene, nearly half of the children did not have cut or clean nails as observed at the time of interview. The observation did not change significantly post intervention.

- Most of the children identified bathing as an important personal hygiene practice. An increase in number of children saying that bathing helps in preventing illnesses increased in experimental group (36.1% to 47.6%) post intervention. No change was reported in control group.
- More than half (56.4%) of the children reported having morbidities during the 15 days reference period.
- A 7.2% reduction in number of children who had experienced morbidities in past 15 days was reported post intervention but no significant difference between the groups was reported indicating no effect of NHE on presence of morbidities among children.
- No significant impact of NHE was reported on cognitive scores and physical work capacity of the children.
- Mean haemoglobin levels among subjects were 11.4±1.3 g/dl. No significant effect of NHE on mean haemoglobin levels of thin children was reported.
- Experimental group (61.5%) had higher anemic children as compared to control group (37.8%) at baseline. The overall prevalence of anemia reduced by 17.9% in experimental group whereas it increased by 5.7% in control group.
- Experimental group showed a significant increase in mean energy intakes (985±261 Kcal to 1116±316 Kcal, $p<0.001$), carbohydrate (134.3±38.4 gm to 160.3±54.4 gm, $p<0.01$) and protein (27.4±9.0 gm to 31.2±8.4 gm, $p<0.01$). Control group did not show significant change post intervention.
- Dietary adequacy in terms of mean percent RDA 2010 and EER/EAR 2020 significantly increased for energy and protein in experimental group vs. no change in control group.

Washout Effect

- Mean weight and BMI increased slightly from post intervention to post washout period in experimental group but control group showed no change in mean weight and a decline in mean BMI.

- Prevalence of stunting showed slight increase in both the groups from pre to washout data collection. All the children below 10 years of age were underweight after washout period. Thus, NHE did not have any effect on stunting and underweight. No effect was seen on underweight due to a very small number in children below 10 years of age.
- One fifth of the children shifted to normal BAZ category post intervention, with a higher shift (11.3%) in experimental group than control group (6.3%). This number slightly decreased after washout period. But the number of children with normal BAZ was higher in experimental group than control group even after two months of washout period.
- A small increase in number of children eating MDM in experimental group was reported from pre to post intervention. However, this decreased to 91.5% children consuming MDM after washout period.
- An increase in number of children who liked the food served under MDM was reported from baseline (88.7%) to post intervention (98.1%), in experimental group. However, this number decreased after washout period to 91.5%.
- Number of children who considered MDM beneficial showed a higher increase in experimental group than control group after intervention. But it dropped after washout period.
- An increase in number of children washing their hands when coming home from outside as well as after doing household chores was reported from pre to washout data.
- A significantly higher increase in number of children washing their hands with soap in school was seen in experimental group than control group post intervention. It slightly decreased after washout period but remained higher in experimental group than control group.
- No significant impact in cognitive scores and step test was seen after intervention as well as after washout.

Table 6.1 Summary of the Impact of NHE Intervention (Post Intervention)

Parameters Studied	Experimental	Control
Anthropometric Measurements		
Mean Weight (kg)	1.2 ↑	0.7↑
Mean Height (cm)	1.6↑	1.6↑
Mean BMI (kg/m2)	0.3↑	0.1↑
Underweight (%)		
Underweight (WAZ: -3 to -2 SD)	4.4↑	23.3↓
Severe Underweight (WAZ: <-3 SD)	4.7↑	1.1↓
Stunting (%)		
Stunting (HAZ: -3 to -2 SD)	0.6↓	1.6↓
Severe Stunting (HAZ: <-3 SD)	0.5↑	2.4↑
Thinness (%)		
Thinness (BAZ: -3 to -2 SD)	13.6↓	8.1↓
Severe Thinness (BAZ: <-3 SD)	No change	2.4↑
Shift from thinness to normal	13.7	5.6
Hemoglobin Status and Anemia		
Mean Hemoglobin (g/dl)	0.2↑	0.1↑
Prevalence of anemia (%)	17.9↓	5.4↓
Mean Nutrient Intake		
Energy (Kcal)	130.6↑	5.3↑
Carbohydrates (gm)	26↑	3.9↑
Protein (gm)	3.8↑	0.2↑
Fat (gm)	3.3↑	No change
Calcium (mg)	1.4↑	19.8↑
Iron (mg)	0.2↑	0.4↑
Practices and Perceptions about MDM (%)		
Number of children consuming MDM	1.1↑	No Change
Number of Children with Increased Frequency of MDM Consumption	24.3	8.5
Number of children who like MDM	7.1↑	No Change
MDM considered beneficial	10.7↑	4.7↑
Personal Hygiene (%)		
Hand-washing with soap in school	50.1↑	0.4↑
Clean and trimmed nails	2.2↑	7.5↓
Others (%)		
Presence of morbidities	9.8↓	3.2↓
Cognitive Scores	0.9↑	0.8↑
Steps test	5.8↑	5↑

Conclusions:

Results of the study showed that prevalence of undernutrition is high among children studying in Government run upper primary schools of rural industrial area of Vadodara. The food provided by the centralised kitchen is hygienically prepared and safe for consumption. However, MDM intakes are not sufficient to meet nutrient requirements among children. Efforts to address this gap need to be made at school level. Apart from this, motivation from teachers to consume MDM, uniformity of serving size depending on the standard and ensuring proper hygiene practices at school need to be focused. Nutrition Health Education with reinforcement strategies was effective in improving the nutritional status. It also showed to slightly improved dietary intakes among children. Improvement was also seen in hygiene practices, especially at school. However, washout study showed a decline in the improved results after intervention indicating a need to carry out continuous NHE activities in school set up for reinforcement of key messages. Interactive and less time consuming NHE strategies can be designed that can be implemented frequently without interrupting the teaching learning process at school. These activities can be woven into the existing MDM programme to ensure adequate knowledge on nutrition, health and hygiene among children.

Recommendations:

- Efforts should be made to standardise the serving size of cooked food according to the nutrient norms for students of primary and upper primary sections. MDM helpers should be trained to serve food in the standardised quantity to ensure that children consume sufficient food to meet the nutrient norms.
- A dedicated time slot should be given for hand washing. Calling it 'hand-washing break' would make it easy for children to recognise hand-washing before meal as an integral part of MDM. A team of teachers and students can be made to monitor hand-washing, MDM serving and consumption.
- There is a need to ensure availability of uniform serving spoons and plates at every school. Proper washing of serving spoons and plates before and after serving MDM also needs to be ensured.
- Interactive NHE strategies with reinforcement strategies can be designed for children. Modules for NHE can be developed that can be handed over to functionaries.
- NHE activities woven as an integral part of the programme can be a continuous process. Students groups can be involved in NHE activities.
- Creating a positive attitude and sense of entitlement for MDM among children can improve outcome of the programme. Children can be made aware about the quantity of MDM that they need to consume everyday. The NHE activities should focus on providing information related to MDM programme in addition to health, nutrition and hygiene related knowledge.