In large areas of the world today, malnutrition, especially affecting growing children, is one of the foremost public health problems in developing countries as they are most vulnerable to its consequences. The frequency of malnutrition cannot be easily estimated from the prevalence of commonly recognized clinical syndromes, such as Kwashiorkor and Marasmus because these syndromes constitute only the proverbial tip of iceberg. Cases with mild to moderate malnutrition are likely to remain unrecognized. Though the aggregated level of undernutrition is shockingly high, the picture is further magnified with significant deficiencies of key vitamins and minerals which continue to be persistent and overlaps with problem of general undernutrition. Worldwide, the most widespread micronutrient deficiencies are of iron, zinc, vitamin A, iodine, and folate. Iron deficiency anaemia (IDA) is the commonest nutritional disorder in the world. Nutritional anaemia though global in occurrence, is more of a concern in the developing countries because of the high prevalence in these regions. In spite of its high prevalence in children, studies on prevalence in school children are relatively few from developing countries.

World Health Organization (WHO) launched 'Global School Health Initiative', in 1995, to mobilize and strengthen health promotion and education activities at the local, national, regional and global levels. The Initiative is designed to improve the health of students, school personnel, families and other members of the community through schools. Although the World Bank has included school health as one component of its essential public health package for cost effective health program, the nutrition and health of school- age children in the developing world has received a little attention.

Schools is an endeavour to meet the goal of Millennium Development Goals as they are a practical platform to deliver an integrated package of interventions, such as nutritious meals or snacks, micronutrient supplements or on-site fortification, infection control, health promotion, and life-skills education, to improve the health and nutrition of school children.

School feeding programs are designed to provide nutritious food to the children and to improve their physical, mental and psychosocial health. MDM programme in India is largest school feeding programme in the world. The present research was undertaken with the broad objective "To assess the nutritional status of primary school children studying in government municipal schools of urban Vadodara and to see the impact of school meals provided by TAPF on nutritional status of school children". The results of the study are presented in 5 phases, as follows:

PHASE 1: FORMATIVE RESEARCH

The study was conducted in 16 municipal schools enlisted from four zones of urban vadodara. From each zone, four schools were randomly selected and all the children from 1^{st} – 7^{th} standard were enrolled for the study. The total number of registered children was 6574 out of which data was collected on 4905 children. Socio economic data of the children was collected using a pre tested semi-structured questionnaire. The anthropometric measurements like weight, height, waist and hip circumference measurements were studied in relation to age and gender. Biochemical estimation of haemoglobin by auto hemato- analyzer was collected on a sub sample of the children studying from 4^{th} – 6^{th} standard.

The major findings of this phase of the study are given below:

Socio Economic Status

- Majority of the children were Hindus (84%) followed by Muslims (17.7%). Caste wise distribution showed that 36.5% were Other Backward Castes followed by General category (31.7%) and Scheduled Caste (16.5%). Only 15.4% of the children belonged to Scheduled Tribe category**.**
- Gender wise equal distribution of boys (48%) and girls (52%) was seen in the study population.
- Majority of the fathers were occupied in service and mothers were housewives.

Anthropometric Indices and prevalence of malnutrition

- The mean weight and height of boys was 23.1kgs and 125.9cms, and that of girls was 22.7kgs and 124.4cms. Thus, the mean weight and height of boys was higher than that of girls. While, the mean BMI for girls (14.35kg/m^2) was significantly higher than that of boys (14.24 kg/m^2). The mean BMI values increased linearly with age in case of both boys and girls.
- The data indicates that both boys and girls had lower weight, height and BMI as compared to WHO 2007 and CDC 2000 reference growth standards
- All the three anthropometric indices showed the prevalence of undernutrition to be very high. The prevalence of underweight was around 61%, stunting was 38% and thinness was 40% by CDC standards. According to WHO standards, the prevalence of underweight was 54%, stunting 38% and thinness was 33%.
- The CDC standards reported higher percentage of children in Grade 3 for underweight and thinness as compared to WHO standards.
- Gender wise, the prevalence of underweight and thinness was significantly more among boys than girls. However, the prevalence of stunting was similar among both the groups with slightly higher prevalence seen among girls.
- The maximum prevalence of all the three anthropometric indices i.e. underweight, stunting and thinness was seen at 10 years of age.
- The prevalence of SAM was 9.9% with higher prevalence seen among girls as well as among 10-12 year old children.
- The overall prevalence of undernutrition by CIAF was found to be 60.9%. with 10.9% stunted only, 4.6% underweight only, 10.6% wasted only, 7.8% wasting and underweight, 12.0% stunted and underweight and lastly 15.0% stunted, wasted and underweight. The prevalence of CIAF was higher as compared to other conventional indicator specifically underweight, stunted and wasted.

- The overall anthropometric failure was seen more in boys (63.1%) than girls (58.9%) and among children less than 10 years of age.
- Almost universal population i.e. 90% of the children was anaemic. The prevalence was predominantly of moderate anaemia (74.1%), followed by mild anaemia (12.9%) and severely anaemic (3.0%).
- Girls were more anaemic than boys and age wise the maximum prevalence of anaemia was seen in 10-12 years.
- The mean haemoglobin levels were almost similar in all the age groups. The mean haemoglobin levels were higher in children with Z-score >-2 SD than in children in ≤-2 SD. Thus with the severity of undernutrition the haemoglobin levels were compromised.
- Only about 27.8% of the children reported morbidities in the last fifteen days of the interview. The most common morbidities reported were fever (37.2%) followed by cough and cold (30.8%).
- The prevalence of Severely Thin Children was 9.9%.
- Multiple regression analysis found that gender, age, religion, education of father and type of family acts as independent variables affecting the nutritional status of the children

Thus, the health and nutritional status of the school children studying in urban Municipal schools of Vadodara was found to be low and highlights the need for increased, concerted efforts towards improvement of their nutrition. The extent of micronutrient malnutrition in the research study was high with both boys and girls in nearly all ages, being deficient in weight and height as compared to WHO 2007 and CDC 2000 standards and low levels of haemoglobin resulting in high prevalence of anaemia. As most of the children belong to low socio-economic background, factors such as gender, age, religion, education of parents and type of family may also account for the high prevalence of undernutrition among the study population.

Thinness was the least common form of undernutrition while underweight was the commonest among children in the present study. Overall, 54.3%, 37.9% and 33.4% were underweight, stunted and thinness respectively. In the

present study, nearly two thirds of the children were in the zone of malnutrition by anthropometric failure. Disintegrating the undernourished children into different groups helps in identifying children with multiple anthropometric failures and these children with multiple failures form the priority group for planners and policy makers. Further, nutritional intervention programs with more emphasis on fortification of meals, improving personal hygiene, prevention of disease like parasitic infection/infestation should be implemented to improve the nutritional status of children with a priority towards children with multiple anthropometric failures.

PHASE 2: PROCESS EVALUATION

Process evaluation was done at both kitchen and at schools. At the centralized kitchen observations were done once every month. A total of 23 observations were made at centralized kitchen. While, in all the schools, visits once in a month were done to observe the execution of the MDM programme at the schools. A total of 229 spot observations were made during the study period. Quantity of MDM consumed by the children was also measured on a sub sample. From each school one girl and one boy were randomly selected every month. The amount of food served to them and the amount of leftover food i.e. plate waste was measured using standard cups. A total of 1404 children were observed during the spot observations.

The findings of this phase are:

- **AT THE AKSHAY PATRA KITCHEN**

  - The Centralized kitchen had good infrastructure to cater to the needs of the MDM programme.
  - Good storage practices, food handling practices were followed at Akshay Patra.
  - Akshay Patra employees followed all the basic sanitation and hygiene practices.

- TAPF has a three item menu and ensured a cereal–pulse–vegetable combination
- The Government of Gujarat provided raw food ingredients such as Fortified Wheat Flour and Rice.
- Cost of various cooked food menu ranged from Rs.4.50 – Rs. 5.50.
- There was a systematic procedure for meal preparation. All the cooking equipment was sterilized using steam before the cooking process began. Six sigma methodology is used for cooking in the kitchen to improve the efficiency of various processes inside the kitchen with an aim at overall improvement in quality and optimization of costs.
- Insulated mobile vans are used for transporting foods to various schools.

❖ **AT SCHOOLS**

- Corridors and playground of the school were the major venues for having school meals.
- Akshay Patra helpers (73%) were mainly responsible for distribution of MDM.
- Motivation by the teachers to consume MDM was insufficient.
- Disposal of plate waste led to unhygienic conditions in the school campus.
- Majority of the leftover food was redistributed to school children.
- Hand washing practices among children was poor.
- The mean nutrient intake of the children was less than 1/3rd of the RDA as well as less than the nutritional norms prescribed in MDM.
- The mean nutrient intake was higher among boys as compared to girls.
- The mean nutrient intake was significantly lower among underweight children as compared to the normal children.
- MDM consumption was 72.6% amongst the children present.
- MDM consumption was highest on Wednesday and least on Saturday.

The centralized kitchen model is applauded for efficiency because of its minimization of labour costs; use of mechanization reducing human contact with the food with lower chances of contamination; lower need for space; and economies of scale. Furthermore, teachers are freed from the responsibility that cooking in the schools would entail. TAPF has enhanced and improved the quality of service of Mid day Meal Programme.

If Mid day meal acts as a regular source of "supplementary nutrition" contributing substantial to school children's diets, then it facilitates their health growth, but in the present study, children's food intakes did not meet dietary recommendations. As the effect on nutrition is ambiguous and depends upon both the quantity and quality of the meal. It is important that the child should receive quality of food in sufficient quantity along with other environment factors.

The study therefore stresses the need for nutritional interventions to improve dietary quality and quantity of school meals given to children in schools. Even, the ration sizes need to be reviewed to determine a more efficient ration that meets nutrition requirements. In addition, the food basket as currently designed is lacking in fruits consumption.

There is also a need to strengthen the present school meal programme along with monitoring and supervision by Teachers'. In the present study, it was found that teachers were not monitoring and supervising the school meals.

Several intervention studies have illustrated 'double advantages' of school hygiene promotion being effective in reaching a large number of school children, and at the same time children as 'hygiene messengers' to their families and communities. The promotion of hygiene practices can be promoted through proper health education by the teachers who are their first contact.

PHASE 3: IMPACT EVALUATION

In this phase, the impact of the MDM programme provided by The Akshaya Patra Foundation on the growth, hemoglobin, morbidity profile, scholastic performance and attendance of the school going children was studied after one year of intervention. As this was a pre-post evaluation the final sample size for anthropometry was 3522 children, for Haemoglobin estimation and morbidity profile, it was 681 children, for scholastic performance 2743 children and school attendance was taken for 2550 children. School attendance and scholastic performance was taken as secondary data from school registers.

The key findings of this phase are:

- There was significant increase in the weight of the children after one year of intervention as compared to their baseline values (boys 3.0 kg and girls 3.4 kg)
- The pattern of height increment among girls was markedly different from the boys. Overall increase in the mean height of boys was 5.6 cms while for girls it was 5.9 cms.
- It was found that the mean BMI of boys was 14.6kg/m^2 and for girls it was 14.9kg/m^2 after one year of intervention. An overall increase in BMI was observed after one year of intervention which was statistically significant.
- The comparison between initial and final WAZ, HAZ and BAZ scores revealed that the mean Z scores had negative values but still were significantly lower after one year of intervention.
- The percent prevalence of underweight after one year of intervention was found to be 47.5%, stunting was 35.0% and thinness was 29.7%. Overall the prevalence of underweight, stunting and thinness reduced by 6.7%, 3.1% and 4% respectively after one year intervention of MDM provided by TAPF.
- The overall prevalence of anthropometric failure reduced to 54.7% i.e. there was an overall reduction by 7.1% after one year of intervention,

with maximum reduction seen among the girls (7.3%) as compared to boys (6.9%).

- There was significant increase in the mean haemoglobin level of boys (0.7g/dl) and girls (1.1g/dl) post intervention. It was seen that the increase in the mean haemoglobin levels of the girls was significantly higher as compared to the boys.
- The prevalence of anaemia reduced from 90% to 62.5% and the reduction was statistically significant.
- No significant reduction in the prevalence of morbidity was seen after one year of intervention.
- The mean attendance of the academic year 2008-09 and 2009-10 revealed that there was significant improvement in the attendance rate.
- The impact of MDM provided by TAPF was significant even on the scholastic performance of school children.

The present study reflects the benefits of Mid-day Meal on the nutritional status of the school children. The result shows the positive impact of Mid-day Meal on children's health status, as it increased remarkably. Greater involvement of the private sector to assist the government would help augment nutrition in children and indirectly impact school performance, attendance and literacy. The study finding also revealed that the objectives envisages through MDM has been achieved to a great extent through private participation.

Despite this program, a substantial number of children at our baseline assessment had micronutrient deficiencies at the biochemical level, indicating that this feeding program did not supply enough micronutrients to prevent or eliminate existing micronutrient deficiencies. Fortification of staple food with iron may be used as a more permanent approach to control anaemia. But as a long term measure, national programmes must be adopted. Our study showed high prevalence of anaemia among both boys and girls, this implies that not only girls, but along with girls, boys should also be targeted for control of anaemia.

Efforts recommended to address health and nutrition problems among school children should include health and nutrition monitoring (e.g. growth monitoring using the existing growth data collected by schools) as it is essential so that effective interventions can be implemented to alleviate and consequently eliminate the health and nutritional problems among these children. It is recommended that active growth monitoring of the school children be implemented as it is an easy and inexpensive tool for health professionals to obtain information on the health and nutrition of the school-age population. An effective strategies to improve nutrition in school-aged children can have a pronounced effect on cognition and, in the longer term, help in positively contributing to individual and national development.

PHASE 4: WORKSHOP ON MID DAY MEAL PROGRAMME FOR MUNICIPAL SCHOOL TEACHERS OF VADODARA

A one day workshop on MDM was conducted for the School Teachers of all the Municipal Schools of urban Vadodara wherein two teachers from each school were invited for the workshop. A total of 195 teachers participated in the workshop wherein they were sensitized about objectives of MDM and role of TAPF in MDM. Their feedback regarding the MDM Programme was collected through self-administered semi-structured questionnaires and group discussion.

The main findings of this phase are:

- Only about 21% of the teachers were aware about all the objectives of MDM programme.
- About 1/3rd of the teachers could correctly identify standard ration (30.77%) and caloric requirement (16.41%) for deciding the quantity of MDM to be given to each child.
- The best cooking method under MDMP is cooked meals provided by TAPF as quality of food and hygiene is maintained.

- Majority of the teachers were of the opinion that the food provided was sufficient (96.41%) and of good quality (88.72%).
- Sukhadi, Dal and Rice were the most liked food item by the children as reported by the teachers.
- Only 12% of the teachers reported problems faced in implementing MDM programme and the issues were related to monthly forms and MDM registers, infrastructure facilities and water supply.
- Improvement in school attendance (98.46%), especially among girls (92.82%), improvement in scholastic performance (93.85%) and rise in the enrolment of girl child (84.62%) was seen because of the MDM provided by Akshay Patra.
- Teachers also suggested that awareness about MDM should be increased by involving media.
- TAPF had agreed to organize meeting for teachers and parents to sensitize them about the objectives of MDMP.

The food provided from centralised kitchen had helped in improving the consumption as well as the attendance and scholastic performance of the children. The Children liked the Mid-Day Meal Provided by the Akshay Patra Foundation. Teachers were satisfied with the functioning of the programme, quality of food, menu and thus suggested for its continuation with addition of newer recipes.

The success of the mid day meal programme depends on the implementation of the programme at the school. Teachers identified the major bottlenecks that hindered with the effective implementation of the mid day meal programme was mainly related to infrastructure facilities like drinking water facility, dining space, cleaning of utensils and MDM registers for monitoring of the programme.

As teachers play a pivotal role in the success of the programme they should ensure that good quality nutritious food with the actual serving is served to the children and motivating them to consume in a spirit of togetherness, under

hygienic conditions, and contributing to their daily intake rather than acting as a substitute.

Teachers also felt that to increase the awareness about mid day meal programme, its importance and objectives, media can be useful and should be involved.

PHASE 5: KAP OF PARENTS, TEACHERS & CHILDREN REGARDING MID DAY MEAL PROGRAMME PROVIDED BY THE AKSHAY PATRA FOUNDATION

In the new academic year, after the workshop conducted with the municipal school teachers of urban vadodara, the information and opinion with respect to the MDM programme provided by TAPF was obtained. The opinion was taken from all the teachers present in 16 schools (N=125), children studying in 3^{rd} – 7^{th} standard (N=301) and parents (n=71) who could be contacted at school using a semi-structured KAP questionnaire.

The main findings of the phase are:

- Teachers felt a positive impact in the nutritional status of school children after the introduction of meals provided by TAPF.
- An improvement in school attendance and enrolment was also reported by teachers.
- Teachers suggested change in the taste or modifications in the recipes provided by TAPF so as to break the cadence of monotonous food.
- Children preferred meals provided by TAPF as compared to the meals cooked at schools as the quality of food provided by TAPF was good.
- 50% of the children reported that they were consuming MDM on all the school days.
- The most preferred food item by the children was Dal, Rice and Sukhadi.

- All the parents acknowledged that their children were consuming MDM offered by TAPF.
- Majority of the parents felt improvement in the health of their children after TAPF intervention as the food provided by TAPF is good.

The finding from the feedback obtained from parents, teachers and children revealed that the objectives envisages through MDM has been achieved up to great extent through private participation.

Majority of the teachers and parents felt improvement in health of the children after introduction of school meals provided by TAPF and also suggested for continuation of the programme.

Conclusions:

The study has provided important new information on nutritional status of children in urban areas of vadodara. The legacy of malnutrition, especially among school children, is a huge obstacle to overall national development. The high prevalence of both chronic and acute malnutrition observed in the present study is unexpected from an urban region. However, the fact is that most of the children attending primary school are from relatively low socio-economic backgrounds. Therefore the low socio-economic background of these children suggests that factors such as education, occupation and economic status of parents may also account for the high prevalence of undernutrition. Thus, from a public health standpoint, such data could be of paramount importance in formulating urgent intervention strategies in order to stem the health hazards of malnutrition among the children in this region.

Urgent steps for initiation of school health program with specific emphasis on prevention of diseases, fortification of meals, improvement of personal hygiene and nutritional status with the collaboration of governmental and non governmental institutions should be taken to improve nutritional status of

children. In the present study, it can be concluded that fortification of hot cooked meals prepared and served from the centralized kitchens under the MDM scheme is feasible and acceptable to the beneficiary children, teachers and parents.

Recommendations:

School aged children are often omitted from health and nutritional surveys and surveillance. National Family Health Survey-3 conducted in 2005-06 in India also excluded this age group for nutritional assessment, so there is need for national health and nutritional survey that include the school aged children and do not limit their investigations to young children up to 5 years of age.

There is an opportunity to capitalise on initiatives such as the centralized kitchen provided by a NGO like Akshay Patra to improve diets and promote healthy eating among children as meals served by NGO gave better outcomes in relation to acceptance and quality of meals.

Regular sensitization workshop regarding MDM should be conducted in schools for teachers, parents and children to improve coverage, compliance and to eradicate class room hunger. The concept of MDM to supplement the home diet and not merely to replace it should also be emphasized. Changing the time of provision of MDM is recommended for afternoon schools. It should be provided during the recess time between 1:30 PM – 2:30 PM instead of providing it immediately after the prayer when the school starts so that the school meal serves as a supplement to the home diet instead of substituting it.

The reduction in the prevalence of undernutrition and IDA among school children showed that MDM programme through Akshay Patra have brought results in terms of growth and improved Haemoglobin levels among school children. The reduction in IDA may be contributed by fortified flour (Iron in particular), used in the preparation of meals by Akshay Patra. The MDM

guidelines also recommend that the school meals should provide adequate quantities of micronutrients, including iron, vitamin A and iodine, but there is no specification on the quantity to be provided or the method through which this can be achieved. Sustained advocacy is needed to convince policy makers to adopt fortification as an important strategy to improve the nutritional status of school children.

For the smooth functioning of the programme, the infrastructure facilities at school especially water and sanitation facilities should be improved.

TAPF should take the initiative to develop a system for leftover food management which could be distributed to street children or orphanage homes for the benefit of the children.

Some suggestive recipes for Akshay Patra are given in the Table below which can be incorporated into the exiting kitchen facilities available at Akshay Patra.

Table 5.1: Recommended recipes using various foods

Sr No	Food Ingredients	Recipes in which it can be Incorporated
1	**Wheat Flour**	Sheera, Vegetable Paratha, Muthiya, Kansaar, Laddu
2	**Green Leafy Vegetables (GLVs)** (Cauliflower Greens, Drumstick Leaves, Spinach, Fenugreek, Cabbage)	Vegetable Paratha, Mix Veg Bhaji, Alu Palak/ Alu Cauliflower Greens, Palak Rice, Veg Khichdi, Veg Pulao, Methi Thepla
3	**Bajri**	Bajri Ladoo, Bajri Thepla, Bajri Dal Dhokli
4	**Fermented Products/ Steamed Products** (Inclusion of Pulses, Vegetables, GLVs)	Idli, Veg Idli, Dhokla, Idada, Handwa, Moong Dal Dhokla,
5	**Other Vegetables** (Tomato, Bottle gourd, Alu, Carrot, Beans, Capsicum, Bengan/Brinjal)	Chole ki Sabji, Tadka Dal, Mix Dal, Mix Veg Bhaji, Veg Paratha, Alu Palak/ Alu Cauliflower Greens, Veg Khichdi, Veg Pulao, Muthiya, Bengal ka Bharta
6	**Pulses** (Kabuli Chana,Desi Chana, Moong (Whole), Moong Dal)	Chole ki Sabji, Tadka Dal, Mix Dal, Tuwer Dal, Whole Moong, Moong Dhal