During the past two decades the prevalence of overweight and obesity in children has increased worldwide. Historically, a fat child meant a healthy child, and the concept of “bigger is better” was widely accepted by pediatricians and caretakers. In recent years, however, this perception has drastically changed as it has been increasingly recognized that obesity in childhood causes a wide range of serious complications and increases the risk of premature illness and death later in life. In view of its rapid development in genetically stable populations, there is a general agreement among experts that the environment, rather than biology is driving this epidemic (SCN News, 2005).

Several studies have documented important increases in prevalence of childhood obesity over time within populations in developed countries. Similarly, a recent global analysis showed a rising trend in childhood overweight in 16 out of 38 developing countries with more than one national survey (SCN News, 2005). de Onis and Blossner (2004) presented trends in developing countries over the past decade based on national surveys included in the WHO Global Database on Child Growth and Malnutrition. They reported that obesity rose from about 3% to 9% in Egypt from 1988 to 1995; from about 7% to 10% in Armenia between 1998 and 2000; and in Romania from just about 2% in 1999 to a little below 6% in 2002. Earlier, de Onis and Blossner (2000) also found that the comparison of both ends of the weight-for-height distribution suggested a population-wide shift, with overweight replacing wasting as countries undergo the nutrition transition. Moreover, the distribution of BMI had shifted in a skewed fashion, such that the heaviest children had become even heavier (Flegal and Troiano, 2000).

**Trends of childhood obesity in India**

In a recent study by Reddy et al (2002), more than 28 percent adult males and 47 percent adult females in urban Delhi were overweight by the WHO standards. In the same study, the corresponding figures for overweight in neighboring Haryana rural area were seven
percent in males and nine percent in females. There is an urban-rural divide that has been documented in an Indian study by Chadha et al (1997).

In children, the difference between the rich and poor is fairly evident in recently conducted urban studies. Ramachandran et al (2002) studied children from six schools in Chennai, two each from high, middle and lower income groups. The prevalence of overweight (including obese) adolescents ranged from 22 percent in high income group schools to 4.5 percent in lower income group schools. Kapil et al (2002) studied trends of overweight in a well-off Delhi school. The prevalence of overweight was 31 percent, of which 7.5 percent were frankly obese. In Pune, figures for overweight children are 24 percent in a well-off school and six percent in a Municipal school (Unpublished data, Bhave et al, 2004).

The World Bank Report (2006) showed the trends in overweight among children under five years. Though based on data from a limited number of countries, it is alarming. Trends in overweight among children under five years, in some countries from developing world are alarming. The numbers of these children from the developing world as a whole increased at a rate of 17 percent between 1995 and 2005. The data suggested a strong correlation between maternal overweight and child overweight. Comparable data for overweight and obesity rates among mothers showed similar alarming trends.

Low birth weight and early under-nutrition predispose children to later obesity. It was also evident that overweight co-existed with maternal and child under-nutrition in the same countries (The World Bank Report, 2006). Recent longitudinal studies in India have highlighted the deleterious effect of accelerated weight gain in childhood ‘crossing of centiles’, especially in low birth weight (LBW) babies (Bavdekar et al, 1999; Bhargava et al, 2004). Indices of insulin resistance and CV risk factors were found to be highest in LBW babies who were big by eight years, in Pune study (Bavdekar et al, 1999).
Higher birth weight appears to correlate with adult obesity as well. Studies have found higher birth weight led to higher adult BMIs (Elrick et al 2002). Martorell et al (2001) reviewed a number of studies and concluded that intra-uterine over-nutrition had an enduring effect on obesity in later life. In addition, in a study in the U.K., Parsons et al (2001) found that children who experienced rapid linear growth in childhood were heavier at birth and had an increased risk of obesity at 33 years of age. However, if low birth weight children had high growth rates, they were more likely to be obese adults.

Height and adiposity were also correlated among children. Freedman et al (2002) found that a child with height for age > 95th percentile was about 2.5 times more likely to have a body mass index (BMI) 30 kg/ m² as an adult. The authors observed that rapid growth appeared to result in early adipose rebound (AD), which could lead to adult obesity.

Changes in the composition of diet

Dietary changes can be attributed to the evolution of per capita energy supplies. The comparison of today’s per capita energy availability with the same 40 years ago revealed an almost universal trend towards higher dietary energy supply levels. Many countries in the developing world have experienced a fast nutrition transition, catching up rapidly with the developed nations in terms of energy supplies and food components. This surge in energy supply has given rise to new concerns. The more rapidly growing developing countries, in particular, are beginning to suffer from an oversupply of food energy and a growing rate of obesity (SCN News, 2005).

The rapid increase in food energy supply has been accompanied by a shift in the composition of the diet. Cheaper foodstuffs of vegetable origin bring contribute to additional calories (e.g. vada pav, samosa etc). This has been an almost universal development and seems to take place regardless of cultural and religious factors, food traditions or agricultural production patterns.
Another visible trend was largely a “substitution effect”, and reflected a shift from calories of carbohydrate rich staples (cereals, roots and tubers) to calories from animal sources, vegetable oils and sugar, largely at the same overall energy supply. Higher intakes of milk and other foods of animal origin increased the quantity and quality of protein of the diet, supply micronutrients, and promoted growth especially in the first year of life. However, higher intakes of these foods were associated with a shift towards higher intake levels of saturated fatty acids and cholesterol (Report of Joint WHO/FAO Expert Consultation, 2003). Consumption of animal proteins tends to increase the risk of colon cancer; similarly, saturated fats increase the risk of coronary heart diseases (CHD).

The main drivers for this transition include factors such as rapidly falling real prices for food, urbanization and spread of supermarkets in developing countries, and freer trade and globalization with the emergence of large food companies. This diet transition has brought about a rapid increase in the prevalence of overweight, obesity and related noncommunicable diseases (NCD) (Report of Joint WHO/FAO Expert Consultation, 2003).

Many experts attribute the high prevalence of obesity to inactivity. Investigators have recorded a decline in physical activity in children as they increase in age. Moderate and vigorous activity levels decreased significantly between 10 to 16 years of age for both sexes, in studies by Dovey et al (1998) and Strauss et al (2001). Strauss et al further observed that children, who spent less time in sedentary behaviours, had higher levels of moderate physical activity in the same age group. Time spent on computer work and television viewings were inversely correlated with moderate activity. Gortmaker et al (1996), in a study in the U.S., showed that there was a dose-response relationship between hours of television viewing, and incidence and prevalence of overweight over a four-year period. The authors concluded that 60 percent of the prevalence in overweight could be attributed to excess television viewing. In an earlier study, Dietz and Gortmaker (1985) linked duration of television viewing with obesity. They found that each
additional hour of television viewing was associated with two percent increase in prevalence of obesity.

Temple et al (2007) designed experiments to examine the effect of watching TV on habituation of ingestive behaviour on children. The authors concluded that TV watching can dishabituate eating or disrupt the development of habituation, which may provide a mechanism for increased energy intake associated with watching the TV.

Earlier, Chopra et al (2000) studied the impact of television advertisement on food consumption pattern in middle childhood in Delhi students. Children watched TV for one to three hours on week days and three to five hours on weekends (2.00 to 5.00 pm and 8.00 to 10.00 pm were the prime viewing hours). The popular food advertisements were of products such as carbonated soft drinks, instant noodles, cheese and wafers. The reasons for liking the advertisements were good photography, attractive models, catchy music and jingles, and identification with the models. The advertisements of the products which were appreciated, influenced majority (84 percent) to purchase the same, and the decision was guided by a feeling of fun, happiness and a sense of achievement.

Wiecha et al (2006) tested whether increased TV viewing was associated with increased total intake and with increased consumption of foods advertised on TV. They also tested whether increased consumption of these foods mediates the relationship between TV viewing and total energy intake. They found that each hour increase in TV viewing was associated with an additional 167 Kcal/ day, and the foods that were advertised frequently were consumed more.

These major changes in life-style that occurred over the past decades have caused obesogenic environment due to easy availability of high-energy food with an increasingly sedentary life-style (The World Bank Report, 2006).
A dramatic increase in the prevalence of overweight and obesity occurred in the last 10 years, and it was estimated that by 2002 about 155 million school-aged children were overweight or obese worldwide (Lobstein et al, 2004).

Co-morbidities in childhood obesity

Cole et al (2000) observed that overweight and obese children were at a raised risk of co-morbidities including Type 2 diabetes, fatty liver disease, endocrinial and orthopedic disorders. Kiess et al (2004) observed that overweight children entered adulthood with a raised risk of adult obesity of up to 17-fold, after adjusting for parental obesity. This adult obesity, in turn, carried an increased likelihood of metabolic and cardiovascular diseases, certain cancers and a range of other disorders including psychiatric problems. Even if subsequent weight loss was achieved and maintained, there was evidence that mortality rates were higher among those adults who had been obese as adolescents.

The prevalence of diabetes, CHD and other lifestyle disorders is increasing alarmingly in India, and is affecting much younger population than in the West. Gestational diabetes is common in mothers with high BMI and central obesity (Shelgikar et al, 1991). In transitional economies, such as India, obesity and malnutrition often coexisted (WHO Technical Report, 2000). Ramachandran et al (2001) found that a large pool of young Indians demonstrated ‘prediabetics’ (insulin resistance and/ or glucose intolerance).

Treatment and prevention of childhood obesity

If obesity could be treated effectively in childhood this might reduce subsequent risk of diseases and health service costs. However, effective treatment involving behaviour modification, family support and life-style change are difficult to put into practice. Life-style modifications require motivation and active participation by the family and the child himself, especially during the transition from childhood to adolescence. Obesity in
adolescence is a major risk factor in adult obesity and its co-morbidities. Lissau et al (2002) and Muller et al (2004) explained prevention in the context of overweight children. The authors stated that in clinical context, prevention referred to preventing an obese child from becoming extremely obese, thereby preventing the co-morbidities. They stated that prevention also consisted of screening and monitoring of children, especially at risk, e.g. overweight children as well as children of obese parents. The prevention at population level referred to the range of measures aimed at ensuring that normal weight children did not become overweight or overweight children did not become further overweight.

Population-based primary prevention is the most desirable and cost effective approach. There is a wide range of potential obesity interventions, ranging from education at the individual level to policy change at the national level. Experience so far is that more successful intervention programmes, such as Finland’s North Karelia project and Brazil’s large scale Agita programme have followed multiple approaches simultaneously (The World Bank Report, 2006).

North Karelia project involved strategies to prevent cardiovascular diseases through lifestyle and risk factor changes along with healthy diets and reduced salt. Agita programme targeted school children, older adults and workers with a combination of special events, information materials, mass media, training for physical educators and physicians, work site health promotion and cooperative ventures with public agencies from several sectors.

Reviews by Lytle et al (2002) and Micucci et al (2004) suggested that the chances of successful prevention at the community level increased if measures were broad-based and well integrated into children lives. Such interventions should include school health policies involving school lunch, policy for plentiful physical activity, teaching of nutrition linked to lunch served at school, a prolonged integrated intervention involving
children, teachers and parents etc. A review of intervention designed to encourage healthy eating pattern in children suggested that a ‘whole school’ approach was better than piecemeal intervention strategy (SCN News, 2005).

Need for Nutrition Education:

Income growth, food production as well as birth spacing and women’s education are important but longer routes to improving nutrition. Shorter routes are providing health and nutrition education services to all in the society. There are few large scale models for tackling overweight and diet-related NCDs. **Action research and learning by doing are the priorities for NCD control efforts.** These cannot be successful without addressing nutrition, and hence the challenge is shorten the time lag between developing a practice/methodology and scaling up action. Tackling obesity in the age bracket of four to seven years, adolescence and early adulthood, implies that obesity programmes must address to a broader target group (The World Bank Report, 2006).

Why School-based Programmes:

School-based programmes are becoming increasingly popular in the US due to the captive audience of children in the school setting. Findings from studies of school-based interventions are modest at best, and do not always sustain results over time. Workplace interventions include promotion of use of stairs for climbing (in stead of elevators), incentives for active commuting to work, physical activity and nutrition counseling. Most of these interventions are able to show short term changes in behaviour, however, they are not able to access whether any change in BMI or adiposity resulted from the programme. The most successful programmes have taken a community-level approach, and have addressed obesity through multiple, simultaneous and different avenues. The key elements of the successful interventions include an environmental and multi-disciplinary approach such as generating local adaptations of the programmes; exploring
cultural norms and fitting the programmes within those boundaries. These programmes also adhered to a social-ecological model of behaviour change and took multi-faceted approach to include health professionals, educators and policy makers (The World Bank Report, 2006).

Studies on benefits of school-based diet and physical activity interventions

Datar and Sturm (2004) studied the effect of additional physical education programmes in school and their effect on the childhood obesity in the early years. They found that the intervention was effective for combating obesity in KG or first standard students, especially in girls.

Anderson et al (2005) assessed the impact of a school-based nutrition education intervention aimed at increasing the consumption of fruits and vegetables. Teaching and training material was developed for children, parents and teachers. Curriculum material for children aged 6-7 and 10-11 years was developed and utilized. Evaluation was undertaken for both the groups by using three-day dietary records with interview, and cognitive and attitudinal measures at baseline; with follow-up at nine months in intervention and control schools. Children in the intervention schools had a significantly higher increase in fruits and vegetables intake. The knowledge about fruits and vegetables was also greater in this group. Researchers concluded that the whole school approach to increasing intakes of fruits and vegetables has a modest but significant effect on cognitive and attitudinal variables, as well as fruit intake.

Bounds et al (2005) studied dietary factors related to bone mineral content (BMC) of children in a longitudinal study. Factors positively related to children’s BMC at eight years included intakes of proteins, phosphorus, vitamin K, magnesium, zinc, iron, energy, height, weight and age. Longitudinal intake of protein and magnesium were positively related to children’s bone mineral density at eight years of age. On the other hand, they
found that girls were negatively associated with BMC and bone mineral density at eight
years. The authors concluded that because many nutrients are related to bone health,
children should consume a varied and nutrient-dense diet.

Zahner et al (2006) pointed out that school seems to provide an excellent setting to
enhance levels of physical activity. They recommended physical activity intervention as
follows –

a) additional physical education classes per week by trained physical education
teachers, adding up to a total of five classes per week,
b) short physical activity breaks of two to five minutes each during academic
lessons,
c) physical activity home work,
d) adaptation of recreational areas around the school.

von Hippel et al (2007) determined whether school or non-school environments
contribute more to childhood obesity. They compared children’s increase in BMI when
school was in session with their gains in BMI during summer vacations. The difference
between school and summer gain rates was especially large for some subgroups. They
concluded that although a school’s diet and exercise policies may be less than ideal, it
appeared that early school environments contributed less to obesity than did non-school
environments.

As few studies are available in Indian school setting for upper socio-economic strata of
the society, where risk is of obesity is higher, it was felt worthwhile to conduct an action
study with multi-pronged strategies. The ultimate goal of any such study would be to lead
to positive behavioural changes which will have beneficial effects on long-term health of
children.
Specific objectives of the study were:

1. To assess knowledge and practices among children.
2. To develop replicable modules for nutrition education, that can be used to alter children’s food habits.
3. To assess nutritional status of children.
4. To assess impact of education on knowledge and practices of children, as well as on children’s BMI.