

II. REVIEW OF LITERATURE

The literature pertaining to the present study on “**Assessment of Health Status of School Children and the Influence of Demographic and Lifestyle Factors**” was reviewed and presented under the following headings:

- A. Demographic, socio-economic, lifestyle and dietary factors affecting health status of children.
- B. Prevalence of nutritional and lifestyle disorders among school children
- C. Influence of child rearing practices on the health status of children
- D. Body measurements of school children
- E. Organization and operation of food services in schools
- F. Impact of diet and lifestyle counseling on health status

A. DEMOGRAPHIC, SOCIO-ECONOMIC, LIFESTYLE AND DIETARY FACTORS AFFECTING HEALTH STATUS OF CHILDREN

Demographic Factors

Commonly examined demographic factors include location, gender and age.

Saraswathi et al. (2011) have brought out differences in gender and area in the prevalence of overweight and obesity. They contend that girls had higher frequency of overweight compared to boys. Likewise, children from urban areas had greater frequency of overweight and obesity in comparison with rural counterparts.

Sil et al. (2011) point out that more boys were thin than girls. With advancement of age (10 years onwards), decreasing trend of thinness was observed among girls.

Gupta et al. (2011) bring out an increase in prevalence of obesity and overweight among boys compared to girls and differences between private funded and government schools with the former having a higher prevalence rate of overweight and obesity.

The prevalence of overweight/obesity was much higher among students enrolled in private schools compared to those in Government schools in their study conducted in Delhi private and Government schools by Stigler et al. (2010).

Goyal et al. (2010) highlight the prevalence of overweight among children being higher in middle social economic section as compared to higher socio

economic groups. However, the prevalence was lowest in the low socio economic group. By contrast, the prevalence of obesity was higher in high socio economic group. The differences in overweight and obesity among different socio economic groups could be attributed to people's lifestyles such as diet, food consumption patterns and public services such as health care, transportation and physical activity differences. There was a higher prevalence of overweight and obesity in boys compared to girls with gender difference acting as an effect modifier. Sedentary behavior and reduced physical activity in children are other contributing factors.

The same is contended by Bhardwaj et al. (2008) who show differences in the prevalence rates of overweight and obesity among children from private schools and government funded schools and brought out the role of South Asian ancestry in the predisposition of obesity and other lifestyle disorders.

Childhood obesity today seems to be largely confined to those whose same-sex parents are obese, and the link does not seem to be genetic (Unnithan and Syamakumari, 2008).

Increased urbanization has been attributed as a major reason for obesity and metabolic syndrome among children by Misra and Khurana (2008).

Sharma et al. (2007) indicate that more boys were overweight/obese than girls. In both boys and girls, the majority of children with higher BMI were from the middle of the age range; thereafter overweight/obesity rates showed a declining trend with age. This was attributed to the trend for weight to decline and linear growth to level off right after the middle years in the children. The decline in weight gain could occur because the children/adolescents become more conscious about their looks with increasing age and restrict their dietary intake.

Lawless (2009) brings out that children attending rural schools face challenges of higher poverty than those attending urban schools and availability of health care components are less for rural school children.

Jodkowska et al. (2010) point out differences in the prevalence of overweight and obesity rates for adolescents 13 to 15 years residing in urban and rural areas.

Studies from the USA and developed European countries indicate a reversal of the situation in which overweight and obesity in children and adolescents appear to be worse in rural areas. (Levin et al., 2001, Joens-

Matre et al., 2008 and Ekblom et al., 2004). There is evidence that rural life presents special cultural and structural challenges in maintaining a healthy weight (higher dietary fat and energy consumption, lower level of physical activity, lack of sport facilities or further distance from them) which predispose to overweight and obesity among rural children compared to those in urban areas (Woynarowska et al., 2000).

In the Grow Healthy Study conducted by Moschonis et al. in Greece, with a special focus on social, economic and demographic correlates of overweight in their urban sample of 10 to 12 year olds, the prevalence of obesity was found to be significantly higher in male than female children. A high prevalence of both overweight and obesity was observed in primary-school children living in the urban area of Greece. There was a significant positive association between socio economic status of parents and obesity among the children.

In a study in Lahore in Pakistan, Mushtaq et al. (2011) describe the state of children living in the urban area with high socioeconomic status (SES) as significantly at risk for being overweight and obese as compared to children living in the urban area with lower SES and rural children. Being in higher grade and living in the urban area with higher SES independently predicted the risk of being overweight.

The same is substantiated by Phillips and McLeroy (2004) who point out to the disadvantage of urban areas in comparison to rural areas due to population density in urban areas, lack of facilities and outdoor areas for exercise and recreation. In addition, air quality is often lower in urban environments which can contribute to chronic diseases. In the developing world, urban dwellers often live in large slums which lack basic sanitation and utilities such as water and electricity. Lack of basic infrastructure can exacerbate rates of infectious disease and further perpetuate the cycle of poverty. Whereas, rural areas frequently have strengths including dense social networks, social ties of long duration, shared life experiences, high quality of life which permit children to play and have recreation and norms of self-help and reciprocity (Phillips and McLeroy, 2004). In addition to higher rates of infectious diseases, rapid urbanization has led to poor living conditions and thus more chronic diseases (Global Health University, 2011).

Bringing out the effect of gender, Kelishadi et al. (2003) and McCarthy et al. (2003) clarify that in both developed and developing countries

there are proportionately more girls overweight than boys, particularly among adolescents.

During the last 3 decades, the prevalence of obesity has tripled among persons aged 6--19 years. Multiple chronic disease risk factors, such as high blood pressure, high cholesterol levels, and high blood glucose levels are related to obesity (CDC, 2011).

Socio economic factors

Socio economic factors include income, education and occupation.

Saraswathi et al. (2011) corroborate in their study that underweight is predominant in rural school children and in some cases the total body fat percent is much below the prescribed limit. This showed that the children in rural areas were undernourished and prone to several deficiencies and disorders, possible risk factors being poor socio-economic conditions and poverty.

The World Bank (2011) calls attention to the overall poor hygiene in South Asia that increases the burden of childhood illnesses and in turn depresses a child's appetite, inhibits nutrient absorption, increases calorie consumption during fevers and in fighting infection and, as a result contributes to child malnutrition.

The prevalence of overweight and obesity was higher in the high income group as compared to low and middle income groups for all age groups, highlighting the possible role of change in the dietary pattern and physical activities with increase in income levels opine Kaur et al.(2008).

This is further supported by Laxmaiah et al. (2007) who found the prevalence of overweight and obesity to be significantly higher among adolescents from high socio-economic background. This in combination with television viewing added the risk further. However, participation in outdoor games and household activities helped decrease the risk.

Significantly more children from higher socio-economic status were obese and overweight than those from lower socio-economic status groups. No significant gender difference for obesity prevalence was seen among children from a less privileged background, however, amongst children from affluent families, significantly more boys were obese as compared to girls. Significant gender disparity is seen, with boys of affluent background having a higher prevalence point out Chhatwal et al. (2004).

Parent education, household income, and school subjective social status were all associated with overweight. (Goodman et al. 2003). Lower parental education was significantly associated with prevalent overweight and obesity in 6 year old children as endorsed by Gopinath et al. (2011).

The risk of underweight was 1.7 times higher among children of illiterate mothers and those suffering from morbidities, while stunting was 1.4 times higher among children belonging to lowest and middle household's wealth indexes as explained by Meshram et al. (2011).

Socio economic status was found to be directly correlated with BMI in a study conducted by Kaur et al. (2008) in Delhi, India.

Gupta et al. (2011) points out to the role of gender and socio economic status influencing prevalence of overweight and obesity. Girls tend to become thinner with advancement in age, as post-pubertal girls become more conscious of their physical appearance. Private schools and high socio economic status influence by the way of children indulging in the practice of purchasing calorie dense fast foods and a lifestyle involving less of physical activity and more of indoor activities like playing games on the computer, internet usage and watching television.

The effect of low and upper socio economic status has been brought out by Marwaha et al. (2006) in Delhi. Similarly, on comparing their data with the height and weight percentiles of Delhi children reported in the Agarwal study (1992), they found that upper socio economic status children were already taller and heavier than their counterparts were 15 years ago. However, a difference was found to exist between the lower and upper socio economic children in the prevalence of obesity and overweight with upper socio economic status children being significantly taller and heavier.

There was a significant relationship between overweight and socio-economic status in males, but not in females. In males, the lowest overweight prevalence was observed in both extreme socio-economic groups. Moreover, overweight prevalence in males increased when socio-economic status decreased, from the high to the medium–low socio-economic group declare Moreno et al. (2004).

Weber (2007) demonstrated a disturbing gap between children from different socio-economic backgrounds, with the number of children having high blood pressure approaching 25 per cent among inner city and minority groups.

Kurpad et al. (2004) have reviewed several papers and indicated that compared with children (aged 5 to 19 years) in industrialized societies, children in developing rural areas sleep less at night, participate longer in moderate and/or heavy physical activities, and have a greater energy expenditure in relation to their basal metabolic rate.

Gordon-Larsen et al (2003) have examined the relationship of family income and parental education to overweight prevalence. They have observed that overweight prevalence decreased with increasing socio-economic status among white females and remained elevated and even increased among African-American females of higher socio-economic status. The African-American/White disparity in overweight prevalence increased at the highest socio-economic status. Among males, disparity was lowest at the average socio-economic status.

Corwyn and Bradley (2002) found that maternal education has the most consistent direct influence on children's cognitive and behavioral outcomes.

In Germany, Langnäse et al. (2002) have observed, in a group of 5 to 7 year old children, an inverse social gradient with obesity. Social class was assessed by means of the highest school education achieved by either mother or father.

Underestimation of their children's weight status by mothers as influenced by their education ranged from 3.6 (Dutch) to 15.7 per cent (Moroccan) in normal-weight children and from 73.0 (Dutch) to 92.3 per cent (Turkish) in overweight/obese children. Maternal educational level and immigrant generation largely explained the ethnic differences, with a minor contribution of maternal age (de Hoog et al., 2011).

In male adolescents, the variables that showed significant differences between overweight and non-overweight individuals were age, maternal occupation, maternal employment status, maternal education level, maternal obesity, and paternal obesity point out Moreno et al. (2004). All the variables were related with the mother, except age and history of paternal obesity. In females, the variables that showed significant differences between groups were age, maternal education level, and maternal obesity.

Lifestyle factors

Lifestyle factors encompass environmental factors, physical exercises and recreational activities.

The possible risk factors in causing childhood obesity as pointed out by Saraswathi et al. (2011) in their study among adolescent children in urban and rural area of Mysore are sedentary lifestyle which makes them stay physically inactive with prevalence of overweight and obesity was significantly lower among the adolescents who participated regularly in the household activities, played outdoor games and performed physical exercises. Parents found it easier to let their children consume junk and fast foods. The burden of school work and academic competitiveness has decreased the participation in sports and other form of physical activities in urban area which leads to high frequency of overweight and obesity.

The western lifestyle, characterized by convenience food, TV and PCs, is taking its toll on children and is producing increased numbers of overweight, passive youngsters with lifestyle diseases. Kids spending too much time slouched in front of the TV or PCs, should be encouraged to find a physical sport or activity they enjoy. Fun exercises should be encouraged into family outings. A pizza-and-video evening should be replaced for a hike and picnics foresee Sharma and Majumdar (2009).

The data pertaining to the physical activity showed that large number of children (54.68%) were engaged in sedentary behaviour with television viewing (43.75), and playing computer games (26.56%) as major leisure time activities. Lack of a regular habit of exercise further increased the state of immobility among them (Goyal et al., 2010).

Misra and Khurana (2008) opine that to prevent increasing morbidity and mortality due to diet related disorders in developing countries it is imperative to increase physical activity and healthier food options, particularly for children opine

Analysis of the association between BMI and physical activity in children as revealed by Kaur et al. (2008) shows that as the amount of physical activity increased, the BMI decreased i.e. the prevalence of overweight and obesity decreased.

Greydanus and Bhave (2004) suggest that obese youth can be taught how to decrease caloric intake by approximately 500 calories a day and increase

physical activity as tolerated. Increased physical activity can be used as part of a comprehensive plan to treat and prevent obesity in children and adolescents.

Actual measurements of physical activity show that obese children spend less time in this domain of energy expenditure. An increase in physical activity was associated with decreasing BMI in girls and in overweight boys, while conversely, an increase in inactivity was associated with increasing BMI in girls. These effects were generally stronger among overweight children. Other risk factors as pointed out by Kurpad et al. (2004) were overweight parents, increased television viewing and influence of peers.

Singh and Sharma (2005) point out that changing life style of families in the so called modernized India with increased purchasing power, easy availability, more comfortable and luxurious living, thanks to improved technology has all attributed to obesity. Increased hours of inactivity due to increasing academic pressure, television, video games and computer have all replaced outdoor games and other social activities.

The main risk factors for simple obesity were familial and environmental conditions declares Weker (2006). Frye and Henrich (2003) believe that the environment promotes behaviors that cause obesity and 'to combat the epidemic of obesity' one must first cure the environment and promote smaller portion sizes, low-energy density foods and physical activity.

The prevalence and severity of obesity have increased in recent years, likely the result of complex interactions between genes, dietary intake, physical activity, and the environment. The consequences of childhood and adolescent obesity include earlier puberty and menarche in girls, type 2 diabetes and increased incidence of the metabolic syndrome in youth and adults, and obesity in adulthood point out Biro and Wlen (2010).

Environmental factors, lifestyle preferences and cultural environment play pivotal roles in the rising prevalence of obesity worldwide. Excessive sugar intake by soft drink, increased portion size, and steady decline in physical activity have been playing major roles in the rising rates of obesity all around the world (Dehghan, 2005).

Srihari et al. (2007) opine that poor dietary habits and lack of exercise are the main causes of overweight and obesity among children.

Physical activity strongly influenced weight gain in a study of monozygotic twins (Dehghan et al., 2005). Sedentary behaviors like watching television and playing computer games are associated with increased prevalence of obesity (Swinbern and Egger, 2002, Tremblay and Williams, 2003).

Furthermore, parents report that they prefer having their children watch television at home rather than play outside unattended because parents are then able to complete their chores while keeping an eye on their children [Gordon-Larsen et al. 2004]. In addition, increased proportions of children are being driven to school and low participation rates in sports and physical education, particularly among adolescent girls point out Swinbern and Egger (2002). This is associated with increased obesity prevalence. Since both parental and children's choices fashion these behaviors, overweight children tend to have overweight parents and are themselves more likely to grow into overweight adults than normal weight children explain Carriere (2003).

Chaput et al. (2010) point out to the hazards of sedentary play namely video games to increased heart rate, systolic and diastolic blood pressures, sympathetic tone and mental workload than during the resting condition. The increase in food intake associated with video game play was observed without increased sensations of hunger and was not compensated for during the rest of the day.

Time spent watching television takes away from important activities such as reading, school work, playing, exercise, family interaction, and social development. They are influenced by the thousands of commercials seen each year, many of which are for alcohol, junk food, fast foods and may exercise less and be overweight (American Academy of Child and Adolescent Psychiatry, 2001).

Factors such as lack of physical exercises, increased sleeping times per day, higher fat intakes and watching TV were impact factors of childhood obesity (Xi et al., 2009).

Gouw et al. (2010) observed a causal relationship between skipping a meal and becoming overweight or obese among children.

The likelihood of the persistence of obesity is positively related to the severity of obesity and the age of the children. Approximately half of the obese school children become obese adults. Older children with more pocket money are more likely to buy junk foods. In addition, older children are more susceptible for

other modern comforts like television and computers which increased the prevalence of obesity among children. Higher social status had a protective effect on obesity associate Frye and Henrich (2003).

Dietary factors

Poor dietary habits combined with decreased physical activity have led to an increase in over weight and obesity among affluent children (WHO 2003). The adoption of western ways of life along with increased availability and accessibility of food rich in energy and fat, inclination towards carbonated drinks, chocolate, pizzas coupled with sedentary mode of life have increased the prevalence of obesity among school children which has detrimental effect on their health.

Altered eating patterns and increased fat content of the diet among affluent children have given rise to many health problems especially among the children. Food in urban area has been replaced by high calorie snacks and junk food which is a major factor leading to health problems among affluent children contend Dhingra et al. (2010)

Sachdev et al. (2011) bring out the high prevalence of vitamin A deficiency in Aligarh district, Uttar Pradesh, India, and reveal the low intake of proteins and vitamin A containing foods as well as predominant maize diet among the children to be significant factors. Nutritional wasting and a preceding history of measles were significant comorbid determinants.

Goyal et al. (2009) explain that junk food and chocolate consumption habit have positive relation with prevalence of obesity and overweight. These junk foods contain more amount of fat than carbohydrate and protein, leading to overweight. Fatty foods and those that are high in starch are frequently inexpensive compared to leaner cuts of meat, fresh fruit, and vegetables leading to increased consumption of fatty foods triggering the problem of overweight and obesity in children (Greydanus and Bhave, 2004).

Home availability of healthy food were positively associated with the vegetable, fruit and starchy food patterns and inversely associated with the fast food pattern according to Cutler et al. (2011). Home availability of unhealthy food was inversely associated with the vegetable, fruit and starchy food patterns and positively associated with the fast food and snack food patterns. Maternal,

paternal, and peer support for healthy eating were positively associated with the vegetable and fruit pattern and inversely associated with the fast food pattern.

Styne (2005) contends that food has become more affordable to larger numbers of people and has changed from a means of nourishment to a marker of lifestyle and a source of pleasure. Clearly, increases in physical activity are not likely to offset an energy rich, poor nutritive diet. It takes between 1 to 2 hours of extremely vigorous activity to counteract a single large-sized (i.e., ≥ 785 kcal) children's meal at a fast food restaurant.

Habituation is influenced by variety of foods and overweight children increase energy intake more with variety than do leaner children (Epstein et al., 2009).

According to Tanofsky-Kraft et al. (2009) children who consumed two lunch time meals ad libitum from a multi-item food array after being instructed to either binge eat (binge meal) or to eat normally (normal meal) showed more energy consumption at the binge meal than at the normal meal.

Vegetarian diets are associated with a lower body mass index (BMI) and a lower prevalence of obesity in children compared with non-vegetarians. A plant-based diet seems to be a sensible approach for the prevention of obesity in children. Plant-based diets are low in energy density and high in complex carbohydrate, fiber, and water, which may increase satiety and resting energy expenditure (Sabate and Wlen, 2010).

Farmer et al. (2010) point out that vegetarian diets are nutrient dense, consistent with dietary guidelines, and could be recommended for weight management without compromising diet quality.

According to Heaney et al. (2002) there is a growing body of evidence suggesting that increasing dairy intake by about two servings per day could reduce the risk of overweight by up to 70 per cent. In addition, Pereira (2003) points out that calcium intake in childhood was associated with 21 per cent reduced risk of development of insulin resistance among overweight younger adults and may reduce diabetes risk and was associated with reduced adiposity in children.

In addition to milk, other foods also have an effect on obesity and osteoporosis originating in childhood. Both diseases are affected by dietary intake and physical activity. A dietary pattern characterized by a high intake of dark-

green and deep-yellow vegetables was related to low fat mass and high bone mass; high processed-meat intake was related to high bone mass; and high fried-food intake was related to high fat mass as pointed out by Wosje et al. (2010).

Considering the scenario in India, a survey was conducted by NNMB in 2000 to 2001 in the rural populations of nine states of India observed that the median intake of all the nutrients was less than the RDA for all age groups and in both the sexes. The diets were grossly deficient in micronutrients such as iron and vitamin A.

The mean daily intake of whole grains was lower than recommended among adolescents. Fast food intake was associated with lower intake of whole grains among adolescents point out Larson et al. (2010).

The pattern of snacking was more prominent among children and adolescents. Chapelot (2011) concludes that regardless of the time of consumption or macronutrient composition, snacks exerted a weak satiety effect, with those higher in protein having the strongest. The energy content of snacks was never compensated for at the next meal and led consistently to a positive energy balance compared with no-snack conditions. Biologically, the snack-induced insulin secretion suppressed the late increase in plasma free fatty acids which may have contributed to the inhibition of satiety. Lastly, snacking was not preceded by the glucose and insulin profile observed prior to a spontaneously requested meal.

Arvaniti et al. (2011) reported greater salty-snack consumption (≥ 1 times/week). Among children which was positively associated with the hours of television/video-game viewing.

The effect of excess calories from snacks and sugar-sweetened beverages are associated with weight gain among youth. Seventy-six percent of students overestimated the daily norm in their School Grade group, with 24 per cent perceiving the norm to be at least three beverages or more per day. These misperceptions may contribute to intake of excess calories, potentially contributing to adolescent obesity (Perkins et al., 2010).

According to Kral et al. (2010) another factor associated with obesity was eating in the absence of hunger which is pointed out as a risk factor for overeating during childhood. Eating in the absence of hunger referred to energy intake from the snacks.

A lifestyle pattern characterized by higher eating frequency and breakfast consumption was negatively associated with BMI after controlling for age, sex, and parental education and against overweight and obesity in children and adolescents bring out Kontogianni et al. (2010).

Supporting the beneficial effects of breakfast Harie-Joshu et al. (2011) explain that those who ate breakfast 6 to 7 days/week consumed 1,197 fewer kilocalories per week from sweet and salty snacks, 1,337 fewer kilocalories per week from sweetened drinks, and had a lower BMI compared to those who ate breakfast fewer than 2 days per week. Consumption of fruit, vegetables, milk, water and cereal as a snack were higher among regular breakfast consumers. Those who regularly consume breakfast had healthier snacking behaviors and weight.

Pereira et al. (2011) highlight that breakfast frequency and quality were related in causal ways to appetite controls and blood sugar control, supporting the fact that the breakfast meal and its quality may have important causal implications for the risk of obesity and type 2 diabetes. Breakfast frequency in children and adults suggest an inverse (protective) association between the frequency of eating breakfast and the risk for obesity and chronic diseases such as type 2 diabetes.

Jennings et al. (2011) point out that as the quality of diet improved in terms of increased vegetable and fruit consumption in children, it was associated with lower body fat and lower waist circumference.

Sweetman et al. (2011) bring out a positive association between family meal times and higher dietary quality in school-aged children and adolescents. Parent intake was positively related to child intake of all food groups except sweetened beverages. Child liking was only significantly related to child intake of vegetables and may influence overweight and obesity prevalence (Raynor et al., 2011).

It was observed by Jimenez-Cruz et al. (2002) that low intake of fruits and vegetables and excessive consumption of soft drinks and high-fat-containing snacks among children could lead to the possibility of costly health complications later in life.

Children with chronic malnutrition or those that eat less than 2 servings of fruits/vegetables per day suffer from Scurvy which is a condition characterized by general weakness, anaemia, gingivitis (gum disease), and skin haemorrhages

caused by a prolonged deficiency of vitamin C (ascorbic acid) in the diet. By following the “five servings of fruit and vegetables per day” rule, they will be getting the RDI and maintain sufficient body stores of vitamin C endorses Ngan (2009).

It was observed that food consumption in children was adjusted according to the stimuli induced by the food served by their caregivers or parents, instead of being regulated by the satiety and increased energy following the previously consumed meals (Mrdjenovic and Levitsky, 2005).

B. PREVALENCE OF NUTRITIONAL AND LIFESTYLE DISORDERS AMONG CHILDREN

Nutritional disorders

WHO (2012) states that nutritional disorders in children can be caused by an insufficient intake of food or of certain nutrients, by an inability of the body to absorb and use nutrients, or by overconsumption of certain foods. Examples include obesity caused by excess energy intake; anaemia caused by insufficient intake of iron and impaired sight because of inadequate intake of vitamin A.

According to IDBI / World Bank (2006) a child whose weight-for-age is less than -2 Standard Deviation (SD) is considered underweight, and one whose weight-for-height is less than -2 SD is deemed wasted. Stunting results from chronic under nutrition, which retards linear growth, whereas wasting results from inadequate nutrition over a shorter period and underweight encompasses both stunting and wasting.

WHO (2012) defines overweight and obesity as abnormal or excessive fat accumulation that may impair health.

Gohde (2011) connotes that lifestyle diseases in children are a result of an inappropriate relationship with their environment.

Underweight

Indian scenario

The World Bank report (2011) implies that the prevalence of child under nutrition in India is among the highest in the world; nearly double that of Sub-Saharan Africa, with dire consequences for morbidity, mortality, productivity and economic growth.

India being home to nearly 60 million children who are underweight, Sil et al. (2011) found prevalence of stunting, thinness and overweight as 23.7, 33.4 and 0.8 per cent, calculated using WHO growth reference charts (2007), thus bringing out the greater extent to which stunting and thinness were prevalent among the children aged six to 15 years in Tripura.

The concept of social inequality has been well brought out in the study of Meshram et al. (2011) who reported the prevalence of underweight, stunting and wasting as 64, 61 and 29 per cent, respectively among children in the tribal regions of Maharashtra, India. However, there was a significant reduction in the prevalence of underweight and stunting over two time periods (1999 and 2008).

Raman (2009) previews that malnutrition prevailed in one in every three children in India. Malnourished children are less likely to perform well in school and more likely to grow into malnourished adults.

Prinja et al. (2009) found in Chandigarh that for children of all ages combined, the prevalence of underweight was 1.4 times higher when IAP (Indian Association of Pediatrics) standards rather than when the new WHO (World Health Organization) standards were used, with the absolute difference being 14.5 per cent pointing out the dire problem of underweight still existent among Indian children.

Bhattacharji (2009) supports the view and states that severe forms of malnutrition like kwashiorkor and marasmus were not seen commonly in India, but almost 50 per cent of Indian children were undernourished. It reflected the high levels of poverty that still existed in the country.

Regardless of gender, the rate of stunting was higher in Indian adolescents from India (25.5 to 51 per cent) when compared with Indian adolescents in UAE (3.1 to 21 per cent). Thinness was also more in India (42 to 75.4 per cent) when compared with adolescents living in the UAE (4.5 to 14.4 per cent) (Haboubi and Shaikh, 2009).

This is further endorsed by Fishman et al. (2004) who point out that 46 per cent children are underweight due to wasting and stunting in South Asia including India, while the figures in East Asia and Pacific is 18 per cent with only two per cent children in high income developed countries are underweight, bringing out disparities in global distribution of underweight among children.

The phenomenon of stunting has been pointed out by Darnton-Hill and Coyne (2000) who found one-third of young children in the world's low-income countries like India to remain stunted because of malnutrition. One-half of all deaths among young children are, in part, a consequence of malnutrition. Actual numbers have not decreased in sub-Saharan Africa and south Asia.

Global scenario

Labadarios et al. (2005) clarified that next to India, at the global level, South Africa is the most affected, with stunting by far the most common nutritional disorder, affecting nearly one in five children. The children least affected (17%) were those living in urban areas. Even with regard to the latter, however, children living in informal urban areas were more severely affected (20%) compared with those living in formal urban areas (16%).

Sarraf et al. (2005) point out that 21 per cent of children were wasted, 57 per cent were stunted and 23 per cent were anaemic in rural Iran. Dietary deficiency of micronutrients, especially Zn and Fe, probably accounted for the high prevalence of stunting and anaemia in these children. Infection with *Helicobacter pylori* is another possible explanation for the Fe-deficiency anaemia.

However, stunting and malnutrition was not an observed phenomenon in developed countries.

Deficiency diseases

Indian scenario

In India, nutritional deficiencies are still prevalent among rural and poor socio economic class children, although certain types of deficiencies are found even among the upper sections of society.

This is substantiated by Dhingra et al. (2011) who diagnosed mild anemia in 50 per cent of affluent children from primary schools in Srinagar, Jammu and Kashmir. It was evident that the haemoglobin estimation identified approximately 50 per cent of children having mild anemia, placing girls at a higher risk in coming years.

Moretti et al. (2006) point out to prevalence of iron deficiency and iron deficiency anemia in the total sample of 6 to 13 year old children in Bangalore, India to be 78 and 29 per cent respectively.

A similar study in Bangalore carried out among children from five to 13 years brings out a prevalence rate of 70 per cent for iron deficiency anemia (Zimmerman et al., 2006).

However, the prevalence rates have been reported lesser among government school children surveyed in Pondicherry, where Hamide and Sethuraman (2005) found a prevalence of 21.3 per cent iron deficiency anemia in 13 to 15 year olds.

Asobayire et al. (2001) portray that in developing countries like India, there is still a higher prevalence of iron deficiency with 41 to 63 per cent children being affected.

The prevalence of xerophthalmia has been recognized as a serious public health importance with prevalence at 9.1 per cent among preschool children point out Sachdeva et al. (2011). The prevalence of both mild (night blindness and Bitot's spots) and severe forms (corneal changes) of xerophthalmia increased with age and so vitamin A deficiency remains a significant public health problem in children.

A similar scenario has been brought out by Arlappa (2011) who contends that vitamin A deficiency continues to be a major public health nutritional problem in India. The prevalence of Bitot's spot, the objective sign of clinical VAD (0.8 %) was higher than the figures recommended by the WHO ($\geq 0.5\%$), indicating the public significance of the deficiency.

However, a more encouraging picture was presented by Umesh (2009) in Indian children, in that clinical signs of mild xerophthalmia such as Bitot's spots and night blindness, still observed in children from deprived communities, were declining. The first repeat survey of the Indian National Nutrition Monitoring Bureau carried out in the same villages showed that prevalence of Bitot's spots had declined in 1988–90 compared with 1975–79, from 1.8 to 0.7.

A survey of the Indian Council of Medical Research in 1988, covering sixteen districts mostly in northern and eastern regions, showed that prevalence of Bitot's spots ranged from 0 to 4.7 per cent and that of night blindness from 0.4 to 4.8 per cent clarify Toteja et al. (2002). Prevalence rates varied widely between and also within states.

Vitamin A deficiency prevalence as judged by Rice et al. (2004) was 40 per cent in South Asia including India, 11 per cent in East Asia and Pacific while it was not prevalent among children in developed countries.

Age wise goiter prevalence among children in India (Gujarat) has been found to be 18.1 per cent with 12.4 per cent of grade 1 and 5.7 per cent of grade 2 by Pandor et al. (2011). This had been supported by Misra et al. (2007) who pointed out an overall prevalence of goitre as 20.5 per cent among the children as examined in a cross-sectional study from Gurjarat (India).

In 969 school children tested for the presence of iodine deficiency in Howrah in the regions of Gangetic West Bengal by Chandra et al. (2004), revealed a total goiter rate of 37.6 per cent. A progressive increase in goiter prevalence was found from the age of six years till the age of nine years followed by a small decline from 10 years to 12 years. Most of the goiters were palpable (32.6%) but visible goiter or Grade 2 (4.9%) was also prevalent among the children.

Zinc deficiency as estimated by Caulfield and Black (2004) was prevalent among 79 per cent children of South Asia inclusive of India, seven per cent from East Asia and Pacific and five per cent from developed countries.

Global scenario

Though global scenario shows an encouraging picture with regard to most deficiencies, still some micro nutrient deficiencies are prevalent in developed countries too.

Anemia declined significantly in U.S. children (from 8.0% to 3.6%) but the prevalence of iron deficiency anemia did not change significantly in children (1.5% compared with 1.2%) opine Cusick et al. (2008).

Of the boys and girls (399) living in a Southwest London suburb 3.5 and 10.5 per cent respectively were anaemic. Prevalence of anaemia was 14.5 per cent in the group with both low Fe and low vitamin C intakes compared with 2.3 per cent in the group with both high Fe intakes and high vitamin C intakes. Anaemia was three times more common in vegetarians than omnivores and in girls who had tried to lose weight in the last year compared with those who had not elaborate Nelson et al. (2007).

Rohner et al. (2007) found the prevalence of anaemia in children of sub-Saharan Africa to be 52 per cent; 59 per cent were iron-deficient and 36 per cent suffered from iron deficiency anaemia.

The prevalence of anaemia among children in rural and urban South Africa who had serum ferritin values below 12 µg/l was only slightly higher than that for the groups as a whole (38.8 % v. 24.3%), while the prevalence in those with values of 12 µg/l or more was only slightly less (18.2%) bringing out the dismal state of children in this continent (Derman et al., 2007).

Among 159 children in Kazakhstan, the prevalence of anaemia and iron deficiency was 27 and 13 per cent respectively. Nine per cent had iron-deficiency anaemia insist Hashizume et al. (2005).

Stoltzfuz et al. (2004) bring out the prevalence of iron deficiency anemia to be 76 per cent in South Asia, 40 per cent in East Asia and Pacific and seven per cent in developed countries.

Pinhas-Hamiel et al. (2002) relate the presence of iron deficiency as defined as iron levels <8 µmol/l (45 mcg/dl), to be 38.8 per cent among obese children, 12.1 per cent among overweight children, compared with 4.4 per cent of the normal-weight group among children and adolescents in Israel, thus correlating anemia to the weight of children.

Among the rural population in Bangladesh, the prevalence of anaemia was 43 per cent in adolescent girls. The rates in the urban population are slightly lower compared with rural areas, but are high enough to pose a considerable problem clarifies Ahmed (2000).

Overall goitre rate among boys and girls from public elementary schools in Mexico was 21.4 per cent; low urinary iodine excretion was found in 19.5 per cent of the children, high urinary iodine excretion in 32.0 per cent explain Pineda-Lucatero et al. (2008)

The total goitre prevalence among children in Tanzania was 24.3 per cent, indicate Assey et al. (2007).

The prevalence of abnormal thyroid volumes, based on the World Health Organization (WHO) body surface area reference of greater than 97th percentile was 18 per cent at baseline among Chinese children (Zhao et al., 2007).

According to Lezama et al. (2001) in Togo, a small West African country, the prevalence of visible goitre in children was 21.6 per cent and 5.3 per cent in two endemic regions.

The prevalence of moderate vitamin A deficiency was 2.3 per cent and vitamin E deficiency was 5.4 per cent among children in Tunisia. Low status in VA (0.70–1.05 $\mu\text{mol/l}$) and VE (6.97–11.61 $\mu\text{mol/l}$) was observed in 17 per cent and 20.2 per cent of children, respectively (Fares et al. 2011).

Ahmed (2007) points out that the prevalence of severe deficiency, based on the prevalence of night blindness in preschool children in Bangladesh, decreased from 3.6 per cent in 1982–83 to 1.78 per cent in 1989 and 0.6 per cent in 1996. However, there was still a high prevalence of subclinical vitamin A deficiency, based on the biochemical assessment of serum retinol levels in preschool children, estimated mainly from hospital-based groups. Night blindness and Bitot's spot are also found to exist among school-aged children and adolescents.

It was found that 86 per cent of the children had vitamin D deficiency, with 38.3 per cent being severely deficient. Prevalence of vitamin D deficiency was higher in girls than in boys state Neyestani et al. (2011).

Children are potentially at high risk for vitamin D deficiency. In a study (Gordon et al. 2004) 52 per cent of Hispanic and black adolescents in Boston and 48 per cent of white preadolescent girls in a study in Maine (Sullivan et al. 2005) had 25-hydroxyvitamin D levels below 20 micro gram per milliliter. At the end of the winter, 42 per cent of black girls throughout the United States had 25-hydroxyvitamin D levels below 20 mg per milliliter point out Nesby et al. (2002).

According to Weisberg (2004) the prevalence of rickets was 83 per cent among children in African American or black population.

Overweight and obesity

Indian scenario

Among Indian children, there is an emerging trend of increased overweight and obesity prevalence, with urban areas and private school children being the most affected.

Using IOTF (International Obesity Task Force) (Cole et al., 2000), the WHO (World Health Organization, 2007) and the Indian growth (Agarwal et al. 2001) references, the prevalence of obesity was estimated at 3.25,

4.95 and 5.05 per cent respectively while the prevalence of overweight was estimated to be 10.4, 11.5 and 12.87 per cent respectively among school children in Delhi, India in a study conducted by Stigler et al. (2011).

This is supported by the prevalence of overweight and obesity in the study conducted by Narayanappa et al. (2011) in Mysore which points to a similar trend of 11 per cent overweight and five per cent obesity among children five to 10 years of age.

Based on Asian-Indian specific cut offs of BMI, Gupta et al. (2011) found among school children aged 14 to 17 years in Delhi that the prevalence of obesity increased significantly from 9.8 per cent in 2006 to 11.7 per cent in 2009, whereas underweight decreased from 11.3 to 3.9 per cent. Overweight among children increased from 24.2 per cent in 2006 to 25.2 per cent in 2009 revealing secular trends in the prevalence of overweight and obesity.

Based on waist circumference measurement, 48 per cent of Indian children selected from urban schools in the PEACH (Pediatric Epidemiology and Child Health) study conducted by St. John's Research Institute, Bangalore were overweight and 30 per cent were found to be obese. In addition, about 21 per cent of the children had a waist to height ratio greater than 0.5 find out Kuriyan et al. (2011).

In a study from Puducherry (Mahajan et al., 2011) the prevalence of overweight among children was 4.41 per cent and prevalence of obesity was 2.12 per cent.

Chou et al. (2006) points to a gender influences in the prevalence of overweight and obesity with 4.24 per cent and 1.97 per cent respectively, among males whereas prevalence of overweight and obesity among females was 4.58 per cent and 2.29 per cent respectively. Mahe region surrounded by Kerala reported the highest prevalence of overweight [8.66%] and obesity [4.69%]. Yanam surrounded by Andhra Pradesh had 2nd highest prevalence of overweight [5.68%] and lowest prevalence of obesity [0.57%]. In Puducherry and Karaikal regions surrounded by Tamil Nadu, the prevalence of overweight and obesity ranged from 2.87 to 3.91 per cent and 1.78 to 2.59 per cent, respectively.

Panjikkaran and Kumari (2009) highlight the prevalence rates based on BMI percentiles as 3.2 per cent children to be obese whereas eight per cent of the children as overweight. Measurement of waist circumference showed a four-fold

increase in obese children. A comparison of waist circumference and BMI showed that at least 53.2 per cent of the children who were obese using waist circumference were either overweight or normal using BMI. The waist to height ratio revealed that 16.8 per cent of the samples were at risk in a study on school children conducted in Kerala, India.

A cross sectional study conducted in Mysore city by Premanath et al. (2009) showed the prevalence of overweight and obesity in school children aged between five to 16 years to be 8.5 per cent overweight and 3.4 per cent obesity in urban area, which is lower than that present in metro cities in India.

The prevalence of overweight among 12 to 18 year old children was 14.3 per cent among boys and 9.3 per cent among girls. Prevalence of obesity was 2.9 per cent (boys) and 1.5 per cent (girls) in Ahmedabad point out Goyal et al. (2009).

Kaur et al. (2008) enlighten on age-wise prevalence rates of overweight and obesity in India according to BMI calculations in low income group school children as 0.1 and 2.7 percent respectively, among middle income group school children as 0.6 and 6.5 percent and in high income group school children as 6.8 and 15.3 percent respectively, thus bringing out the disparities based on income.

The prevalence of overweight/obesity in urban children in Delhi has shown an increase from 16 per cent in 2002 to about 24 per cent in 2006. The prevalence among adolescent children (14-17 years) was 29 per cent in private schools and 11.3 per cent in government funded schools in 2006-2007 point out Bhardwaj et al. (2008).

A similar finding was reported from Kerala (Raj et al. 2007) that showed an increased prevalence of overweight and obesity from 4.94 and 1.26 per cent in 2003 to 6.57 and 1.89 per cent in 2005.

Sharma et al. (2007) revealed that in Delhi adolescents had a high prevalence of overweight/obesity. Of the total, 22 per cent were overweight and 6.4 per cent were obese.

Laxmaiah et al. (2007) reported in Hyderabad a prevalence of overweight of 6.1 per cent among boys and 8.2 per cent among girls; the rate of obesity was 1.6 and one per cent respectively among boys and girls.

Anju et al. (2007) and Bhave et al. (2004) report a prevalence of overweight and obesity in affluent adolescent school girls in Bangalore to be 13.1 per cent and five per cent respectively.

There are studies reporting prevalence of childhood and adolescent obesity and overweight from different parts of India (Punjab, Maharashtra, Delhi and South India) that range from 3 to 29 per cent, and prevalence is higher in urban than in rural areas and more in metros than in other Indian cities (Kaur et al. 2005).

The prevalence of obesity and overweight among children who belonged to well to do families (Chhatwal et al. 2004) was 11.1 and 14.2 per cent respectively. The prevalence of obesity as well as overweight was higher in boys as compared to girls (12.4% vs 9.9%, 15.7% vs 12.9%). Prevalence of obesity decreased significantly with age, from 18.5 per cent at 9 years to 7.6 per cent at 14 years.

Kumar (2004) points out that obesity among children in India has become a public health problem with prevalence rate of greater than five per cent.

In a study by Popkin (2003) in the five metros of Delhi, Mumbai, Chennai, Hyderabad and Kolkata it had been noticed that one out of every five school children or 20 percent are overweight. The overweight prevalence in urban boys was found to be 21.31 percent whereas that in rural boys was only 8.31 per cent. Similarly when the prevalence of overweight was 20.90 per cent among urban girls it was only 11.92 percent in rural girls pointing to significant differences between urban and rural areas.

A study from Chennai, (Subramanyam et al., 2003) Tamil Nadu, reported a high prevalence of overweight (8.0-10.81%) and obesity (5.26-9.52%).

Kapil et al. (2002) bring out a prevalence rate for obesity as six per cent among girls and eight per cent among boys in an affluent community school in Delhi.

A study done by Nutrition Foundation of India among children aged 4 to 18 years in a Delhi private school found that 29 per cent of them were overweight with a body mass index above 25 (Chatterjee, 2002).

Ramachandran et al. (2002) brought out a prevalence of overweight and obesity of 22 per cent in high income schools and 4.5 per cent in lower income group schools.

Global scenario

Ogden et al. (2012) and Seegers et al. (2011) found out that 27 per cent of U.S. children were overweight while 16.9 per cent were obese. A prevalence of 50.9 per cent overweight among New York city public elementary school children by Stingone et al. (2011). This is endorsed by Lazorick et al. (2011) in North Carolina and Hack et al. (2011). A similar trend had been pointed out by Stark et al. (2011) among children from Pacific Islands.

A contrast is seen among Filipino children, where prevalence of overweight was negligible among 6-9 year old children while 2 in every 1000 children 10 years old were overweight point out PASSO (Philippines Association for Study of Overweight and Obesity) (2012).

In a study in Lahore in Pakistan (Mushtaq et al. 2011) seventeen percent children were overweight and 7.5 per cent were obese, showing a similar trend in overweight as children from the developed countries.

De Gouw et al. (2010) point out overweight prevalence rates as 6.1 to 16.7 per cent between girls and boys, with marked age and sex differences in prevalence rates.

The Australian Government (2010) brings out that overweight and obesity affects approximately one in five Australian children.

Jodkowska et al. (2010) present data on overweight and obesity among children from different regions of Poland as 12.5 per cent, and was similar for boys and girls.

The study by Lazzeri et al. (2008) represents a decrease in prevalence of thinness, followed by an increase in prevalence of overweight and obesity over the years from 2002 to 2006, providing a final statistics of 4.2 per cent thinness and 33.4 per cent overweight among Tuscan children.

In Australia, an estimated 1.5 million young people under the age of 18 are overweight or obese (Australian Sports Federation Alliance, 2007).

The prevalence of overweight and obesity estimated in UAE using International Obesity Task Force criteria showed an overall 21.5 per cent of children being overweight and 13.7 per cent were obese as observed by Malik and Bakir (2007). A similar observation was made by Al-Haddad et al. (2005) among UAE children.

In Netherlands more girls than boys were overweight and obese (boys 18.7%, girls 24.4%) as pointed out by Hurk et al. (2007).

According to Hedley et al. (2004) the prevalence among children in the United States was 31.0 per cent for risk for overweight and 16.0 per cent for overweight in the year 1999-2000. A similar observation has been made by Moreno et al. (2002) among U.S. children, bringing out an overweight prevalence, using the IOTF reference standard (Cole et al. 2000) as 34 per cent in boys and 36 per cent in girls.

A study among East German school children showed a clear increasing trend for the prevalence of overweight in boys from 13.9 to 25.6 per cent whereas the prevalence of obesity tripled, ranging from 2.8 to 7.1 per cent. In girls the prevalence of overweight increased from 15.5 to 22.8 per cent whereas the prevalence of obesity rose from 3.5 to 7.9 per cent (Frye and Henrich, 2003).

The prevalence of overweight in Canadian children was significantly higher with 27.7 per cent among boys and 33.7 per cent among girls (Hanley et al., 2000).

Double burden of underweight and overweight/obesity

Many countries have significant pockets of malnutrition and increased mortality of children, while obesity and non-communicable disease (NCDs) prevalence are increasing. It is the poor and relatively disadvantaged sectors of the population who are suffering both point out Darnton-Hill and Coyne (2000).

A randomized cross-sectional epidemiological study conducted among children of 13 to 17 years in urban and rural areas of Mysore, India, by Saraswathi et al. (2011) brought out prevalence of underweight to be 31.82 per cent and 45.33 per cent in urban and rural children respectively while the prevalence of overweight and obesity was reported as 8.75 per cent in urban schools and 0.8 per cent from rural area.

In India, the prevalence of underweight was highest in peri-urban areas (30.2% and 53.2% according to Indian and International criteria, respectively). In urban and highly urban areas, the prevalence of underweight was 14.1 and 9.8 per cent respectively, according to the Indian and 27.1 and 19.2 per cent respectively, according to international criteria. The prevalence of overweight children was highest in the highly urban category (19.1% and 13.4% according to Indian and international criteria, respectively) point out Jeemon et al. (2009).

In Kerala, India, 4.99 per cent of children were obese, 17.73 per cent were overweight, 58.67 per cent were normal weight, 16.16 per cent were underweight with a BMI less than 15, and 2.44 per cent were severely underweight with a BMI less than 13. An interesting observation made was that the overall prevalence of overweight and underweight was comparable at 16 to 18 per cent by Unnithan and Syamakumari (2012).

In South Africa, (South Africa Report Card, 2010) the prevalence of overweight and obesity in teens has increased (overweight from 17 to 20% and obesity from 4 to 5%). Despite this trend, stunting is also prevalent, and reported in 13 per cent of teens surveyed (up from 11% in 2002). Stunting is also prevalent in over 25 per cent of rural and about 12 per cent of urban primary school children.

Moschonis et al. (2010) point out that the observed prevalence in Greece, was 3.5 per cent for underweight, 57.7 per cent for normal weight, 27.9 per cent for overweight and 10.9 per cent for obesity among children.

Lifestyle disorder

Khadilkar et al. (2012) found among Indian children from Pune schools that as BMI percentile values increased, they had symptoms of metabolic syndrome. Maximum risk was observed for a cut-off value of BMI of 23kg/m² and 28kg/m².

In the study by Dhingra et al. (2011) conducted among primary school children in Srinagar, Jammu and Kashmir, 40 per cent of children were diagnosed with symptomatic hypertension which was higher among boys as compared to girls.

In a school-based cross sectional study in Mysore among five to 10 year old children, pre-diabetes was present in 3.9 per cent boys and 3.4 per cent girls. Type 2 diabetes mellitus was prevalent among 0.6 per cent of the children which is a new find point out Narayanappa et al. (2011).

A study conducted on students from government and public schools in Delhi showed that 26 per cent of the kids aged 14 to 17 years had Syndrome X (caused by obesity), a precursor to diabetes (Misra and Khurana, 2009).

A similar observation has been recorded by Sharma and Majumdar (2009) who bring out complications like diabetes, stroke, liver diseases, infertility, hypertension, arthritis and cancer among obese children as they grow

up. Obese children also have a high risk of development of early heart diseases, 40 to 50 per cent had increased triglyceride levels and 30 to 70 per cent had low HDL levels. Syndrome X was present in 28 per cent of children and junk food aggravated the problem.

Of the 3,000 cases of hypertension diagnosed in hospitals in India, a disease often linked with a stressful lifestyle, around 2 per cent were children. Cases of both Type I and II diabetes in hospitals were around 2,000, affecting around one per cent of children reports Sharma (2008).

Health consequences of childhood obesity as previewed by Bhardwaj et al. (2008) were metabolic syndrome, affecting one-third of overweight or obese urban Asian Indian children in the form of insulin resistance, type 2 diabetes mellitus, having strong links to abdominal obesity in children, hyper triglyceridemia and family history of diabetes, sub-clinical inflammation manifested as high C-reactive protein levels denoting future risk for development of CHD and type 2 DM. Obese adolescent girls also suffer from PCOS (Poly cystic ovarian syndrome), a syndrome of variable combinations of menstrual irregularity, acne with obesity and insulin resistance.

In Ernakulam Kerala, India, the prevalence of hypertension in normal weight, overweight and obese groups of children was 10.1, 17.34 and 18.32 per cent, respectively. The prevalence of systolic hypertension (first instance) in normal weight, overweight and obese groups was 5.38, 12.31 and 14.66 per cent respectively. The prevalence of diastolic hypertension (first instance) in normal weight, overweight and obese groups was 6.45, 8.86 and 8.9 per cent respectively point out Raj et al. (2007).

A school based screening revealed that the prevalence of elevated blood pressure after first, second, and third screenings was 19.4 per cent, 9.5 per cent and 4.5 per cent respectively signifies Sorof (2004).

By comparison, the national incidence of type 1 diabetes among those aged 10 to 19 years is 19 per 100,000 detects Centers for Disease Control and Prevention (2011). This is supported by the American Diabetes Association (2011).

In 2008, it was estimated that over 5,700 children aged 0 to 14 years had Type 1 diabetes in Australia. The prevalence rate increased with age and varied by state and territory points out Australian Institute of Health and Welfare (2011).

Among children ages younger than 10 years, the rate of new cases was 19.7 per for type 1 and 0.4 per 100,000 for type 2 diabetes. Among children ages 10 years or older, the rate of new cases was 18.6 for type 1 and 8.5 per 100,000 for type 2 diabetes (National Diabetes Information Clearing house, 2011) and Goldenholz, 2011).

Perichart-Perera et al. (2007) point out that in Mexico, high systolic blood pressure was seen in 8.4 per cent of children and 6.2 per cent of children had prehypertension. Higher hypertension risk was seen in children with body mass index $\geq 95^{\text{th}}$ percentile and waist circumference $\geq 90^{\text{th}}$ percentile (88 cm).

Among hypertensive children, 81 per cent had isolated systolic hypertension. Hypertension was associated with excess body weight, elevated heart rate and parents' history of hypertension. Of the children, 16.1 per cent of boys and 12.4 per cent of girls were overweight or obese (CDC criteria). Thirty-seven percent of cases of hypertension could be attributed to overweight or obesity opine Chiolerio et al. (2007).

Luma and Spiottia (2006) bring out the risk factors for metabolic syndrome as low plasma high-density lipoprotein, elevated plasma triglycerides, abdominal obesity and insulin resistance/ hyperinsulinemia. The prevalence of metabolic syndrome among adolescents was between 4.2 and 8.4 percent.

The prevalence of hypertension among children was found in the ranges of 5.4 to 19.4 per cent point out Urrutia-Rojas et al. (2006), Sorof et al. (2004) and Cervantes et al. (2000).

The prevalence of hypertension increases progressively with increasing BMI and studies by Graf et al. (2005) and Sorof and Daniel (2002) have detected hypertension in over 30 per cent of obese children (BMI $> 95^{\text{th}}$ percentile). The increase in childhood overweight made these children prone to diet-related risks of chronic degenerative diseases, such as cardiovascular disease, type 2 diabetes, cancer, obesity, and osteoporosis (ADA, 2004).

Metabolic syndrome in obese children and adolescents has been estimated to range from 28.7 to 49.7 per cent according to Weiss et al. (2004) and Cook et al. (2003). Prevalence of metabolic syndrome was found to be 30 per cent among Hispanic children according to Cruz and Goran (2004) and Cruz et al. (2004).

According to Children with Cancer, U.K. (2012) around 1,500 children are diagnosed with cancer each year in the UK. The majority of childhood cancers are

malignant (93%). Leukaemias form the most commonly diagnosed cancer in children, accounting for around a third (31%) of all cases.

C. INFLUENCE OF CHILD REARING PRACTICES ON THE HEALTH STATUS OF CHILDREN

Child rearing practices starts right from birth, including birth weight, initiation and continuation of breastfeeding and weaning practices and introduction of complementary feeding (Swaminathan, 2010).

Exclusively breastfed infants had a slower weight-growth velocity as early as one month of age compared with exclusively formula-fed infants explain Regnault et al. (2010).

Exclusive breastfeeding for the first six months of life followed by a combination of breastfeeding and complementary feeding up to age two years or beyond, helps to prevent malnutrition elaborates WHO (2009).

Preterm birth, defined as child birth occurring at less than 37 completed weeks or 259 days of gestation has long-term adverse consequences for health. The morbidity associated with preterm birth often extends to later life, resulting in enormous physical, psychological and economic costs (Beck et al., 2011).

As they are born too early, premature babies weigh much less than full-term babies. They may have health problems because their organs did not have enough time to develop. These health problems are known to continue into their childhood either in the form of underweight or as overweight and obesity (NIH, 2011).

Children born prematurely have higher rates of learning disabilities, cerebral palsy, sensory deficits and respiratory illnesses compared to children born at term. These negative health and developmental effects of preterm birth often extend to later life, resulting in enormous medical, educational, psychological and social costs proposes Vashishtha (2009).

The health of the child in later years is influenced by the birth weight with premature children being the most affected. Perinatal mortality was significantly higher among premature infants purport Mukherjee and Mukherjee (2010).

Child rearing practices

The World Health Organization (2001) estimates that 16 per cent of neonates, or nearly 20 million are born as Low Birth Weight each year across the

globe. The morbidity and mortality later on in life is inversely linked to birth weight. The lower the birth weight, higher the mortality rising 3 to 4 times in newborns weighing less than 1500 gm. The subsequent development of these children is also less. The long-term growth is lower. There is link between low birth weight and the adult degenerative diseases of hypertension, diabetes, hyperlipidemia, and syndrome X. These children lack behind in weight as well as height opines Sachdev (2011).

Gupta et al. (2007) disclosed that birth weight of children had inverse correlation with current waist, hip, WHR,, height and mid upper arm circumference and positive correlation with growth rate and fasting glucose. Children born with a birth weight <2.5kg have more insulin resistance at mid and late childhood as compared with normal birth weight babies.

A positive association has been found between birth weight and BMI in childhood and adolescence in studies carried out by Persons et al. (2008). A birth weight greater than 4,000 g is associated with an increased risk of obesity in both childhood and adolescence. Childhood obesity is influenced by birth weight, gestational age, parental obesity, socioeconomic status, single parent household, and birth order.

In the obesity prevalence study carried out among 4 to 17 year old children in Delhi, India by Sharma et al. (2007) it was found that only 6 per cent had low birth weight (≤ 2.5 kg). The birth weight of these subjects was positively correlated to their present BMI. Children with birth weight >3.0 kg were found to have a higher BMI than those who had either low birth weight or birth weight in the category 2.5 to 3.0 kg.

According to Hirani (2008) effective child-care practices play a vital role in children's growth, brain development, personality enhancement, and health promotion. In most nations, child-rearing practices are highly influenced by the traditional norms and values. In fact, child-care practices and beliefs have the greatest effect on a child's health status.

WHO recommends early (i.e. within one hour of giving birth) initiation of breastfeeding which reduced neonatal mortality by 22 per cent (Jana, 2009). Breastfeeding has been found to have an impact on the health of children in early and late childhood in the form of greater rate of deficiency diseases and obesity among those who were not breastfed (WHO, 2006).

Exclusive breastfeeding has been recognized as the single most effective intervention to reduce mortality; optimal feeding practices - including early initiation, exclusive breastfeeding and continued breastfeeding would influence the feeding habits of children later on (WHO, 2011 and UNICEF, 2011).

Breastfeeding contributes to a lifetime of good health. Adults who were breastfed as infants are more likely to have lower blood pressure and lower cholesterol levels and less at risk of becoming overweight or obese. These adults also suffer less frequently from type-2 diabetes (WHO, 2011).

Davis et al. (2012) contend that in comparison with no breastfeeding participants, the odds of obesity were lower in the ≥ 12 -months breastfed participants. Breastfeeding for \geq one year and low sugar sweetened beverages intake during the toddler years has profound effects on reducing the prevalence of obesity in children.

Castellote et al. (2011) confirm that human breast milk is the ideal nutrition for the newborn, and in addition to its nutritional contribution, necessary for infant growth and development, it contains various immune bioactive factors that confer some of the numerous beneficial effects of breastfeeding.

Longer breastfeeding (either any or exclusive) was associated with a higher stamina among adolescents, especially those who were breastfed for ≥ 6 months (Artero et al. (2010)).

Evelein et al. (2011) observed that the choice of infant feeding had an effect on the vascular system of children even at age of five years with exclusive breastfed infants (for 3 to 6 months) having a greater carotid intima-media thickness, distensibility and elastic modulus compared to exclusively formula-fed children.

Owen et al. (2003) state that the case for breast feeding rests on a combination of short and long term benefits such as potential protection against obesity and allergic disease and lower blood cholesterol levels in later life.

Martin et al. (200) support breast-feeding as being associated with a lowering of later blood pressure in children born at term. Blood pressure differences were similar whether breast-feeding was partial or exclusive.

Lene et al. (2006) state that breast feeding was likely to protect against immune-related diseases later in life, such as type 1 diabetes, coeliac disease,

inflammatory bowel diseases and cancer. Breast feeding was associated with a lower blood pressure and serum cholesterol and had a protective effect against later obesity.

Mayer-Davis et al. (2006) endorse the fact that breast-feeding was inversely associated with childhood obesity. The same is contended by Arenz et al. (2004) who bring out an inverse relationship between obesity and breastfeeding.

The weaning period is crucial for the maintenance and continued growth and development of the child and yet it is often the time when foods are given to provide the volume necessary to keep the child from being hungry without regard to the nutritional quality of the transitional foods. In addition, a reduction in breast milk consumption and the protection it provides during gastrointestinal infection can increase the risk for diarrheal illness in children during weaning (UNICEF, 2011).

Corvalan et al. (2009) opine that BMI gain in early life, particularly from 6 months to 24 months, is positively associated with adiposity and CVD risk status after 4 years.

D. BODY MEASUREMENTS OF SCHOOL CHILDREN

Body weight is determined by several factors like genetic background, eating habits, metabolic rate and general activity level (Mills, 2005).

Height is determined by genetic factors, nutritional factors in infancy and hormonal influence in puberty (Veldhuis et al. 2005) and gene-environment interactions (Thomis and Towne, 2006).

Body measurements were performed in a quiet and tempered room by trained clinical officers at the initial visit in the study by Chiolerio (2007). Weight and height were measured with precision electronic scales (at 0.1 kg) and fixed stadiometers (at 0.1 cm). Children were measured without shoes and in light garments. The mid-arm circumference was measured and the cuff width adapted accordingly (i.e. pediatric or normal cuff for a mid-arm circumference of 17.0 to 21.9 cm or 22.0 to 32.0 cm, respectively).

Significance of Body Measurements

1. Body Mass Index

Body Mass Index (BMI) is a number calculated from a child's weight and height. BMI is a reliable indicator of body fatness for most children and teens. BMI does not measure body fat directly, but Mei et al.(2002) has shown that BMI correlates to direct measures of body fat, such as underwater weighing and dual energy x-ray absorptiometry (DXA). BMI can be considered an alternative for direct measures of body fat. Additionally, BMI is an inexpensive and easy-to-perform method of screening for weight categories that may lead to health problems. For children and teens, BMI is age- and sex-specific and is often referred to as BMI-for-age.

BMI-for-age weight status categories and the corresponding percentiles are shown in the following table.

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

(CDC, 2011)

BMI measurement programs in schools may be conducted for the purpose of surveillance, screening, or both to identify the percentage of students who are underweight, normal weight, overweight or obese. BMI screening programs assess the weight status of individual students to identify those at risk for weight-related health programs, such as obesity, and provide parents with information to help them take appropriate action. BMI screening meets some of the criteria established by the American Academy of Pediatrics (AAP) for determining whether school-based screening should be implemented for any pediatric health condition like obesity. BMI is an acceptable measure to assess weight status and schools are a logical measurement site because they reach virtually all youth (CDC, 2011).

Measuring the BMI of students in schools is an approach to addressing obesity. Some states, cities, and communities have established school-based BMI-measurement programs in recent years, and many others are considering the

merits of initiating such programs. BMI is the ratio of an individual's weight to height squared (kg/m^2) and is used to estimate a person's risk of weight-related health problems. It is often used to assess weight status, because it is relatively easy to measure and correlates with body fat. BMI is recommended widely for use among children and adolescents to determine overweight. The risk of adult overweight from childhood overweight provides the best available evidence to judge the clinical validity of BMI as an overweight criterion for children and adolescents. BMI measures in childhood track to adulthood moderately or very well, with stronger tracking seen for children with ≥ 1 obese parent and children who are more overweight or older. The probability of adult obesity (BMI of $>30 \text{ kg/m}^2$) is $\geq 50\%$ among children >13 years of age whose BMI percentiles meet or exceed the 95th percentile for age and gender (Mei et al. 2002, Whitlock et al. 2005).

Katzmarzyk et al. (2011) point out that Body mass index (BMI) is used as an indicator of overall adiposity, whereas waist circumference has been advocated as an indicator of central obesity because it is a good predictor of abdominal fat and is related to the development of cardiovascular diseases, type 2 diabetes mellitus and premature death.

An obesity prevalence study conducted in Delhi, India among 4 to 17 year old children by Sharma et al. (2007) found that most anthropometric parameters (weight, height, sitting height and MUAC) were higher in boys than in girls for almost all age groups. Blood pressure was found to be associated with BMI both in normal and obese children by Krishna et al. (2006).

Baker et al. (2007) observed that a one-unit increase in BMI z-score among a large cohort of Danish school children aged seven to 13 years was associated with a 10 to 22 per cent increased risk among boys and a five to 15 per cent increased risk among girls, of having a coronary heart disease event in adulthood.

Caballerro et al. (2003) found that 48.9 per cent children were above the 85th percentile of BMI-for-age in his study which was higher than that reported in 1990 in a 5 to 18 year old population. The prevalence of overweight was somewhat higher in girls than in boys (30.5% compared with 26.8%). In others, the prevalence of overweight was higher in boys and in some there was little difference between the sexes.

Goals of BMI screening programs in schools include preventing and reducing obesity in a population, correcting misperceptions of parents and children about the children's weight, motivating parents and their children to make healthy and safe lifestyle changes, motivating parents to take children at risk to medical care providers for further evaluation and guidance and treatment and increasing awareness of school administrators and school staff of the importance of addressing obesity (Florida Departments of Education and Health Coordinated School Health Program, 2006). The same is supported by Nihiser et al. (2009).

Khadiolkar et al. (2011) have presented age and sex specific BMI cut-offs for Indian children, based on a reference population of urban Indian affluent children, such that the cut-offs are linked to the adult accepted BMI of 23 and 28 kg/m² for overweight and obesity for Asians. The BMI values suggested would help pick up obesity early and prevent future complications occurring due to child obesity.

According to Goyal et al. (2010) found that the mean and medium BMI of school-going children in Delhi, India were found to be 19.16 and 18.14 kg/m², respectively. It was identified that tenth graders had a higher BMI than eighth graders, girls had a higher BMI than boys and private school students had a higher BMI than students in Government schools.

Story (2003) assessed Body Mass Index (BMI) and dietary habits and found an overweight prevalence of 11.4 per cent among children from first to fifth grades, based on the children's BMI. Most of the overweight students were either African American or female due to higher intake of calories from fat and were more likely to worry about being fat.

Himes (2009) suggests that BMI is an important indicator of overweight and obesity in childhood and adolescence. When measurements are taken carefully and compared with appropriate growth charts and recommended cutoffs, BMI provides an excellent indicator of overweight and obesity that is sufficient for most clinical, screening, and surveillance purposes. Choosing appropriate equipment and measurement protocols and providing regular training are critical aspects that apply to all settings in which BMI will be measured and used.

Chhatwal et al. (2004) apprise that children whose BMI was >85th percentile for age and sex were defined as overweight.

Freedman and Sherry (2009) advocate that the accuracy of BMI varies according to the degree of body fatness. Among relatively fat children, BMI is a good indicator of excess adiposity, but differences in the BMIs of relatively thin children can be largely due to fat-free mass. Children with a high BMI are much more likely to have adverse risk factor levels and to become obese adults than are thinner children. Waist circumference may be useful in identifying children with moderately elevated levels of BMI who truly have excess body fatness or adverse risk factor.

Maynard et al. (2001) and Huybrechts et al. (2006) find that correlations between BMI and body composition variables were strong and significantly different from zero. Means for BMI throughout childhood were similar for boys and girls, although significantly larger values were observed for girls at ages 12 to 13 years.

Mei et al. (2007) mention that in contrast to the recommendations of expert panels, skinfold measurements do not seem to provide additional information about excess body fat beyond BMI-for-age alone if the BMI-for-age is >95th percentile. If BMI-for-age was already known and was >95th percentile, the additional measurement of skinfolds did not significantly increase the sensitivity or specificity in the identification of excess body fat.

Dhingra et al. (2011) evaluate a comparison of anthropometric measurements with ICMR standard and record that the mean height, weight and mid upper arm circumference of children exceeded 95th percentile of ICMR for all ages, with an exception in 8 to 9 years where mean height of boys was less than ICMR values. The mean values exceeding the 95th percentile of ICMR in itself indicated the presence of excessive body mass.

Utter et al. (2009) caution that the mean BMI among adolescents significantly increased from 25.3 in 1997/1998 to 27.2 in 2005, with the greatest increases at the high end of the distribution. Increases in BMI did not differ by age, gender or ethnicity. The mean waist circumference increased from 76.2 cm in 1997/1998 to 89.4 cm in 2005, with increases in waist circumference measurements at all points in the distribution.

In Chinese girls, BMI, waist circumference, total body fat, percentage of body fat, trunk fat, and percentage of trunk fat all increased linearly with age. In Chinese boys, BMI and waist circumference increased linearly with age, but total

body fat, percentage of body fat, and trunk fat did not increase significantly with age. Before puberty (6–11 years), BMI and waist circumference were correlated well with total body fat, percentage of body fat, and trunk fat in both genders. In this relatively lean rural Chinese population, BMI and waist circumference were highly correlated with each other and were good surrogates of total body fat, trunk fat, and percentage of body fat in pre pubertal children of both genders and in pubertal girls (Wang et al., 2007).

Bartok et al. (2011) indicate that increases in BMI percentile tended to be indicative of increasing adiposity only in girls with a BMI >30th to 40th percentile for age.

Freedman et al. (2009) suggest that levels of risk factors and adult BMI (median: 32 kg/m²) among overweight children were midway between those of thinner children and obese children (BMI for age ≥ 95th percentile). Overweight children with a relatively high waist/height ratio. Among these overweight children, levels of waist/height ratio were more strongly associated with adverse risk-factor levels than were levels of BMI for age or skinfold thickness.

Chiolero (2007) clarifies that hypertension was associated with children's excess weight, children's heart rate, and parents' history of hypertension. One-third of all children with hypertension could be accounted for by excess body weight.

The argument as to which reference values could be chosen (IOTF, WHO or CDC) as an ideal for Body Mass Index values of Indian children brings out the conclusion that what really matters is not which reference of threshold is used, but there should be consistency when comparing one research study to another. These thresholds are essentially public health constructs. Ultimately, it is the persuasive effort of a pediatrician which would help take preventive action rather than a line on a chart. Parental role is also recognized in controlling overweight and obesity in children (Wright 2011).

2. Waist Circumference

Savva et al. (2000) observe that waist circumference was a better predictor of cardiovascular disease risk factors than was BMI for a sample of 10 to 14 year old children from Cyprus; those with a waist circumference above the 75th percentile had significantly higher odds of having high blood pressure, high total cholesterol levels, high low-density lipoprotein cholesterol levels, and high

triglyceride levels. Maffeis et al. (2001) speculate in a sample of pre-pubertal (3–11 years of age) Italian children that those with waist circumferences greater than the 90th percentile were more likely (19%) to have multiple risk factors (≥ 2), compared with children with values below the 90th percentile (9.4%) for cardiovascular diseases.

The arguments by McCarthy, *et al* . (2001) and Reilly et al. (2000) suggests BMI may be a less sensitive indicator of fatness among children and give no indication about fat distribution, which was again supported by Panjikkaran and Kumari (2009) in their experiments on Indian children. Many Asian races show a tendency for fat deposition in the abdominal area, which is known as central adiposity. Waist circumference is recommended as an index for central fat distribution but there is no global standard for it (Ramachandran, 2004).

A comparison between waist circumference and BMI had shown that at least 53.2 per cent of the children who were obese using waist circumference were either overweight or normal using BMI. During growth in childhood, body fat is laid down both subcutaneously and intra-abdominally. The relationship between increasing waist circumferences in obese children 12 to 14 years old with an adverse lipoprotein profile was observed. From the Bogalusa Heart study, an abdominal fat distribution (indicated by waist circumference) in children between 5 and 17 years old was associated with an adverse concentration of triacyl glycerol, LDL cholesterol, HDL cholesterol, and insulin correlate Freedman et al. (2009). Moreover, it is a straight forward methodology for predicting cardiovascular disorders and could be adopted as an alternative or additional measurement to BMI in children (McCarthy et al. 2001) and correlates well with BMI in comparison with waist to hip ratios (Kurpad et al., 2003).

Thomas et al. (2003) point out that the prevalence of child obesity in the Indian population as 13 per cent using waist to height ratio against the observed value of 3.2 per cent using BMI percentiles.

Fernandez et al. (2004) utilized the NHANES III data set to determine 10th, 25th, 50th, 75th, and 90th percentiles for waist circumference by ethnic background. In general, Mexican American boys and girls had higher waist circumferences than African American or European American children at each age. Mexican

American girls had the fastest rate of increase of all girls proving the debt of waist circumference.

A new long-term study published by researchers at the University of Georgia, the Menzies Research Institute in Hobart, Australia and the Murdoch Children Research Institute in Melbourne, Australia suggests that waist circumference, rather than the commonly used body mass index measure, is the best clinical measure to predict a child's risk for cardiovascular disease and diabetes later in life. Children with high waist circumference values (in the top 25 percent for their age and sex) were five to six times more likely than children with low waist circumferences (in the bottom 25 percent) to develop metabolic syndrome by early adulthood. Metabolic syndrome is a cluster of key cardiovascular risk factors and is associated with an increased risk of subsequent coronary artery disease, stroke and type 2 diabetes (Schmidt et al., 2010).

Maffeis et al. (2001) proved that each centimeter increase of waist circumference at the age of eight years doubled the risk of having a relative BMI greater than 120 per cent at the age of 12 years. Waist circumference measured at the age of eight years, which is simple to perform and easy to reproduce, may be a promising index to assess adiposity as well as to predict overweight at puberty.

Hirschler et al. (2005) found that waist circumference was a predictor of insulin resistance syndrome in children and adolescents and could be included in clinical practice as a simple tool to help identify children at risk. An association between waist circumference and height, BMI and age were arrived at in this study.

In a British study, done on children aged 5 to 17 years, mean weight, height, BMI and waist circumference increased with age for both boys and girls. Mean waist circumference increased with age in both sexes, although the absolute increase was greater for boys. At the upper end of the age range, the curves tended to plateau in girls, whereas in boys they continued to increase, and this probably reflected the different timings of the onset of puberty and gender-specific influences on waist circumference (McCarthy et al., 2001).

3. Waist to height ratio

Waist-to-height ratio (WHtR) was calculated by dividing waist circumference by height. Childhood waist circumference continued to be a

significant predictor of Metabolic Syndrome in young adulthood. Higher levels of adiposity in childhood are associated with an increased risk of cardio-metabolic disease in adulthood (Schmidt et al., 2011).

Ashwell (2011) corroborates that as the height and waist circumference of children normally increase continually with age, the same boundary value of waist to height ratio of 0.5 could be used to indicate increased risk across all age groups. In children the values between 0.5 and 0.6 implicate that action is needed to be taken to prevent further increase in abdominal obesity.

The PEACH (Pediatric Epidemiology and Child Health) study conducted by St. John's Research Institute, India, among eight urban middle income preschool and school children has evolved waist-to-height ratio percentile curves for middle class South Indian children of both sexes. This helped to know that the waist circumference of the Indian children from the study was higher compared to age and gender matched British children using the same techniques of measurement. Waist-to-height ratio is a good measure to represent waist circumference in relation to another easily measurable body proportion so that distortions based on the body frame size in different populations are removed and Kurian et al. (2011) suggest the 75th percentile values to be used as 'action point' for Indian children.

The waist-to-height ratio is more sensitive than BMI as an early warning of health risks. It is significantly associated with all risk factors for obesity and metabolic syndrome and can predict morbidity and mortality in longitudinal studies, often better than BMI (Ashwell and Hsieh, 2005).

Waist-to-height ratio is a simple and effective global indicator for health risks (Hara et al., 2002, Kahn et al. 2005) but the risk lies in over sensitivity of this methodology as proven by Panjikkaran and Kumari (2009). Since the height and waist circumference of children increases continually as they age, the same boundary value (WHTR-/0.5) could not be used across all age groups.

An increasing number of studies documented that the ratio of waist circumference to height [waist-to-height ratio (WHTR)] was even superior to waist circumference and BMI to predict cardiovascular risk factors in European and Asian children. The value of 0.5 was suggested as an appropriate cut-off point for both adults and children (Savva et al., 2000; Hsieh et al., 2003; McCarthy et al., 2006).

Savva et al. (2000) point out that waist circumference and waist to height ratio were better predictors of cardio vascular disease risk factors in children than BMI. BMI was a better indicator of high blood pressure.

Abdominal obesity may be a better predictor than overall obesity for the risk of cardiovascular disease and type 2 diabetes. Waist circumference and waist-height ratio are two simple, yet effective, surrogate measures of abdominal obesity. The relative change in waist-height ratio among children in the NHANES surveys was similar to waist circumference at each age group for both boys and girls. Using the 90th percentile values of waist circumference for gender and age, the prevalence of abdominal obesity increased by 65.4 per cent (from 10.5% to 17.4%) and 69.4 per cent (from 10.5% to 17.8%) for boys and girls, respectively (Li et al., 2006).

Maffeis et al. (2008) conclude that waist circumference and waist to height ratio are helpful in detecting, among overweight children, those with a higher likelihood of having metabolic and cardiovascular risks. However, contrary to waist circumference, waist to height ratio had the advantage of not requiring population specific reference tables as well as age and sex specific cutoffs.

Panjikkaran and Kumari (2009) reflect that a waist to height ratio is an effective predictor of metabolic risks in all related investigations in Indian children, which may be due to better measurement of relative fat distribution among children of different ages and statures and the possible independent effect of height on the metabolic risks in addition to its independent effect of coronary disease itself. A waist to height ratio of 0.5 may be simple and effective index not only to identify almost overweight children, but also to identify children within the normal weight range.

Browning et al. (2010) propagate that waist-to-height ratio and waist circumference are similar predictors of diabetes and cardio vascular disease risk, both being stronger than and independent of BMI. Waist to height ratio may be more useful global screening tool than waist circumference, with a weighted mean boundary value of 0.5, supporting the simple public health message, 'keep your waist circumference to less than half your height'.

A Norwegian study conducted among children of four to eighteen years presented the first reference values of waist circumference and waist to height

ratio and also represented the first reference in Scandinavian school children (Brannsether et al., 2011).

Yan et al. (2007) point out the advantages of waist-to-height ratio in that it combines the advantages of both BMI and waist-to-hip ratio by taking not only height, but also the abdominal obesity into account, it is less correlated with age than BMI, which makes it possible to propose a non-age-dependent cut-off point, and waist-to-height ratio, as a diagnostic test, was shown as having higher accuracy than waist circumference in identifying overweight and obesity in children defined by BMI.

These views are endorsed by Mokha et al. (2010) in his study of four to 18 year old children in U.S. who state that waist-to-height ratio not only detects central obesity and related adverse cardio metabolic risk among normal weight children, but also identifies those without such conditions among the overweight/obese children, which has implications for pediatric primary care practice.

4. Arm measurements

Candido et al. (2011) observe that arm fat area measurements are most suitable for adiposity screening in pre-pubertal and pubertal boys and in pubertal and pre-pubertal girls, respectively.

Correlations of skeletal age (SA) and skeletal and chronological age (SA-CA) differences with body dimensions (height, sitting height, leg length, weight, triceps skinfold, arm and estimated mid-arm muscle circumferences) were consistent and approximately equal in magnitude for the well-nourished samples but were different among Oaxaca children who were mild to moderately undernourished. SAs of Philadelphia children were significantly more highly correlated with body dimensions than were SA-CA differences compared to Oaxaca Mestizo children (Little and Malina, 2007).

E. ORGANIZATION AND OPERATION OF FOOD SERVICES IN SCHOOLS

Food Service (US English) or catering industry (British English) defines those businesses, institutions and companies responsible for any meal prepared outside the home. This industry includes restaurants, school and hospital cafeterias, catering operations and many other formats (Wikipedia, 2011).

School food service means all food service operations conducted by the school food authority principally for the benefit of school children, all of the

revenue from which is used solely for the operation or improvement of such food services (US Legal, 2007).

School Food Service is an integral part of a healthy school environment. The cafeteria plays a central role in educating and modeling healthy behavior and can serve as a learning lab for nutrition education (Dairy Council of California, 2011).

School foodservice is one of the most complex departments in a school. For a variety of reasons, some schools have turned to private foodservice management companies to assume responsibility for these programs. The decision to outsource foodservices should not be made lightly, as it may or may not be in the best interest of the school district or its students (USDA Team Nutrition, 2007).

The New York Department of Education (2011) reinforces its commitment to promoting healthy food choices for the students and maintaining high nutritional standards while offering delicious, healthy and satisfying menu options to reach the goal and enhance learning process.

Schools play an important role in providing healthful meals to children and teaching them lifelong healthy habits. Due to financial considerations and the demand from students for more variety and food choices, schools were challenged to offer a wider range of appealing and nutritious meal choices in creative ways. In most secondary schools, the amount of time to eat lunch is a major factor in the students' meal choice. To address the issues of time and available healthy food options, some schools are considering offering healthful vended reimbursable lunches. Healthier, appealing and affordable foods and beverages could be given for school children (NFSMI, 2007).

The National Food Service Management Institute, U.S. (2007) opines that vended reimbursable lunch is a possible option for providing healthful options at affordable prices for children. In one school, traditional food-based menu planning option with the menu being developed and prepared in the school premises was utilized. Sandwiches, salads, fruit drinks, milk and fruits were prepared and loaded into the vending machines. In another school, food-based menu planning option and vending was used and lunches were prepared on-site. Sandwiches, yogurt, fruits, salads, juices and milk choices were available. There was an increase of 20 to 25 per cent participation in the school vending programme.

Bogden and Vega-Matos (2011) insist on the necessity of a school board to address the role its school foodservice program plays in meeting the district's mission. *Fit, Healthy and Ready to Learn*, the authoritative set of policy recommendations for a comprehensive school health program, was developed by the National Association of State Boards of Education. The program was an essential educational and support activity.

Sackin (2006) reasons out that there were situations why a school board may opt to outsource its foodservice program. A school board must commit to treating its school foodservice program as an integral part of the educational environment. The shared goal of all the partners involved is the achievement of children and the school should provide the best opportunity for them to succeed. Part of that goal is to ensure that children are healthy, well-nourished and able to take advantage of educational opportunities offered to them in the classroom and beyond.

Pointing out to distinctions in the types of foods served Subratty et al. (2004) divide them into the following broad categories: Fast foods are those foods sold in a restaurant or store which are rapidly prepared and quickly served foods in a packaged form for take away. Examples are Burgers, pizzas, fries, hamburgers, patties, nuggets, Indian foods like pakora, samosa, namkeen etc. Junk foods are energy dense foods with high sugar/ fat/ salt content and low in nutrient value in terms of protein, fiber, vitamin and mineral content. Examples are chips, chocolate, ice cream, soft drinks, burgers, pizzas etc. Instant foods are foods that undergo special processing that are ready to be served once dissolved or dispersed in a liquid with low cooking time. Examples are Noodles, corn flakes, soup powder. Street foods are ready to eat foods and beverages prepared and sold by hawkers or vendors in streets or other public places. Examples are Chaat, samosa, tikki, noodles, chowmein and burgers.

Riet et al.(2001) define street foods as 'ready-to-eat foods and beverages, processed or fresh, which are sold on the streets as opposed to stores and licensed establishments (such as kiosks), and which are sold at a stationary location or by mobile vendors'. Street foods play an important role in the diet of the low-income urban dwelling children.

The most popular foods in the school cafeterias in U.S.(with a popularity rating of 30 per cent or greater) included chicken nuggets, steak, potato puffs and

mashed potatoes along with cheese pizza at the higher socio economic treatment schools, while oven baked fries were considered as slow foods. Go Organic foods like chocolate milk, sherbet, fruit cocktail, pineapple, pears, applesauce and corn (NFSMI, 2001).

Some school foodservice directors have expressed concern that children will not participate in the school lunch program or purchase a la carte foods if lower fat foods and more fruits and vegetables were emphasized through menu offerings (U.S. Department of Agriculture, Food and Nutrition Service, 2005). Many of the typical fried and fast food choices, such as pizza and French fries, ranked as “favorites” for the participants. The only ‘vegetables’ that ranked in the ‘Top 20’ foods were potato options such as French fries, mashed and baked potatoes. When looking at national vegetable consumption data as pointed out by Guthrie et al. (2005), the most popular vegetable choice was fried potatoes.

Georgiou et al. (2005) demonstrated that 3rd graders were more likely to select entrees and milk than the vegetable selections. Overall preference for vegetables was low. Krukowski et al. (2011) endorse this fact by pointing out that few healthier options were available on children's menus and most menus did not provide parents with information for making healthy choices, including nutrition information or identification of healthier options.

Middle school students with access to snack bar foods consumed fewer fruit and vegetable (FV) servings compared with elementary school students who only received NSLP meals (Cullen et al., 2000). Among students followed from elementary into middle school, consumption of fruit, regular vegetables (i.e., not fried) and milk decreased, while consumption of fried vegetables and sweetened beverages increased (Cullen and Zakeri, 2004). The number of school snack vending machines was negatively related to lunch fruit consumption (Kubik et al., 2003).

School food policies that decreased access to foods high in fats and sugars were found to be associated with less frequent purchase of these items in school among high school students in a study conducted at 20 schools in Minnesota, U.S.A. Schools should examine their food-related policies and decrease access to foods that are low in nutrients and high in fats and sugars (Neumark-Sztainer et al. 2005).

Lytle et al. (2000) demonstrated decreases in fruit, vegetable, milk, and fruit juice consumption with an increase in soft drink consumption between elementary and middle school children. Insight into the food preferences reported by children and adolescents is valuable information that may be used by foodservice managers and others who are seeking to improve the diets of school age children while developing life-long healthy eating habits.

Chocolate milk was ranked as the third most preferred food on the list and white milk made the 'Top 20' list in a study conducted by Enns et al. (2002) at the National School Lunch Program. Children between the ages of 6 to 11 drank 1.5 times as much milk as soft drinks, in the absence of sale of soft drinks.

Caine-Bish and Scheule (2007) emphasize that those planning menus and meals for children should include a wide variety of menu selections as means to improve nutritional quality as well as satisfaction. Even some of the most favored foods were disliked by some students and thus these children were at a disadvantage when menus lack variety.

Goran (2001) stresses on the public health concern with fast-food marketing which lies in the proposed relationship between fast-food consumption and obesity in children as well as in the nutritional profile of most fast-food menus. Sustained imbalance of approximately two per cent of energy results in the development of obesity over time in children.

Students gain access to snack bars, a la carte lines, and vending machines in middle school (Cullen et al., 2000; Fox et al., 2001). Blanchette and Brug (2005) suggest that these school food environments may have a negative impact on National School Lunch Program participation and student consumption, with more junk food consumption rather than consumption of nutrient rich foods.

Fast food has become a regular part of the American diet, and on average, almost one-third of youths aged 4 to 19 eat fast food on a typical day as surveyed by Bowman et al. (2004) and Guthrie et al. (2002). Studies by Paeratakul et al. (2003) have found that youths aged 11 to 18 eat at fast-food outlets an average of twice per week.

Research study from Nestle (2002) points out that because they fulfill consumers' desires for tasty, convenient, and inexpensive food, fast-food outlets have become a "home away from home for breakfast, lunch and dinner" among consumers of all ages.

Student snack food purchases from vending machines were significantly more frequent among students from schools with a greater number of snack food vending machines. School food policies that decreased access to foods high in fats and sugars were associated with less frequent purchase of these items in school among high school students (Neumark-Sztainer et al. 2005).

The Korea Youth Risk Behavior Web-based Survey (KYRBWS) carried out by Bae et al. (2010) found poor dietary behaviors and nutritional imbalance to be two of the main health behavior problems in Korean youth. There is concern over high rates of fast food consumption because of the high energy, fat, and sodium content found in them.

Friends appeared to be the most influential people for the participants' fast food consumption. Although the subjects' motivation to comply was similar for family, teachers and friends, it was more positive with friends than with family and teachers. This finding shows that nutrition education about fast food consumption for students should emphasize changing the norm among students (Seo et al., 2011).

Subratty et al. (2004) opine that junk foods often contain colors that are inedible, carcinogenic and harmful to the body. Poor nutritional habits can undermine pre-requisites of learning and decrease the strength that children need for participating in sports and games. Fast food consumption and globalization of diet has led to loss of traditional healthy food practices. Trans-fat content in Indian fast foods are far higher than western foods.

Prentice and Jebb (2003) support the concept of a 2 per cent imbalance for a child corresponding to about 30 kilocalories per day. Foods' energy density is a key determinant of energy intake and most fast foods have extremely high energy density.

Fast food consumption leads to excess energy intake and in turn, increased risk of overweight and obesity. Among adolescents, fast-food consumption was positively associated with higher intake of total energy and percentage of energy from fat and inversely associated with daily servings of fruit, vegetables, and milk. (French, et al., 2000 and 2001 and Paeratakul et al., 2003).

Kaushik et al. (2011) sense that consumption of diet high in sugar, saturated fat, salt and calorie content in children can lead to early development of obesity, hypertension, dyslipidemia and impaired glucose tolerance. Fast foods

have high level of fat and sugars, especially high content of trans fat which predispose children to risk of future heart diseases. Energy density of fast food is more than twice the recommended daily allowance for children and leads to higher proportion of calories being derived from total and saturated fat. The micronutrient content (carotene, vitamin A, vitamin C) of the fast food is also low. Low levels of calcium and magnesium in the diet can contribute to osteoporosis.

Zoumas and colleagues (2001) find that the calorie content of out-of-home meals that children consumed was 55 per cent higher than that of in-home meals. Fast foods are rich in saturated fats, trans fats, simple carbohydrates, and sodium—all of which are nutrients associated with hypertension, cardiovascular disease, and type 2 diabetes (World Health Organization, 2003).

Abramowitz (2006) observes that concern about childhood obesity has also prompted fast-food industry collaborators to make strategic changes. Disney's non-renewal of a long term promotional partnership with a fast-food franchise to growing concerns about childhood obesity. The same is endorsed by Institute of Medicine (2006) and Seiders and Petty (2004).

Cranage et al. (2006) uphold that students became bored with menu offerings and cafeteria settings and that supplying nutrition information not only halts such a waning trend in satisfaction, but increases student satisfaction from baseline measures.

Much effort has been focused on modifying foods offered in school vending machines, but these foods provided a very small proportion of daily energy intake (2.8%) in comparison to foods consumed during school lunch (11.2%) enlighten Adair and Popkin (2005) and Nielsen et al. (2002). There had been some success in efforts designed to help students make better food choices. As part of a study by Conklin et al. (2005) school lunches were labeled with nutrition information. Results showed that high school students, when presented with nutrition information prior to the point of selection, chose lower-fat lunches and foods with fewer calories.

Health concerns surrounding food offered by schools have grown and, as a result, school nutrition programs have achieved a higher level importance on many schools' agendas (Kubik et al., 2003; Wechsler et al., 2000). Efforts to modify the food environment in schools have involved the elimination of "unhealthy" food items and their substitution with healthier options (Murphy-Zive et

al., 2002; Story et al., 2003). Promoting consumption of fruits and vegetables had been positive, especially efforts to increase fruit intake as investigated by French (2005). Offering healthier snacks in vending machines, such as soy-based snacks and baked potato chips, appeared to be a successful approach when attempting to lower high-fat snack choices (French et al., 2001; Jacobson & Brownell, 2000).

Neelon et al. (2010) brought out a comparison of the menus listed and those served in food service in schools which revealed that grains, juice and vegetables were served less often than indicated on the menus and milk, protein-rich foods, fruits, mixed dishes and foods of low nutritional value were served more often than listed on the menus.

Cavadini et al. (2000) insist that part of the challenge in modifying the school food environment rests in achieving a balance between a healthy diet and one that is accepted by students with gradual formulation changes to student favorites that were highest in fat and energy density.

Stroebele et al. (2006) find out that modified versions (reduce fat and energy density as much as possible in the foods while attempting to maintain the taste of the original items in school food services) of popular lunch items were highly accepted by the Denver Public Schools students.

The vendors who provided meals and snacks in mobile eateries were mainly women, who offered a wide range of other products, including fried potatoes, fried rice, rice and beans, fried banana, fried tomato-and-onion pancakes, fried groundnuts with sugar, fried sweet potatoes, and sweetened and flavoured water. Most had no formal training at all in the preparation of food under safe, hygienic conditions. Vendors also rarely sold fruits, owing to their high cost out-of-season and their low profit margin in-season. One type of food that school children do not seem to purchase is fruit (FAO of the UN, 2011).

Subratty et al. (2004) call attention to the fact that food vendors were quite aware of hygienic conditions, which have to be respected while handling and preparing foods. However, it was found that the majority of them was not implementing their knowledge into practice and still perceived that their products were of relatively low risk to the consumers.

Risk from food brought into school from other places or that is handled with unwashed hands was greater. Training all foodservice staff in basic food safety practices, including cooking foods to proper temperatures, upon employment and

periodically thereafter was found mandatory. Washing hands at appropriate times proved to be essential (USDA, 2005). The food safety certification process was initiated to establish minimum standards of food safety practices and provided information necessary to train employees in food safety and implement a food safety system (American Food Safety Institute, 2000).

Henroid and Sneed (2004) concluded that training programs on implementing prerequisite HACCP programs were needed in school foodservice after they evaluated several factors, including employee food safety knowledge, attitudes and food handling practices. Hwang et al. (2001) reported that only 62 per cent of school foodservice operations had a sanitation-training program for employees. Henroid and Sneed (2004) summarized that employees in school foodservice may have sufficient knowledge about food safety but needed assistance in developing prerequisite programs in preparation for HACCP.

F. IMPACT OF DIET AND LIFESTYLE COUNSELING ON HEALTH STATUS

Nutrition counseling is an ongoing process in which a health professional works with an individual to assess his or her usual dietary intake and identify areas where change is needed. The nutrition counselor provides information, educational materials, support, and follow-up to help the individual make and maintain the needed dietary changes (Encyclopedia of Mental Disorders, 2011).

Dhingra et al. (2011) suggest that health education should be given to parents, teachers and children regarding dietary habits and sedentary life style. The children should be motivated to participate in various physical activities both inside school and outside home. The change in lifestyle should be taken under small steps so that the family could accommodate and appreciate them.

Kaczkowski (2011) defines dietary counseling as the process which provides individualizing nutritional care for encouraging modification of eating habits. It may also assist in prevention or treatment of nutrition-related illnesses such as obesity.

Kurpad et al. (2004) observe that even if interventions are undertaken, they should be holistic, incorporating changes in lifestyle, diet and physical activity. A combined approach should also be undertaken so that intervention strategies are implemented at the home and family level, at school and within the community. Curriculum time should be given for physical activity and schools

should embrace policies that encourage participation in physical activity. Interventions should also be designed to be inclusive of all children. Adequately trained, motivated personnel should be involved in these programs. It is better to implement primary prevention, rather than targeted or secondary prevention.

The U.S. Preventive Services Task Force (2011) found good evidence that medium- to high-intensity counseling interventions can produce medium to large changes in average daily intake of the core components of a healthy diet (including reduced consumption of saturated fat and increased consumption of fiber, fruits, and vegetables) in adult patients at increased risk of diet-related chronic diseases.

Each intervention session to combat obesity among children conducted by Bruss et al. (2010) utilized the following ROPES format to engage primary school children. *Review*: facilitators helped participants to establish where they are as learners in their understanding of childhood obesity concepts; *Overview*: facilitators helped participants to know the specific concept that would be covered in the session i.e., preserving self-esteem; *Presentation*: facilitators used a power point presentation to discuss content related to each topic, i.e., reading food labels; *Exercise*: facilitators used cultural-based hands-on activities, discussion questions, role playing, and case studies to apply information gained in the presentation, i.e., highlight a behavior and engage participants to respond; and *Summary*: facilitators asked relevant questions and discussed take-home assignments related to the topic for family engagement, i.e., logging physical activity/inactivity.

Parent, school, and community participation is an approach that can be followed for interventions.

Schools are ideal settings for nutrition education as schools can reach almost to all children and adolescents; they provide opportunities to practice healthy eating. Schools can teach students how to resist social pressures, school-based programs can directly address peer pressure that discourages healthy eating and harness the power of peer pressure to reinforce healthy eating habits. After appropriate training, teachers can use their instructional skills and food service personnel can contribute their expertise to nutrition education programs. School based programs improved eating behavior of children (CDC, 2011).

Olander (2011) considers the necessity for inclusion of parents in the intervention studies for primary school children (4 to 11 years) aimed at improving their physical activity levels and dietary intake. Parental involvement ensured that the children's physical activity increased and their diet improved in quality. The most promising strategy to do this is to involve parents in events together with their children so that they can reinforce the intervention messages to their children. Communicating advices on nutrition recommendations, food choices and portion sizes for children related to their age and level of physical activity can help parents adapt their menus. Rather than imposing qualitative or quantitative restraints on the children, the diets of the entire family could be reoriented. Early intervention at school age helps to curb the problem of obesity and overweight.

Nutrition education imparted to government school children from 13 to 19 years in Himachal Pradesh resulted in an improvement in the level of nutrition knowledge as well as nutrient intake. Nutrition education was imparted in classrooms once a week for a period of three months through group contact and lecture cum discussion methods. Charts, leaflets, posters and demonstrations were used. The topics involved were functions of food, balanced diet, nutrients and their functions and requirements. Better cooking practices, food hygiene and sanitation were also covered in the study (Kaur et al., 2007).

In children, strong evidence of effect was found for multicomponent interventions carried out by Cauwenberghe et al. (2010) on fruit and vegetable intakes. In adolescents, moderate evidence of effect was found for educational interventions on behavior. Evidence was found for the effectiveness of especially multicomponent interventions promoting a healthy diet in school-aged children in European Union countries on self-reported dietary behaviour.

A food-based intervention study focused on three behavioural changes that were supported by environmental changes such as increasing fruit consumption to at least two pieces a day, reducing soft drinks consumption and increasing water consumption and reducing fat intake. Children received information about the improved health consequences of eating fruit as opposed to snacks and drinking water rather than soft drinks. During classes children received the computer-tailored intervention for fat intake and fruit intake. The intervention had positive effects on fat-related outcomes in girls, but only when parental support was included (Haerens et al., 2007).

An intervention study carried out with 14 group sessions by Waling et al. (2010) with different themes regarding food and physical activity was found to be effective in decreasing energy intake in the intervention group compared to the control group which had no such intervention.

An intervention program implemented with the target population consisting of first- through fourth-grade students in urban schools by Gower et al. (2010) with only students from the intervention group participating in four weekly nutrition classes showed improvement in nutrition knowledge, while scores for the control group remained unchanged.

According to Contento (2010), students in intervention schools who received the 24 *Choice, Control and Change* lessons that used science inquiry investigations to enhance motivation for action and social cognitive and self-determination theories to increase personal and autonomous motivation to take action compared to the delayed intervention controls reported consumption of considerably fewer sweetened drinks and packaged snacks, smaller sizes of fast food, increased intentional walking for exercise, and decreased leisure screen time.

The Pro Children intervention study by te Velde et al. (2008) combined a fruit – vegetable (FV) curriculum with efforts to improve FV availability at schools and at home. Effects were examined in a group-randomised trial of 10 to 11 year old children Norway, the Netherlands and Spain. Interventions comprised of components like classroom curriculum consisting of school education materials, the school component consisting of the provision of fruit and vegetables, the family component which encouraged parents to be involved in the project by means of their children's homework assignments, parental newsletters and a parent version of the web-based computer-tailored tool that enabled them to get personalised feedback on their own fruit and vegetable intake levels. Positive intervention effects on FV intake occurred both at school and outside school.

The most successful school based interventions have been multi component, as demonstrated by Perez-Rodrigo et al. (2005) to get children eating more fruits and vegetables. One of these interventions was the Pro children study which showed good and sustained effect on increasing the consumption of fruits and vegetables among children. Promotion of fruit- and vegetable intake was split

into performance objectives and related personal, social and environmental determinants (Rasmussen et al., 2006).

FAO of the UN (2007) stresses that children should be educated to make healthy food choices and public information campaigns should encourage families to ensure that children eat breakfast before they leave home.

Results of an Internet-based computer-tailored nutrition intervention in adolescents in six European cities revealed that in most participating centers the intervention was feasible and generally well appreciated, especially by girls, as pointed out by Maes et al. (2011). In the overweight group there was a clear positive effect for reducing fat intake compared to the adolescents receiving standardized advice.

Kaistha et al. (2001) bring out the importance of nutritional counseling for obese children on a fat restricted diet. They insist on incorporating the necessary vitamins, minerals and nutrients in the diet without enabling weight gain through effective counseling strategies.

Intervention participants who received primary care restructuring and families who received motivational interviewing by clinicians and educational modules targeting television viewing and fast food and sugar-sweetened beverage intake change in BMI, greater decreases in television viewing and slightly greater decreases in fast food and sugar-sweetened beverage intake (Taveras et al., 2011).

Greydanus and Bhave (2004) ascertain that general recommendations to increase physical activity in Indian obese children and adolescents often fail because inappropriate activity may be offered, opportunities for physical activities for obese children and adolescents are usually lacking in the school environment. These youth can be taught that various activities are fun as well as healthy-such as walking, dancing, aerobics, cycling, swimming and many others. Water-sports may be preferred by many obese youth, since the excess adipose tissue allows excellent buoyancy.

Jago and Baranowski (2004) and Wechsler (2000) point out that the school environment is an ideal setting for the promotion of physical activity (PA), since all children can be reached. Schools could provide opportunities to be physically active during physical education, during recess, and before and after school hours.

An intervention study in elementary schools done by Kahn et al. (2002) had attempted to increase children's physical activity (PA) levels at school by focusing on physical education (PE). Significant intervention effects for PA were found mainly for moderate-intensity activities. Self-reported PA measurements indicated that the intervention was effective in increasing children's moderate PA and moderate to vigorous PA in leisure time. The intervention was as effective in boys as in girls (Jago and Baronowski , 2004).

In the USA, the SPARK programme (Sports, Play and Active Recreation for Kids) designed by Cavill et al. (2001) to increase children's PA levels during PE classes and outside school by implementing a health-related PE programme and a self-management programme showed good improvement in the levels of physical activity in children. This was implemented by Verstraete et al. (2007) in his study on eleven-year-old children and in the intervention group, children were made to increase their physical activity and awareness of physical activity for children was brought out among teachers. The intervention was effective in promoting physical activity among the children. A slight positive effect was noted in anthropometric measurements in the intervention group children compared to the control group.

Interventions should focus on health, not weight, so as to not contribute to the overvaluation of weight and shape and negative attitudes about fatness that are common among children and have harmful effects on their physical, social and psychological well-being. Interventions aimed at addressing weight concerns should be constructed from a holistic perspective, where equal consideration is given to social, emotional and physical aspects of children's health. Interventions should focus only on modifiable behaviors (e.g. physical activity, intake of sugar-sweetened beverages, time spent watching television). Interventions should be referred to as "health promotion," as the ultimate goal is the health and well-being of all children and health encompasses many factors besides weight. Interventions should provide diversity training for parents, teachers and school-staff for the purpose of recognizing and addressing weight-related stigma and harassment and constructing a size-friendly environment in and out of school (Daníelsdóttir et al., 2011).

Freeman et al. (2011) suggest that interventions are urgently required to target parents as a key strategy for childhood obesity prevention and/or treatment.

Family-based behavioural treatment (FBBT) showed a significant reduction in systolic blood pressure and improvements in quality of life and eating attitudes for obese children, with no significant changes for the control group in the study conducted by Croker et al. (2011).

Sharma et al. (2007) feel that there is a need to raise awareness not only among children on the importance of body measurements but also among parents to reduce the epidemic of high BMI (overweight/obesity). Dietary excesses should be counteracted with dietary modifications, as even small additions to the diet can increase overall food intake. This could also be done through improved physical activity which must be stressed in school environments through proper counseling techniques.

A follow-up study by Taylor et al. (2008) was done on intervention group children to adjudge whether the BMI of the children, who were instructed to improve their physical activity levels and promote healthy eating, were normal. The follow-up revealed that BMI scores remained significantly lower in these children even after 2 years of the initial study.