REVIEW OF LITERATURE
II REVIEW OF LITERATURE

The literature pertaining to the study entitled “Prevalence of Obesity among School Children in Coimbatore and Impact of Intervention Strategies” is reviewed under the following headings:

A. Prevalence of Obesity in Children
B. Contributory Factors of Childhood Obesity
C. Consequences of Childhood Obesity and
D. Management of Obesity in Children
   1. Nutrition Education
   2. Physical Activity
   3. Dietary Interventions
   4. Other Interventions

A. PREVALENCE OF OBESITY IN CHILDREN

‘Obesity’ originates from a Latin word (Obdere - to devour) which means ‘very fat’ and refers to the degree of fatness in the total body composition (Nix, 2005). It is an abnormal accumulation of body fat, usually 20 per cent or more than an individual’s ideal body weight. Ideal body weight is that weight essential to maintain good health. Body weight depends primarily on three factors: gender, age and height. In obesity, there is an evidence of changing body composition with increasing fat and reduction in muscle (Rogers, 2005).

Obesity is the most common disorder of childhood in the developed and developing countries (Reilly, 2005). The prevalence of over-weight is dramatically higher in economically developed regions but is rising significantly in other parts of the world. In many countries the problem of childhood obesity is worsening at an alarming rate. Surveys during the 1990s show that in Brazil and in USA, an additional 0.5 per cent of the entire child population became overweight each year.
Childhood obesity has been increasing steadily, particularly during the past two decades. According to Ogden et al. (2006) as depicted in Figure 1, the number of children above the 95th percentile of weight for height has tripled among those in the age of 12 to 19 years, rising from five per cent in 1966-70 to 17 per cent in 2003-04.

![FIGURE 1](image)

**FIGURE 1**

**CHILDHOOD OBESITY EPIDEMIC**

Wang et al. (2006) reported that approximately 0.5 per cent is being added to the prevalence rates of childhood obesity each year. It affects more than 30 per cent of children, making it the most common chronic disease of childhood (www.obesitysurgeryindia.org).

According to WHO, the worldwide prevalence of overweight by 2025 is expected to rise to 300 million, 76 per cent of whom will be in developed countries and it is predicted that the three countries with the largest number of overweight will be China, India and USA (Zimmet et al., 2007).

The prevalence of childhood obesity around the world and in India is presented in Table I (Misra and Misra, 2006).
TABLE I
THE PREVALENCE OF CHILDHOOD OBESITY

<table>
<thead>
<tr>
<th>Country / City</th>
<th>Year</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>2004</td>
<td>10</td>
</tr>
<tr>
<td>USA / UK</td>
<td>2000</td>
<td>20</td>
</tr>
<tr>
<td>Australia</td>
<td>1995</td>
<td>20</td>
</tr>
<tr>
<td>India / Chennai</td>
<td>2002</td>
<td>22</td>
</tr>
</tbody>
</table>

1. Child Obesity – A Growing Epidemic

Childhood obesity statistics shown in Table II clearly indicate an increasing trend.

TABLE II
CHILD OBESITY STATISTICS

<table>
<thead>
<tr>
<th>Year of Survey</th>
<th>Percentage distribution of overweight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-5 years</td>
</tr>
<tr>
<td>1971 – 74</td>
<td>5.0</td>
</tr>
<tr>
<td>2003 – 04</td>
<td>13.9</td>
</tr>
</tbody>
</table>

Source: Iannelli, 2008 (Child Obesity Statistics, About.com)

Globally the prevalence of childhood obesity varied from over 30 per cent in USA to less than two per cent in subSaharan Africa. Currently the prevalence of obesity among school children is 20 per cent in U K and Australia, 15.8 per cent in Saudi Arabia, 15.6 per cent in Thailand, 10 per cent in Japan and 7.8 per cent in Iran (http://www.mayoclinic.com/health/childhood-obesity/DS006_98,2009)

In Canada, Australia and parts of Europe the rates were higher, with an additional one per cent of all children becoming overweight each year. More than 20 per cent of European children are overweight and nine per cent are obese and this is likely to rise to 25 per cent and 11 per cent respectively in the near future (www.nutraingredients.com.)
The increasing prevalence of obesity in children is a significant and alarming public health problem. An estimate of global obesity revealed that about 17.6 million children under five years are overweight and 1.7 billion adults are overweight with at least 312 million being clinically obese (http://www.who.int/nut/),

Epidemiological data of International Obesity Task Force (IOTF) (2006) shows that prevalence rates are increasing not only in industrialized countries, but also in developing countries especially, as far as the adolescent population is concerned. The IOTF report also predicts that in the year 2010, 155 million school aged children in the world will be overweight and 40 million children will be obese. Among the various WHO regions, the highest prevalence rates are found in America, followed by Europe and Middle East (International Association for the Study of Obesity (IASO), 2004).

Overweight was prevalent among 15.3 per cent of boys, 21.8 per cent of girls with further 7.9 per cent boys and 8.1 per cent girls considered obese among school aged children in Australia (Zuo, et al., 2006).

Shields (2005) reported that 26 per cent of Canadian children and adolescents aged 2-17 years were obese. Prevalence of overweight and obesity among children in China was approximately five per cent and two per cent respectively in 2002 (Li, et al., 2007).

A cross-sectional study carried out in Qatar, targeting 271 (124 males and 147 females) primary school students revealed that 3.2 per cent males and 8.8 per cent females were overweight and 1.6 and 5.4 per cent were obese respectively (Qotba and Alisa, 2007).

Barbara et al. (2006) reported that overweight population exceeded underweight in almost half of the Asian countries and the median ratio of overweight to underweight was 5.8 in urban and 2.1 in rural areas. Asian
countries with high gross national income and high levels of urbanization had high absolute prevalence of overweight and revealed small urban-rural differences in overweight.

Evidence from several national health surveys in Asia points to significant differences in prevalence of overweight and obesity among countries. While Taiwan and China have experienced rapid increases in prevalence of childhood obesity (Chu, 2005 and Wu, 2006). The prevalence of overweight and obesity in 14 Asian countries ranged from less than 15 per cent in India to 60 per cent in other countries (Kelishadi, 2008). Mohan (2007) reported that the incidence of overweight is increasing at an alarming rate in India.

A study based in India, based on the CDC cut offs revealed that 9.9 per cent of boys and 12.0 per cent of girls aged 10–15 years were overweight, and five per cent of the boys and 6.3 per cent of girls were obese (Sidhu et al., 2005).

Bhasin et al. (2005) reported the prevalence of overweight in India has been growing by leaps with a threefold increase over the last 20 years and that the prevalence of overweight and obesity was highest in the Northern part of India than in the Southern part.

Bhave et al. (2004) reported that the prevalence of overweight and obesity was the highest in Delhi and Punjab and lower in the economically less developed states of Uttar Pradesh, Madhya Pradesh, Rajasthan, Orissa, Assam, and Bihar. In Delhi, the proportion of overweight rose from less than 10 per cent during 15 to 24 years to about 40 per cent during 45 to 49 years while in Punjab it increased from 11 per cent during 15 to 24 to about 49 per cent between 45–49 years.
National representative data for childhood obesity in India is not available. However available studies of Chennai and Delhi have shown a prevalence of 6.2 per cent and 7.4 per cent respectively (Kumar et al., 2007).

A cross-sectional study carried out in 31 middle-schools (5th to 7th standard) and high-schools (8th to 10th standard) of Wardha city, Central India revealed the percentage prevalence of overweight and obesity to be 3.1 and 1.2 respectively (Bharati et al., 2008).

According to a report from urban South India, 21.4 per cent of boys and 18.5 per cent of girls aged 13-18 years were overweight or obese (http://www.incidenttrust.org/index.php?option=content&task=view&id=225 item id=277).

A study conducted in Chennai, TamilNadu showed that the prevalence of over weight was 28 per cent and that of obesity was three per cent (Kaur et al., 2005). The prevalence of obesity among children (7-12 years) from selected schools of Chennai was found to be 8.6 per cent (Jayapradha and Kalpana, 2006).

A study conducted at Thiruvananthapuram, Kerala on 3886 school going children reported that 4.99 per cent were obese and 17.73 per cent were overweight (Unnithan and Syamakumari, 2008). Another study at Central Kerala among 20,263 children revealed that 6.57 per cent were found to be overweight (Manuraj et al., 2007).

B. CONTRIBUTORY FACTORS OF CHILDHOOD OBESITY

In developing countries, rapid progress of urbanization and demographic trends is associated with a cluster of non-communicable diseases and unhealthy lifestyles described as the “lifestyle syndrome” or the “New World syndrome.” This is suggested as the most important etiology for the very high rates of obesity and its consequent morbidity and mortality in developing nations. In addition, in such communities, childhood obesity is
still considered a sign of healthiness and high social class (Kelishadi, 2007).

In India, under nutrition attracted the focus of health workers, as childhood obesity was rarely seen earlier. But over the past few years, childhood obesity is increasingly being observed. This is because of the changing lifestyle of families, increased purchasing power, increased hours of inactivity due to television, video games and computers replacing outdoor games and other social activities (Singh and Sharma, 2005).

WHO (2009) recognized that the increasing prevalence of childhood obesity results from changes in society. Childhood obesity is mainly associated with unhealthy eating and low levels of physical activity but the problem is linked not only to children's behaviour but also to social and economic development and policies in the areas of agriculture, transport, urban planning, environment, food processing, distribution and marketing, as well as education.

Peters (2006) opined that the recent rise in obesity is a function of multi factorial causes, reflecting an interaction between susceptible genetic heritage and an environment that promotes excessive food consumption and sedentary lifestyle.

Childhood obesity is partly due to genetic components and due to environmental factors such as lifestyle, socio economic factors and nutritional habits of the family (Sangha et al., 2006). Body weight is the result of a combination of genetic, metabolic, behavioural, environmental, cultural and socio economic influences (Fluqrud, 2007).

The causes of obesity according to www.health.nsw.gov.au is depicted below:
Monterio et al. (2004) outlined that the changes in dietary and lifestyle patterns, collectively known as the “nutrition transition”, have led to a worldwide trend of increase in obesity. The nutrition transition is generally associated with an increase in the consumption of energy dense foods that are low in fibre, sugar and sweetened drinks, a decrease in physical activity and a more sedentary life style.

The primary cause for being overweight and obese is the unlimited access to food, reduction in physical activity as well as the fulfilment of the genetic response that the body stores up fat reserves during times of abundance for leaner periods later on (Wechsler et al., 2005).

Changes in life styles have led people to become overweight or obese in almost every country around the world and cultural changes. Economy and technology also contribute to obesity (Crawford, 2006). Nutritional and lifestyle transition resulting in high fat intakes linked with the consumption of refined foods and foods of animal origin with an increased fat content coupled with a low physical activity would result in an increased total body fat mass and obesity (Kurpad et al., 2006).

Panidis (2007) observed that through urbanization and modernization, our lives are becoming more sedentary and less physically active than before, having an impact on dietary practices and physical activity which increases the risk of obesity.

Changes in the family system particularly an increase in dual-career or single-parent working families, may also have increased demand for food away from home or pre-prepared foods which ultimately leads to obesity in children (http://www/futureofchildren.org/information2826/information-show.htm?doc-id=351454,2008).
Childhood obesity is partly due to genetic components and due to environmental factors such as lifestyle, socio economic factors and nutritional habits of the family (Sangha et al., 2006). The chief cause is an "Obesogenic environment" that favours poor food choices coupled with passive entertainment and sedentary living (http://www.who.int/mediacentre/news/release/2009/pr81/en/).

Ochoa et al. (2007) concluded that leisure time, decreased physical activity, family history of obesity, watching television, and sugar-sweetened beverage consumption are important predictive variables of childhood obesity.

However, the primary causes associated with childhood obesity include environment, genetics, dietary habits and lack of physical activity.

1. Environment

Today's environment plays a major role in shaping the habits and perceptions of children and adolescents. The presence of television commercials promoting unhealthy foods and eating habits is a large contributor. More money is spent on food outside home, at restaurants, cafeterias, sporting events, etc. In addition, as portion sizes have increased, when people eat out they tend to eat a larger quantity of food (calories) than when they eat at home (Lytle et al., 2006).

Unhealthy diet and sedentary lifestyle among school-goers has led to a nearly three-fold increase among the prevalence of overweight in children within a decade, substantially raising the risk of a future diabetes onset (Varma, 2009).

2. Genetics

Childhood obesity is often the result of an interplay between many genetic and environmental factors. Polymorphisms in various genes controlling appetite and metabolism predispose individuals to obesity when
sufficient calories are present. As such obesity is a major feature of a number of rare genetic conditions that are often present in childhood (Farooqi and Rahilly, 2006).

According to Tiromo and Calude (2006) sequence variants in genes and single genes associated with classical eating disorders are responsible for eating behaviour and cause overweight in children. Pevin (2006) revealed that genetic predisposition to become obese is accentuated in offsprings of mothers who are obese during gestation and lactation or by overfeeding during early postnatal period.

Estimates say that heredity contributes between 5 to 25 per cent of the risk for obesity. A child with two obese parents has 80 per cent risk of becoming overweight, a child with only one obese parent has 40 per cent risk and a child with parents of normal weight has 7 per cent risk of becoming overweight (http://www.fags.org/nutrition/ca-de/childhood-obesity.html, 2009).

Birth weight has been shown to be associated with obesity and metabolic diseases in adulthood. Phenotypically, birth weight was positively correlated to childhood body size parameters. Higher birth weight has also been linked to greater likelihood of being obese early in childhood (Guri, 2007). According to Rugholm et al. (2005) the birth weight distribution remained relatively stable over time compared with children with a birth weight of 3 - 3.5 kg and the risk of overweight increased consistently with each increase in birth weight among girls and at all ages between 6 and 13 years. Studies of prenatal exposure to maternal diabetes found higher prevalence of childhood overweight or obesity among offspring of diabetic mothers (Joan et al., 2005).
3. Dietary Habits

Although genes play a role in the problem, overweight is explained mainly by excessive food intake and sedentary lifestyle (Fulkerson et al., 2006). Over the past few decades, dietary patterns have changed significantly. The average amount of calories consumed per day has dramatically increased. In addition, the increase in caloric intake has also decreased the nutrients needed for a healthy diet.

Despite the importance of healthful eating patterns during childhood and adolescence, studies have consistently shown that this group has poor eating habits and does not meet dietary recommendations. (Institute of Medicine, 2007).

Brownell and Horgen (2006) and Ariza et al. (2006) reported that, high consumption of energy dense snacks, fast foods and soft drinks correlated with rising obesity rates worldwide. Rangan et al. (2007), indicated that extra foods overconsumed at two to four times the recommended limits had contributed excessively to the energy, fat and sugar intake of children, while providing relatively few micronutrients.

An increase in portion sizes and in the consumption of energy-dense foods, fast foods, and soft drinks are important etiological factors for obesity being recognized worldwide (Arroyo et al., 2004). A steady intake of fast foods from childhood to adulthood greatly increased the risk of serious disease conditions (Andrea, 2004).

According to Pevin (2006) the growing popularity of fast foods is just one of many cultural changes that have been brought by globalization and its consumption can have a negative impact on the nutritional quality of the diets of children and adolescents and may increase the risk for obesity.
Saibaba (2005) reported that, snacks and other dishes served in fast food centers have become very popular these days, because they are prepared fast, fairly priced, convenient to consume and taste good. It is also observed that fast food habits have strong positive and independent association with weight gain. Clement and Ferre, (2006) expressed that consumption of fast foods which are rich in sugar, salt and fat causes obesity in children. Fast foods are much higher in fat and calories and significantly lower in nutritional value important for healthy diets (Saletan, 2006).

Junk is the general term used for food that is described as nutritionally deficient and high in calories (Mercola, 2005). Junk foods are potentially harmful, containing high sodium, high saturated fat, high nitrates and nitrites, high sugar candies, anything deep fried, gelatin desserts and coloured sweets (Brown, 2004). Junk food intake also contribute to a number of health problems like tiredness, lack of enthusiasm, constipation, dull hair, skin, weight problem, nausea, headache and poor concentration (Suzannah, 2005).

Kannan (2006) reported that, bakery items are tasty foods which tempt one to eat more and more. Such foods contain nothing but salt, sugar, refined flour, dalda, hydrogenated fat, butter and some additives, which on different combinations are branded and advertised exorbitantly. Sweet products contain ghee, vanaspathy, cooking oil, milk and white flour with food colour, flavour and chemicals, all of which promote weight gain.

The role of fat in the diet is complicated because different types of fatty acids have different effects on health. However, it is clear that children consume too much dietary fat and too much of the fat is from saturated fatty acids (Department of Health and Human Services, USA, 2000).

Taveras et al. (2005) found, from a study of more than 14,000 girls and boys, that greater consumption of fried foods eaten away from home was evident for heavier adolescents and that increasing consumption of
fried foods over a long time to an increase in BMI. In addition, the frequency of eating fried foods away from home was associated with greater intakes of total energy, sugar sweetened beverages and transfats, as well as less consumption of low fat dairy foods and fruits and vegetables.

James and Kerr (2005) reported that there is an association between obesity and consumption of soft drinks. Luduig et al. (2007) found that an increase in soft drink consumption and decrease in milk intake may partly explain the rise in body weights. Childhood obesity coincides with increase in soft drink consumption (American Dietetic Association, 2007).

Beverages such as carbonated soft drinks and juice boxes also greatly contribute to the childhood obesity epidemic. Scientific studies have documented a 60 per cent increased risk of obesity for every regular soft drink consumed per day. Box drinks, juice, fruit drinks and sports drinks present another significant problem. These beverages contain a significant amount of calories and it is estimated that 20 per cent of children who are currently overweight are due to excessive caloric intake from beverages (Vartanian et al., 2007).

Breakfast is the first meal of the day, eaten before or at the start of daily activities, within 2 hours of waking, typically not later than 10:00 a.m, and of a calorie level between 20 and 35 per cent of total daily energy needs. Among all school-age children and adolescents, breakfast provide an average of 18 per cent of total daily energy intake. Breakfast, when consumed, tended to be lower in fat compared to other meals. Breakfast consumption has been shown to be associated with more favorable nutrient intakes and improved dietary quality in children and adolescents (Merten et al., 2009).

Breakfast skipping has also been linked to poorer overall dietary quality. Since the breakfast commonly includes cereal, individual who eats breakfast on a regular basis may benefit from a number of physiological mechanisms hypothesized to reduce appetite and subsequently chronic disease risk (Farshchi et al., 2005).
4. Lack of physical activity

Children, in today's society show a decrease in overall physical activity. The growing use of computers, increased time of watching television and decreased physical education in schools, all contribute to children and adolescents to live a more sedentary lifestyle (Must and Tybor, 2005).

Several studies suggest that sedentary children are more likely than active children to become sedentary adults and to have increased risks of obesity, diabetes, hypertension, dyslipidemias and cardiovascular diseases. (American Cancer Society, 2006).

Both physical activity and energy intake have a major contribution to the establishment of childhood obesity (Stubbs and Lee, 2004). A lower level of physical activity and habitual exercise among children is associated with higher BMI (Moria and Scotlerow, 2004).

Time spent on television viewing is a significant predictor of BMI and overweight in childhood (Hancox and Poulton, 2006). Television viewing exposed children to food marketing, increased opportunities for snacking on high-energy foods and drinks, decreased opportunities for physical activity, and reinforced sedentary behaviour.

Muthukumar (2006) reported that labour saving devices have reduced physical activities and watching television has given rise to the couch potato syndrome.

The barriers to physical activity identified by youth aged 7 to 17 years as reported by Gordon et al. (2006) included preference for indoor activities, lack of energy and motivation, time constraints, low care giver motivation and lack of awareness of television viewing time.

Speiser et al. (2005) suggested that sleep duration may be related to secretion of growth hormone, a child's exposure to obesity related factors in the environment such as evening snacking or the amount of physical activity during the day.
Parents play an important role in the development of children's physical activity patterns (Bogaert et al., 2003) and are also responsible for eating behaviours and attitude of children (Benton, 2004).

C. CONSEQUENCES OF CHILDHOOD OBESITY

The rising prevalence of childhood obesity is receiving greater attention because of its association with adult obesity and its complications (Reddy, 2006). Studies by Centre for Disease Control and Prevention (2005) revealed that 83 per cent of children between ages of 10 - 15 and with a BMI greater or equal to 95th percentile become obese as adults (Reilly, 2005). Studies have shown that 80 per cent of obese children are most likely to become obese in adulthood. Pediatricians roughly estimated that around 60 per cent of the children from upper middle class and urban families have unhealthy nutritional habits that could lead to serious problems (Harsha Kumar et al., 2008).

Figure 2 depicts the critical events of obesity in Indians by Misra, 2006.

![Figure 2: Obesity in Indians: Critical Events](image-url)
Complications of adult obesity are made worse if the obesity begins in childhood. Obesity is harder to treat in adults than in children (Park, 2005). Schrager (2005) found that overweight and obesity in children are directly associated with being overweight in adulthood.

According to Daniels et al. (2005) overweight and obesity in childhood have significant impact on both physical and psychological health and are associated with hyperlipidemia, hypertension, abnormal glucose tolerance and infertility in adults.

The first problems to occur in obese children are usually emotional or psychological. Childhood obesity however can also lead to life-threatening conditions including diabetes, high blood pressure, heart disease, sleep problems, cancer and other disorders, liver disease, early puberty or menarche, eating disorders such as anorexia and bulimia, skin infections, asthma and other respiratory problems. Obesity during adolescence has been found to increase mortality rates during adulthood (Kopelman, 2005).

Obesity can cause a variety of adverse health consequences. These include many emotional and physical problems, for example, emotional problems include feelings of inferiority, low self esteem, and bullying from classmates. Physical problems include high blood pressure, heart disease, some cancers and Type II Diabetes Mellitus where the body no longer responds to insulin and hence cannot control its blood sugar levels. By 2025, 300 million people are expected to suffer from obesity related diabetes (Frayling and McCarthy, 2007).
Obesity in children and adolescents is associated with a number of immediate health risks, such as high blood pressure, Type II Diabetes, metabolic syndrome, sleep disturbances, orthopedic problems and psychosocial problems (Institute Of Medicine, 2005).

Overweight and obesity have been linked to premature death, hypertension, gall bladder disease, snoring, kidney disease and depression (Jorge Cruise, 2005). Consequences of childhood obesity diagnoses excessive fatness and denote increased risk of adverse health outcomes (Reilly, 2005).

Table III gives details on the effect of obesity on body systems.

**TABLE III**

**EFFECT OF OBESITY ON BODY SYSTEMS**

<table>
<thead>
<tr>
<th>System</th>
<th>Condition</th>
<th>System</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endocrine</td>
<td>• Impaired glucose tolerance</td>
<td>Cardiovascular</td>
<td>• Hypertension</td>
</tr>
<tr>
<td></td>
<td>• Diabetes mellitus</td>
<td></td>
<td>• Hyperlipidemia</td>
</tr>
<tr>
<td></td>
<td>• Metabolic syndrome</td>
<td></td>
<td>• Increased risk of coronary heart disease</td>
</tr>
<tr>
<td></td>
<td>• Hyperandrogenism</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Effects on growth and puberty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>• Nonalcoholic fatty liver disease</td>
<td>Respiratory</td>
<td>• Obstructive sleep apnoea</td>
</tr>
<tr>
<td></td>
<td>• Cholelithias</td>
<td></td>
<td>• Obesity hypoventilation syndrome</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>• Slipped capital femoral epiphysis (SCFE)</td>
<td>Neurological</td>
<td>• Idiopathic intracranial hypertension</td>
</tr>
<tr>
<td></td>
<td>• Tibia vara (Blount disease)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychosocial</td>
<td>• Distorted peer relationships</td>
<td>Skin</td>
<td>• Furunculosis</td>
</tr>
<tr>
<td></td>
<td>• Poor self esteem</td>
<td></td>
<td>• Intertrigo</td>
</tr>
<tr>
<td></td>
<td>• Anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Depression</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Uptodate.com

1. **Health consequences**

a. **Cardiovascular diseases**

The increased prevalence of obesity in childhood is of great concern because of its strong association with cardiovascular disease risk, hypertension, dyslipidemia and Type II diabetes that begins in childhood and continues into adulthood.
Although the clinical effects of the process do not usually show up until middle age, atherosclerosis begins in childhood and the extent of atherosclerotic change in childhood and young adulthood is correlated with elevated risk in adults (Rodriguez et al., 2006).

Risk factors for CVD, such as elevated serum cholesterol and blood pressure occur with increased frequency in obese children and adolescents compared to children with a normal weight. Endothelial dysfunction and carotid stiffness have been found in obese children consistent with an increased risk for atherosclerosis (Singhal, 2005). Obese children have composite risk of having low concentration of HDL which cause coronary heart disease (Perry, 2007).

b. Hypertension

Obesity is an important contributor to developing high blood pressure not only in adults, but also in children and adolescents. Hypertension contributes substantially to CVD, renal failure, and premature death. Recent studies with participants who were predominantly minority and, on average, higher in weight, have shown around 20 to 25 per cent of children with hypertension or prehypertension (Falkner and Daniels, 2004). Elevated blood pressure in children is an early risk factor for cardiovascular disease and is positively associated with BMI (Brion et al., 2007).

Primary hypertension in children once considered to be rare, has become increasingly common in association with obesity and other risk factors, including a family history of hypertension and an ethnic predisposition. Obese children are approximately at three fold higher risk for hypertension than non obese children. In addition, the risk of hypertension in children increases across the entire range of BMI values and is not defined by a simple threshold effect (Sharon and Hiremathi, 2004).
c. Hyperlipidemia

The characteristic pattern of hyperlipidemia consists of elevated total cholesterol, LDL, triglycerides and low HDL levels, which is considered as an atherogenic profile. Increased levels of triglycerides, cholesterol and LDL cholesterol have been described in 10 to 40 per cent of obese children and adolescents, whereas decreased levels of HDL cholesterol were found among 10 per cent of obese children. The Urinary Albumin/Creatinine ratio (U-ACR) was almost increased two fold in obese children with normal cholesterol levels, underlying the importance of high cholesterol levels in the development of obesity related renal damage (Csernus et al., 2005).

d. Type II diabetes mellitus

An even more dramatic health consequence of overweight is the rapid increase in the incidence of Type II diabetes in children and adolescents which has a serious impact on adult health. Weiss and Caprio (2005) reported that impaired glucose tolerance (IGT) appears early in obese children and adolescents.

Obesity in children is a major element in insulin resistance and is thus a risk factor for Type II diabetes which has been considered an adult disease, commonly diagnosed in persons of 40-74 years of age. However, the diagnosis of Type II Diabetes has increased dramatically in children and adolescents and is related to body fatness (American Diabetes Association, 2003). Type II diabetes can lead to serious consequences such as diabetic retinopathy, peripheral neuropathy and kidney failure and also increases the risk of atherosclerosis with its attendant risks of stroke, heart attack, and hypertension.

The Center for Disease Control (CDC) predicts that 1 in 3 children born in 2000 could develop Type II diabetes during his or her lifetime because
of childhood obesity (CDC, 2007). Obesity is linked to lowered insulin sensitivity and the risk of heart disease (Kurpad et al., 2006).

In addition, children with Type-I diabetes has evidence of insulin resistance with increased abdominal circumference as a proxy for abdominal fat (Betts et al, 2005).

e. Metabolic Syndrome

Problems of overweight and obesity are caused by a chronic imbalance between energy intake and actual energy needs of the body. The metabolic factors concerned include a low metabolic rate, low insulin sensitivity and high respiratory quotient (Ogden, 2007).

Metabolic syndrome, hormonal alteration during and after puberty, respiratory problem such as sleep apnea and asthma are found in obese children (Gyorgi, 2007).

Metabolic syndrome is a constellation of clinical findings, including abdominal obesity, high blood pressure, dyslipidemia and high glucose levels, that confers increased risk for CVD and Type II diabetes. Metabolic syndrome is also called “syndrome X” and insulin resistance syndrome. The prevalence of metabolic syndrome increased with the severity of obesity had reached 50 per cent in severely obese children and adolescents (Weiss et al., 2004).

f. Respiratory complications and asthma

Obesity can also lead to severe respiratory problems since fat accumulates in the upper body and throat. Prospective studies consistently supported a link between obesity and reported wheezing or asthma diagnosis in children. After puberty, the association between asthma and obesity tends to be stronger in girls than in boys (Mislura, 2006).

Obese children have a significantly greater frequency and degree of bronchospasm of the smaller air ways that is related partially to the amount
of subcutaneous fat present in these children. Children with a BMI above the 85th percentile had an increased risk of asthma independent of age, sex, ethnicity, socio economic status and exposure to tobacco smoke (Chinn, 2006).

**g. Obstructive Sleep Apnea (OSA)**

Children with sleep apnea literally stop breathing repeatedly during their sleep, often for a minute or longer usually ten to sixty times during a single night (www.entnet.com, 2008).

Obesity can produce several physiologic derangements that result in upper airway anatomic obstruction and poor gas exchange. Obstructive sleep apnea can lead to severe cardiopulmonary problems including pulmonary hypertension. Severe OSA can lead to hypoventilation, carbon dioxide retention, hypoxia, polycythemia, right ventricular hypertrophy and failure and possibly pulmonary embolism. Other adverse consequences of OSA include enuresis, day time somnolence or hyperactivity and deficits in learning and memory function, resulting in poor school performance (www.meadjohnson.com, 2008).

**h. Orthopaedic complications**

Overweight children and adolescents are more likely than their normal weight counter-parts to suffer from bone fractures and have joint and muscle pains (www.vitaminvetailers.com, 2008).

A study conducted among normal weight and overweight children, by Vaneltallie (2006) revealed a greater prevalence of fractures and musculoskeletal discomfort among overweight children. The most common self-reported joint complaint included knee pain among 21.4 per cent overweight children than among normal children. Overweight children reported greater impairment scores in mobility (17.0 ± 6.8 vs 11.6 ± 2.8) than did normal weight children.
Chinn and Rona (2007) reported that among children, the growth plates, particularly in the legs are susceptible to damage when the child reaches a level of obesity. These growth plates become impaired, and result in inadequate bone growth which leads to flatfeet, narrowing of thorax, knee pain, back pain and irregular hip position. For most children these pain and deformities will progress into adulthood with little chance for recovery. It is the excess weight on a child’s body which creates these deformed growth patterns which then leads to a cyclical effect in which the child is unable to perform any level of physical activity and thus gain more weight.

i. Renal complications

The prevalence of end stage renal disease has risen dramatically in the past decades, in parallel with increasing obesity (Young et al., 2007).

Csernus et al. (2005) reported that healthy obese children have a higher degree of albuminuria and beta-z- microglobulinuria than normal weight children, indicating early renal glomerular and tubular dysfunction as a consequence of childhood obesity.

2. Psychological consequences

Obese children often suffer from teasing by their peers. Some are harassed or discriminated against by their own family. Stereotypes abound and may lead to low self esteem and depression (Cornette, 2008).

The most common consequences of obesity in childhood and adolescence are psychological which include poor self esteem, negative self image, social difficulties, sadness, loneliness and depression (www.iaso.org.)

The physical health risk of obesity may not manifest themselves for years but the psychological and social problems experienced by the obese are felt everyday (Green, 2006). Psychological factors influence a child’s
eating habits and many children eat in response to stress or negative emotions such as boredom, anger, sadness, anxiety or depression (www.google.com).

3. Economic consequences

Obesity constitutes a major health problem with serious social and economic consequences worldwide. According to Loke (2006) for obese children, adolescents and adults, there is the burden of direct medical cost covering the costs of prevention, diagnosis and treatment. There are also indirect costs that refer to the value of lost output through the cessation of productivity caused by morbidity and mortality. In many countries, obesity accounts for 2-4 per cent of total health care costs.

Obesity is associated with major health risks and a high economic burden impacting on health care systems (Bundred et al., 2006).

D) MANAGEMENT OF OBESITY IN CHILDREN

The key for achieving and maintaining a healthy weight is not about short term dietary changes, it is about a lifestyle that includes healthy eating, regular physical activity and balancing the number of calories consumed with the number of calories the body uses (Flegal et al., 2008).

In the opinion of Khor (2006) to prevent overweight and obesity among children and adolescents, strategies that address eating behaviours and physical activity are required. The method of treatment depends on the level of obesity, overall health condition and motivation to lose weight. The goal of any weight loss intervention is to achieve an energy balance (Ritchie, 2006).

Prevention and treatment of obesity and overweight are easier in children than in adults because children are still growing in height. Related to the increased energy needs during growth, a child can achieve reductions in adiposity without reducing energy intake (Doak et al., 2006).
According to WHO (2009) the following guidelines are recommended for weight loss

- increased consumption of fruits and vegetables, legumes, whole grains and nuts
- limited energy intake from total fats and a shift in fat consumption from saturated to unsaturated fats
- limited intake of sugar and
- physical activity - at least 60 minutes of regular, moderate to vigorous intensity exercises each day that are developmentally appropriate and involving a variety of activities. More activity may be required for weight control.

Kathleen et al. (2008) suggested a reduction in the consumption of foods that are high in energy density as one of the approaches to prevent childhood obesity. Obesity management programmes for children should focus on prevention of weight gain, promotion of weight maintenance and promotion of weight loss. Apart from these treatment strategies, family involvement through gradual changes in activity pattern and eating pattern of children is essential because obesity is chronic and may require life long attention (Mahan et al., 2004).

Breat (2005) reported new methods for treatment of obese children which included stimulus control diaries, contract evaluation, self evaluation, self reinforcement, problem solving, thinking, behavioural training, homework tasks, peer group pressure, psycho education and booster sessions.

Behaviour change involving physical activity and nutrition are the cornerstones for preventing obesity in children and adolescents. Families and schools are the two most critical links in providing the foundation for such behaviours. Children and adolescents spend majority of their time in
schools which provide an environment that promotes health, nutrition and physical activity habits (http://obesitytempdomainname.com).

Jones et al. (2007) reported that lifestyle modification such as diet, physical activity and behaviour therapy are used in the prevention of overweight. Laessle (2006) recommended specific features of the behavioural approach for overweight including goal orientation, diet modification, exercise behaviour, process orientation, evaluation and advocacy of small changes.

School based care should focus not only on the provision of nutrition information, but also on the development of skills and behaviours related to areas such as food preparations, food preservation and storage, social and cultural aspects of food and eating, enhanced self-esteem, positive body image and other consumer aspects (Sharma, 2006).

**Principles of childhood obesity management**

Teaching healthy behaviours at a young age is important since change becomes more difficult with age. Obesity management at a younger age may have a greater effect because

- Motivation may be easier to generate and maintain for both the child and the other family members while the child is young;
- It can be easier to control and modify behavior in younger individuals; there may be less resistance to treatment stigmatization and greater influence of the family on the child;
- There may be more frequent opportunities for medical observation during earlier childhood compared with later years and
- Longitudinal growth and an increase of lean body mass occur during childhood so that children can 'grow into their weight' (Lobstein et al., 2004).
Clinicians may find community based weight management programs to be useful adjunctive resources to assist youth and families to practice and maintain healthy nutrition and physical behaviour (Heshmat et al., 2006).

Onis et al. (2004) reported that the psychological immaturity of children and their greater susceptibility to peer pressure when compared to adults present additional difficulties in the successful treatment of childhood obesity. Owing to this there seems to be a consensus that prevention is the most realistic and cost effective approach for dealing with the problem of childhood obesity.

Dorsete et al. (2004) stated that nutrition education and promotion of physical activity together with behaviour modifications, decrease in sedentary activities and the collaboration of the family could be the determining factors in the prevention of childhood obesity.

Golan and Crow (2004) pointed out that family characteristics play an important role in predisposing the children to overweight/obesity and hence the interventions need to be directed towards the families as obese children need acceptance, support and encouragement from their family. The most feasible interventions are:

1. **Nutrition education**

   Nutrition Education involves a combination of activities including nutrition information, increasing people's knowledge about the benefits of specific foods, behaviour, influencing attitudes and beliefs, and motivating the adoption of healthy eating practices (www.FAO.nutritioneducation.org).

   Nutrition education offers a great opportunity to individuals to learn about the essentials of nutrition for health and to take steps to improve the quality of their diets, thus their well-being (Robinson et al., 2004). Nutrition education at school level was found effective in reducing the percentage of overweight children aged 8 to 12 years (Epstein, 2004).
Nutrition education influences the attitude of youngsters and enhances the knowledge and skills required for them to understand on temporary food and nutrition issues. Studies have shown that educational institutions are the most effective and efficient ways to reach a large segment of the population including young people and their families. The beneficiaries can act as agents by spreading the message to a large segment of the population (Vijayapushpam et al., 2008).

Nutrition education through interactive computer assisted instruction tools where the child could see, hear, participate and interact makes it more effective and purposeful in the management of childhood obesity (Latner, 2007). Computers can be used for a wide range of educational and research purposes. The information gathered can be useful in the construction of nutrition education programmes and to give dietary advices (Gordon, 2009).

Nutrition softwares are designed for use in schools as well as health organizations and the softwares allowed educators/health professionals to personalize obesity prevention programs and encourage students and individuals to make healthy lifestyle choices when it comes to topics on obesity such as proper diet and regular exercise (http://www.aprilage.com/applicatgion.html).

Weight management software will help, create and evaluate a diet, fitness and weight loss plan to maintain good health. It is excellent for obese adults and children interested in keeping their competitive edge through nutrition and diet (http://www.benutrifit.com/2008).

A school - based obesity prevention program, ‘New Moves’, was developed to meet the needs of girls at risk for overweight due to low levels of physical activity. The program promoted long-term healthful eating and physical activity behaviours as alternatives to short-term dieting and the use
of unhealthful weight-control behaviours. 'New Moves' was implemented as an alternative physical education program within high schools and included physical education, nutritional guidance and social support components (Linda et al., 2006).

Television watching seems to be a most modifiable behaviour, followed by physical activity and nutrition behaviours (Sharma, 2006).

2. Physical activity

Physical inactivity has been shown to be a risk factor for obesity and insulin resistance in school-aged children. Regular physical activity is beneficial psychologically for all youth regardless of weight. It is associated with an increase in self-esteem and self-concept and a decrease in anxiety and depression (Hayman et al., 2004).

The more we move our body the more calories we burn. To lose a kilogram of fat we need to burn 8,000 calories (1 pound of fat = 3,500 calories). Walking briskly is a good way to start increasing our physical activity if we are obese. Combining increased physical activity with a good diet will significantly increase our chances of losing weight successfully and permanently (MediLexicon International Ltd., 2009).

Physical activity is the only modifiable component of the energy expenditure portion of the energy balance equation. Consequently, increasing physical activity has the potential to improve weight loss and maintenance (Stettler et al., 2004).

According to Nowicka and Flodmark (2007) changes in physical activity with the aim of increasing energy expenditure are usually an important component in the treatment of childhood obesity.

Physical exercise programs combined with normal calorie intake resulted in reductions in body weight and body fat while allowing for normal growth and preservation of lean body mass (Dao et al., 2004).
In the opinion of Taras (2005), physical activity needs to be promoted at home, in the community and at school in perhaps the most uncompressing way for all children to benefit. Children can increase their physical activity levels in many other ways during school and non school hours, including active transportation, unorganized outdoor free play, personal fitness and recreational activities and organized sports.

Increased energy expenditure through exercise and other forms of physical activity may be an important component of effective interventions to enhance initial weight loss and the prevention of weight regain. However to achieve these outcomes, adequate levels of exercise and physical activity appear to be necessary with 60 to 90 min/day currently being recommended (Jackie and Ochoa, 2007).

According to Hill and Wyatt (2005), moderate intensity exercises of 60-90 minutes are required to maintain significant weight loss in children.

Center for Disease Control and Prevention (2007) suggested that parents can help children meet physical activity goal by serving as role models, incorporating enjoyable physical activity into family life, monitoring the time their children spend watching television, playing video games and using the computer and intervening if too much time is spent in sedentary pursuits.

3. Dietary interventions

Dietary Modification is the most commonly used weight loss strategy and can achieve weight reduction over the short term in both children and adults (Ello-Martin et al., 2004).

Dehghan et al. (2005) emphasized that prevention could be the key strategy for controlling the current epidemic of obesity. It includes primary prevention of overweight or obesity, secondary prevention or prevention of
weight regain following weight loss and avoidance of more weight increase in obese persons unable to lose weight. Most approaches have focused on changing the behaviour of individuals in diet and exercise.

Kumar et al. (2007) recommended that consumption of high fat and high energy (Junk) foods and snacking in between the meals should be avoided by children.

Weigle et al. (2005) suggested that there are two mechanisms by which increased dietary protein impedes an increase in the drive to eat, usually experienced during negative energy balance. The first is the capacity of dietary protein to increase energy expenditure, partly due to greater diet-induced thermogenesis after protein consumption than after consumption of equally calorific loads of carbohydrate or fat. The second is the greater satiating power of protein compared with the other macronutrients.

Dietary interventions should emphasize energy reduction, lower fat food choices, increased vegetable and fruit intake, healthier snacks and decreased portion sizes. Soft drinks and fruit drinks should be limited. Changes in eating habits, shopping practices and types of food for the whole family will support a child's ability to self-regulate his or her food intake (Batch and Baur, 2005).

Consuming excessive quantities of low nutrient, energy dense foods such as sugar sweetened beverages is a risk factor for obesity. Reducing the intake of sugared beverages may be one of the earliest and most effective ways to reduce ingested energy levels (Striegel – Moore, et al., 2006). Reduction of carbonated drink consumption resulted in a reduction in the number of overweight children after 12 months (James et al., 2004).

Diets that include three servings of dairy products daily result in significant reductions in adipose tissue mass in overweight humans in the absence of caloric restriction and markedly accelerate weight and body fat
loss secondary to caloric restrictions compared with diet low in dairy products (Das et al., 2007).

Heitmann et al. (2007) reported that dietary fat has a lower thermogenic effect than does carbohydrate. A moderate fat diet with high mono saturated fatty acid may decrease energy expenditure and thereby induce weight gain. White and Jacques (2007) emphasized that dietary fat is more energy dense than other nutrients, because less energy is required to convert dietary fat to adipose tissue and the capacity for fat oxidation appears to distinguish those at risk of weight gain. Reduction in dietary fat to 30 per cent of energy intake appears to be a reasonable target to prevent overweight.

According to Gardner et al. (2007) a low carbohydrate, high protein, high fiber diet is recommended for weight loss for a long term effect. Kolhydrat (2006) suggested that the weight reducing diet of Banting and Atkins which were basically carbohydrate reducing diets are not more effective than diets based on increased consumption of fruits, vegetables and whole grain products, together with physical exercise which are recommended for overweight individuals.

Werthammer et al. (2006) observed that high protein, low carbohydrate diet was superior to restricted calorie protocol for weight loss. National Institute of Health (2006) recommended that a low carbohydrate, high protein diet may be superior to low fat, low calorie diet in producing weight loss.

Changes in eating habits, shopping practices and types of food for the whole family will support a child’s ability to self regulate his or her food intake (Batch and Baur, 2005).

Evan (2006) emphasized a reduction in the huge volume of marketing of energy dense foods, drinks and fast foods through food restaurants to school going children.
Diet therapy consists of instructing patients as to how to modify the individual dietary intake to achieve decrease in energy intake while maintaining a nutritionally adequate diet (Butryn, 2005). A nutritious diet follows the a,b,c,m,v principles - adequacy, balance, calorie control, moderation and variety (Mahan and Stump, 2005).

**Role of fibre in obesity management**

A hypocaloric diet with fiber rich whole grain cereals is effective for improving or maintaining other aspects of dietary quality during weight loss. Such a diet along with exercise decreased energy intake more than exercise alone (Mark and Pereira, 2007). Dietary fibre intake could play an interesting role in the management of metabolic syndrome controlling body weight, glucose and lipid homeostasis, insulin sensitivity and regulating many inflammation markers (Young-In-Kim, 2006).

Recent epidemiologic investigations have begun to shed light on the role of foods in the development of chronic diseases. The health benefits of a diet rich in fruits, vegetables, and legumes have been recognized for some time. Fruits and vegetables consumption have been associated with decreased incidence of and mortality from a variety of chronic diseases such as cardiovascular diseases, stroke, hypertension, diabetes, obesity and certain types of cancer (Lydia, 2006).

Slavin (2006) recommended increasing the consumption of dietary fibre with fruits, vegetables, whole grains, and legumes across the life cycle as a critical step in stemming the epidemic of obesity. Fibre intake is inversely associated with body weight and body fat. The addition of dietary fibre generally decreases food intake, and, hence, body weight. Dietary fibre aids in weight management, including promoting satiation, decreasing absorption of macronutrients and altering secretion of gut hormones.
Williams (2006) suggested that dietary fibre has important health benefits in childhood, especially in promoting normal laxation. Dietary fibre in childhood may be useful in preventing and treating obesity and also in lowering blood cholesterol levels, both of which may help reduce the risk of future cardiovascular disease.

**Mechanism of action**

Slavin and Green (2007) emphasized that dietary fibres have different physiological effects and provide a variety of health benefits, including satiety. Pre-absorptive factors such as gastric distention and the work and time required for chewing are important for satiation. For this reason, the bulking and textural properties of fibre make it an attractive ingredient for enhancing diet. Satiety signals are generated both pre and post absorptively. Viscous soluble fibres may be useful because they prolong the intestinal phase of nutrient digestion and absorption. This means that there is a longer time over which the macronutrients can interact with the pre-absorptive mechanisms of satiation and satiety, as well as prolong the time course of post-absorptive signals. Adding fibre to low calorie/low fat foods may enhance satiety, but because weight-loss meals are low in energy and fat, satiety is likely to be short lasting.

Fibre lowers blood cholesterol levels through the following mechanisms. 1) Bind fecal bile acids and increase excretion of bile acid derived cholesterol, 2) prevent dietary fat and cholesterol absorption by binding bile acids or fat, 3) fermented by intestinal bacteria and produce short chain fatty acids (SCFAs) which inhibits cholesterol synthesis in liver and lower blood lipids (Mahan and Stump, 2004).

Horse gram is one of the lesser known beans, available at low cost in local markets but have more health benefits. The whole seeds of horse
gram are generally utilized as cattle feed. However, it is consumed as a whole seed, as sprouts, or as whole meal by a large population in rural areas of southern India. The seeds are small, flattened, light red, brown-black or mottled. It can be eaten whole or after grinding into a meal, unlike other pulses, which are consumed after splitting. According to Ravindran and Bino Sundar (2009) horse gram contains high amounts of protein (22g), fiber (5.3g), iron (6.8g), calcium (287mg), phosphorous (311mg) with a very low carbohydrate (57g) and fat content (0.5g).

Kodo millet also known as varagu was domesticated in India almost 3000 years ago. It is found across the old world in humid habitats of tropics and subtropics. It is a minor grain crop in India, and an important crop in the Deccan plateau. The fibre content of the whole grain is very high. Kodo millet has around 11g protein, and the nutritional value of the protein has been found to be slightly better than that of foxtail millet but comparable to that of other small millets. As with other food grains, the nutritive value of Kodo millet protein could be improved by supplementation with legume protein (icrisat@cgiar.org).

Hegde et al. (2005) revealed that kodomillet is a rich source of phenolics, tannins and phytates, which can act as antioxidants.

Curry leaves which is botanically designated as Murraya koenigi is a household name in Indian houses. Curry leaves are extensively used in Southern India for centuries and to a lesser extent in rest of India as a natural flavoring agent in various curries and chutneys. Leaves, dried leaves and powdered leaves are also used. It helps in weight reduction. In general, it can be stated that there are optimum scientific evidences that Murraya koenigi can be considered as a potent dietary supplement for improving weight loss (Diet and Health, 2009).
4. OTHER INTERVENTIONS

a. Behaviour Therapy

A program of behaviour modification includes control of overeating, promotion of physical activity to increase energy output and emotional, social and psychological health (Steinbeck, 2005). A family based behavioural intervention was reported to be feasible for use in treating obesity in school children in Beijing, China. After two years of implementation, it successfully decreased the degree of obesity, reduced levels of blood pressure and decreased serum lipids (Jiang et al., 2005).

b. Pharmacotherapy

There are no medications currently approved for the treatment of obesity in children. Orlistat and sibutramine may however be helpful in managing moderate obesity in adolescence. Sibutramine is approved for adolescents older than 16 years. It works by altering the brain’s chemistry and decreasing appetite. Orlistat is approved for adolescents older than 12 years. It works by preventing the absorption of fat in the intestines (www.mayoclinic.com).

Metformin the medication that is used for diabetes is the only medication that can be used to treat obesity in children. Metformin prevents the release of glucose from the liver. It also manages to reduce appetite in obese children without causing hypoglycemia or abnormal decrease of blood sugar (Math, 2006).

c. Surgery

Bariatric surgery though not used to treat obese children, is the most rapidly growing area of surgical practice in world today and it is shown to be an effective method for weight loss in obese patients at both short and long term (Douchi et al., 2005). Multiple studies have demonstrated that substantial
weight loss induced by bariatric surgery can improve or resolve more than 30 obesity-related conditions, including Type II Diabetes, heart disease, sleep apnea, hypertension and high cholesterol, reduced fasting blood glucose, serum insulin, glyoxylated haemoglobin levels, insulin resistance and improvement of beta cell functions (Dhanasekar et al., 2006).

Basically, bariatric surgery alters the stomach or small intestine so that it is unable to consume much food in one sitting. This reduces the total number of calories consumed each day, thus helping to lose weight.

There are two types of bariatric surgeries:

- **Restrictive surgery** - This makes the stomach smaller. The surgeon may use a gastric band, staples, or both. After the operation the patient cannot consume more than about one cup of food during each sitting, significantly reducing his food intake. Over time, some patients’ stomach may stretch and they are gradually able to consume larger quantities.

- **Malabsorptive surgery** - Parts of the digestive system, especially the first part of the small intestine (duodenum) or the mid-section (jejunum), are bypassed. Doctors may also reduce the size of the stomach. This procedure is generally more effective than restrictive surgery. However, the patient has a higher risk of experiencing vitamin/mineral deficiencies because overall absorption is reduced (The American Society for Bariatric and Metabolic Surgery, 2008).

d. Alternative Treatment

According to the Weight-Control Information Network (2008) the following alternative forms of treatment for obesity have been suggested. The Chinese herb ephedra has been recommended in a weight-loss program that also includes a low-fat diet and exercise. The herb does help a person
lose weight on a short-term basis. But the weight tends to return when use of the herb is discontinued. In addition, large amounts of ephedra can produce a number of side effects, such as anxiety, irregular heartbeat, heart attack, high blood pressure, insomnia, irritability, nervousness, seizures, stroke, and even death. Diuretic herbs have also been suggested for the treatment of obesity. A diuretic is a substance that increases the rate of urine output. As a person produces more urine, his or her weight decreases. However, once the herb is discontinued, urine production returns to normal, as does obesity.

Other natural remedies that have been suggested by the same network for weight loss include:

- Red peppers and mustard, because they increase a person’s metabolic rate (the rate at which food is digested). They also make a person thirsty, so he or she is more likely to drink water (which contains no calories) than to eat food.
- Walnuts, because they increase the level of brain chemicals that tell a person he or she is no longer hungry.
- Dandelion, because it increases the metabolic rate and decreases desire for sugary foods.

Acupressure and acupuncture are also said to decrease the desire for food. Acupuncture is a Chinese therapy that uses fine needles to pierce the body; acupressure involves applying pressure to certain points in the body. Mental techniques such as visualization and meditation may create a better self-image and decrease the need to overeat. Mental concentration, yoga, and similar techniques may provide similar benefits. In many cases, support groups can help a person deal with the problems that led to his or her obesity.
Yoga along with proper eating habits and certain changes in life-style gives excellent results in weight loss. Various Asanas along with Suryanamaskar and Pranayama (breathing exercise) are advised to reduce weight. Deep breathing exercise helps in increasing the oxygen carrying capacity of the cell. It also improves blood circulation providing more oxygen to each cell, helps in combustion thus increasing the cellular activity and helping in burning off fat cells and helps in increasing the lung capacity which help to perform heavy activities in future (http://www.ayurvedach.com).