Chapter 2

REVIEW OF LITERATURE

The literature pertaining to this study on “Correlates of Body Mass Index and body composition of adults in Kochi” is reviewed under the following heads:

<table>
<thead>
<tr>
<th>2.1</th>
<th>Nutrition and health scenario in India over the decades.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>Correlates of Body Mass Index among adults.</td>
</tr>
<tr>
<td>2.3</td>
<td>Comparative profile of anthropometry and body composition</td>
</tr>
<tr>
<td>2.4</td>
<td>Need for nutrition education on lifestyle modification among adults</td>
</tr>
<tr>
<td>2.5</td>
<td>Scope of modern tool for nutrition and health awareness creation</td>
</tr>
</tbody>
</table>

2.1 Nutrition and health scenario in India over the decades

During the first two decades after independence, India had to import food grains to meet the short-fall in domestic production. The extent of vulnerability came into sharp focus during the severe drought of 1965 and 1966. The cessation of food aid, because of Indo Pak war of 1965 lead to unacceptably high famine death in the country. It was this scenario that powered the green revolution. In a relatively short period of time the country began to produce food not only to meet the demands but also to generate surplus. As a result, famine disappeared and undernutrition started to decline (Pant, 2003).

At the time of independence majority of Indians were poor and had high morbidity due to infections; as a result, majority of Indians especially children were undernourished. The country initiated programmes to improve economic
growth, reduce poverty, and improve household food security and nutritional status of its citizens. After a period of slow but steady economic growth, the last few decades witnessed acceleration in economic growth. There has been a steady but slow decline in poverty. In the 1970s, the country became self sufficient in food production; adequate buffer stocks also have been built up. The poor had access to subsidized food through the public distribution system. As a result, famines have been eliminated. Over the years there has been a decline in household expenditure on food due to availability of food grains at low cost. There has been some reduction in undernutrition and increase in overnutrition in adults. This is most probably due to reduction in physical activity (Ramachandran, 2007).

According to the National Survey Sample Organisation reports 1978-88, nearly 29.2 per cent of India's population was estimated to be below the defined poverty line. Even though there has been a drop in the population below poverty line since 1960 from 56.8 per cent to 29.2 per cent in 1987-88 in terms of numbers, a staggering 250 million people suffered from varying degrees of malnutrition in India. There is, however, no doubt that the impressive gains of the Green Revolution in terms of national food security and effective early warning systems have eradicated famines and situations of extreme hunger and starvation. What still remain are different degrees of chronic and endemic hunger which, in the context of prevailing patterns of intra-household food distribution particularly in rural families, translate into a grave danger for the nutrition status of women and children. This is the crux of the nutrition situation in India (NNP Government of India, 1993).

National Nutrition Monitoring Bureau (NNMB, 1993-1994) survey of three distinct economic categories namely the high, middle and low income groups, and slum dwellers in urban area showed that the
prevalence of chronic energy deficiency in males (BMI <18.5) was highest in Bhubaneshwar/Cuttack (58%) and lowest in Trivandrum (28%). Chronic energy deficiency was slightly less in females than in males in almost all the cities surveyed. Similarly, higher proportion of overweight/obese population (BMI >25.0) was observed in females than in males in each city. It ranged from 4 per cent in Bhubaneshwar to 17 per cent each in Trivandrum and Hyderabad.

NNMB (1996-1997) reports indicated that the extent of undernutrition and stunting declined during the past two decades and there was reduction in the prevalence of nutritional deficiency signs over time, but about a half of the adults and elderly still suffer from chronic energy deficiency as measured by body mass index (< 18.5). The proportion of adults with normal BMI values (18.5-25.0), at the aggregate level was around 52 per cent.

Over the last three decades, there have been substantial changes in the socio-economic status of people, some increase in the dietary intake of men and women especially of the affluent segments in rural and urban areas. Ready availability of fast foods, ice creams and other energy rich food items at affordable costs have resulted in increased energy consumption. There has been some reduction in under-nutrition and some increase in obesity over the last two decades. Over the last two decades there have been a growing number of reports that Indians are a very high-risk group for cardiovascular diseases and diabetes (Government of India Planning commission, 2002-2007).

As per NFHS -3 (2005-2006) reports, adults in India suffer from a dual burden of malnutrition; thirty-six per cent of women and 34 per cent of men are undernourished and 13 per cent of women and 9 per cent of men are overweight or obese. Only 57 per cent of men and 52 per cent of women are at
a healthy weight for their height. More than two out of five (40 per cent) of women are too thin in Bihar, Chattisgarh, Jharkhand, Madhya Pradesh, and Orissa. In 13 states, more than 35 per cent of women are too thin. Delhi, Kerala, Punjab, and six small northeastern states have the lowest proportion of women who are too thin (less than 20 per cent). Overweight or obesity is most common among adults in Punjab, Kerala, and Delhi. More than one-quarter of women in Punjab, Kerala, and Delhi are overweight or obese. Tamil Nadu and Goa also have a high prevalence of overweight and obesity among women (more than 20 per cent).

Prevalence of overweight and obesity among adult urban females of Punjab showed that out of 1000 subjects 4.5 per cent were underweight, 25.3 per cent were obese (i.e. 12.1% obesity grade I, 8% obesity grade II and 5.2% obesity grade III). Thus it was apparent that nearly half of the females belonging to upper middle class in Punjab are overweight / obese. If the present trend of overweight or obesity continues the situation can worsen even within a decade and overweight could emerge as the single most important public health problem in adults (Sindhu and Tatla, 2002).

A study by Chhabra and Chhabra (2007) among adults in Delhi showed that, both underweight and overweight or obesity co-exists. These problems affect nearly half of the population. Overweight and obesity are more common in urban areas while underweight was more frequent in rural areas. India appears to be in a stage of nutritional transition, especially in urban areas. In the backdrop of early origin of adult disease, nutrition transition poses a major challenge for the future. Efforts at the national level are needed to address the problem of overnutrition on one hand and combat undernutrition on the other.
Being a country in developmental transition, India faces the double burden of pre-transition diseases like undernutrition and infectious diseases as well as post transition chronic degenerative diseases associated with overweight and obesity. After over 60 years of independence, the resistant problem of undernutrition persists though some of the severe clinical forms have declined and except that of anemia magnitude has marginally decreased despite increase in population (INSA, 2009).

Epidemiologists in India and International agencies such as the WHO have been sounding an alarm on the rapidly rising burden of cardiovascular diseases (CVD) for the past 15 years. The reported prevalence of coronary heart disease in adult surveys even in rural areas, the prevalence has doubled over the past 30 years. In 2005, 53 per cent of the deaths were on account of chronic diseases and 29 per cent were due to CVD alone. It is estimated that by 2020 CVD will be the largest cause of disability and death in India. The country already has more than 40.9 million people with diabetes and more than 18 million people with hypertension which is expected to increase to 69.9 million and 213 million respectively by 2025 unless urgent preventive steps are taken (Goenka et al., 2009).

Hypertension is a critical public health problem in urban and rural areas of India. A cross sectional study conducted in rural Maharashtra showed that overall prevalence was 7.24 per cent which increased with increasing age and was maximum (31.25%) in the age group of 79-90 years, while it was minimum (0.41%) in the age group of 19-28 years (Todkar et al., 2009).

India, is experiencing rapid socioeconomic progress and urbanization and carries a considerable share of the global diabetes burden. Studies in different parts of India have demonstrated an escalating prevalence of diabetes.
not only in urban populations, but also in rural populations as a result of the urbanization of lifestyle parameters. Recent studies have shown a rapid conversion of impaired glucose tolerance to diabetes in the southern states of India, where the prevalence of diabetes among adults has reached approximately 20 per cent in urban populations and approximately 10 per cent in rural populations (Ramachandran and Snehalatha, 2009).

India’s health system is not shining. While India’s burden of infectious diseases remains huge, the gathering clouds of diseases like diabetes, chronic renal failure and cardiovascular diseases are in urgent need for comprehensive public health responses for control (John, 2010). India is passing through the phase of economic transition and while the problem of undernutrition continues to be a major problem, prevalence of overnutrition is emerging as another significant problem, especially in the urban areas. The prevalence of overweight or obesity was higher among women (10.9%) compared to men (7.8%) in rural areas. The prevalence of diabetes mellitus and coronary heart disease (CHD) is also higher in urban areas as compared to their rural counterparts. The incidence rate of cancer is comparatively higher among women compared to men (Indian Council of Medical Research, 2010).

A population-based survey of cohort of subjects in the metropolitan city of Mumbai showed the prevalence of metabolic syndrome (MS) to be 19.5 per cent. Increased hyper triglyceridemia and decreased levels of high density lipoprotein cholesterol were found to be more. This study revealed the higher prevalence of MS in subjects of the age group 41–60 years, suggesting this age group is at increased risk. The high prevalence of overweight and obesity was one of the major driving forces in the development of MS. Therefore, early identification of the metabolic abnormalities and appropriate intervention may be of primary importance in populations (Sawant et al., 2011).
Das et al. (2005) studied the growing trend of high prevalence of hypertension in an urban community of West Bengal and showed that hypertension has increased by about 30 times among urban dwellers and by about 10 times among rural inhabitants from the last three decades. Further, there was an age and sex specific increasing trend of mean systolic and diastolic pressures in both men and women which indicates significant role of environmental factors.

As the world entered the new millennium, chronic diseases accounted for 60 per cent of all deaths worldwide of which, 80 per cent occur in developing countries. Similarly like developed countries, today chronic diseases represent the lion’s share of India’s disease burden. The four leading chronic diseases in India, as measured by their prevalence are in descending order: cardiovascular diseases (CVDs), diabetes mellitus (diabetes), chronic obstructive pulmonary disease (COPD) and cancer. All of these diseases are projected to be continuing their increase in prevalence in the near future, given the demographic trends and lifestyle changes underway in India (Taylor, 2010).

A study conducted among adolescents of Thriuvanthapuram district by Unnithan and Syamakumari (2007) reported that when compared to the prevalence studies done before two decades or more in Kerala, it was found that the rate of underweight to be reducing but at the same time overweight and obesity are increasing. The results of the study expose the fact that the percentage of overweight and obesity were seen more in boys, severe underweight were more among girls indicating an increasing trend in the percentage of overweight in boys compared to girls.
Though Kerala has registered a significant improvement in key health care indicators, the health situation in the state reflects a paradox. Recently the state is under the octopus hold of both communicable and chronic diseases. Arrival of rainy season brings about communicable diseases in different areas of the state. In the pervasiveness of chronic diseases Kerala tops all the Indian states. The dominant chronic illness like diabetes, blood pressure, mental illness, cardiac illness etc., is common among all households in Kerala. Thus the paradox is that on the one side Kerala stands as the state with all indicators of better health care development in terms of IMR, MMR, PNMR, NNMR, birth rate, death rate etc. on the other it outstrips all other Indian states in terms of morbidity especially the chronic illness (Gangadharan, 2007).

The age-standardized prevalence (for Kerala’s age structure) of diabetes works out to be 14.9 per cent in men and 13.2 per cent in women. In absolute terms, it translates to approximately 16 million males and 14 million women suffering from Type 2 diabetes. The term “diabetes capital of India” suits Kerala. In fact, the prevalence of hypertension is higher than that of Type 2 diabetes, both in men and women at every age. Unlike in Type 2 diabetes, after the age of 50 more women have hypertension. Rapid changes in lifestyle have contributed to an alarming increase in non-communicable diseases. The prevalence of Type 2 diabetes, hypertension, over-weight and obesity, and cardio-vascular diseases has assumed alarming proportions. The state of Kerala has not yet taken note of the magnitude or the developmental consequences of the burden of non-communicable diseases (Soman, 2007).

Kutty et al. (2000) studied the incidence of type 2 diabetes in southern Kerala. The overall crude prevalence rate of type 2 diabetes was 5.9per cent. It was highest in the urban (12.4%), followed by midland (8.1 %), highland (5.8%), and coastal (2.5%) regions. The prevalence of obesity (BMI >29.99)
was 3.1 per cent in the highland, 3.6 per cent in the midland, 5.6 per cent in the coastal and 13.1 per cent in the urban areas, respectively.

A cross sectional study carried out in the Venganoor village in Kerala among 464 adults showed that 38.5 per cent were smokers, while 5.5 per cent were in the habit of consuming alcohol, 27.8 per cent of the subjects were found to be obese and 20.3 per cent of the subjects reported raised waist circumferences. The level of physical activity in the majority of the subjects was either sedentary or mild (Tiwari et al., 2008).

According to Sugathan et al. (2008) substantially high levels of the various behavioral risk factors among adults in Kerala suggest an urgent need for adopting healthy life style modifications among the population in general. The increased risk observed among the younger generation for behavioral risk factors such as smoking and alcohol consumption calls for urgent corrective steps and measures for long-term monitoring of all major risk factors as well as the major chronic disease condition.

Ramesh and Jareena (2009) reported that chronic underweight and overweight are equally present among women in Kerala, with important public health implications for the burden of diseases associated with both extremes of physical status. The substantial proportion of underweight persons together with continuing high overall levels of overweight and obese persons produce dual burden of nutritional disorders for the state. The existence of a double burden poses a big challenge.

Though marked thinness is less prevalent in Kerala compared to the national scenario, the percentage of women who are overweight or obese is much higher in Kerala compared to the situation elsewhere in India. In fact, in Kerala the proportion of overweight or obese women exceeded that of
underweight or thinness. It is also found that the difference between men and women is more marked in Kerala. In 1998-99 the obese women in Kerala was 17 per cent which has increased to 28 per cent in 2005-06. Obesity is known to create health problems which need to get the attention of health officials making policies and plans for the future. (Ajithkumar and Radhadevi, 2010).

Though India is a country still combating the communicable diseases, Kerala has an admirable health status comparable to the West and is now going through an epidemiological transition where non-communicable diseases are more prevalent. The popularity of ‘fast foods’, food from outside, sedentary lifestyles, increased ‘pocket money’, lack of sports, increased TV watching and computer usage and working parents have all led to a change in the way of life, the effects of which have to be studied. There is paucity of data on prevalence of overweight and obesity in Kerala (Ramesh, 2010).

According to Thankappan et al. (2010) in India, non-communicable diseases (NCD) are responsible for 53 per cent of deaths and 44 per cent disability adjusted life years lost in experiencing a rapid health transition. Within India, the state of Kerala well known for health at low cost is the most advanced state in this transition and a harbinger of what awaits the rest of India in the future. Based on a study done at Thiruvananthapuram in Kerala overall prevalence of diabetes in Kerala is about 16.2 per cent 50 per cent higher than in U. S. High blood pressure is present in 32 per cent people comparable to recent estimates in U. S. Fifty seven per cent people had abnormal levels of cholesterol again comparable to rates seen in the U.S. The prevalence of smoking in men was double than that observed in the U.S.
Non-communicable diseases (NCD) account for nearly half of all deaths in India. Among the NCD, cardiovascular diseases account for 52% of mortality followed by chronic obstructive pulmonary disease, cancer, diabetes and injuries. Projection estimates have shown that unless interventions are made, burden due to NCD will increase substantially. The potentially productive years of life lost (PPYLL) due to CVD in the age group of 35-64 years was 9.2 million in 2000 and is expected to be 17.9 million in 2030. Since majority of deaths are premature there is a substantial loss of lives during the productive years as compared to other countries. Heart diseases, stroke and diabetes are projected to increase cumulatively and India stands to lose 237 billion dollars during the decade 2005-2015 (Govt. of India planning commission, 2011).

The health of India’s people has improved significantly since independence (Since sixty years). But a high proportion of the population continues to suffer and die from easily preventable diseases and child birth related complications. At the same time, new health challenges are emerging. The rise in chronic adult diseases and injuries is stretching the system’s capacity to respond. Non-communicable diseases and injuries already account for about 60% of India’s disease burden, led by cardiovascular disease, mental health, injuries, cancer, and diabetes (World Bank, 2011).

2.2 Correlates of Body Mass Index among adults

Body Mass Index (BMI) is a simple index of weight-for-height (weight (Kg)/ Height (meter$^2$)) that is commonly used to classify underweight, overweight and obesity in adults. BMI values are age-independent and are the same for both sexes. The prevalence of obesity has risen sharply since 1980s worldwide (WHO, 2012). Globally, the prevalence of obesity ranges from as low as 0.6 per cent in Gambia among males to as high as 80.2 per cent in
Nauru in Pacific Islands. Among females, obesity ranges from 0.2 per cent in Ethiopia to 78.6 per cent in Nauru (Shayo and Mugusi, 2011).

According to WHO Media Center (2012) the fundamental cause of obesity and overweight is an energy imbalance between calories consumed and calories expended. Globally, there has been an increased intake of energy-dense foods that are high in fat, salt and sugars but low in vitamins, minerals and other micronutrients; and a decrease in physical activity due to the increasingly sedentary nature of many forms of work, changing modes of transportation and increasing urbanization.

Food Research and Action Centre (FRAC, 2010) opined that obesity is a complex condition with biological, genetic, behavioural, social, cultural and environmental influences; however primarily due to excess calorie intake and inadequate amounts of physical activity.

The rise of the obesity epidemic seemed to begin almost concurrently in most high-income countries in the 1970s and 1980s; since then, most middle-income and many low-income countries have joined the global surge in obesity prevalence in adults. By 2008, an estimated 1.46 billion adults globally were overweight and 502 million adults were obese. In most high-income countries, the energy expenditure needed for daily life has decreased since the beginning of the 20th century because of increased mechanisation, urbanisation, motorisation, and computerization. A parallel reduction of food energy intake coupled with decreasing physical activity is one possible explanation for the low prevalence of obesity during the first three-quarters of the 20th century. Since 1970s the increased availability and marketing of cheap, readily available food was so great due to environmental push factors that are increasingly available, cheap, tasty, highly promoted obesogenic
foods, the concomitant rise in weight was the physiological mechanism for restoration of energy balance (Swinburn et al., 2011).

The factors responsible for the epidemic of obesity in Nauru are a dramatic decrease in physical activity and dependence on a Western diet. The traditional foods of the islands such as fresh fish, meat, local fruits and vegetables have been replaced by rice, sugar, flour, canned meats, canned fruits and vegetables, soft drinks and beer. Specifically, traditional foods of past generations have been supplanted with food purchased from Western nations, such as the United States, Australia and New Zealand (Curtis, 2004).

Misra and Khurana (2008) reviewed the data from 212,021 adults from 51 countries, most of which were developing countries and showed that about 15 per cent of men and 20 per cent of women were at risk for chronic diseases due to physical inactivity. The prevalence of physical inactivity at less than the levels recommended for enhancing health was high in developing countries, ranging from 17 to 91 per cent. Remarkably, data from Brazil show that 70–80 per cent of the populations are inactive, in Colombia an estimated 7.6 per cent of all-cause mortality and 20.1 per cent of mortality due to chronic diseases were attributed to physical inactivity. Physical inactivity contributed to 9.6 per cent population attributable risk and was an important risk factor for CVD in Costa Rica and increase in obesity has been directly linked to physical inactivity in Chinese adults.

Results of 2010 Health Survey for England showed that the prevalence of obesity is similar in men and women, but men are more likely to be overweight (42% of men compared to 32% of women). However there are many complex behavioural and societal factors that combine to contribute to the causes of obesity. This include the influence of the environment on an
individual’s activity behaviour, physical activity type, frequency and intensity of activities, the impact of society, the influence of the media, education, peer pressure or culture, individual psychology, food environment and the quality, quantity (portion sizes) and frequency (snacking patterns) of an individual’s diet (NOO, 2010).

According to Martin et al. (2009) the currently estimated prevalence of obesity for the Spanish population is 14.5 per cent. They found that the prevalence of obesity increases in line with increase in the age and reaches its highest levels in the 55-60 year old age group but recently prevalence is growing significantly, even in younger age groups. The prevalence of both obesity and overweight in general is greater in men. The combination of changes in eating and increase in sedentary behaviour of various kinds have contributed significantly to the increased prevalence of overweight and obesity in Spain. There appears to be no doubt about the inverse relationship existing between physical activity and obesity.

In Bangladesh, the prevalence of underweight is very high with an increasing trend of overweight and obesity. The rising urbanisation and continued economic development found to be positively associated with the prevalence of being overweight. Excessive use of cars and other fuel-based vehicles, limited space for walking and physical activity, the availability, preference and consumption of fast and fatty foods and less preference for vegetables, improved technologies that require less energy, and sedentary and changing lifestyles, all contribute to the rising trend of being overweight or obese in Bangladesh. Education appears as a protective factor for the underweight but as a risk factor for the overweight (Khan and Kraemer, 2009).
Heini and Weinsier (1997) reported that reduced fat and calorie intake and frequent use of low-calorie food products have been associated with a paradoxical increase in the prevalence of obesity in United States of America. These diverging trends suggest that there has been a dramatic decrease in total physical activity related energy expenditure. Efforts to increase the average American's total exercise and non exercise related physical activities may be essential for the prevention of obesity.

Willett (2002) opined that in the United States of America, a substantial decline in the percentage of energy from fat during the last two decades has corresponded with a massive increase in obesity, and similar trends are occurring in other affluent countries. Diets high in fat do not account for the high prevalence of excess body fat in Western countries; reductions in the percentage of energy from fat will have no important benefits and could further exacerbate this problem. In contrast to this, McCrory et al. (2002) states that United States of America, food supply data indicated gradual increase in energy intake since 1970 and the per capita energy intake was 1.42 MJ/d (340 kcal/d) higher in 1994 than that in 1984. In contrast, self-reported physical activity remained constant between 1990 and 1998. Taken together, these data indicated that the increasing trend in United States of America in adult weight gain is primarily attributable to over consumption of energy.

Krassas et al. (2003) studied prevalence of obesity among adults from large territories of Greece, Serbia and Turkey. Overall male participants had a higher mean BMI than females. However, Greek females were more obese than males. Both in males and females mean BMI tend to increase with age up to 50-59 years and declined slightly thereafter.
Duvigneaud et al. (2007) studied socio-economic and lifestyle factors associated with overweight in Flemish adult men and women and confirmed the contention that overweight is a multifaceted problem. Age and TV viewing are positively associated with overweight, while educational level and health related sports are negatively related to overweight in both genders. In men, alcohol consumption and smoking in the past were also among the lifestyle factors associated with overweight. Changes to the traditional diet, reduced levels of physical activity, increased sedentary lifestyles, lack of health knowledge on obesity, and traditional social attitudes towards body fatness are major drives of the increasing trend of overweight in China (Wu et al., 2009).

Kim et al. (2010) studied the nutritional status of adult Vietnamese in the rural area. The prevalence of overweight progressively increased with advancing age. This may be related to the decrease in the degree of physical activity from work with age, since a larger proportion of younger subjects were currently engaged in jobs that required a high level of physical activity such as farmers and labourers. The overweight subjects over-ate more frequently and consumed fish and fruits more often. The results of this study suggest that eating habits may be related to the prevalence of overweight Vietnamese, living in rural areas. According to St-Onge et al. (2010) physical activity and dietary patterns have received much attention in attempts to explain the increasing trend in overweight and obesity of past decades.

According to Hill et al. (2000) although there are many environmental factors promoting excess energy intake and discouraging energy expenditure, it is clear that consumption of a high fat diet increases the likelihood of obesity and that, the risk of obesity is low in individuals consuming low fat diets. On the basis of the available data, the current public health recommendations to lower dietary fat intake appear to be appropriate. Bray (2005) observed that
large portion sizes, high fat intakes, easy access to sweetened beverages, and lack of any need to be physically active; all play a role in the toxic environment that leads to obesity. The genetic and physiologic responses of a host determine whether this toxic environment will produce obesity or not. Reversing the current trends of obesity requires a new outlook at the limits of the energy balance concept and a better understanding of how environmental factors acutely and chronically change the responses of susceptible hosts.

Study done by Miller et al. (1990) found that when subgroups of lean and obese subjects were compared, the lean subjects derived approximately 29 per cent of their energy from fat and 53 per cent from carbohydrate, whereas for the obese subjects it was 35 and 46 per cent, respectively. No differences were found between groups for total energy intake but the lean individuals exercised more often than did the obese individuals. These data suggest that diet composition may play an important role in fat deposition as do energy intake and lack of exercise.

Greenwood and Stanford (2008) opined that consumption of restaurant and fast food, large portion sizes, and sugar-added beverages increase energy intake, creating a positive energy balance. These behaviours are positively associated with overweight and obesity. Conversely, fruit and vegetable consumption and healthy breakfast consumption are negatively associated with overweight and obesity. Micallef et al. (2009) suggested that n-3 PUFA (poly unsaturated fatty acids) play an important role in weight status and abdominal obesity. Results of their study revealed that Body Mass Index, waist circumference and hip circumference are inversely correlated with PUFA in the obese group. They concluded that higher plasma levels of total n-3 PUFA are associated with healthier BMI.
A review of the results from 28 clinical trials that studied the effects of reduction in the amount of energy from fat in the diet showed that a reduction of 10 per cent in the proportion of energy from fat was associated with a reduction in weight of 16 g/d. Dietary fat plays a role in the development of obesity. To reduce the prevalence of obesity, there must be an increase in energy expenditure, a reduction in total energy intake, or both. This goal can be facilitated by reducing the amount of fat in the diet (Bray and Popkin, 1998).

Most epidemiological studies show an inverse relationship between carbohydrate intake and BMI (Gaesser, 2007). Whole-grain intake is generally inversely associated with BMI. Ma et al. (2005) reported that Body Mass Index was found to be positively associated with glycaemic index. Glycaemic index influences hunger and therefore may be related to overeating. Because the overall dietary quality tends to be higher for high-carbohydrate diets, a low-fat dietary strategy with emphasis on fiber-rich carbohydrates, particularly cereal fiber, may be beneficial for health and weight control.

Several studies investigating the relationship between Body Mass Index and energy intake have suggested that the macronutrient composition of the diet (protein, carbohydrate, fat) may play an important contributing role to obesity in adults (Elliot et al., 2011). Although research advances have highlighted the importance of molecular genetic factors in determining individual susceptibility to obesity, the landmark discoveries of leptin, uncoupling proteins and neuropeptides involved in body weight regulation, cannot explain the obesity epidemic. Our genes have not changed substantially during the past two decades. The culprit is an environment which promotes behaviors that cause obesity. To stop and ultimately reverse the obesity epidemic, we must “cure” this environment (Hill and Peters, 1998).
Environmental components influence food acquisition, eating, and lifestyle habits. However, the genetic components also wield some control (Fernandez et al., 2008). According to Johnson et al. (2011) though obesity must occur through genetic expression, the twin and adoption studies have demonstrated that along with genetic influence there are important environmental influences on body weight, and the ongoing obesity epidemic must be due to changes in some environmental exposures. Obesity is thus a multi-factorial abnormality that has a genetic foundation, but is more likely to be manifested in some environmental circumstances than others.

Andreasen and Andersen (2009) opined that genetic variance alone probably cannot account for obesity susceptibility without the addition of pre- and postnatal environmental and/or behavioral factors. With a focus on obesity they describe some of the recently reported gene–environment interactions for polymorphisms identified in the FTO and INSIG2 genes. Sonestedt et al. (2009) examined whether dietary factors (macronutrient and fiber intakes) and leisure-time physical activity modify the association between genetic variation in fat mass and obesity associated gene (FTO) and Body Mass Index. Results indicated that high-fat diets and low physical activity levels may accentuate the susceptibility to obesity by the FTO variant.

Higher BMI gain in early childhood and adolescence was associated with adult adiposity and central adiposity (Sachdev et al., 2005). Frisancho (2003) has reported that in the developing nations obesity is associated with short stature resulting from developmental undernutrition, while in the developed countries obesity is associated with tall stature. Studies by Maddah et al. (2003) Khan and Kraemer (2009) and Hermann et al. (2011) found significant association with level of education and BMI.
Cleland *et al.* (2008) found relationship between television viewing and abdominal obesity in young adults. Association between TV viewing and overweight was partially explained by food and beverage consumption during TV viewing. Chhabra and Chhabra (2007) and Bose *et al.* (2007) state that the economic status had a significant impact on the nutritional status with the economically better-off subjects being more likely to be overweight or obese and those with the lowest income were more likely to be underweight. According to Schmeiser (2009) income is found to significantly raise the BMI.

According to Chaput *et al.* (2007) short sleep duration predicts an increased risk of being overweight or obese among adults and is related to a reduced circulating leptin level relative to what is predicted by fat mass. Because sleep duration is a potentially modifiable risk factor, these findings might have important clinical implications for the prevention and treatment of obesity. Sex combined frequency of undernutrition was much higher among vegetarian (48%) compared with non vegetarian (25.5), the respective frequencies of overweight were 1.7 and 12.8 per cent (Bose *et al.*, 2009). The result of the logistic regression analysis of underweight women with those of normal weight showed that underweight was negatively and significantly associated with residence, education, household, standard of living and current age (Poluru and Mukherjee, 2010). Subramanian *et al.* (2011) did socio economic analysis of women in low to middle income countries and revealed that there is an association between wealth and BMI. According to Moli and Mini (2012) wealth index seems to be an important determinant of the prevalence of overweight in Kerala, as the chances to be overweight found to increase with increase in the income level.

Bouchard and Peter (2010) done a study regarding the gender on the global prevalence of obesity and showed that in most of the countries there is a
greater proportion of women than men are obese and more men are overweight than women. Allman- Farinelli et al., (2010) did an analysis of Australian Health Survey to explore the occupational risk of overweight and obesity. The results showed that men in professional and intermediate production and transport occupation had a higher risk of BMI >25kg/ m² than those without occupation and women in professional, management and advanced clerical and service occupation, had a lower risk.

NFHS-3 (2005-2006) reports state that over the last three decades there has been a progressive decline in undernutrition and some increase in overnutrition both in urban and in rural areas of India. Prevalence of both undernutrition and overnutrition are higher in women as compared to men. Undernutrition is particularly serious in the lower wealth quantile those with no education. Overweight and obesity are most common in older adults, those in urban areas, the well-educated and those in the highest wealth quantile. In most of the states with low energy intake, undernutrition rates are high (Bihar). In states with high-energy intake for example in Punjab undernutrition rates are low.

The last two decades witnessed tremendous change in lifestyle. The availability of transport both personal and public has improved several folds and energy expenditure in reaching places of study or work has become a fraction of what it was two decades ago. Economic improvement inevitably results in improved purchasing power, ability to purchase variety of food items and consume many of them. This in turn can lead to some increase in energy intake. Simultaneously there is a reduction in physical activity and perhaps increase in work related stress because of change in occupation. The combination of all these factors might be responsible for the rapid increase in over nutrition in the Indian population (Ramachandran, 2007).
Punjab is an economically advanced and physically robust state of the country. Urban upper middle class population of Punjab has achieved a socio-economic status similar to that of the developed societies, especially with respect to living conditions and nutritional intake. The socio-economic development has created changes in dietary intake, food consumption patterns and physical activity levels. They all have contributed to the problem of increasing overweight and obesity in Punjabi population (Sindhu and Tatla, 2002).

Over the last three decades there has not been any significant change in the dietary intake of Indian population, except in affluent families, especially in urban areas. Though there has not been any increase in dietary intake, a reduction was seen in under nutrition rates and an increase in over nutrition rates. These changes might be due to reduction in physical activity over the last three decades. It is therefore obvious that increase in dietary intake of fats, oils, and sugar is not a major factor in over nutrition in India (Ramachandran, 2007 and Hill and Melanson, 1999).

Martin et al. (2009) did a cross sectional study among 1203 Bengali adults in India which showed that frequency of under nutrition was higher among females (31.7%) compared to males (23.6%). There existed significant relationship between the level of formal education and nutritional status. Overall the frequency of chronic energy deficiency (43.5%) was much higher than overweight (7.0%) among subjects with no formal education.

Ramesh and Jareena (2009) found out that in Kerala standard of living and age are positively and significantly associated with overweight and obesity and negatively related to under nutrition. Further it has been observed that Muslim and Christian women are more likely to be overweight or obese than
Hindu women. This is related to differences in diet, physical activity and socio-economic status. Thankappan et al., (2010) reported that physical inactivity and alcoholism were associated with greater prevalence of overweight and abdominal obesity and smoking was associated with a lower prevalence of the same in Kerala. Ramesh (2010) states that, in the past 10 years there has been a tremendous growth in Kerala in the number of fast food joints. This has changed the diet to a high fat, high sugar, low fiber diet which in turn resulted in increased prevalence of overweight.

Rosen and Rosen (2012) opined that even though the increase in fat cell number in early years of development is due to gene and environment, the increase in fat cell size during later years is primarily due to diet. Therefore the fundamental cause of obesity is consequence of positive energy balance.

2.3 Comparative profile of anthropometry and body composition

The quest for a practical index of relative body weight that began shortly after actuaries reported increased mortality of their overweight policyholders culminated after World War II, when the relationship between weight and cardiovascular disease became the subject of epidemiological studies. It became evident then that the best index was the ratio of the weight in kilograms divided by the square of the height in meters, or the Quetelet Index described in 1832. Adolphe Quetelet (1796–1874) was a Belgian mathematician, astronomer and statistician, who developed a passionate interest in probability calculus that he applied to study human physical characteristics and social aptitudes. His pioneering cross-sectional studies of human growth led him to conclude that other than the spurts of growth after birth and during puberty, ‘the weight increases as the square of the height’, known as the Quetelet Index.
until it was termed the Body Mass Index in 1972 by Ancel Keys (1904–2004) (Eknoyan, 2008).

Anthropometry, which consists of body dimension and subcutaneous fat measures, is a noninvasive method of evaluation used to characterize body composition and growth or other changes related to nutritional status. Combinations of measures at various sites have been used to compare individuals to population norms (Knox et al., 2003).

The assessment of body composition in developing countries is usually made under field conditions and is limited to simple techniques such as anthropometry. Many equations have been developed for the prediction of body composition using common anthropometric measurements. These results suggest that for a marginally undernourished population with relatively little body fat, simple anthropometrics are as useful as more sophisticated measures for the prediction of body composition (Conlisk et al., 1992).

Most anthropometric methods used to assess body composition are based on a model in which the body consists of two chemically distinct compartments; fat and fat free mass. It can indirectly assess fat and fat free mass and the variations in their amount and proportion can be used as indices of nutritional status. Alteration in fat content provides indirect estimates of changes in energy balance. Anthropometric measurement of body composition is both fast and non invasive and it requires minimum equipment compared to laboratory techniques (Gibson, 2005).

The assessment of body composition can be performed with several sophisticated techniques, but in many circumstances it is more desirable to utilize widely available and simple techniques such as anthropometry. This would allow
quick determination of body composition without specialized laboratories, radiation exposure or expensive equipment (Dezenberg et al., 1999).

According to Otte et al. (2000) it might be advantageous to use the BMI to estimate body fatness provided there is a strong association between the two measurements. Numerous prediction equations have been developed for use in various populations. The advantage of the skinfold prediction technique is that it is a relatively quick and easy but may depend on the skill and background training of the technician performing the measurement. Population studies of body composition may be useful, although the impossibility of adopting precise and sophisticated methods, such as the laboratorial ones, may represent a disadvantage. Body mass index (BMI), an alternative to these methods, is frequently used to evaluate the subject's nutritional status with a special focus on obesity (Sampei et al., 2003).

Over the past decade a considerable amount of research has been done to evaluate the usefulness of BMI as a measure to identify overweight and obesity. Studies have shown that BMI, although not a direct measure of fatness is significantly correlated with body fat measured by laboratory methods, including hydro densitometry, isotope dilution and total body potassium. One of the major advantages of using BMI as a measure of overweight and obesity is that it can be derived from measures of height and weight. It is much easier to obtain reliable measures of weight and height than skinfold thickness. However BMI cannot distinguish whether the excess weight is due to fat or due to muscle mass (Bandini and Flynn, 2003).

According to Jordao et al. (2004) and Bhat et al. (2005) the current classification of obesity is based on body mass index (BMI, kg/m²), which is a surrogate for the total body fat and is the most traditional method for body
composition assessment. BMI is a simple and inexpensive index that is often used as an indicator of overall adiposity.

Body Mass Index (BMI, kg/m²) is an indicator of nutritional status. The extreme categories of BMI viz. underweight, overweight and obese as compared to the normal BMI are associated with a variety of adverse health outcomes. In particular being overweight or obese is associated with high mortality, disability and poor quality of life (Khan and Kraemer, 2009).

According to Corral et al. (2008), Shah and Bilal (2009) and Meeuwsen et al. (2010) body mass index should continue to be used in clinical practice to identify those at the two extremes of the body weight spectrum. Furthermore, BMI or plain body weight might still be the best way to evaluate changes in body fatness over time because increments on body weight or BMI most likely represents fat gain, with the exception of body builders, athletes or patients with conditions that increase the volume of third space such as heart failure, ascitis or renal failure. However, the use of BMI to detect excess body fat for those individuals with intermediate levels of BMI, it fails to distinguish whether the excess is in body fat or preserved lean mass.

Because of difference in weight between individuals are only partly due to variations in body fat many people object to the use of weight or indices based on height and weight (as BMI) to discriminate between overweight and normal weight people. However despite these, BMI correlates well with the percentage of body fat in large population; BMI probably is linearly related to increased mortality in men and women (Visscher et al., 2010).

In the recent years, anthropometric evaluations of the upper limb have become valuable in the assessment of nutritional status of adults. It is assumed that the triceps skinfold thickness indicates the calorie reserves stored in the
form of fat and the arm muscle size reflects the reserves of muscle protein. It is recommended that assessments of nutritional status be made on the basis of areas of fat and areas of muscle rather than direct skinfold thickness and arm circumference (Frisancho, 1981). The mid upper arm circumference can be used as an efficient alternative measurement in the evaluation of chronic energy deficiency status among adult males (Chakraborty et al., 2009).

Skinfolds are the most widely used technique to measure body fat in epidemiological studies. This method has potential for widespread use because of their simplicity and low cost and any method can be used depending on the resources available as this method shows a fairly good correlation with dual energy X-ray absorptiometry (Brodie, 1998 and Vasudev et al., 2004).

A study conducted by Snehalatha et al. (2003) concluded that it may be appropriate to use waist circumference as an index of upper body adiposity and also felt that WC is more sensitive than WHR as shown by interactions between WC and BMI. Biggard et al. (2003) observed that despite the high correlation between waist circumference and BMI, the combination may be very relevant in clinical practice because waist circumference for given BMI was a strong predictor of all-cause mortality. They are inexpensive and easy to use even in primary healthcare centers (Goel et al., 2008).

Waist-to-height ratio (WHtR) has been proposed as an easily measurable anthropometric index for detection of central obesity and to assess associations between cardio metabolic risk factor variables and central intra-abdominal obesity (Hsieh et al., 2003 and Mokha et al., 2010). Ashwell et al. (2012) shows the superiority of WHtR over WC and BMI for detecting cardiometabolic risk factors in both sexes therefore can be considered as a screening tool.
2.4 Need for nutrition education on lifestyle modification among adults

According to Aranceta et al. (2009) there is sound evidence that positive changes in food habits and physical activity could contribute to preventing the problem of overweight and obesity. Accordingly, in 2004 the WHO approved, as part of the 57th World Health Assembly, the Global Strategy on Diet and Physical Activity, which encourages all member states to develop and implement national action plans. Public health experts, academics, and politicians agree that there is a need for action, to prevent obesity. Evidence shows that prevention is potentially more efficient than treatment alone in reducing obesity and therefore should be addressed with priority in the public health sector.

FAO (2006) states that, given current economic and social trends, observed changes in dietary patterns are likely to continue and combined with changes in lifestyle, particularly the decrease in physical activity will exacerbate emerging problems of over nutrition and diet-related chronic disease. The challenge is to develop effective programmes and policies aimed at preventing and controlling both aspects of the 'double burden'. That is a task not only for nutritionists but also for everyone working in food production, processing and marketing, as well as food safety and education.

For India, the emerging nutrition transition has enormous resource implications for future health and nutrition programs and policies. As the nutrition transition progresses, educated people and high socio-economic groups are the first to respond to nutrition education messages and reduce the risk of obesity. Hence providing health education messages and interventions for overweight people in the higher socio economic groups in healthy diets and healthy life styles might be effective in reducing the incidence of overweight and obesity in the community (Griffiths and Bentley, 2001).
Potential strategies are needed to reduce obesity prevalence and obesity related morbidities and each intervention strategy has to be specific to the locality and culture of the intervention population. Strategies to increase physical activity levels would be a key part of any several approaches to obesity prevention. Mass media campaigns and other communication strategies are used in many countries to educate the public about healthy eating choices. Such campaigns and promotions can have a significant impact on awareness, attitudes, knowledge and intention to change. Overall, the promotion of healthier eating choices appears to be a necessary strategy for improving dietary intake (Swinburn et al., 2004).

Obesity is a significant public health problem that requires the development and implementation of effective interventions for both prevention and treatment. It is important to target interventions to improve physical activity participation in overweight and obese individuals to maximize weight control and corresponding improvements in health-related outcomes (Jakicic and Otto, 2005). Shanthy and Bowman (2006) suggested that obesity intervention programmes should emphasize reducing time spent in viewing television or videos or participating in similar sedentary activities and discourage snacking or eating while watching television. The severity of overweight and obesity trends in community implores life and social scientists to work together to devise effective strategies to improve the food intake patterns and enhance physical activity among the citizens. According to Otten et al. (2009) public health efforts to prevent and reduce obesity in adults have largely focused on modifying physical activity and diet. Strategies to reduce TV viewing should be further explored as a method to reduce and prevent obesity in adults.
Future programs aimed at decreasing the spread of overweight and obesity in adults should consider an improvement in health habits, including leisure-time physical activity and diet as well as socioeconomic factors (Sapp and Weng, 2007 and Hu et al. (2007). Well-targeted health education interventions should assist in reducing the obesity epidemic and a better understanding of socioeconomic differences in obesity should contribute to reducing the prevalence of obesity (Kaleta et al., 2007).

According to Khan and Kraemer (2009) co-existence of two extremes of BMIs is indeed, a great challenge for public health and therefore intervention to promote healthy diets and lifestyles that lead to the optimal BMI and other health outcomes is essential. The target population needs to be motivated to consume low calorie food and to increase physical activity and walking. Improving level of awareness about the hazards associated with excess weight through wide reaching health education campaigns is a fundamental first step in combating the epidemic (Wu et al., 2009).

According Mohan et al. (2007) mass awareness programmes can help in increasing the concern about other non communicable diseases. The fact that there is a shift in the age of onset of diabetes to younger age group is alarming as this could have adverse effects on the nation’s economy. Hence an appropriate intervention in the form of weight reduction, changes in dietary habits and increased physical activity could greatly help to prevent or at least delay the onset of diabetes and thus reduce the burden due to non communicable diseases in India.

According to Das et al. (2005) there is an urgent need to have public health remedial measures to address growing hypertension in the community
through health education on life style changes, dietary modification and avoidance of urban stress.

Cardiovascular diseases burden of India is increasing mainly because of changes in living habits, whereby behavioural risk factors are transformed into biological risk factors. Such environmentally determined risk factors are more amenable to change through public health and clinical interventions and therefore warrant early recognition at the individual level and surveillance at the population level (Reddy et al., 2006).

Gopalan (2007) opined that Home Science Colleges (nearly 400 in the country) with active departments of food and nutrition and the department of preventive medicine in medical colleges can play important role in health and nutrition education in the community.

Strategies for prevention of non-communicable disease, must address multiple risk factors to reduce the risk across the whole population. Public health intervention which influence life style behaviour through policy, public education or a combination of both have been demonstrated to yield risk dividends in reducing the risk of NCD in populations as well as individuals. The population strategy has advantage of being lifestyle linked, inexpensive and behaviourally more appropriate (Goenka et al., 2009).

Intervention strategies like eat less, eat on time and walk more have to be included to save citizens from developing these present day disorders. Pragmatic life style intervention can definitely delay and / or prevent diabetes and a host of other disorders (Mehta et al., 2009).

The early identification of at-risk individuals and implementation of appropriate intervention to increase physical activity and to bring about
changes in dietary habits could to a great extent help to prevent or delay, the onset of diabetes and thus reduce the burden due to its associated complications in India (Mohan and Pradeepa, 2009). Poluru and Mukherjee (2010) illustrated the need for public health programs that are able to address both underweight and overweight simultaneously. Effective policies and programmes are urgently required to reduce both forms of malnutrition. Baker et al. (2011) suggests that a behavioural change strategy that focuses on achievable, modest changes across multiple lifestyle goals may be the key to diabetes prevention among adults.

Soman (2007) opined that fortunately, interventions needed for controlling non communicable diseases among adults in Kerala are not expensive or high technology interventions. Simple dietary and lifestyle interventions like exercise, increased consumption of fruits and vegetables and abstinence from tobacco and alcohol can make a substantial dent in the problem of non-communicable diseases in Kerala. According to Raj et al. (2007) observations in the trend of increasing overweight in Kochi indicates that unless effective interventions and preventive strategies are instituted at the local and national level, the trend of increasing cardiovascular disease in adults observed in recent decades will accelerate even further. These trends are disturbing and call for concerted efforts targeted at improving lifestyles. Moli and Mini (2012) state that the level of overweight or obesity among adults in Kerala points out, a need for change in their lifestyle, dietary habits and increase in the level of physical activity. Healthy life style promotion programs should be integrated with existing health care system in the state.
2.5 **Scope of modern tool for nutrition and health awareness creation**

Looking forward the 21st century, health planning particularly at the community level will be substantially improved by developments in informatics that is through application of information science and technology in public health practice and research (Richards *et al.*, 1999). It is possible that lifestyle interventions could be integrated and delivered by new technologies such as interactive computer-mediated programs, telephone, or computer web-based formats. All of these recommended approaches should utilize valid and reliable measures of physical activity and should examine the health effects, particularly on a longitudinal basis (Dunn *et al.*, 1998).

The computer-tailored nutrition education is more likely to be read, remembered, and experienced as personally relevant compared to standard materials. Furthermore, computer-tailored nutrition education also appears to have a greater impact in motivating people to change their diet, fat intake in particular, although at present no definite conclusions can be drawn (Brug *et al.*, 1999). Computer mediated communications (stand alone or linkage applications) have emerged as a viable means of both gathering and disseminating nutrition information. Nutrition educators have many opportunities to enhance their work by using new technologies. Stand alone applications are computer programs that run without connection to telephone, television, satellite or other electronic transmission. These software and multimedia applications have received the greatest use in nutrition education (Kolasa and Miller, 1996).

Computer tailored nutrition education is an innovative and promising tool to motivate people to make healthy dietary changes. It provides respondents with individualized feedback about their dietary behaviors, motivations, attitudes, norms, and skills and mimics the process of "person-to-person"
dietary counselling. The available evidence indicates that computer-tailored nutrition education is more effective in motivating people to make dietary changes than general nutrition information, especially for reduction of dietary fat. The effectiveness of computer tailoring has been attributed to the fact that, individualized feedback commands greater attention, is processed more intensively, contains less redundant information, and is appreciated better than more general intervention materials. Interactive technology offers good opportunities for the application of computer-tailored nutrition education and a controlled study of Web-based computer tailoring shows promising results. However, using the Web for interactive personalized nutrition education also presents new challenges (Brug et al., 2003).

Anhøj and Jensen (2004) reported that there is a need for a receptive attitude toward a Web-based program that supports people who want to improve their life style and health. According to Brug et al. (2005) the research into the effectiveness and applicability of interventions provided through the internet is still in its infancy and the evidence for the effectiveness of web-based nutrition education is very limited. Nevertheless, the available evidence does show that web-based computer tailoring may be a promising strategy to encourage people to adopt healthier diets, but more research is needed to obtain evidence for the effectiveness in field studies.

According to Ware et al. (2008) internet-based physical activity (PA) and weight management programs have the potential to improve employees' health in large occupational health settings. A Web-based PA and weight management programme showed high levels of engagement across a wide range of employees, including overweight or obese workers, shift workers, and those who do not work with computers. Weight loss was observed at both office and manufacturing sites. The use of monitoring devices to capture and
send data to the automated Web-based coaching program may have influenced
the high levels of engagement observed in this study.

Computer tailored interventions simulate individual feedback based on
the behaviour motivation and attitudes of the user (Wanner et al., 2009). Given
increases in access and high rates of interest in internet use in general and for
health promotion specifically, technology-based interventions offer a potential
means to reach rural populations. With proper design and dissemination, e-
health programmes could be a critical tool in the elimination of health
disparities (Atkinson et al., 2009).

Misra and Khurana (2008) opined that awareness about healthy nutrition
and lifestyle should be imparted by physicians and nongovernmental
organizations through their networks along with endorsed messages by famous
personalities (e.g. film celebrities, sportsmen, etc.). Audiovisual media can
play an important role by televising healthy messages emphasizing the
importance of healthy diets and physical activity and awareness about the
complications of obesity and diabetes.

Computer-based health information has largely been viewed as positive,
influencing health decisions and changing the user’s view about diet and exercise.
With almost universal internet access and adoption, the reach, effectiveness and
the function of theoretical mechanisms have become pivotal issues facing
Internet-based public health interventions (Anderson-Bill et al., 2011).

The Internet has become a primary source for obtaining health
information by the public, making it an interesting medium for providing
interventions aimed at promoting healthful behaviors. In the last decade, the
number of behavior change interventions that have become available through
the Internet had greatly expanded. Further advantages of the Internet are the
easy and constant accessibility of interventions; visitors can access the intervention program at any time and location, can work through the program at their own convenience and can be more anonymous than face-to-face contacts (Brouwer et al., 2011).

As of September 2011, in India there are 112 million Internet users: 88 million from urban cities and 24 million from rural villages. Compared to the previous year, there has been a growth of around 13 per cent. The momentum is expected to hold up and by December 2011, it is expected that there will be 121 million claimed Internet users. Youngsters in India continue to drive Internet usage in India (IAMAI, 2011).

Glasgow et al. (2011) found that increased access to the Internet and the availability of efficacious e-Health interventions offer great promise for assisting adults to change and maintain health behaviours. A key concern is whether levels of engagement in Internet programs are sufficient to promote and sustain behavior change. Evaluation of an intervention on internet-based diabetes self-management showed that the participants visited the website fairly often and used all of the theoretically important sections, but engagement decreased over 4 months. Usage rates and patterns were similar for a wide range of participants, which has encouraging implications for the potential reach of online interventions.

Joshy (2011) had pointed out that computer based programmes had provided a new source of variable health information. Traditional sources of information include written material (pamphlets, leaflets, etc.), oral communication with nutritionist or dietitian, and formal educational programs. But currently the increased access to the Internet has provided with a new source of information and the rapid growth of the Internet has triggered an information revolution.
Computer based programme has the advantage of delivering health education in a structured, tailored, self-paced interactive format using combination of text, audio, video and animation to improve nutrition education awareness among individuals even with minimal health and computer literacy.