Introduction
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Globalization and industrialization have brought about rapid transition in the world, demographically, nutritionally and epidemiologically. Improvements in health and longevity are dramatically changing burden of diseases throughout the world. Developing countries are now undergoing the same dramatic shift in the causes of illnesses and deaths that developed countries experienced in the 1900's. Communicable diseases are no longer the only threat. With rapidly transitioning dietary and lifestyle patterns coupled with control of communicable diseases and better health facilities, chronic Non Communicable Diseases (NCDs) including cardiovascular diseases, cancer, hypertension, chronic obstructive pulmonary disease and diabetes have been recognized as a major cause of morbidity and mortality (WHO 2006). The WHO report (2001) stated that NCDs account for almost 60% of deaths, 46% of global burden of diseases and 75% of the total deaths occurring in developing countries.

India is also witnessing a state of constant nutritional, demographic and epidemiological transition (Popkin et al 2001, Pingali and Khwaja 2004, Shetty 2002). There is substantial evidence of the proposed theory of chronologically linked demographic/ nutritional/ epidemiological transition. The theory proposes that when populations face a massive social and technological change that includes urbanization as a key component, the pattern of food supplies and therefore the diets with associated factors also changes, consequently disease patterns also change.

Dietary transition

The nutrition transition in India has taken place in two stages, namely Income Induced Diet Diversification and Diet Globalization (Pingali and Khwaja 2004). Typically, there are dramatic increases in overall fat intake, a corresponding reduction in the proportion of energy from starchy staple foods accompanied by a shift from coarse grains and legumes toward more refined grains and increased consumption of processed foods, meat, fish,
diary products, edible oils, saturated and trans fats. The general effect is that the diet is less bulky and denser in energy. There is also an associated reduction in the fruit and vegetable intake.

**Income Induced Diet Diversification** is characterized by

- Increased consumption of superior quality rice, wheat & energy dense food
- Reduction in traditional staples
- Female participation in work
  - a) Erosion of traditional methods of food preparation
  - b) Eating out often
  - c) Consumption of ready to eat food & mixes (convenience food)
- Age
  - a) Elderly - Food preferences are static but superior quality ingredients used in traditional technique food preparation
  - b) Children and Adolescents – Adoption of extremely diverse diets and dietary practices that are difficult to modify

**Diet Globalization** is characterized by

**1980's**

- a) Increased consumption of animal foods & vegetable products
- b) Increased consumption of rice, wheat, pulses, spices & oil crops
- c) No marked change in consumption pattern of major food groups

**1990's**

- a) Significant change in pattern of food consumption
- b) Increased consumption of animal products especially animal fat
- c) Increased consumption of vegetable products especially wheat & wheat products, starchy roots, sugars & sweeteners and fruits
- d) Increased consumption of baked products, fast foods, aerated drinks, canned foods, etc.
- e) Reduction in consumption of rice, pulses and other cereals
**Physical Activity Pattern Transition**

Physical inactivity at and outside work is apparent. Increased television ownerships has played a major role not only in globalizing diets thereby, catalyzing faulty dietary patterns but also in displacing more active leisure time activities. Thus, television viewing has been linked to greater inactivity among all age groups as well as obesity. Urbanization has also led to increased desk jobs as compared to work involving physical labour like agriculture. Even physically exertive jobs have been simplified by increased mechanization. The shift away from walking and cycling to mass transit and cars represents a major change in regular physical activity resulting in lower energy expenditure (Popkin *et al* 2001).

**Epidemiological Transition**

Nutritional transition is accompanied by rapid changes in the levels of physical activity and body composition. Studies on genetic and environmental determinants of NCDs (diabetes, cardiovascular diseases and certain cancers) have shown that adoption of diet, lifestyle patterns and socio-cultural practices, like that of the indigenous populations by the migrants results in acquisition of disease patterns similar to the native population. Also, substantial evidence is available on the genetic predisposition to the risk of early onset of NCDs following migration and the consequent environmental changes. Rural and Urban differences in the prevalence of NCDs within a region or state in India show variances in disease risk due to internal migration and urbanization increasing risk of developing chronic diseases (Shetty 2002). Occurrence of NCDs like obesity, adult onset diabetes, cardiovascular diseases, hypertension and dyslipidemia are a part of the epidemiological transition fuelled by excessive energy intake coupled with sedentary behaviour/physical inactivity (Popkin *et al* 2001, Shetty 2002).

**Foetal Insults and Related Effects**

Extensive studies suggest that perinatal and infant nutrition insults affect predisposition to cardiovascular disease, obesity, hypertension and adult onset diabetes (Barker 1997). This factor is especially important in rapidly developing countries such as those of Asia where, rates of Low Birth Weight (LBW) and stunting are accompanied by concurrent
rapid shifts in diet, activity patterns and increased obesity. The concept was first articulated when gestational diabetes was described as being the result of a ‘thrifty genotype rendered detrimental by progress’. More recently, this hypothesis has been extended to the concept of a ‘thrifty phenotype’ to describe the metabolic adaptations adopted as a survival strategy by a malnourished foetus. These changes may also be inappropriate to deal with a later life of affluence, thus resulting in rapid catch up growth predisposing the individual to NCDs. Both the thrifty genotype and the thrifty phenotype hypotheses would predict that populations in some areas of the developing world would be at greater risk of obesity and its co-morbidities (Prentice et al 2005).

Modifiable Risk Factors of NCDs

For prevention of disease and injury, it is necessary to identify underlying health risks. Each risk has its own causes too, and many have their roots in a complex chain of events over time, consisting of socio-economic factors, environmental and community conditions, and individual behaviour. As a country develops, the types of diseases that affect a population shift from primarily infectious, such as diarrhoea and pneumonia, to NCDs, such as cardiovascular disease and cancers (Figure 1). This shift is caused by:

- Improvements in medical care leading to reduced child mortality and increased life expectancy
- Increased average age of the population, leading to higher NCD incidence
- Public health interventions such as vaccinations, hygienic surroundings, which reduce the incidence of infectious diseases.

Low-income populations are most affected by risks associated with poverty, such as undernutrition, unsafe water, poor sanitation and hygiene, and indoor smoke from solid fuels; these are the so-called “traditional risks”. As life expectancies increase and the major causes of death and disability shift to the chronic and non communicable, populations are increasingly facing modern risks due to physical inactivity; overweight and obesity, and other diet-related factors; and tobacco and alcohol related risks. Modern risks may take different trajectories in different countries, depending on the
risk and the context. As a result, many low and middle income countries now face a growing burden from the modern risks to health, while still fighting an unfinished battle with the traditional risks to health (WHO 2009). The impact of these modern risks varies at different levels of socioeconomic development (Table 1). Increasing exposure to these emerging risks is not inevitable but is amenable to public health intervention (WHO 2009).

**High Blood Pressure**

Raised blood pressure changes the structure of the arteries resulting in stroke, heart disease, kidney failure and other diseases increase. The risk is high not only in people with hypertension but also in those with average, or even below average, blood pressure. Diet, especially excessive salt and alcohol, lack of exercise and obesity raise blood pressure, and these effects accumulate with age. In developing and developed countries, most adults' blood pressure is higher than the ideal level. Globally, 51% of stroke (cerebrovascular disease) and 45% of ischemic heart disease deaths are attributable to high systolic blood pressure. At any given age, the risk of dying from high blood pressure in low and middle income countries is more than double that in high income countries. In the high income countries only 7% of deaths caused by high blood pressure occur under age 60, while in the African Region this increases to 25% (WHO 2009).

**High Blood Glucose**

Changes in diet and reductions in physical activity levels increase resistance to insulin, which in turn raises blood glucose. Genetics play an important role in whether individuals with similar diets and physical activity levels become resistant to insulin. Individuals with high levels of insulin resistance are classified as having diabetes, but individuals with raised blood glucose who do not have diabetes also face higher risks of cardiovascular diseases. Globally, 6% of deaths are caused by high blood glucose, with 83% of those deaths occur in low and middle income countries (WHO 2009).
Figure 1: The Risk Transition

![Risk Transition Diagram]

Table 1: Deaths and DALYs attributable to six diet-related risks and physical inactivity, and to all six risks combined, by region (Global Health Risks. WHO 2009).

<table>
<thead>
<tr>
<th>Risk</th>
<th>World</th>
<th>Low and Middle Income</th>
<th>High Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of deaths</td>
<td></td>
<td></td>
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<tr>
<td>High Blood Pressure</td>
<td>12.8</td>
<td>12.1</td>
<td>16.8</td>
</tr>
<tr>
<td>High Blood Glucose</td>
<td>5.8</td>
<td>5.6</td>
<td>7.0</td>
</tr>
<tr>
<td>Physical inactivity</td>
<td>5.5</td>
<td>5.1</td>
<td>7.7</td>
</tr>
<tr>
<td>Overweight and Obesity</td>
<td>4.8</td>
<td>4.2</td>
<td>8.4</td>
</tr>
<tr>
<td>High Cholesterol</td>
<td>4.5</td>
<td>4.3</td>
<td>5.8</td>
</tr>
<tr>
<td>Low Fruit and Vegetable intake</td>
<td>2.9</td>
<td>2.9</td>
<td>2.5</td>
</tr>
<tr>
<td>All six risks</td>
<td>19.1</td>
<td>18.1</td>
<td>25.2</td>
</tr>
<tr>
<td>Percentage of DALYs</td>
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<tr>
<td>High Blood Pressure</td>
<td>3.8</td>
<td>3.5</td>
<td>6.1</td>
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<tr>
<td>High Blood Glucose</td>
<td>2.7</td>
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<tr>
<td>All six risks</td>
<td>7.0</td>
<td>6.5</td>
<td>12.6</td>
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Physical Inactivity

Physical activity reduces the risk of cardiovascular disease, cancers, type 2 diabetes and premature death (WHO 2009, Paffenbarger et al 1993). Physical activity occurs across different domains, including work, transport, domestic duties and during leisure. In high income countries, most activity occurs during leisure time, while in low income countries most activity occurs during work, chores or transport. Physical inactivity is estimated to cause around 21–25% of breast and colon cancer burden, 27% of diabetes and about 30% of ischemic heart disease burden (WHO 2009). In a ten year follow up of Multiple Risk Factor Trial (MRFIT) subjects in treatment engaged in moderate physical activity showed a 27% lower coronary artery disease mortality rate than less active subjects (Leon and Connett 1990). Physical activity reduces insulin resistance, improves glycemic control and insulin sensitivity thus helps prevent type 2 diabetes (Blair et al 1983, Warburton et al 2006). Physical activity also improves HDL – C levels, body weight, blood pressure (Blair et al 1983).

Overweight and obesity

Mean BMI, overweight and obesity are increasing worldwide due to changes in diet and increasing physical inactivity. Rates of overweight and obesity are projected to increase in almost all countries, with 1.5 billion people overweight in 2015 (Ness and Powles 1997). The risk of coronary heart disease, ischemic stroke and type 2 diabetes grows steadily with increasing body mass, as do the risks of cancers of the breast, colon, prostate and other organs. Globally, 44% of diabetes burden, 23% of ischemic heart disease burden and 7–41% of certain cancer burdens are attributable to overweight and obesity. In both South East Asia and Africa, 41% of deaths caused by high body mass index occur under age 60, compared with 18% in high income countries (WHO 2009).

High Cholesterol levels

Diets high in saturated fat, physical inactivity and genetics can increase cholesterol levels. Recent research shows that levels of low density lipoproteins and high density
lipoproteins are more important for health than total cholesterol. Cholesterol increases the risks of heart disease, stroke and other vascular diseases. Globally, one third of ischemic heart disease is attributable to high blood cholesterol. High blood cholesterol increases the risk of heart disease, most in the middle income European countries, and least in the low and middle income countries in Asia (WHO 2009).

**Smoking and Tobacco use**

Smoking substantially increases the risk of death from lung and other cancers, heart disease, stroke and other conditions. Smoking is increasing in many low and middle income countries, while steadily, but slowly, decreasing in many high income countries (WHO 2008). Globally, smoking causes about 71% of lung cancer and nearly 10% of cardiovascular disease. It is responsible for 12% of male deaths and 6% of female deaths in the world. Tobacco caused an estimated 5.1 million deaths globally in 2004, or almost one in every eight deaths among adults aged 30 years and over. In India, 11% of deaths in men aged 30 –59 years were caused by tobacco smoking (WHO 2009). Smokers have 2 - 4 times the risk of developing coronary heart disease than non-smokers. Smoking causes increased vasoconstriction, blood pressure, platelet aggregation and adhesion, thus, hastening the formation of atherosclerotic lesions. It increases the incidence of acute myocardial infarction, sudden cardiac death and acute stroke (Lavie et al 1987). It is a reversible risk as the risk associated with cigarette smoking can be erased in 2 - 8 years of smoking cessation (Framingham study 1998). It has also been reported that cessation of smoking leads to 25% reduction in prevalence of coronary heart disease.

**Alcohol consumption:**

Alcohol contributes to more than 60 types of disease and injury, although it can also decrease the risk of coronary heart disease, stroke and diabetes (WHO 2009). The evidence relating alcohol intake to CVD is complex. Alcohol consumption has shown to have an adverse effect on blood pressure, body weight and glucose tolerance of an individual. Therefore, it is more detrimental to health. Various epidemiological studies have positively associated small amount of alcohol consumption with reduced coronary risk. The positive effect is mediated by increased HDL (Gaziano et al 1993). All
alcoholic beverages confer a protective effect (Seigneur et al 1990, Klatsky et al 1992), though a recent study found decreased risk only with wine (Gronbek et al 1995). The beneficial effect of alcohol wanes away as the amount of consumption increases and poses as an independent risk factor in development of coronary heart disease (Gronbek et al 1995).

**Dietary Factors**

Epidemiological studies conducted on population show that faulty diet pattern is a major modifiable risk factor for NCDs. Insufficient intake of fruit and vegetables is estimated to cause around 14% of gastrointestinal cancer, about 11% of ischemic heart disease and about 9% of stroke deaths worldwide. Rates of deaths and DALYs attributed to low fruit and vegetable intakes are highest in middle income European countries and in South-East Asia (WHO 2009).

Review of dietary patterns of South Asians revealed that these diets result in increase adiposity especially abdominal adiposity, insulin resistance and dyslipidemia, predisposing South Asians to obesity, type 2 diabetes and cardiovascular diseases (Lovegrove 2007, Misra et al 2008). Cardiovascular disease was found to be positively correlated with the consumption of saturated fat, total fat, total protein, animal protein, total calories, milk, sugar and salt consumption. Significant negative correlation was observed for grains, fruits and vegetables (ICDH Report 1994). Excess energy intake either in the form of fats or carbohydrates results in accumulation of fat and increase in weight leading to obesity, diabetes or an aberrant lipid profile (Krauss et al 2000, Mani and Tiwari 2002, Desai and Mani 2002). A high fibre diet is associated with improved ability to lower blood glucose levels, insulin requirements, insulin resistance and visceral adiposity (Davis et al 2009, Weickert and Pfeiffer 2008).

Dietary fibre also lowers the systolic and diastolic blood pressure when combined with a low fat diet (Hallfrisch et al 1998). Dietary fibre has a protective action against high C-Reactive Protein (CRP) levels. Reduced CRP levels decrease the risk of CVD, diabetes and their complications (Ma et al 2006). Fibre rich foods have lower Glycemic Index. Low

**Non Communicable Diseases**

Non communicable diseases are chronic degenerative diseases such as Obesity, Diabetes, Hypertension, Dyslipidemia, Cardiovascular diseases and Cancer also known as ‘Diseases of Affluence’ that are emerging to be a burden in many developing countries. These diseases are taxing not only on the health of an individual but also on socio – economic status of the country.

**Obesity**

Obesity is defined as a condition when adipose tissue makes up a greater than normal fraction of total body weight. Its aetiology is multifactoral involving genetic, environmental, metabolic and behavioural issues. Development of obesity is associated with common causes of morbidity and mortality like diabetes, hypertension, dyslipidemia, cardiovascular diseases and certain cancers (WHO 2009). Thus, it has been aptly named ‘Mother of all Chronic Degenerative Diseases’. Visceral obesity has been associated with increased insulin resistance, hyperinsulinemia, increased blood pressure and dyslipidemia (Qatanani and Lazar 2007, Wang et al 2005, Yusuf et al 2005). Repeated episodes of malnutrition followed by nutritional rehabilitation are known to alter body composition and increase risk of obesity (Shetty 2002). Percent prevalence of overweight and obesity in the SEAR region was 22% and 2% respectively using the WHO standards (WHO 2009). The prevalence would be much higher if the South Asian cut offs are used.

**Cardiovascular diseases (CVD)**

CVD is a global epidemic and is the number one cause of death worldwide (WHO 2009). Coronary arteries act as the main blood supply for the heart muscle and nourish it with nutrients and oxygen. Coronary heart disease (CHD) occurs when these smooth elastic...
arterial walls become narrowed or clogged due to atherosclerosis. Atherosclerosis involves infiltration of different cells like monocytes and T lymphocytes which interact with the cell layer and migrate to the subendothelial space where monocytes differentiate into macrophages. These in turn release chemicals and also take up low density lipoproteins (LDL-C) to form foam cells. Macrophages and foam cells contribute to lesion growth and thrombotic events (Ross 1999). Once an atheroma is established it can cause angina, myocardial infarction or sudden cardiac arrest. Atheroma in the cerebrovascular or peripheral arteries can cause strokes and critical limb ischemia. CVD was once confined to developed countries but now is very common in low and middle income countries like India where 80% of the 13 million annual CVD deaths occur (WHO 2006).

**Hypertension**

Hypertension is defined as systolic blood pressure greater than 140 mmHg and diastolic blood pressure greater than 90 mmHg. The nervous system and the kidneys work together in harmony to control blood pressure. But stress, obesity, diabetes, etc. can disrupt this harmonious balance that lead to elevated blood pressure or hypertension. Hypertension increases the arterial pressure and thus can predispose the body to CHD and strokes, increasing the chances of death and disability. Globally, 7.1 million deaths were attributed to high blood pressure in 2000 (WHO 2006). In the SEAR region 19% of the population has SBP ≥ 140mmHg (WHO 2009).

**Dyslipidemia**

The aetiology of dyslipidemia remains under investigation but most researchers favour the hypothesis that highly lypolytic nature of adipocytes especially the visceral adipocytes (abdominal) triggers a cascade of metabolic abnormalities resulting in dyslipidemia (Rippe et al 1998). Faulty diets, obesity and diabetes predispose the body to dyslipidemia. Dyslipidemia in turn, predisposes the body to death and disability due to CHD and strokes. Globally, 4.4 million deaths were attributed to high cholesterol levels in 2000 (WHO 2006). 5.1% of the population of the SEAR region has been found to have high cholesterol levels (≥6 mmol/l) (WHO 2009).
Cancer
Cancer is caused by mutation or abnormal activation of cellular genes that control cell growth and cell mitosis. The probability of mutations can be increased manifold when one is exposed to certain chemical, physical and biological factors. There are more than 100 types of cancers; any part of the body can be affected. The epidemiology of cancer in developing countries clearly differs from that in developed countries. While developed countries often have relatively high rates of lung, colorectal, breast, and prostate cancer (some of which is tied to tobacco use, occupational carcinogens, and diet and lifestyle), up to 25% of cancers in developing countries are associated with chronic infections. Cancer imposes a major and growing disease burden worldwide. Globally, deaths from cancer are projected to rise from 7.4 million in 2004 to 11.8 million in 2030 (WHO 2008).

Diabetes
The syndrome of diabetes mellitus is characterized by chronic hyperglycemia and disturbances of the carbohydrate, protein and lipid metabolism. Uncontrolled diabetes accelerates the development of microvascular and macrovascular complications of diabetes that cause damage and dysfunction of various organs of the body like eyes, kidneys, peripheral and coronary arteries (Rossetti 2002). Prevalence of diabetes worldwide was 171 million which would escalate to 366 million by 2030 (WHO 2006). South Asians, especially Indians, are genetically susceptible to diabetes. The percent prevalence of diabetes ($\geq 7\text{mmol/l}$) in the SEAR region is known to be as high as 17% (WHO 2009).

Patient participation is the key success factor in the treatment of diabetes that demands motivation, knowledge and compliance to a difficult lifetime regimen. Self management on lifestyle behaviours reported improvements in dietary carbohydrates or fat intake, decrease in calorie intake, and increase in the consumption of low glycemic index foods. Improved dietary habits correspond with improvements in weight and glycemic control.
The low cost, non pharmacological nature of exercise enhances its therapeutic appeal. Initial management of type 2 diabetics focuses on increasing physical activity to reduce hyperglycemia, hyperlipidemia and body fat (Pigman et al 2002). Increased physical activity has been reported depending on the duration and intensity of the intervention (Norris et al 2001). Even though exercise is considered to be an essential component of diabetes therapy, the effects of exercise in type 2 diabetes are not well established, since exercise interventions are difficult and expensive to conduct. Consequently, the type, frequency, intensity and duration of exercise for optimal therapeutic outcomes in type 2 diabetes are unclear (Brown et al 1996).

Lately, apart from conventional strategies like dietary restriction, physical activity/exercise and pharmacological interventions alternate therapies are being sought to tackle the diabetes pandemic. Several medicinal plants, herbs and functional foods have been found to improve blood glucose control and many more are still being explored. Clinical trials have shown some plants as antidiabetic agents, but the pure chemical compounds isolated from the crude extracts of these plants do not bear any structural resemblance to the antidiabetic drugs in current clinical use nor do they have similar mechanisms of action. Still, the search for a novel antidiabetic drug advocates the utilization of plants as a potential source (Rout et al 2009).

Medicinal plants used to treat hyperglycemic conditions are of considerable interest as a number of plants and their derivatives have shown varying degrees of hypoglycemic and anti-hyperglycemic activity. Traditional plant medicines or herbal formulations might offer a natural key to unlock diabetic complications (Rout et al 2009). A number of medicinal herbs and other functional foods like tulsi (Rai and Mani 1997, Rai and Mani 1997), spirulina (Parikh and Mani 2001, Mani et al 2000), cereal pulse mix with spices and condiments (Mani et al 1994, Mani et al 1997) have been studied and found to help diabetics.

_Gymnema sylvestre_ (Gurmar) is a plant native to the tropical forests of India, has long been used for the treatment of diabetes and is hyped as a ‘sugar blocker’ (Dey et al 2001).
Previously conducted clinical trials have revealed that the herb and its extracts significantly improve glycemic control of diabetic patients and reduce the daily requirement of OHA (Bhakaran et al. 1990, Shanmugasundaram et al. 1990). However, Gymnema sylvestre may temporarily reduce taste sensation of sweet and bitter flavours on consumption (Mozersky 1999). Gymnema provides a simple and effective method to help maintain healthy glucose levels and it works safely within the current regimen to promote proper pancreatic function. It is also said to have lipid lowering properties. These studies indicate the suitability of Gymnema sylvestre as a potential novel treatment for NIDDM.

**Health costs and NCDs**

In a review of costs pertaining to diet related NCDs, Popkin et al. (2001) placed India in a less advantageous position compared with China. It has been stated that mortality due to diet related NCDs is expected to increase to 43.3% of all deaths by 2020 in India. The cost will rise substantially, as in 1995, total cost of diet-related-NCDs (health and productivity) was $3.4 billion, costing 1.1% of the GDP in India. The loss is not only in terms of premature mortality but also due to DALYs. One DALY can be thought of as one lost year of "healthy" life, and the burden of disease can be thought of as a measurement of the gap between current health status and an ideal situation where everyone lives into old age, free of disease and disability. The loss, due to death and disability, of productive persons in mid-life, cripples development and perpetuates social conditions which foster communicable and nutritional disorders. The loss of a wage earner in the family has devastating effects on the nutrition, education, and health care access of other family members, especially young dependents. Much of these economic and health burdens could be obviated by

(a) **Short term** strategies which involve low cost screening for early detection of NCDs in whom early interventions effectively alter the natural history of disease and the use of the several low cost, high impact interventions for secondary prevention and clinical care which are now readily available (Reddy 2003).
(b) Long term investment in population based prevention strategies for preventing the acquisition or augmentation of risk in hitherto low risk populations and reduction of risk in populations already affected by health transition (Reddy 2003).

Prevention of NCDs

The principles of prevention which underline the strategies for NCD control are as follows.

**Principle 1:** Risk operates in a continuum - not across arbitrary thresholds; Risk reduction benefits across the range.

**Principle 2:** Majority of NCD events arise in a population from the middle of the distribution (of a risk factor) than from its high end.

**Principle 3:** Co-existence of risk factors leads to interactive risk which is multiplicative.

**Principle 4:** The absolute risk of a major NCD event (e.g. CHD/stroke) is dependent on the overall risk profile contributed by co-existent risk factors operating in a continuum.

Traditionally, public health approaches to NCD control have been (a) a high risk strategy, targeting persons with high levels of risk factors and employing interventions to reduce them, usually with drugs, and (b) a population strategy which attempts to reduce risk factor levels in the whole community, usually through lifestyle related measures (Rose 1985, Rose and Day 1990). The former provides higher benefits to individuals at maximum risk. However, since such individuals are a small segment of the society, there is no major impact on national morbidity or mortality of the country. The population approach aims at relatively modest reductions in the risk for each individual, but the cumulative benefits to the community are large since there are many more persons in the mild or moderate range of risk factor elevation than there are in the highest range. The two strategies are not mutually exclusive but are synergistically complementary. However, population-based and lifestyle linked strategies are likely to prevent the acquisition or augmentation of NCD risk factors in transitional societies like India, while avoiding the economic and biological costs of pharmacological risk reduction strategies practiced in the developed countries (Reddy 2003).
Health promotion

There are many definitions that explain health promotion. In simple terms it is an activity or program designed to improve social and environmental conditions such that people’s experience of well being is increased. It is also defines as the science and art of helping people choose their lifestyles to move towards a state of optimal health. Although some risk factors like age, gender, ethnicity, are non modifiable lifestyle and behavioural patterns that are the major risk factors can be changed, thereby preventing the occurrence of NCDs. Interventions aimed at changing diet and lifestyle factors include educating individuals, changing the environment, modifying food supplies, undertaking specific approaches to community interventions and implementing economic policies (WHO 2006).

WHO advises a ‘settings’ approach for prevention of NCDs (WHO 2002). Intervention programs need to be devised keeping the different settings (home, school and workplace) their demands, their strengths and weaknesses to ensure functionality. The need of the hour is to devise a user friendly intervention program using the pillars of good health that are diet, physical activity, appropriate lifestyle and behavioural changes to aid in the prevention of chronic degenerative diseases. But, over a period of time the compliance of an individual tends to wear off and does not get translated into a behavioural change. Small changes in knowledge, attitude, efficacy, etc. may dramatically alter motivation and behavioural outcomes. The interaction of such variables can yield almost infinite potential patterns of motivation and behaviour change (Reniscow and Vaughan 2006). To bring about a sustainable behavioural change, one needs to create awareness and constantly reinforce the message. It has also been studied that individually tailored interventions increase receiver attention and message salience thereby eliciting more motivation required for sustenance of change (Kreuter and Wray 2003, Reniscow and Vaughan 2006).
The industrial set up has a high prevalence of risk factors for metabolic syndrome like tobacco chewing, smoking, central obesity, overweight, physical inactivity, dyslipidemia and faulty dietary habits (Desai and Mani 2002). If such a setting is used to its advantage i.e. the availability of groups of people with similar background, a food supply system (canteen) and availability of a large and safe campus can be exploited to create an innovative ‘Chronic Disease Prevention and Control program’ (Desai and Mani 2002, Prabakaran et al 2009). When done in groups or with families, acts like a great motivator and improves efficacy and compliance (Peersman et al 1998). Lifestyle and behavioural intervention programs involve strategies to reduce substance abuse (tobacco, smoking and alcohol), balance energy intake and energy expenditure. Thus, appropriate diet, physical activity and lifestyle counselling that translated into a behavioural modification could be the key to bringing down the high prevalence of NCDs and also promote a better quality life. Keeping all these aspects in mind, a study was designed with the following objectives:

**Broad Objectives**

♦ To look into the role of Physical Activity and its influence on the Pathobiochemistry and Development of Secondary Complications in Diabetes Mellitus.

♦ To study the impact of supplementation of *Gymnema Sylvestre* in Type 2 Diabetics.

♦ To study the impact of Nutrition Health Promotion program in an industrial set up for the non executive and executive staff (DEAR study).
Specific Objectives

- To look into the metabolic derangements and development of secondary complications in Type 2 diabetes and to analyze the influence of physical activity among them.
- To investigate the effect of supplementation of the herb *Gymnema sylvestre* among Type 2 diabetics.
- To study the efficacy of a multifaceted nutrition health promotion program that encompasses dietary counselling, physical activity counselling, lifestyle counselling and focused physical activity in an industrial set up.
- To study the efficacy of a distance learning lifestyle, diet and physical activity counselling program for executives in an industrial set up.