Chapter 1
Introduction
“Better to hunt in fields, for health unbought, than fee the doctor for nauseous draught; the wise, for cure, on exercise depend; God never made his work for man to mend” wrote by John Dryden (1631–1700) in the seventeenth century (Paffenbarger and Hyde, 1980).

From the records of earlier times, the importance of physical activity to health and fitness has been acknowledged as an important component of life, along with work, play, and social, religious and cultural activities. The early Greeks knew the importance of a sound body to hardy spirits and tough minds. Early Europeans also knew the value of regular physical activity.

In 1961, Hans Kraus and Wilhelm Raab published the book Hypokinetic Disease, which many consider to be a landmark publication linking disease to physical inactivity.

From 1950 through the 1980s the study of physical activity epidemiology led researchers to conclude the evidence “that the relationship between exercise and good health is more than circumstantial. If some questions are not yet answered, they are far less important than those that have been” (Paffenbarger and Hyde, 1980). In 1996, ’Physical Activity and Health: A Report of the Surgeon General’ (USDHHS) synthesized the escalating evidence that physical activity and good health are inextricably linked.

The human organism is designed to be physically active. Anthropologists indicate that the need to be active is associated with our need to find food, fight predators and to flee for safety. While the “fight or flight” response that prepares people for physical activity still exists, automation and technology have freed many from the heavy physical labor that was characteristic of previous generations. To some extent these differences are influenced by education and socioeconomic status. Low socioeconomic groups with low education levels are less likely to be active than middle and high socioeconomic groups with higher education levels (Blaxter, 1990; Sallis et al, 1992; Andersen et al, 1996; King et al, 1997; Droomers et al, 1998).

Medical progress in preventing and treating infectious disease resulted in major changes in the causes of death between 1900 and 2000. Pneumonia, tuberculosis and diarrhea were the three most common causes of death in 1900. In 2000, in developed countries, the leading causes of death were heart disease, cancer and stroke.
Most significantly, regular physical activity greatly reduces the risk of coronary heart disease, the leading cause of death in the United States in 1994 (USDHHS, 1996). Physical activity also reduces the risk of developing diabetes, hypertension and colon cancer; enhances feelings of general wellbeing; is important for healthy bones and joints; and helps maintain function and preserves independence in older adults (Corbin et al, 1999). The focus on exercise for fitness and performance began to change with the accumulation of public health research outlining the health benefits of physical activity.

Blair (1993) suggested the need for a shift from the strategy of exercise for fitness to a new strategy of physical activity for public health. This new strategy, sometimes referred to as the “lifetime physical activity strategy,” differs from earlier strategies in three ways.

- First, the new strategy focuses on the amount of physical activity necessary to produce health benefits associated with reduced morbidity and mortality rather than fitness or performance benefits.
- It focuses on moderate activity rather than the vigorous physical activity of the old strategy designed to enhance fitness and performance.
- Finally, the new strategy emphasizes the value of accumulating physical activity throughout the day, as opposed to having to perform the activity in a single bout.

**Physical activity**

Physical activity is defined as any bodily movement performed by skeletal muscles that result in energy expenditure (USDHHS, 1996). It includes occupational activities, sports, conditioning, exercise, household activities and transport related activities.

The term “physical activity” should not be erroneous with “exercise and physical fitness”.

Exercise is a subset of physical activity “that is planned, structured and repetitive and has as a final or an intermediate objective for the improvement or maintenance of physical fitness”. It is performed in leisure time and designed to maintain or improve cardio respiratory or muscular fitness (Caspersen et al, 1985).
Physical fitness is the ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies. It implies a set of attributes that are either health or skill related. It is performed for health related components like cardio respiratory endurance, muscular strength, muscular endurance, body composition and flexibility of body.

Divergent to physical activity is sedentary behavior/lifestyle. Sedentary behavior is defined as engagement in pursuits that require expending low amounts of energy, equivalent to less sleeping but more sitting (Biddle, 2007). It is not merely absence of moderate or vigorous physical activity. Sedentary behavior can co exists with physical activity. It may draw interest as an independent health risk factor (Spainer et al, 2006; Healy et al, 2008a).

Physical activity directly benefits a person’s physical and mental health. People who exercise regularly are less susceptible to a number of chronic health conditions. Evidence also suggests that regular physical activity can contribute to improved mental health (Jones & O’Beney, 2004).

**Why there is a need to study physical activity?**

1. Changing food choices
   - People are more westernized now than a decade ago.
   - High in saturated fats and sugar.
   - Changes linked to “nutrition transition” characterized by decreased consumption of traditional diet and increased intake of processed foods, foods of animal origin, fats and sugar (Popkin et al, 2001).

2. Changing lifestyle
   - More stress, less leisure time.
   - More technology dependent lifestyle.
   - Less physical activity more sedentary activities (television and video game viewing, computer operation etc).
3. Increased urbanization
   - Rapid unplanned migration to cities. By 2030, 40.7% of India’s population will be living in urban areas compared to about 30% in 2007 (UNFPA, State of world population, 2007).

4. Changed disease pattern:
   - Moving from infectious/communicable disease to non-communicable/chronic disease.
   - Chronic diseases like diabetes, cardiovascular disease, stroke have increased drastically—a “epidemiologic transition”.
   - Projected increase in cerebrovascular mortality by 104% in women and 124% in men in 2020 (Yusuf et al, 2001).

5. Disruption of energy balance and rising obesity levels:
   - 1.3% of men and 2.5% of women in India are obese (WHO, 2008).
   - Around 16% of the adults and 25% of children in the urban areas in the country are obese, which is the underlying cause for complex ailments like diabetes, blood pressure and heart disease (The Hindu 14th September, 2009).

6. Elimination of modifiable risk factors—unhealthy diet, physical inactivity and tobacco use—would prevent 80% of premature heart disease, 80% of premature stroke, 80% of type 2 diabetes and 40% of cancers.


Further benefits of activity—pathways of interests

Main evidence-based pathways on how physical activity or exercise therapy delays progression of diseases and occurrence of disability and deaths (Kujala, 2009).
**Introduction**

**How much physical activity is needed?**

**Recommended activity levels**

- The ACSM and AHA 2007: 30 minutes of moderate intensity exercise at least 5 days a week.
- CDC 2008: 30 to 60 minutes per day of moderate to vigorous intensity physical activity on 5 or more days of the week.
- Indian (MOHFW and WHO) recommendations 2009: 45 minutes of physical activity on every day of the week. Moderate and vigorous activity should be mixed.

**How much are we doing?**

**Current physical activity level (WHO, 2006)**

- 60-85% of the world population is not physically active.
- Physical inactivity associated mortality is at least 1.9 million.
- In India as many as 61% of males and 51% of females are sedentary.
What are the factors that affect activity pattern?

*Environmental factors*

- Access and availability of open spaces and recreational facilities
- Walkability of roads
- Climatic conditions
- Pollution
- Transport infrastructure
- School environment- curriculum structure, homework, exam schedule

*Social factors*

- Perceived available time
- Education
- Age and gender
- Socio economic status
- Smoking
- Ethnicity
- Physician’s advice
- Social reinforcement (exercise partner, running group)
- Social acceptance
- Family, teacher and peer support and encouragement
- Activity modeling- presence of sports icons, celebrities

Strategy addressing physical activity must take in to account the bio- mental, social and personal determinants to be able to have any sustainable effects on activity levels (Popkin et al, 2005).

How is physical activity measured in populations?

*Measurement of physical activity*

Various instruments are available for measuring physical activity of populations in epidemiological studies to assess difference in their health outcomes.
Subjective measures

- Physical activity questionnaire (self or interviewer administered) - GPAQ, IPAQ especially developed for surveillance study in developing countries.
- 7 day recall (time/week) logs.
- 24 hour physical activity diary.

Benefits: Cheap, data can be collected from a large sample, large age range covered by questionnaires, quick to administer.

Limitations: Over reporting particularly vigorous activity, recall bias, test-re test reliability low, validity/reliability/sensitivity is questioned, challenge to capture all dimensions and kind of physical activity.

Objective measures

- Doubly labeled water: It requires the individual to consume water containing non radioactive isotopes of hydrogen and oxygen. Isotopes are eliminated at different rates from the body in the course of time in urine, sweat and from breathing. The difference in the rates of loss of hydrogen and oxygen isotopes is used to estimate the energy expenditure. However, it is an expensive method (Welk, 2002).
- Activity measures like pedometers, actigraphs device worn by individual that measures actual motion in the vertical plane.
- Heart rate and oxygen consumption method: energy expenditure is calculated based on heart rate of the individual, the oxygen consumed and the carbon dioxide produced.

Benefits: Better reliability and accuracy.

Limitations: Time consuming, costly.

Need of the day

Well designed programme and interventions need to be developed, implemented and rigorously monitored drawing on lessons by previously mentioned literature.

- Global effort at promoting activity
- School based interventions
Introduction

- Community based interventions
- Worksite interventions
- Clinical interventions
- Mass media campaigns

Future research prospective of physical activity (PA) in the domain of public health

- More research, data collection on perceptions and barriers to PA.
- Refining data collection instruments to make them more contextually relevant
- Surveillance systems required.
- Designing, implementing, monitoring and evaluating PA promotion programs.
- Need for suitable programs, policies and guidelines relevant to the Indian context.
- Settings to promote PA in offices, schools, community at large.
- Ministries need to be sensitized and engaged: Ministries like Health and Family Welfare, Youth Affairs and Sports, Information and Broadcasting, Urban Development, Finance and Education.
- International agencies, Resident Welfare associations, Non-governmental organizations also need to be engaged.

There is an urgent need to push back against the environmental forces that are producing gradual weight gain in the populations.

According to WHO, globally there are more than 1 billion overweight adults and 300 million obese people. The problem of obesity is increasing in the developing world with more than 115 million people. Along with overweight and obesity, various cardio respiratory problems are also increasing rapidly in developing countries including India.

Yoga appraised as physical activity

Today physical activity is considered to be need of every individual for disease free life. Yoga, walking, running, aerobics, cycling or swimming etc are various types of physical activities. These are the activities which will become regime for healthy survival in
coming era. Various studies have been done all over the world by taking a type of activity and its association with different health problems.

Yoga is a science of right living and it works when integrated in our daily life. It works on all aspects of the person: the physical, mental, emotional, psychic and spiritual. The word yoga means ‘unity’ or ‘oneness’ and is derived from the Sanskrit word ‘yuj’ which means ‘to join’ (www.introductiontoyoga.com).

Yoga is a way of life. It must be practiced regularly and conscientiously, with thorough preparation, bearing all precautions in mind for true mental and physical relaxation. One has to keep in mind that any result depends purely upon the individual, the nature of ailment and the regularity of yogic practice.

There are various types of yoga like Bhakti yoga, Hatha yoga, Jnana yoga, Karma yoga, Kundalini yoga, Mantra yoga, Purna yoga and Raja yoga. One of the yoga practices, Hatha Yoga, is based on the knowledge, development and balance of psychophysical energies in the body and can, therefore, be referred to as the ‘psychophysical yoga’. Hatha yoga is said to be the basis of all yoga systems. The word Hatha is made of two words, ‘Ha’ and ‘Tha’, Ha means sun and Tha means moon. Thus, Hatha yoga refers to positive (sun) and to negative (moon) currents in the system. It rejuvenates the body and prolongs its life. Hatha yoga is an important yoga type. It is an easy form of yoga and besides India it is very popular in the US and other western countries also.

Agrawal et al (2007) evaluated the beneficial effects of yoga and meditation on 101 adults in Bikaner who showed symptoms of metabolic syndrome. In their study, 55 adults received three months of regular yoga including standard stress management yoga poses and a form of transcendental meditation daily. During that time they continued to receive their standard care. The results showed yoga to be anti-aging, it lowered blood pressure and was beneficial for treating metabolic syndrome or syndrome X. Waist circumference, blood sugar and triglycerides were significantly lower, and “good” HDL cholesterol levels were higher in the yoga group as compared to controls.
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Yoga has been known to balance the endocrine system and hormones for centuries. Now it is also being recognized as a way to balance blood sugar levels and reduce the risk of diseases brought on by a classically western diet (Walters, 2008).

Over the last 10 years, a growing number of research studies have shown that the practice of Hatha Yoga can improve strength and flexibility and may help control such physiological variables as blood pressure, respiration and heart rate, and metabolic rate to improve overall exercise capacity (James, 2002).

Data indicated that yoga positively affects mental and physical health by regulating the hypothalamic pituitary adrenal (HPA) axis and the sympathetic nervous system, resulting in the individual feeling less anxious and reporting greater emotional, social and spiritual well being (Ross and Thomas, 2010).

Danucalov et al (2008) investigated the changes in cardio respiratory and metabolic intensity brought about by the practice of pranayam and meditation. They found reduced metabolic rate where as the specific pranayam technique in this study increased it when compared with the resting state. According to Joshi (2003), yoga is an accurate solution for several physical and mental diseases.

Many scholars like Blair et al (1984); Oscar et al (2005); Fuster et al (2008), found that by avoiding sedentary life style permanence of cardiovascular disease is reduced and it inflates the total life expectancy of an individual.

Respiratory health problems are also associated with cardio vascular problems. According to Anderson et al (2007), low cardio respiratory fitness is a strong predictor for clustering of cardiovascular disease risk factor in children independent of country, age and sex. It was found that metabolic syndrome is a part of sedentary lifestyle, poor cardio respiratory fitness, unhealthy diet and increased overweight and obesity. Higher level of physical activity and cardio respiratory fitness decreased the risk of developing metabolic syndrome (Hassinen et al, 2008). Weight reduction is one of the main methods for treatment of metabolic syndrome. Changes in fitness and physical activity were significantly correlated with weight loss (Jakicic et al, 2009).
Overall mortality and morbidity due to cardiovascular and Ischemic heart disease were found to be inversely related to the level of physical activity for men (Kannel & Sorlie, 1979). Ming et al (1999) found the relationship between low cardio respiratory fitness and mortality in normal weight, overweight and obese men. The study concludes that 50% obese men had low fitness. Cardio respiratory fitness was a strong and independent predictor of cardiovascular disease and all cause mortality.

These health problems may increase due to genetic component but it was found that physical activity reduced the influence of genetic factor to develop high body mass index and waist circumference. This study suggested that the individual at the greatest genetic risk for obesity would benefit the most from physical activity (Silventoinen et al, 2009).

Blair et al (1984) found that physical inactivity is a leading public health problem associated with decreased longevity as well as cardiovascular disease, cancer, obesity, diabetes and others. Likewise Fuster et al (2008), identified physical performance difference between active and sedentary subjects. In active males and females heart rate after exercise was lowered when compared with sedentary group that indicated greater cardiovascular benefit for those who adopted physical activities. Physical fitness and activity status are known risk predictors of cardiovascular disease (Laukkanen et al, 2002). In light of above discussion one can conclude that in coming era every individual has to follow some physical activity regime for healthy survival. The studies on association of physical activities with the body composition, metabolic syndrome and cardio respiratory fitness are relatively less on Indian population. The follow up studies of impact of regular physical activity on health problems or health risks are scanty in India.

Obesity is an expected outcome of over nutrition and sedentary lifestyle. Persistent obesity dysregulates metabolic processes including action of insulin on glucose-lipid-free fatty acid metabolism and severely affects processes controlling blood glucose, blood pressure and lipids. Thus begins a cluster of conditioning; dysglycemia, dyslipidemia, hypertension and procoagulant state known as metabolic syndrome (Grundy, 2003).
Various epidemiologic studies (cross-sectional and cohort) have primarily demonstrated the association between cardio respiratory fitness and metabolic risk or the association with self reported participation in recreational activities and metabolic risk. These studies attempted to explore the relationship between subjectively determined physical activity and metabolic syndrome (Carroll et al, 2000; Blair et al, 2001; Laaksonen et al, 2002a; Lakka et al, 2003; Laaksonen et al, 2003; Rennie et al, 2003).

**Metabolic syndrome**

**Table 1.1 Synonyms for Metabolic Syndrome**

<table>
<thead>
<tr>
<th>Android obesity syndrome</th>
<th>Atherothrombogenic syndrome</th>
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<tr>
<td>Syndrome of Affluence</td>
<td>Metabolic cardiovascular syndrome</td>
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<tr>
<td>Plurimetabolic syndrome</td>
<td>Syndrome X plus</td>
</tr>
<tr>
<td>GHO (Glucose intolerance/Hypertension/Obesity syndrome)</td>
<td>Deadly quartet</td>
</tr>
<tr>
<td>Syndrome X</td>
<td>Cardiovascular and metabolic syndrome</td>
</tr>
<tr>
<td>Metabolic syndrome X</td>
<td>Dysmetabolic syndrome X</td>
</tr>
<tr>
<td>Reaven syndrome</td>
<td>MetSyn</td>
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<tr>
<td>Insulin resistance syndrome</td>
<td>CHOAS (Australia)</td>
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<tr>
<td>Insulin resistance/hyperinsulinemia syndrome</td>
<td>Wohlstands syndrome (Germany)</td>
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Metabolic Syndrome (MS) is a common disorder caused by a combination of unhealthy diet, sedentary lifestyle and genetic predisposition (Eckel et al, 2005).

The prevalence of metabolic syndrome has dramatically increased over the last few decades and has become a major health challenge worldwide, increasing the risk of cardiovascular disease (CVD), type 2 diabetes (T2D), nonalcoholic liver disease, renal disease, and some forms of cancer in adults (Zimmet et al, 2001; Yach et al, 2004).

The metabolic syndrome is a multiplex risk factor for type 2 diabetes mellitus and cardiovascular disease that reflects the clustering of individual risk factors due to abdominal obesity and insulin resistance (Blaha et al, 2008).

The concept of metabolic syndrome is useful because of its emphasis on underlying dysmetabolism and the attention it calls to coexisting cardiovascular risk factors.
Table 1.2 Three international definitions of metabolic syndrome (MS)

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<tr>
<td>Glucose intolerance, IGT or diabetes and/or insulin resistance with two or more of the following symptoms</td>
<td>Three or more of the following five risk factors</td>
<td>Central obesity (defined as waist circumference, ethnic specific), plus any two of the following four factors</td>
</tr>
<tr>
<td>Waist circumference</td>
<td>≥102 cm in men, ≥88 cm in women</td>
<td>≥90 cm in men, ≥80 cm in women (South Asians includes Chinese, Malay and Asian-Indian population).</td>
</tr>
<tr>
<td>Waist hip ratio</td>
<td>&gt;0.90 in men &gt;0.85 in women</td>
<td>-</td>
</tr>
<tr>
<td>BMI</td>
<td>BMI &gt;30 kg/m²</td>
<td>-</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>≥150 mg/dL</td>
<td>≥150 mg/dL</td>
</tr>
<tr>
<td>HDL</td>
<td>≤35 mg/dL in men, ≤39 mg/dL in women</td>
<td>≤40 mg/dL in men, ≤50 mg/dL in women</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>≥140/90 mm Hg</td>
<td>≥130/85 mm Hg</td>
</tr>
<tr>
<td>Glucose</td>
<td>IGT, IFG, or T2D</td>
<td>Fasting &gt;110 mg/dL</td>
</tr>
</tbody>
</table>

WHO (1998) defined metabolic syndrome as glucose intolerance, IGT or diabetes and/or insulin resistance with two or more of the following symptoms, 1) waist hip ratio >0.90 in men and >0.85 in women; 2) BMI >30 kg/m²; 3) serum triglyceride level of ≥150 mg/dL; 4) HDL cholesterol level, <35 mg/dL for men and, < 39 mg/dL for women; 5) systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥90 mmHg.

Metabolic syndrome is defined according to the NCEP ATP III (2002) guidelines as meeting three or more of the following criteria: 1) waist circumference ≥102 cm for men and ≥88 cm for women; 2) serum triglyceride level of ≥ 150 mg/dL; 3) HDL cholesterol level, <40 mg/dL for men and, < 50 mg/dL for women; 4) fasting glucose level ≥ 110 mg/dL or use of anti diabetic medications (insulin or oral agents); or 5) systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥85 mmHg, or use of antihypertensive medications.

According to IDF (2006), metabolic syndrome is defined as central obesity (defined as waist circumference, ethnic specific), plus any two of the following four factors: 1) serum triglyceride level of ≥150 mg/dL; 2) HDL cholesterol level, <40 mg/dL for men and,
< 50 mg/dL for women; 3) fasting glucose level ≥ 110 mg/dL; 4) systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg.

Both genetic predisposition and the environment play important roles in the development of metabolic syndrome

Genetic factors

Genetic factors increasing the chance that an individual will develop metabolic syndrome include:

- Family history of diabetes or heart disease
- Type 2 diabetes
- Hypertension

Environmental factors

Environmental factors that enhance the possibility of becoming a high-risk metabolic syndrome candidate and that can be prevented.

Obesity, likely to be the greatest risk factor, is mainly due to:

- Low activity level and a sedentary lifestyle
- Diet rich in saturated fats, cholesterol and sugar

Other factors

Additional factors that play a role in the development of metabolic syndrome are:

- Aging
- Hormonal imbalance
- Smoking
- Chronic stress

Lifestyle therapies are the first-line interventions to reduce metabolic risk factors. These include:

- Normalization of body weight (BMI under 25 kg/m²)
- Increased physical activity with a goal of at least 30 minutes of moderate-intensity activity on most days of the week
• Healthy eating habits with reduced intake of saturated fats and cholesterol

Metabolic syndrome is associated with an increased risk of cardiovascular disease and death, producing a large adverse impact on public health (Lakka et al, 2002; Alexender et al, 2003; Sattar et al, 2003; Ford, 2004; Girman et al, 2004; Malik et al, 2004; Schillaci et al, 2004; Dekker et al, 2005).

The prevalence of the disease is almost super imposable in European and non European countries (about 23-25% of the general population is affected), although higher values have been reported in certain geographic areas (such as America), characterized by an increased propensity to obesity reaching sometimes endemic proportions (Ford & Giles, 2003; Meigs, 2003; Grundy et al, 2004; Hu et al, 2004; Muntner et al, 2004).

A profound shift in the balance of the major causes of death and disease has already occurred in developed countries and is under way in many developing countries. Globally, the burden of non communicable diseases has increased rapidly.

In 2001, non communicable diseases accounted for almost 60% of the 56 million deaths annually and 47% of the global burden of disease. In view of these figures and the predicted future growth in this disease burden, the prevention of non communicable diseases presents a major challenge to global public health (Global Strategy on Diet, Physical Activity and Health, WHO, 2004).

![Figure 1.1 Prevalence of metabolic syndrome in developing countries](image-url)

Source: Viswanathan et al, 2006
For non communicable diseases, the most important risks included high blood pressure, high concentrations of cholesterol in the blood, inadequate intake of fruit and vegetables, overweight or obesity, physical inactivity and tobacco use. Five of these risk factors are closely related to diet and physical activity. Unhealthy diets and physical inactivity are thus among the leading causes of the major non communicable diseases, including cardiovascular disease, type 2 diabetes, certain types of cancer, and contribute substantially to the global burden of disease, death and disability (Global Strategy on Diet, Physical Activity and Health, WHO, 2004).

Table 1.3 Prevalence of metabolic syndrome in Asian Indians residing in India

<table>
<thead>
<tr>
<th>Author, Year, City</th>
<th>Prevalence</th>
<th>Overall</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kasliwal et al, 2005, Delhi</td>
<td>28.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gupta et al, 2004, Jaipur</td>
<td>25</td>
<td>18</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Misra et al, 2004, Delhi</td>
<td>12</td>
<td>08</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Gupta et al, 2003, Jaipur</td>
<td>13</td>
<td>10</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Ramachandran et al, 2003, Chennai</td>
<td>41</td>
<td>-</td>
<td>-</td>
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</table>

Source: Wasir and Mishra, 2004

In 2001 in France, the National Nutrition and Health Program (Programme National Nutrition Santé — PNNS) was implemented in order to improve the health status of the population through nutritional measures (Hercberg et al, 2008).

The objective of the study was to examine the relationship between adherence to nutritional recommendations, as assessed using the PNNS-GS, and MS components and prevalence in a national sample, in order to identify targets for preventive strategies aimed at reducing the risk of MS (Chantal et al, 2010). MS was defined as the presence of abdominal obesity, plus two or more other risk factor components (Alberti et al, 2005). Adults diagnosed as having cardiovascular risk factors probably altered their diet and physical activity according to recommendations, since nutritional modifications are part of medical care (Fung et al, 2001; WHO, 2007). The study found an inverse association between adherence to PNNS recommendations and MS in young adults not under medication, which probably existed prior to diagnosis of a cardiovascular-disease related condition. The results suggested that targeting diet and physical activity changes
in this youthful population could be effective in preventing MS and therefore in lowering cardiovascular-disease risk in the population (Chantal et al, 2010).

Metabolic syndrome (MS) is a high-risk condition associated with overall and cardiovascular mortality (Lakka et al, 2002; Hunt et al, 2004; Galassi et al, 2006). This relationship was first documented in middle-aged adults, but evidence suggests that its impact on health could occur at an earlier age, accounting in part for early cardiovascular disease (Lakka et al, 2002; Iribarren et al, 2006; Milionis et al, 2007). Reducing the prevalence of MS could therefore lower the incidence of cardiovascular disease and associated mortality.

**Sedentary behaviour and metabolic syndrome**

The ubiquitous presence of televisions and computers in many societies has contributed significantly to the sedentary lifestyles of many. A sedentary lifestyle has been found to be linked to the metabolic syndrome (Ford et al, 2005), obesity (Foster et al, 2006), and diabetes (Hu, 2003).

The following daily routine might be a reality for many employees: travel to work by car, take the elevator to an office and sit behind a desk for a majority of the working day. At the end of the day, many workers commutes home by car or train, and when at home, inactivity may continue, as computerized and television entertainment is popular. This transition from a physically demanding environment to a predominantly mechanical environment focusing on convenience, has significantly contributed to a decline in physical activity levels. The following factors are often cited as important components of changing environment that may have had consequences for dietary habits: convenience in food availability (e.g., increase in food stores, vending machines, etc), increasing availability of energy dense, nutrient poor (ready-to-eat) foods, and greater amount of meals consumed away from home in large portions (i.e., pizza, Mexican food, fast food culture etc; Popkin et al, 2005). This ‘new’ environment can be called the ‘obesogenic’ environment (Swinburn & Egger, 2004) where the choice to make healthy decisions has become increasingly difficult and more importantly not obvious for most individuals. In this regard, unhealthy behavior has become a normal response to an abnormal environment.
Watching television is a favorite pastime among both children and adults in US. According to Nielsen (2008), Americans watched on average about 151 hours of television per month in the fourth quarter of 2008. The amount of time spent watching television proved to be strongly and positively associated with concentrations of insulin. This finding is consistent with previous research showing significant associations between the amount of time spent watching television and prevalent or incident obesity, metabolic syndrome and diabetes (Hu, 2003; Ford et al, 2005; Foster et al, 2006).

Of the types of physical activity examined in this study, reported leisure-time physical activity was the only component that was significantly and inversely associated with concentrations of insulin (Ford et al, 2010). The inverse association between physical activity and concentrations of insulin is well known (Kelley and Goodpaster, 1999).

Physical activity and sedentary behavior were self-reported and therefore subject to some degree of misclassification. The associations were based on data collected at a single point in time, which may have underestimated the strength of the associations. The reliability and validity of the questions concerning television watching and computer use have not been established. However, they are similar to those used in other studies (Clark et al, 2009). No trials have apparently assessed the impact of reductions in screen time on concentrations of insulin, but evidence suggests that interventions that reduce screen time or that include a component to reduce screen time can have a beneficial effect on obesity in youth (Epstein et al, 1995; Gortmaker et al, 1999; Robinson et al, 1999; Epstein et al, 2000; 2008).

The accumulated evidence suggests strongly that excessive television watching negatively impacts health. Furthermore, if public health efforts to combat obesity, the metabolic syndrome, and diabetes are to be successful, reducing the amount of time spent watching television in the US population is likely to be an important strategy (Ford et al, 2010).

In the past few decades a great deal of attention has been focused on the relationships between body weight and eating habits and behaviors. The prevalence of obesity has increased worldwide and it is commonly held that understanding the correlations between food intake, lifestyle and overweight could lead to improvement in preventing
weight gain or in treating obesity (WHO, 2000; Swinburn and Egger, 2002). Unfortunately, studies centering on the associations between relative weight, food intake, eating attitudes and behaviors, physical activity, smoking and alcohol consumption have yielded no conclusive evidence that these habits promote or maintain weight gain (Bouchard, 1996; Seidell, 1998; Sherwood et al, 2000).

Physical inactivity (Laaksonen et al, 2002b; Bianchi et al, 2008), often defined as the lack of moderate-to-vigorous physical activity, and sedentary behavior (Ford et al, 2005; Wijndaele et al, 2009) have been shown to be important risk factors of metabolic syndrome.

Sedentary behavior is not defined as the lack of moderate-to-vigorous physical activity, it is important to study it separately from light, moderate, or vigorous activity. Further, sedentary behavior is independently associated with health outcomes (Lakka et al, 2007; Pate et al, 2008). Self-reported sedentary behavior, such as television viewing time, has been positively associated with metabolic risk factors and metabolic syndrome (Ford et al, 2005; Dunstan et al, 2007; Healy et al, 2008b; Wijndaele et al, 2009). Several studies with objectively measured sedentary data have shown that the number of hours of sedentary time is related to metabolic risk factors (Ekelund et al, 2007; Healy et al, 2008c). A study among Australian adults found that sedentary time was positively associated with metabolic syndrome (Healy et al, 2008c).

The relationship of the MS with a sedentary lifestyle differed according to sex and type of sedentary occupation. These results suggested the need to assess selected indicators of sedentary behavior in preventive programs (Sandrine et al, 2005).

**Physical Activity and Metabolic Syndrome**

Studies among adults and also among adolescents revealed that physical activity (PA) - a modifiable lifestyle factor – is strongly associated with clustering of metabolic syndrome components (Brage et al, 2004; Andersen et al, 2006; Kelishadi et al, 2007; Li et al, 2007; Ekelund et al, 2009; Hong et al, 2009).

Physical activity is a cost effective way to decrease obesity and possess potential for having a major public health impact. Many studies have documented an association
between sedentary behavior and obesity (Jebb & Moore, 1999). Inverse relationship between habitual physical activity and obesity was observed (Slattery et al, 1997; Pietilainen et al, 2008). Physical activity is considered important in the prevention of weight gain (Rissanen et al, 1991; Hill & Melanson, 1999; Fogelholm et al, 2000).

Metabolic Syndrome has been demonstrated as a common precursor to the development of type 2 diabetes and cardiovascular disease (Grundy et al, 2005), as well as a risk factor for all cause mortality (Hui et al, 2010). More effort are needed to promote a healthy lifestyle with increased physical activity and reduced obesity (Grundy et al, 2005; Misra & Khurana, 2008). Individuals with metabolic syndrome should be identified early so that their cardiovascular risk factors can be reduced (Galassi et al, 2006).

Oscar et al (2005), concluded that avoiding a sedentary lifestyle during adulthood not only prevent cardiovascular disease independently of other risk factors but also substantially expands the total life expectancy. Blair et al (1984), found that physical inactivity is a leading public health problem associated with decreased longevity as well as cardiovascular disease, cancer, obesity, diabetes and others. Likewise, Fuster et al (2008) identified physical performance difference between active and sedentary subjects. In active males and females heart rate after exercise was lowered when compared with sedentary group that indicated greater cardiovascular benefit for those who adopted physical activities. Physical fitness and activity status are known risk predictors of cardiovascular disease (Laukkanen et al, 2002). In the light of the above discussion, the importance of physical activity for healthy survival becomes clear. Although some studies are available on different sports activities and yoga in India, few studies has been conducted on association of physical activities with body composition, metabolic syndrome and cardio respiratory fitness. Further, a follow up study of impact of regular and irregular physical activity on health problems or health risks using anthropological approach would be a pioneering study in India.

Globally, the prevalence of cardiovascular and respiratory health problems is increasing at an alarming rate. About 18 million people die every year from cardiovascular disease, for which diabetes and hypertension are major predisposing factors (Haslam et al, 2005).
Obesity is considered as an epidemic all over the world. According to the international obesity Task force and WHO, 1.7 billion people are classified as overweight worldwide after revising the definition of obesity to adjust for ethnic differences.

It is difficult to study type 2 diabetes, hypertension, obesity or dislipidemia alone. So by combining these problems the metabolic syndrome emerges. National Cholesterol Education Program ATP III defined metabolic syndrome as an individual suffering from three risk factors out of five of the following; presence of elevated blood pressure, increased fasting plasma glucose, low serum HDL cholesterol, high serum triglycerides and abdominal obesity. All these health problems increase because of sedentary lifestyle of individual. Today physical activity is considered to be need of every individual for disease free life.

There is a relation between physical inactivity and cardiovascular mortality, and inactivity is a risk factor for the development of coronary artery disease (Powell et al, 1987; Blair et al, 1989; Morris et al, 1990). People with the metabolic syndrome are at increased risk for developing diabetes and cardiovascular disease (Lakka et al, 2002; Laaksonen et al, 2002b; Onat et al, 2002; Resnick et al, 2003).

One of the earliest study (ICMR) on prevalence of Metabolic Syndrome in India was conducted in the urban areas of Delhi and rural Haryana and the prevalence was 30% and 11% respectively during 1992-94 (criteria: ATP III). Later, Ramachandran et al (2003) using modified ATP III criteria documented a higher prevalence of metabolic syndrome (41%) in 1995.

Excess weight and lack of physical activity are two important determinants of the metabolic syndrome (Liese et al, 1997; Everson et al, 1998; Vanhala et al, 1998; Yarbough et al, 1998; Case et al, 2002; Gazzaruso et al, 2002; Gustat et al, 2002; Han et al, 2002; Irwin et al, 2002; Kullo et al, 2002; Laaksonen et al, 2002b; Pereira et al, 2002; Lakka et al, 2003; Rennie et al, 2003;).

Kapoor et al (2010) conducted a study among adult Saharia, a primitive tribal group of Madhya Pradesh. It was reported that despite being a socio-economically weaker population with very low literacy level, there was a clustering of higher blood sugar level, higher blood pressure and higher fat percentage among them which is an indicator of a beginning of metabolic syndrome among primitive tribal group in India.
Excess weight, too much inactivity, and too little physical activity are major modifiable risk factors of metabolic syndrome. Overweight status and obesity are associated with sedentariness, while normal weight correlates with the habit of exercise (Guitierrez-Fisac et al, 1996; Martinez-Gonzales et al, 1999; Lahti-Koski et al, 2002).

(i) Physical Activity and Obesity

The rising epidemic of obesity reflects the profound changes in society and in behavioral patterns of communities over recent decades. While genes are important in determining a person’s susceptibility to weight gain, energy balance is determined by calorie intake and physical activity. Thus societal changes and worldwide nutrition transition are driving the obesity epidemic.

The global emergence of obesity is one of the greatest challenges in public health research today. Obesity is an expected outcome of over nutrition and sedentary lifestyle. It is likely and reasonable to assume that acute changes in behavior and the environment have contributed to the rapid increase in obesity and that genetic factors may be important in determining an individual’s susceptibility to obesity. Many researches had been done on genetics of obesity including variants of FTO, MC4R gene or leptin. There are variants of genes that make it harder for subjects to control appetite, reduce energy intake, and sustain weight loss. Energy balance to prevent the development of obesity is dependent on energy expenditure. Although physical activity is the dominant mechanism for dissipating excess energy, a system of thermogenesis that evolved to protect body from hypothermia is based upon the uncoupling of oxidative phosphorylation in brown adipocytes by the mitochondrial uncoupling protein 1. It has been shown up that regulation of UCP 1 by genetic manipulations or pharmacological agents can reduce obesity and improve insulin sensitivity (Kozak & Koza, 2008). In humans, although uncoupling protein 1 can be detected, the inability to quantify brown adipose tissue makes it difficult to argue for the role of uncoupling protein 1 in thermogenesis and energy expenditure. While advancements in molecular technology are rapidly expanding the field of genetic epidemiology and the capabilities of the genetic epidemiologist, it should be noted that limitations of genetic epidemiologic studies of obesity still exist.
Prevalence of obesity is on the rise and deaths attributable to it are higher than ever. Television, videogames, the internet, high fat low-cost food, low physical activity level and low level of education puts society at greater risk for obesity because all of these factors combine to make an inactive lifestyle. According to Cottam (2004) this inactive lifestyle, the pleasured attitude predisposes people to becoming obese. Lack of education is a large determinant in having a predisposition to obesity as well. The accumulated evidence suggests strongly that excessive television watching negatively impacts health (Forda et al, 2010).

An effective way to lose weight is to decrease the amount of energy taken in and to increase the amount of energy expended. This means eating less food and being more physically active, because a positive energy balance is the cause of obesity (Grundy et al, 1999). Physical activity increase alone can change the energy balance and the body of an obese person (Grundy et al, 1999). This causes changes such as lowering the white blood cell count of the body which lowers the risk of developing atherosclerosis, also lowers the risk of cardiovascular disease (Veronelli et al, 2004).

Obese people are often teased, ridiculed and physically abused throughout their life. Stigmatization and impaired well-being of obese subjects have been established in several studies (Crocker et al, 1993; Myers and Rosen, 1999). This can lead to depression and low self-esteem. Obese women are found to be at a higher risk to be depressed than men (Dixon et al, 2003).

According to Fowler et al, (2004), those who are depressed are more likely to develop a sedentary lifestyle, while Hill, (2004) confirmed that obesity is a result of physical inactivity. The most important concept according to Osness and Mulligan (1998) is that short bouts of physical activity are not what are essential to relieve depressive symptoms. It is a continuously physically active lifestyle that is more effective.

Abdominal adiposity is an active metabolic tissue and releases fatty acids, which accumulates in the liver and peripheral tissues, reducing the effect of insulin on liver and muscle cells. The muscles at the expense of glucose utilize the free fatty acid causing elevated level of glucose in the blood that in turn results in increased insulin output by the pancreas (Caterson, 1999).
Variation in fat distribution pattern in different communities with increasing age has been studied by few. Importance of fat distribution and how age related changes in adiposity may affect the health of older population was studied by Satwanti et al (1980); Rimm et al (1995); Joyce and Kapoor (1996). The level of physical activity and its impact on fat distribution pattern was studied by Bhalla et al (1983); Satwanti et al (1984); Depres et al (1985) and also on ethnic variations on fat distribution (Satwanti et al, 1977; Kapoor et al, 1999). They found that physically active individual have less central fat.

Besides increasing physical inactivity, the eating patterns in industrialized countries are characterized by high energy intake and over-consumption of saturated fat, cholesterol, sugar and salt. Low energy expenditure (physical inactivity) combined with high and unhealthy energy intake will lead in time to overweight and obesity (WHO, 1998). Besides lowering the intake of energy dense foods, maintaining a healthy diet (i.e., a low saturated fat intake and high fruit and vegetable intake) has also been found to be important in the prevention of overweight and consequently chronic health problems (Visscher et al, 2001 & 2002; Seidell, 2005).

In modern times, many of these demands on the human body are no longer part of daily life due to the mechanization of the society, i.e., an increased use of automobiles, decreased opportunities to walk (e.g., no sidewalks) and bad connectivity (e.g., not being able to walk or bike between home and shopping areas) in many modern living places, and an increase in televised and computerized entertainment.

Studies on public health have found that increased levels of sprawl are associated with increased obesity, decreased physical activity (Ewing et al, 2003; Lopez, 2004) and poorer health (Cohen and Sturm, 2004; Kelly-Schwartz et al, 2004)

With regard to the relationship between smoking status, alcohol consumption and obesity, the influence of this cognitive factor could explain the contrasting literature findings (Seidell et al, 1991; Molarius et al, 1997; Je’quier, 1999) and the lack of correlation observed in the Kuk et al (2009) study.
All that is needed to bring the energy balance back to equilibrium and to stop the gain in obesity is to increase energy expenditure by 100 kcal/day (Proietto, 2004). This could cause 90% of the population to stop gaining and start maintaining (Hill et al, 2003).

Factors – such as lack of parks, high speed traffic and automobile focused transport – may function to discourage activity and ultimately increase obesity risk (Berrigan and Troiano, 2002). Studies find that people who live close to parks are more likely to use them and to be physically active than those who live farther from them (Giles-Corti and Giles-Corti 2002).

(ii) Physical Activity and Diabetes

The number of people with diabetes is increasing due to population growth, aging, urbanization and increasing prevalence of obesity and physical inactivity (Wild et al, 2004). Obesity has been shown to be associated with an increased prevalence of type 2 diabetes mellitus in both men and women (AACE/ACE, 1998). The initiating event is positive energy balance, which leads to increased fat mass. As fat mass increases and as fat cell size increases, the regulation of free fatty acid (FFA) metabolism becomes abnormal. These changes lead to an increase in FFA production. The increased FFA concentrations compete with glucose for oxygen in insulin-sensitive tissues and stimulate endogenous glucose production, causing insulin resistance, which is the earliest detectable abnormality in patients with type 2 diabetes (Gary, 1996). It is now recognized that excess abdominal distribution of fat is more closely associated with the development of metabolic abnormalities. It is speculated that the unfavorable changes observed with high BMI may in fact be attributed to the detrimental influence of abdominal adiposity on the metabolic processes. While the cause of this association is not fully established, the possible mechanism is hypothesized to be mediated by the intra-abdominal fat depot. A preponderance of enlarged fat cells in this type of adipose tissue increases the risk of glucose intolerance, hyperinsulinemia and hypertriglyceridemia (Fujioka et al, 1987; Kannel et al, 1996; Karter et al, 1996).

The effect of watching television on concentrations of insulin may operate through at least 2 pathways. First, physical activity has been shown to be associated with concentrations of insulin (Kelley et al, 1999), thus, a reduction in physical activity due
to sedentary behavior would be expected to increase concentrations of insulin. Second, the influence of watching television on dietary behavior has received considerable attention. The cumulative evidence indicates that watching television is generally associated with a less healthy dietary behavior as characterized by increased snacking, increased intake of energy-dense foods, decreased consumption of fruits and vegetables. Because diet is one of the determinants of concentrations of insulin (Lara-Castro et al, 2004), alterations in dietary behavior could also impact concentrations of insulin.

Figure 1.2 Global diabetes prevalence by age and sex for 2000 (Wild et al, 2004)

Table 1.4 Countries with the highest numbers of estimated cases of diabetes for 2000 and 2030

<table>
<thead>
<tr>
<th>Ranking</th>
<th>2000</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Country</td>
<td>People with diabetes (millions)</td>
</tr>
<tr>
<td>1</td>
<td>India</td>
<td>31.7</td>
</tr>
<tr>
<td>2</td>
<td>China</td>
<td>20.8</td>
</tr>
<tr>
<td>3</td>
<td>U.S.</td>
<td>17.7</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>8.4</td>
</tr>
<tr>
<td>5</td>
<td>Japan</td>
<td>6.8</td>
</tr>
<tr>
<td>6</td>
<td>Pakistan</td>
<td>5.2</td>
</tr>
<tr>
<td>7</td>
<td>Russian Federation</td>
<td>4.6</td>
</tr>
<tr>
<td>8</td>
<td>Brazil</td>
<td>4.6</td>
</tr>
<tr>
<td>9</td>
<td>Italy</td>
<td>4.3</td>
</tr>
<tr>
<td>10</td>
<td>Bangladesh</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Wild et al, 2004
(iii) Physical activity and lipid profile

High serum lipid levels are major risk factors of coronary heart diseases that are influenced by lifestyle transition and urbanization. Lipid profile included total cholesterol, triglycerides, high density lipoprotein, low density lipoprotein. High density lipoprotein (HDL) is often referred to as the “good cholesterol”. HDL carries approximately one third of blood cholesterol. HDL protects arteries by harvesting cholesterol from the arterial walls and the blood. It brings the scavenged low density lipoproteins (LDL) back to the liver where it is converted to bile and excreted. HDL counteracts the accumulation and growth of plaque from LDL, also known as the “bad or lousy cholesterol” A higher HDL level is equated with the body operating at optimal capacity. Low levels of HDL may be linked to a higher risk of coronary heart disease (CHD). Opposite trend are seen between LDL and risk for cardiovascular problems, including coronary heart disease.

Lifestyle factors appear to have the most significant influence on HDL levels. Obesity, smoking and inactivity may lower HDL. Genetics may play a role in determining total cholesterol level as well. Further, the presence of type 2 diabetes mellitus also tends to be related to lower levels of HDL cholesterol. Exercise and weight loss are the key lifestyle factors that can contribute to more favorable blood cholesterol levels (higher HDL and lower LDL). Furthermore, quitting smoking may raise HDL and decrease the tendency of the blood to form clots. There is no medication specifically designed to raise HDL. Some medications designed to lower LDL may raise HDL. Lifestyle changes appear to exhibit the most significant positive impact on raising HDL (Keller, 2008).

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).
(iv) Physical activity and hypertension

It is a sign of modern times that increasing rates of urbanization and associated behavioral changes have led to a higher prevalence of a sedentary lifestyle and less exercise. As a consequence, we are facing an epidemic of hypertension, obesity, metabolic syndrome and diabetes mellitus — which, unless tackled proactively, will result in an increase in cardiovascular diseases, especially in the young and middle aged.

Many national guidelines for the prevention and treatment of hypertension recommend lifestyle modifications in the form of ‘regular aerobic exercise’, as well as a reduction of dietary sodium intake, weight loss and moderation of alcohol intake (Williams et al, 2004).

For many years, physical inactivity has been recognized as a risk factor for coronary heart disease (CHD) and most recommendations suggest regular physical activity as a part of the strategy in preventing/reducing CHD (Thompson et al, 2003). The burden of cardiovascular disease (CVD) has increased over the last two decades in nearly all developing countries, particularly in urban areas (Boutayeb and Boutayeb, 2005).

A major factor of the increasing prevalence of CVD in developing countries is the on-going nutrition transition with progressive shifts to a westernized diet high in saturated fats and sugar and a more sedentary lifestyle (Popkin, 2002). Urbanization and globalization are fuelling the nutrition transition.

Raised blood pressure changes the structure of the arteries. As a result, risks of stroke, heart disease, kidney failure and other diseases increase, not only in people with hypertension but also in those with average, or even below-average, blood pressure. Diet — especially too much salt — alcohol, lack of exercise and obesity all raise blood pressure, and these effects accumulate with age (Global Health Risk, WHO, 2009).

Globally, 51% of stroke (cerebrovascular disease) and 45% of ischaemic 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 of that in high-income countries. In the high-income countries, only 7% of deaths caused by high blood pressure occur under age 60; in the African Region, this has increased to 25% (WHO 2009).
**Pattern of physical activity and cardiovascular factors**

An irregular pattern of physical activity although is better than ‘no voluntary physical activity’, it may render a subject with a false sense of security of performing physical activity as compared to regular activity. If counter measures with respect to life style indicators are not taken, then it may increase the risk of metabolic syndrome.

Hahn et al (2009) indicated that physical activity performed at regular intervals was more effective than irregular exercise. Many studies reported the risk of MS with sedentary lifestyle rather than irregular activities (Paffenbarger et al, 1993). The effects of physical activity on MS have been examined in European and American populations, with results showing that physical activity improves the metabolic profile and that those who are physically active are less likely to have MS (Byberg et al, 2001; Laaksonen et al, 2002b; Zhu et al, 2004).

Ecologic data suggest that physical inactivity may be one of the main modifiable risk factors in the etiology of the common complex metabolic disorders (NIH, 1997).

Physical inactivity and low physical conditioning level have been considered as risk factors for early mortality as important as smoking, dyslipidemia and arterial hypertension (Blair, 1993).

Epidemiological studies have demonstrated direct relation between physical inactivity and the presence of cardiovascular risk factors such as arterial hypertension, insulin resistance, diabetes, dyslipidemia and obesity (Wareham et al, 1998; Gustat et al, 2002; Lakka et al, 2003; Rennie et al, 2003). On the other hand, regular practice of physical activity has been recommended for the prevention and treatment of cardiovascular disease, their risk factors and other chronic diseases (Paffenbarger et al, 1991; Durstine & Haskell WL, 1994; Pate et al, 1995; DHHS, 1996; NIH, 1996; Eriksson et al, 1997; Fletcher et al, 2001; Castaneda et al, 2002; Whelton et al, 2002).

The present study has been conceptualized to know the effects of various patterns of physical activities and life style pattern on metabolic syndrome among adult males and females.
Introduction

Significance of the study

The present study was aimed to assess the impact of patterns of physical activity on components of metabolic syndrome and respiratory functions among adults of Delhi.

1. This study would create general awareness among the population about their health status.
2. This study would be helpful in understanding the impact of different pattern of physical activities on various cardiovascular and respiratory health problems by using holistic approach.
3. This research data will be data bank for researchers, academicians, planners and social workers for developing action and academic programme for prevention of various life style diseases through physical activities.
4. To establish cut off values of exercise level for various health problems.
5. This study would be helpful to find whether physical activity, other life style factors or both were beneficial to decrease the risk of cardio respiratory problems and weight loss.

Objectives

1. To study the socio-demographic profile, lifestyle and health parameters of adult Punjabi males and females of Delhi
2. To study and compare the impact of different patterns of physical activities on various obesity and cardio respiratory markers among adult Punjabi males and females of Delhi
3. To study and compare the impact of different patterns of physical activities on various obesity and cardio respiratory markers among adult Punjabi males and females in different follow up cohorts
4. To study the distribution of metabolic syndrome (MS) and its correlation with various anthropometric measurements among adult Punjabi males and females
5. To study the impact of different patterns of physical activity on symptoms of metabolic syndrome among adult Punjabi males and females of Delhi
6. To study the impact of socioeconomic factors on pattern of physical activity and metabolic syndrome among adult Punjabi males and females
7. To study the effect of life style pattern on cardio vascular functions
8. To estimate the coronary heart disease (CHD) risk of 10 years among adult males and females
9. To find the association of obesity and its covariates with variants of uncoupling protein 1 (UCP 1).