

# **CHAPTER I**

# **INTRODUCTION**

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### INTRODUCTION

Life is characterized by movement and it is imperative that all parts of the body should be exercised daily. Scientific evidences indicated that daily exercise stimulates the process of growth and development. Patterns of modern living channelled the average man into an increasingly sedentary existence. Man, however was designed and build for movement, and it appears that physiologically, he has not adopted well to this reduced level of activity. Regular exercise is necessary to develop and maintain an optimal level of good health performance and appearance. It can increase an individual's physical working capacity by increasing muscle strength and endurance enhancing the function of the lungs, heart and blood vessels; increasing the flexibility of joints and improving the efficiency or skill movements.

Physical fitness is the very basis of our daily life. It is the development of a body to a state or condition which permits upon the mutual development of the muscular, respiratory and circulatory systems and is co ordinated with the activity of central nervous system which led to top performance in sports. **(Kamalesh and Sangral, 1981)**

Fitness is the ability to perform daily tasks energetically and alertly, with energy left over for enjoying leisure time activities besides meeting emergency demands. Physical exercise plays an important role for maintaining physical fitness which contributes positively in maintaining healthy weight, building and maintaining strong bone density, muscle strength, joint mobility, promoting physiological well-being, reducing surgical risks, and strengthening immune system.

**Clarke and Clarke (1976)** state physical fitness is the capacity for doing all type of activities. Greater the physical fitness, better the endurance, precision of movement and are highly essential for top performance in all activities. The nature of physical fitness can also be understood in terms of its components which includes speed, strength, endurance, power, agility balance, co-ordination, flexibility and the most important complex of them is cardio-respiratory endurance while other components are inter related.

Total fitness includes physical, mental, emotional, social and spiritual. Physically fit person gets the maximum satisfaction in everyday life, better physical co-ordination, mental judgment and emotional control. Regular exercise therefore not only keeps the body fit but also helps in maintaining fresh mind for a longer period of time without fatigue. It increases the blood circulation of the body and prepares people for hard work, throughout the day. It prevents chronic diseases and other health problems related to lungs and heart. Regular exercise helps to strengthen the heart by increasing muscle mass and to control the weight.

### **1.1 HEALTH**

Sound mind and healthy body are the foundations for the human life. **WHO (2006)** defines “Health is a state of complete physical, mental and social well being not merely the absence of disease or infirmity”. Health also states “It is the quality of life that enables the person to live most and serve best”. Therefore health is a level of functional efficiency of living being and the condition of person’s mind, body and spirit. A person can be said to be healthy when his or her body is healthy and the mind is clear and calm. Health is the foundation upon which lie the happiness of the people and the strength of the nation rest.

Medical experts pinpoint that, exercise helps in keeping good health and one who is in a good physical condition is seldom prone to any disease. Unfortunately one of the most ignored aspects in a healthy lifestyle is proper exercise, which is one of the main reasons why over weight and obesity is becoming very common. Majority of individuals do not perform adequate exercise to balance their calorie intake, which results in excess weight gain. To live a healthy life, the individuals need to be known with the basics of good exercise, as well as how regular exercise can do well to the body. The wellness of a nation is dependent to a large extent on the total fitness of every citizen.

### **1.2 TRAINING**

The word “training” is usually defined as a systematic process of repetitive, progressive exercise which involves the learning processes and has the ultimate goal of improving the systems and functions in order to optimize performance. It enables the person to recover from tough workouts and helps to develop the capacity to increase repetitions.

**Singh (1984)** opines that physical training makes a valuable contribution to the preparation of oncoming generation. It is the most and mainly dependent upon the capacity of performance and is determined by the physical abilities and in sports technical and tactical skills, the intellectual qualities as well as by the athletes knowledge and experience.

Training responses result in stress and adaptation. A stress is placed on the system on the body adapt to it. If the stress is not too intense, the adaptation will result in the body being stronger than before. In physical education, exercise or regular physical work is a very powerful stimulus for adaptation.

Training has a specific effect only the body part that is overloaded improves, and the improvement is specific to the type of exercise used. It is important to know the training effect expected from each type, to become physically fit, one needs to device a program that stress work in circulatory endurance, muscular endurance, strength and flexibility. (**Miller, 1976**).

The major objective of training is to cause biological adaptations in order to improve performance in a specific task to enhance physiological improvement effectively and to bring about a change, over load must be followed. Most of the changes that occur in the muscles or in the physiological systems of the body are as a result of gradual training and occur over a practice of several weeks or months. The magnitude of muscular adaptations is somewhat proportional to the amount of exercise performed during training.

The person who just wants to “get fit” may start with some distance training, then insert some brief cardio and strength training and finally aim for rapid recovery training. However, many people will be content to function at a much lower level. Exercise does not have to be vigorous and it may include activities such as walking or dancing. There are many reasons why an individual may wish to take up physical training such as:

- To take up a sport and join a team with social benefits attached.
- To reach entry standards for certain careers such as the armed forces, police or fire service.

- To lose weight.
- To feel better
- To look better (This may help person feel better and to be more self – confident and happier)
- To reduce risks factors for disease (particularly when there is a family history)

## **1.2 AIM OF SPORTS TRAINING**

- Physical component is focussed on developing motor abilities. Technical component is focussed on acquiring sports skills through motor learning.
- Tactical component is focussed on further development of different ways to conduct sports contest on a purposeful basis.
- Psychological component is focussed on improving the athletes personality.

### **1.2.2 PRINCIPLES OF SPORTS TRAINING**

1. Uninterrupted training
2. Increasing load steadily
3. Individual load
4. Interval between load
5. Active participation
6. General and special preparation
7. Clarity
8. Cyclic process of training
9. Ensuring results

### **1.2.3 TYPES OF TRAINING**

Sport training consists of activities and movements which generally lead to high fatigue. Fatigue is the direct result of the load by physical activity. Load therefore, is of central importance in sports training. Without maintaining the load caused through

physical exercise, performance cannot be improved, stabilized and maintained because over load results in stagnation of performance.

Different training methods have been commonly used to improve the physical fitness and its related standards of the performance of the individual. The training methods include aerobic training, altitude training, alternate pace training, anaerobic training, continuous training, fartlek training, hypoxic training, interval training, plyometric training, resistance training, weight training and yogic practices etc.

### 1.3 HISTORY OF AEROBICS

Aerobic movement is a formal exercise which has been popular since the late 1960's. Exercise appears to strengthen the immune system and ameliorate depression. Aerobic workout innovations from the 1980s to the early 2000s included such equipment as steps, weights, and elastic bands; cross-training programs, which involve two or more types of exercise; aerobic dances that combine yoga, martial arts, and other forms of movement with music including African, Caribbean, salsa, hip-hop, rock, and jazz; and adaptations of such traditional activities as bicycling and boxing into aerobic routines such as spinning and cardio-kickboxing.

"Aerobics" is a particular form of aerobic exercise. Aerobics classes generally involve rapid stepping patterns, performed to music with cues provided by an instructor. This type of aerobic activity became quite popular in the United States. After the 1970 publication of *The New Aerobics* by **Kenneth H. Cooper** went through a brief period of intense popularity in the 1980s, when many celebrities such as **Jane Fonda** and **Richard Simmons** produced videos or created television shows promoting this type of aerobic exercise. Group aerobics can be divided into two major types: freestyle aerobics and pre-choreographed aerobics.

Aerobic capacity describes the functional status of the cardio respiratory system, (the heart, lungs and blood vessels). It is maximum amount of oxygen the body can use during a specified period, usually during intense exercise. It is a function both of cardio respiratory performance and the maximum ability to remove and utilize oxygen from circulating blood. The higher the measured cardio respiratory endurance level, the more

oxygen has been transported to and used by exercising muscles, and the higher the level of intensity at which the individual can exercise the higher aerobic capacity develops higher level of fitness.

A sports event, or activity that will build cardio respiratory endurance, is termed aerobic when the majority of the energy in the athlete is derived aerobically (aerobic training is without oxygen debt). Aerobic training should be activities that are performed continuously for a minimum of 15 to 20 minutes at a level of 70% to 90% of maximal heart rate; no less than three times a week.

### **1.3.1 AEROBIC TRAINING**

The word 'aerobic ' means "with oxygen" and refers to the use of oxygen in the body's metabolic or energy generating process (**Oxford English Dictionary**). According to **Sen (1998)** "A system of physical conditioning designed to enhance circulatory and respiratory efficiency that involves vigorous, sustained exercise such as jogging, swimming or cycling.

Aerobic training builds up the lung capacity. The heart is forced to pump more blood to the body, resulting in heart strength. It begins with warm-up of short duration with a low intensity and has very short recovery times between repetitions; the recovery must be done by jogging. Longer runs of 300 - 500m with a more comfortable rhythm belong to an aerobic training.

This training efficiently improves aerobic capacity, such as trains the body to utilize fat for energy, improves recovery and better prepares the person for higher performance. It causes the lungs to fill it up with as much oxygen as possible so that it may get transferred to the blood vessels. The heart then pumps the oxygenated blood and sends it to all the muscles in the body and helps in the contraction of the muscle as the muscle absorbs this oxygen. The faster the contraction of the muscle, the faster will be the burning of excess fat.

### **1.3.2 AIM OF AEROBIC TRAINING**

- Suppressed appetite
- Reduced total body fat

- High basal metabolic rate
- Increased circulatory and respiratory function
- Increased energy expenditure
- Lowered genetic setting for body fat
- Retention of tissue protein and building of lean body mass level

### 1.3.4 EFFECTS OF AEROBIC TRAINING

Aerobic training increases both number of capillaries per muscle fiber and number of capillaries for a given cross sectional area of muscle. The above changes improve blood perfusion through the muscles, thereby enhancing the exchange of gases, water and nutrients between the blood and muscle fibers. The mitochondria in skeletal muscles increase both in size and number providing the muscles with more efficient oxidative metabolism. Activities of many oxidative enzymes are also increased. All these changes that occur in the muscles, combined with adaptations in the oxygen transport system, enhance functioning of the oxidative system.

The results of aerobic training begin after about 4 weeks of practicing a rigorous programme, though it takes about 3 to 4 months to see visible changes in the body as well as to feel healthier in a well balanced way. The exercises should be practiced at a pace that is possible for a person and as often as possible as the metabolism and fat burning speed diminishes after two days. Exercise such as walking, running, jogging, biking, water aerobics and even aerobic dancing help in pumping more oxygen to the muscles and thus burning calories faster. It is very important to include a balanced diet into the exercise regimen as the body needs more energy.

According to **Kolata and Gina (2002)** the effects of regular aerobic training are:

Strengthening the muscles involved in respiration, to facilitate the flow of air in and out of the lungs.

- Strengthening and enlarging the heart muscle, to improve its functional efficiency and reducing the resting heart rate, known as aerobic conditioning.
- Toning muscles throughout the body.



- Improving circulation efficiency and reducing blood pressure.
- Increasing total number of red blood cells in the body, facilitating transport of oxygen.
- Improving mental health, reducing stress and lowering the incidence of depression.

### **1.3.5 BENEFITS OF AEROBIC TRAINING**

- Regular aerobic training helps the heart to become stronger and more efficient and carries more amount of oxygenated blood at a time.
- Makes the heart to attain a better fitness as it makes the resting heart rate slow down to about 60 beats per minute (BPM).
- The number of oxidative (fat-burning) enzymes also increases, as does the number of mitochondria.
- Helps to keep the immune system much stronger and resistant.
- Helps in reducing the cholesterol in arteries and thereby eases the circulation of blood.
- Increases the Basal Metabolic Rate (BMR), which is the energy expended at a daily rate even when the body is at rest.
- Reduces the bad cholesterol or Low Density Lipoprotein (LDL) levels in the blood.
- Decreases blood pressure and stops it from reaching degenerating at high levels.
- Makes the body more flexible and substantially reduces the possibility of muscle injury.
- The body becomes more muscular, agile and slimmer.
- Helps to relieve the stress as the adrenalin as well as the endorphins produced during the exercise makes a person feel more comfort and happier.

## 1.4 AEROBIC EXERCISE

**Cooper (2009)** describes aerobics as a form of physical exercise that combines rhythmic aerobic exercise with stretching and strength training routines with the goal of improving all elements of fitness (flexibility, muscular strength and cardio – vascular fitness). It is usually performed to music and may be practiced in a group. It can be done solo and without musical accompaniment with the goal of promoting and sustaining physical fitness. Formal aerobic classes are divided into different levels of intensity and complexity. It allows participants to select their level of participation according to their fitness level.

Aerobic exercise is physical exercise of relatively low intensity that depends primarily on the aerobic energy-generating process. It is a type of exercise that works the heart and lungs and causes them to work harder than at rest. It refers to the use of oxygen to adequately meet energy demands during exercise via aerobic energy system. The aerobic capacity is the maximal amount of energy that can be produced by the system (**Reid and Thomson**).

The **American College of Sports Medicine (ACSM 2000)** defines aerobic exercise as “an activity that uses large muscle group, maintained continuously and is rhythmic in nature”. It involves large muscle groups namely the legs, sustained continuously for long period of time. It also states that, to improve fitness, controlling body weight, and to reduce the risk of premature chronic diseases, an individual should perform 30 to 60 minutes of aerobic exercise at an intensity between 50% and 85% of their maximal oxygen intake, for 3 to 5 days per week.

Aerobic exercise involves or improves oxygen consumption by the body. To obtain the best results, an aerobic exercise session involves a warming up period, followed by at least 20 minutes of moderate to intense exercise involving large muscle groups, and a cooling down period at the end.

Aerobic movement is rhythmic and repetitive, engaging the large muscle groups in the arms and legs for at least twenty minutes at each session. The ensuing demand for a continuous supply of oxygen creates the aerobic training effect, physiological changes that enhance the ability of the lungs, heart, and blood vessels to transport oxygen

throughout the body. The most beneficial aerobic exercises include walking, jogging, cycling, running, stair climbing, rowing, cross-country, skiing, swimming, elliptical exercise and aerobic dance.

#### **1.4.1 TYPES OF AEROBIC TRAINING**

Aerobic training is a moderate intensity workout, which extends over a certain period of time i.e., at least at the target heart rate and overloads the heart and lungs, making them work harder than the rest. most popular types of aerobics exercises are:

##### **Jumping Rope**

Jumping rope is an excellent way to build cardio fitness and it makes works the players all important calf and ankle muscles. The goal is to improve their endurance and build strength, not to tax them to the limit, considering throw in a few quick, step food combinations, like a boxer, to improve their dexterity and coordination. They limit themselves to not more than three sets, 5 to 10 minutes each set.

##### **Jogging**

Jogging is a form of running at a slow or leisurely pace. The main intension is to increas physical fitness with less stress on the body than from faster running, or to maintain a steady pace for longer periods of time. It is a form of aerobic endurance training performed over long distances.

##### **Fitness Walking**

Walking at a moderate pace for 30-60 minutes burns stored fact and can build muscle to speed up your metabolism. Walking an hour a day is also associated with cutting the risk of heart disease, breast cancer, colon cancer, diabetes and stroke. Walking is highly recommended for overweight and older people.

##### **Running**

Running is a means of terrestrial locomotion allowing humans to move rapidly on foot. It is simply defined in athletics as a gait in which at regular points during the running cycle both feet are off the ground. This is in contrast to waling, where one foot is always in contract with the ground, the legs are kept mostly straight and the center of gravity vaults over the stance leg or legs in an inverted pendulum fashion. (Biewener, 2003).

### **Elliptical trainer**

An elliptical trainer or cross trainer is a stationary exercise machine used to stimulate stair climbing, walking or running without carrying excessive pressure to the joints by decreasing the risk of injuries. It is a "low impact" machine which offers a non impact cardio vascular that can vary from higher to high intensity based on the speed of exercise and the resistance.

### **Cycling**

Cycling is the best types of aerobic exercises for people to achieve good health and fitness. Cycling provides great cardiovascular benefits, without causing any kind of mechanical stress to the back, hips, knees and ankles in the form of pain.

### **Stair Climbing**

Stair climbing provides a triple workout because it strengthens heart, leg muscles and even bones. Because legs bear the body weight while working vigorously, the leg muscles pull against leg bones, bones strengthen and become denser. Accordingly, stair climbing not only makes the legs stronger, but also helps to prevent osteoporosis. Stair climbing provides aerobic exercise as well as strength training; in other words it raises the heart rate and increases endurance.

### **Treadmill**

Walking regularly on a treadmill helps to maintain a system, which includes muscles, bones, ligaments, tendons and joints. As a weight-bearing exercise, treadmill walking exerts a pulling force on bones that helps prevent age-related bone loss and tones the muscles of legs and buttocks. Adjusting the treadmill to an incline position improves the toning effect on legs.

### **Rowing Machine**

Rowing is an excellent exercise to attain maximum physical Fitness. For example rowing a boat on the water; a stationary rowing machine can help to build and tone muscles, strengthen cardiovascular function and increase stamina. Rowing helps to develop all the muscle groups in the body, including the legs, buttocks, back, abdominals and arms. Since it involves the entire body, it effectively burn more calories than any other type of aerobic exercises.

## **Aerobic Dance**

Dance aerobics is an exercise that combines the rhythmic steps of aerobics with graceful dance movements. It can be broadly divided into four types – high-impact exercises, low-impact exercise, step aerobics and water aerobics. High impact exercises involve intense jumping actions that are synchronized with the rhythmic beats of the music being played. Low impact exercises, the second type of dance aerobics, involves less jumping action, but more of footwork, which are coordinated with the rhythm of the music being played. Step aerobics is performed in a raised platform, while water aerobics is done in waist-deep water. Typically, a dance aerobic exercise is performed for about 20-30 minutes. The steps are performed in a rhythmic way, with 4 or 8 counts. Dance aerobics helps in strengthening body, and give energy to carry out day-to-day activities effectively and efficiently.

## **Swimming**

Swimming is a healthy activity that can be continued for a lifetime. Aerobic swimming workouts are designed to keep one to improve the swimming strokes. While many aerobic swimming workouts involve performing traditional swimming strokes, others involve performing unique water-based exercise that will tone the body in different ways. Aerobic swimming workouts range from breast stroke workouts to somersault workouts.

### **The performance benefits of aerobic exercises are**

- Increased storage of energy molecules such as fats and carbohydrates within the muscles, allowing for increased endurance.
- Neovascularization of the muscle sarcomeres to increase blood flow through the muscles.
- Increasing speed of aerobic metabolism within muscles, allows greater part of energy for intense exercise.
- Improving the ability of muscles to use fats during exercise, preserving intramuscular glycogen.
- Enhancing the speed at which muscles recover from high intensity exercise (Kolata and Gina, 2002).

The health benefits of exercise are well documented to

1. Exercise protects against heart disease and stroke.
2. Reduces the risk of the development of non-insulin dependent diabetes mellitus and a reduced risk of cancer of the colon.
3. Controls blood pressure, improves circulation and controls body fat levels.
4. Weight bearing exercise (e.g. walking) protects against developing osteoporosis (brittle-bones) later in life.
5. Exercise can also have a very positive impact on other disorders such as menstrual problems, pre-menstrual problems, pre-menstrual syndrome and constipation. Exercise can slow down the ageing process.

### 1.5 PHYSIOLOGY OF AEROBIC TRAINING

During exercise, there is an increase in metabolic needs of body tissues, particularly the muscles. The various adjustments which take place in the body are aimed at:

- Supply of various metabolic requisites like nutrients and oxygen to muscles and other tissues involved in exercise.
- Prevention of increase in body temperature.

The aerobic systems use fat in order to produce energy for exercise. During resting conditions, the body uses a slightly larger amount of fat than blood glucose/stored glycogen for energy. As one can see, duration of exercise determines to a large extent what source of fuel that they use.

**Burgess et al. (2006)** explain that initially during aerobic exercise, glycogen is broken down to produce glucose, which is then broken down with the help of oxygen to generate energy. In the absence of these carbohydrates, fat metabolism is initiated. The latter is a slow process, and is accompanied by a decline in performance level. This gradual switch to fat as fuel is a major cause of what marathon runner's call "hitting the wall". For the first 10 seconds of aerobic exercise, the major energy source comes from the adenosine triphosphate-phosphocreatine system (ATP-PC system). This fuel source is primarily used for ultra short-term performances. The next 10 seconds to

The stored fat called body fat is converted into carbohydrate, which is utilized by the muscles. This allows the person to do the exercise for a longer period.

### 1.7 ENERGY UTILIZATION

During prolonged aerobic training typically greater than 45 minutes the body learns to more efficiently utilize fat for energy. The body gets the energy it needs by combining food molecules with oxygen in a process called cellular respiration. This form of energy is produced utilizing glycogen and fat. It is therefore, the more efficiently the body utilizes fat, the better will be the performance. This is shown in the following chemical reaction:



The muscles and other parts of the body need to have a continuous supply of glucose or other high-energy molecules and oxygen to provide the energy for muscle contraction and other body functions.

### 1.8 EXERCISE INTENSITY AND FUEL USE

Exercise intensity is defined as the amount of physical power expressed as a percentage of maximum, the body uses in performing an activity. Intramuscular triglycerides, the fat storage sites within the muscles are an important source of fuel during moderate to high intensity exercise. It is estimated that up to 50% of fat oxidized during moderate intensity exercise wherein 60% to 80%  $\dot{V}O_2$  max is derived from Intramuscular triglycerides (IMTG). Rest of the oxidized fat mostly comes from adipose tissue, and the least from triglycerides (TG) in the blood stream.

Studies have shown that IMTG stores decrease by approximately 20% to 40% after 1 to 2 hours of moderate-intensity exercise. Endurance training can lead to an increased reliance on IMTG for fuel during exercise. During exercise, increasing levels of epinephrine activate Hormone Sensitive Lipase (HSL) begin the breakdown of IMTG. The Free Fatty Acid (FFA) molecules released from IMTG are located within muscle cells and the FFA can be transported directly to the mitochondria for oxidation. The glycerol molecule released is either transported to the liver for oxidation or recycled to form additional IMTG stores (**Roberg and Robert, 1997**).

During high intensity exercise (85% of VO<sub>2</sub> max), the rate of total fat oxidation falls, mainly because the appearance of fatty acids into the plasma is suppressed. At the same time, lipolysis of intramuscular triglycerides does not rise substantially when exercise intensity increases from 65% to 85% of VO<sub>2</sub> max. When low-intensity exercise continues more than 90 minutes, the pattern of substrate metabolism changes little during first 20 to 30 minutes of exercise.

The same is true for moderate-intensity exercise (65% of VO<sub>2</sub> max): the rate of total fat or carbohydrate oxidation changes little after two hours of jogging or cycling at this intensity compared with the first 30 minutes. However, this level of exercise induces a progressive increase in the mobilization of fatty acids from peripheral adipocytes into the plasma. Therefore, the contribution of intramuscular substrates (triglyceride and glycogen) to total energy expenditure possibly decreases when the duration of moderate-intensity exercise increases beyond 90 minutes (**Howley, 1986**).

### **1.9 PHYSICAL EFFICIENCY INDEX**

Pointed out physical fitness is important for all human beings irrespective of their age. A given work may not be carried out if the required physical strength is not available. Modernizations and urbanization have reduced the physical fitness of human beings as man depends more and more on machines for all his work. Manual labour has been considerably reduced and physical activity is considered to be low in dignity. Therefore general fitness has come down and to restore it, human beings have to revert to the age old habits.

Physical fitness includes speed, flexibility, rhythm, power, strength, co-ordination, muscular endurance, cardio vascular endurance, agility etcetera. These characters are all equated with the healthy functioning of the body. Another important component of physical fitness is the athletic skill. The various aspects of the physical fitness and skills are interrelated. In day to day life of human beings, physical health and nutrition appear to have gained a place of priority.

States the other benefits of physical efficiency index as physical fitness are the delay in aging process, protection from overweight, reduction in the rate of incidence of heart diseases and the dependence on drugs that induce sleep. It is only through physical



activity that physical fitness is built and maintained. If one has improved his physical fitness, it can be presumed that he /she has improved the efficiency of his/her heart and lungs. Some researchers attribute the beneficial effects of exercise on stress, the reduced electrical activity in the muscles and increased feeling of fitness. It depends on the nature of activity and is indicative of the level of physical fitness. The total fitness involves the combination of strength, flexibility, endurance, rhythm and balance etcetera.

**Tanner (1995)** describes during aerobic training blood flow to the muscles is considerably large in relation to other tissues. These consequences due to vasoconstriction of the parasympathetic system working muscles need all the blood and oxygen that they can get. In response to this, the parasympathetic system, will constrict since it is not working as hard does not read as much blood whereas the sympathetic system contains the muscles and will dilate to obtain more blood

**Barrow and McGee (1979)** emphasize, the cardiovascular endurance is identified as the most important component in health related fitness. It is the ability of the heart, lungs and the vascular system to function efficiently for an extended period of time. Directly related to this function is physical working capacity of a heart and circulatory system that is functioning at a higher level thus delivering more blood is also making more oxygen available to working muscles. This process increases the individual's ability to work at a greater intensity and over a longer period of time without debilitating fatigue.

Endurance are of different types and one among them is cardiovascular endurance which refers to the ability of the circulatory system to provide oxygen to the cells to support the oxidative energy schemes of the body and to remove the waste products of metabolism. The primary objective of cardiovascular endurance training is to improve the circulation of blood to the working muscles and thus increase the delivery of oxygen to the cells. This can be divided into two main categories i.e. Aerobic training and anaerobic training. Aerobic training involves the systems that supply energy with the presence of oxygen (aerobic capacity} is the key to cardiovascular endurance. (**Barney and Jensen, 1972**)

## **1.10 BODY COMPOSITION**

In physical fitness, body composition is used to describe the percentage of fat, bone and muscle in human bodies. Two people at the same height and same body weight may look completely different from each other because they have a different body composition.

Body composition refers to the proportion of fat and fat free mass or lean body mass in the body. Those with a higher proportion of fat-free mass to a lower proportion of body fat have a healthy body composition. Total body weight is divided into fat free mass or lean body mass and body fat or fat mass. Fat-free mass comprises of all of the body's non-fat tissues. Fat free mass includes bone, water, muscle and tissues. Body fat is a lipid (fat) produced in the body, and this may be influenced by diet, exercise and genetics. Body fat percentage is the percentage of total body weight that is comprise of fat. ([www.yahoo.com](http://www.yahoo.com))

Body composition comprises fat weight and lean weight, the later refers to the fat free weight of the body which includes the weight of muscle, bone, skin and organs among others. With chronic exercise the lean body weight is increased and the fat weight is decreased. The magnitude of these changes is largely dependent on the type of exercise used in a training program with strength training facilities gains in lean weight and endurance training facilitating losses in fat weight.

**According to Colfer and others (1986)** body composition is the amount of lean body skeleton muscles, organs and other tissues and the amount of body fat, which is the amount of tissues contained or stored in the body as fat, people who are too fat have a higher death rate than do lean people and are subject to more health problems such as heart disease, hypertension and diabetes. Excess body fat may lead to obesity and increase the risk of getting many diseases. It is often represented as a two compartment system: lean body weight and fat weight. The fat weight is then expressed as a percentage of total body weight, where Percent Body Fat =  $(\text{Fat Weight}/\text{Total Body Weight}) \times 100$ .

A two component model of body composition divides the body into fat component and fat-free component. The total amount of body fat consists of essential fat (fat in the marrow of bones, in the heart, lungs, liver, spleen, kidneys, muscles and central nervous system) and storage fat (fat that accumulates in adipose tissue, located around internal organs and subcutaneous).

**Howley (1986)** classifies body fat into two categories, essential and non essential fat. Essential fat is necessary for temperature regulation, shock absorption and regulation of essential body nutrients. Non essential fat is found mainly within fat cells and adipose

tissue, below the skin and surrounding major organs. If non essential fat accumulates in excess amount and the individual may become over fat. A person who has a large muscle mass has a result of regular exercise could appear to the overweight.

The relationship between subcutaneous fat and internal fat may not be the same for all individuals and may fluctuate during the life cycle. Lean body mass represents the weight of our muscles, bones, ligaments, tendons and internal organs. Lean body mass differs from fat-free mass. Lean body mass includes a small percentage of essential fat (essential fat in the marrow of bones and internal organs).

Body composition particularly body fat percentage can be measured in several ways. The most common method is by using a set of measurement calipers to measure the thickness of subcutaneous fat in multiple places on the body. This includes the abdominal area, the subscapular region, arms, buttocks and thighs. These measurements are then used to estimate total body fat with a margin of error of approximately four percentage points. Body composition has been estimated by measuring body height and weight and calculating body mass index (weight/height).

#### **1.10.1 Body Mass Index**

Body mass index or BMI is a simple and widely used method for estimating body fat mass. BMI was developed in the 19th century by the Belgian statistician and anthropometrist Adolphe Quetelet. BMI is an accurate reflection of body fat percentage in the majority of the adult population. It defines people as overweight (pre-obese) if their BMI is between 25.0 to 29.9 kg/m<sup>2</sup>, and obese when it is greater than 30 mkg/m<sup>2</sup>. A formula combining BMI, age, and gender can be used to estimate a person's body fat percentage to an accuracy of 4%. An alternative method, body volume index (BVI), is being developed in an effort to better take into account different body shapes.

$$\text{BMI} = \text{Mass (kg)}/\text{Height (M}^2\text{)}$$

The BMI is categorized as

BMI	Classification
< 18.4	Underweight
18.5-24.9	normal weight
25.0-29.9	Overweight
30.0-34.9	class I obesity
35.0-39.9	class II obesity
40.0-9.9	class III obesity
50.0-59.9	class IV obesity
> 60.0	class V obesity

BMI is calculated by dividing the subject's mass by the square of his or her height, typically expressed either in metric or US "Customary" units:

US/Customary and imperial: The most commonly used definitions, established by the World Health Organization (**WHO**) in 1997 and published in **2000**, provide the values listed in the table at right.

Some modifications to the WHO definitions have been made by particular bodies. The surgical literature breaks down class III obesity into further categories, though the exact values are still disputed.

- Any BMI  $\geq$  35 or 40 is severe obesity
- A BMI of  $\geq$  35 or 40-44.9 or 49.9 is morbid obesity
- A BMI of  $\geq$  45 or 50 is super obese

As Asian populations develop negative health consequences at a lower BMI than Caucasians, some nations have redefined obesity. The Japanese have defined obesity as any BMI greater than 25 while China uses a BMI of greater than 28.

The BMI-based definition is easy to use and it is particularly convenient for statistical purposes, since it only depends on two commonly measured quantities, one's

height and weight. However, it ignores variations between individuals in amounts of lean body mass, particularly muscle mass. Individuals involved in heavy physical labor or sports may have high BMI values despite having little fat) For example, more than half of all NFL players are classified as “obese” ( $\text{BMI} \geq 30$ ), and 1 in 4 are classified as “extremely obese” ( $\text{BMI} \geq 35$ ), according to the BMI metric. However, their mean body fat percentage, 14%, is well within what’s considered a healthy range.

The preferred obesity metric in scholarly circles is the body fat percentage (BF%) - the ratio of the total weight of person’s fat to his or her body weight, and BMI is viewed merely as a way to approximate BF%. Levels in excess of 32% for women and 25% for men are generally considered to indicate obesity. However, accurate measurement of body fat percentage is much more difficult than measurement of BMI. Several methods of varying accuracy and complexity exist.

Other proposed but less common obesity measures include waist circumference and waist-hip ratio. These measure a common form of obesity known as abdominal or central obesity, characterized by excess deposits of fat in the abdominal region and inside peritoneal cavity. They have been shown to be comparable to BMI in their power to predict the risk of metabolic abnormalities such as type II diabetes, and possibly superior to BMI as predictors of cardiovascular disease.

### **Waist circumference and waist-hip ratio**

In the United States a waist circumference of  $>102$  cm ( $\sim 40$ ”) in men and  $>88$  cm ( $\sim 34.5$ ”) in women or the waist-hip ratio (the circumference of the waist divided by that of the hips of  $>0.9$  for men and  $>0.85$  for women) are used to define central obesity.

In the European Union waist circumference of  $\geq 94$ cm ( $\sim 37$ ”) in men and  $\geq 80$  cm ( $\sim 31.5$ ”) in non pregnant women are used as cut offs for central obesity. A lower cut off of 90 cm has been recommended for South Asian and Chinese men, while a cut off of 85 cm has been recommended for Japanese men. In those with a BMI under 35, intra-abdominal body fat is related to negative health outcomes independent of total body fat. Intra-abdominal or visceral fat has a particularly strong correlation with cardiovascular disease. In a study of 15,000 people, waist circumference also correlated better with metabolic syndrome than BMI. Women with abdominal obesity have a cardiovascular

risk similar to that of men. In people with a BMI over 35, measurement of waist circumference however adds little to the predictive power of BMI as most individuals with this BMI have abnormal waist circumferences.

### **1.10.2 Body Fat:**

The scientific name for body tissue is “adipose tissue”. Its primary purpose is to store lipids from which the body create energy. It also secretes a number of hormones. Having an excess of body fat leads to condition of overweight and obesity, and that can be unhealthy. Some people are more genetically predisposed to excess body fat, and others build it up from lack of exercise and bad diets. But body fat stored in the abdominal region can be reduced by diet and exercise.

**Chaudry and Chauhan (1985)**, opine that human fat is classified into three categories; subcutaneous, depot and essential. Subcutaneous is located directly under the skin all over the body and makes up about 50 percent of the total body fat. Depots are inherited storage spots that vary somewhat among people depending on their genetics and about 45% of the body fat is depot. Essential fat makes up the remaining five percent. It is necessary for life itself and is found around the nerves, membranes and internal organs. A person never loses essential fat but can significantly reduces subcutaneous and depot fat stores.

There are two factors that determine the amount of fat in the body

- (a) The number of fat or adipose cells and
- (b) The size of the adipose cell.

Proliferation of adipose cells begins at birth and continues to puberty. The size of adipose tissue mass depends of the number and the size of lipid-filled cells. An increase in adipose tissue can occur by an increase in the number of adiposities (hyperplastic growth) or by an increase in the size of adiposities by lipid accumulation within the cell (Hypertrophic growth) Hyperplastic growth occurs in childhood per-adolescence and adolescence, and once new adiposities are formed, they remain throughout life. This increased number of adiposities has negative far- reaching consequences.

The adipose cell stores triglyceride (a form of liquid fat). This liquid fat moves in and out of the cell according to the energy needs of the body. The greater the amount of total

body weight is composed of fat. One pound of fat is made up of approximately 3,500 calories stored as triglyceride within the adipose cell. (Bucher and Prentice, 1985).

**Shaver, (1984)** states the high percentage of fat in relation to the total body weight is detrimental and may lead to obesity. It is generally believed that the normal percent body fat for young men and women should not exceed 15 and 25 percent respectively, values over these are considered to be above normal and may lean toward obesity.

The smaller the fat contents of the body, the larger the so-called “fat free” or lean body weight. A substantial amount of evidence is available to indicate that the relative degree of fat free body weight is not only valuable from a health point of view (over weight and obesity are closely associated with hypertension and heart disease), but it is also an important factor contributing to higher levels of physical performance in activities, where the total body weight must be moved.

### **1.10.3 Types of Body Fat**

Body fat is more technically called adipose tissue, with individual cells being called adipocytes (adipo = fat; cyte = cell). In humans, the primary type of fat cell is called white adipose tissue, or WAT, so named because of its color (it’s actually sort of a milky yellow). While there is another type of fat, called brown adipose tissue or BAT (which is actually reddish/orangeish), it’s generally been thought that humans didn’t have much BAT. WAT in humans is composed primarily (anywhere from 80 to 95%) of lipid.

The stored triglycerides (TG) which is simply a glycerol molecule bound to three free fatty acid (FFA) chains. The remaining part of the fat cell is comprised of a little bit of water as well as all of the cellular machinery needed to produce the various enzymes, proteins and products that fat cells need to do their duty. As it’s turning out, fat cells produce quite a bit of some good, bad, that affects your overall metabolism.

Fats have several major functions in the body. They are as follows :

1. Energy storage which can be used as fuel as the body needs it.
2. Carrier for fat-soluble vitamins A, D, E and K throughout the body.
3. As a soft cushion for protection against inside and outside shocks or blows to vital organs such as the heart, lungs, kidneys, liver and spinal cord etc.,

4. Heat insulator to protect body against cold weather, a fat molecule consists of carbon, oxygen and hydrogen atoms only in different amounts.
5. While fat plays an essential part in our diet, there is suggestive evidence that a diet high in saturated fats may be directly or indirectly related to cardio-vascular disease.

**Dey, (1984)** states training or conditioning in general produces specific effects on body composition. Usually after training or conditioning, the lean body mass increases, weight of body fat reduces and depending upon these two factors, the total body weight may alter accordingly. Ideal body composition is always significantly related to physical fitness of an individual.

The changes induced by training on body composition are as follows:

1. Decrease in total body fat.
2. Slight change in lean body mass.
3. Decrease in total body weight. (**Uppal, Dey and Singh, 1984**)

#### **1.10.4 Disadvantages of Excess Body Fat:**

Fat is an important producer of essential hormones. Our body functions are controlled by hormones, and so excess or lack of critical ones can seriously affect our health. Scientists have learned that excess body fat, especially abdominal fat, disrupts the normal balance and functioning of these hormones. It is known that body fat pumps out immune system chemicals called cytokines that can increase the risk of cardiovascular disease.

The above stated bio chemicals are thought to make cells less sensitive to insulin, blood pressure, and blood clotting. Another reason that abdominal body fat in excess can be so harmful is that it is located near the portal vein, which carries blood from the intestinal area to the liver. Substances released by body fat, including free fatty acids, enter the portal vein and travel to the liver, where they can impede its functioning. Abdominal body fat is directly linked with higher total cholesterol and specifically with the so-called “bad” cholesterol that can clog arteries and lead to a heart attack.



### 1.10.5 Fat metabolism

Body fat has long been recognised as one of the major variables associated with changes in body compositions. It can be altered by changing in nutrition. The basic cause of obesity is simply over eating and calorie is taken greater than energy expanded through work or exercise and the excess is stored as body fat. When ingests a high fat meal a certain amount of this fat passes through the blood stream and is deposited in the liver or stored as adipose tissue. This process is referred to as lipid metabolism. The efficiency with which are clears these lipids from the blood stream is termed fat tolerance where as poor fat tolerance refers to a delayed clearing of fat from blood stream. Exercise after a high fat meal has been shown to reduce the level of fat in the blood stream and thus increases the fat tolerance. (**Hockey, 1986**).

### 1.11 FATS AS AN ENERGY SOURCE

In a healthy, untrained individual, between 70,000 and 1, 00,000 kcal of energy is stored as fat, mainly in the peripheral adipocytes. Even highly trained athletes who have little adipose tissue have fat stored in excess of their athletic requirements. Although most fat is stored in adipose tissue, endurance athletes have small but physiologically important amount of triglycerides within muscle cells, active muscle mass may contain up to 300 g of fat, mostly stored within the myocyte as small, lipid droplets. As a source of stored energy, fat has advantage over carbohydrate with high energy density and lower relative weight. Fatty acids provide more adenosine triphosphate (ATP) per molecule than glucose. However, to produce the equivalent amount of triphosphate, the complete oxidation of fatty acids requires more oxygen than the oxidation of carbohydrate (**Howley, 1998**)

There are many other methods used to determine body fat percentage. Hydrostatic weighing, one of the most accurate methods of body fat calculation, involves weighting a person under water. Two other simpler and less accurate methods have been used historically. The first is the skinfold test, in which a pinch of skin is precisely measured to determine the thickness of the subcutaneous fat layer. The other is bioelectrical impedance analysis which uses electrical resistance. Bioelectrical impedance has not been shown to provide an advantage over BMI.

### 1.12 BODY FAT AND BEING OVERWEIGHT

Overweight and obesity are often used interchangeably; there are important differences between them. Overweight is weight that exceeds the normal weight defined for an individual on the basis of sex height and frame size. Obesity is the excessive accumulation of fat. **Baumgartner and Jackson (1987)**

Being overweight does not necessarily mean that you have an excess of body fat. Powerfully muscled people often are overweight. A certain amount of body fat is also necessary to staying alive. Human beings also have a specialized kind of body fat called "Brown fat". It is located mainly around the neck and large blood vessels of the thorax, and it serves to generate heat to help keep us warm in severe cold.

### 1.13 BIOCHEMISTRY

Biochemistry is the study of the chemical substances, reactions and other vital processes occurs in living organisms. It involves the quantitative determination and structural analysis of organic compounds that make up cells that play key roles in chemical reactions which are very important for life i.e. the chemical reactions by which

proteins and their precursors are synthesized, how food is converted to energy, transmission of hereditary characteristics, mechanism of energy storage and catalyses of all biological chemical reactions.

### 1.14 CHOLESTEROL

Cholesterol is a waxy fat like substance that is important for normal body functioning. It is a type of fat that circulates in the blood. It is used for cellular functions and the production of hormones. The body, in most cases, will produce enough cholesterol to maintain its regular needs. The liver is the major production centre for cholesterol of about 70%. Diets high in saturated fats significantly enhance the amount of cholesterol in the blood stream. High cholesterol levels are strong indicators of coronary heart disease. The build-up of plaque in the artery may lead to narrowing or complete blockage of vessel.

Obesity itself does not cause high cholesterol, but it is the pathway to cholesterol that can lead health at risk. Becoming overweight or obese is a result of unhealthy lifestyle choices, including minimum physical activity and more diet. Eating more calories than the body uses in a given day, results in a positive caloric balance. When the body has more calories than it needs, it stores these calories as fat. A diet, high in fat and cholesterol contributes to obesity. One gram of fat provides nine calories, while other macronutrients like carbohydrate provide only four calories per gram.

Therefore, eating foods that are high in fat can contribute to a positive calorie balance. In addition, high-fat foods are generally high in cholesterol. The body produces cholesterol, making as dietary cholesterol. The combination of body's production of cholesterol as well as dietary cholesterol can raise levels of cholesterol in the blood. Cholesterol can't travel in the blood on its own and is being carried by special proteins. Combinations of cholesterol and protein carriers are called "lipoproteins". There are two types of lipoproteins:

1. Low Density Lipoproteins (LDL).
2. High Density Lipoproteins (HDL).

### **1.15 LIPOPROTEINS**

The lipoproteins are combinations of fat (lipids) with protein (apoprotein) and other fat- related substances that serve as the major vehicle for fat transport in the blood stream. Since, fat is insoluble in water and cannot travel freely in the blood. It needs a water-soluble carrier. The body transports it by wrapping small particles of fat with a covering of protein, which is soluble in water. These little packages of fat wrapped in water-soluble protein are then carried by the blood to and from the cells to supply needed nutrients. Obesity is correlated with unhealthy levels of bad and good cholesterol.

#### **1.15.1 HIGH DENSITY LIPOPROTEIN**

High-density lipoprotein cholesterol is filled with the particles of more protein and less fat (lipids). It is considered good, because it can contribute to lowering the chance of chronic disease. Its job is to transport cholesterol molecules from the blood to the liver. Once in the liver, they are used to produce bile. HDL cholesterol is beneficial

for number of reasons. The most important is its ability to drive a process called “reverse cholesterol transport”.

HDL cholesterol is something of a mop that it helps to extract excess cholesterol deposited in the walls of blood vessels and deliver it back to the liver for elimination through the gastrointestinal tract. If HDL cholesterol is higher the capacity to remove cholesterol is greater which in turn prevent dangerous blockages developing in the blood vessels. HDL cholesterol helps to keep the blood vessels dilated, thereby prompting better blood flow. An obese person has a greater likelihood of having low levels of HDL cholesterol (Toth, 2005).

### **1.15.2 LOW DENSITY LIPOPROTEIN**

Low density lipoprotein (LDL) is filled with particles of more fat (lipids) and less protein. It is known as bad cholesterol. It is the cholesterol transporting molecule, carries cholesterol around the body and into tissues. An obese person has a greater likelihood of having high levels of LDL cholesterol. Excess LDL cholesterol in the blood gets deposited in arteries, the vessels that feed blood to the heart and brain. These deposits can join with other substances to form plaque.

Plaque is a thick, hard deposit in the blood vessel. The name for build-up of plaque in the arteries is atherosclerosis, or “hardening of the arteries”. Atherosclerosis mainly causes deposition of cholesterol in the walls of the arteries. Plaque can narrow the passageway inside the artery and pinch off the flow of blood to the heart muscles. This limits the flow of oxygen-rich blood to the heart and other vital organs. This can lead to cardiac diseases like heart attack.

### **1.16 IMPORTANCE OF CHOLESTEROL**

Cholesterol is a vital molecule, without which people cannot survive. It supports the body’s needs and helps the person to produce vitamin D, sex hormones, and steroid hormones. It is essential to all the cell membranes, important to the brain for nerve signal functioning, metabolism of fats and immune defenses. Therefore avoiding cholesterol can deprive us of several important nutrients and impair many body functions. But the elevated level of blood cholesterol can lead to buildup of gallstones and atherosclerosis.

### 1.17 NEED OF THE STUDY

It has been viewed that the number of fat cells cannot be effectively decreased by exercise or dietary restrictions once adulthood is reached. The fat (adipose tissue) that is stored is determined by the number of fat – storing cells or adipocytes and the size, or capacity of the adipocytes. During weight reduction involving fat loss in adults, it is the size but not the number of adipocytes that decreases. However, exercise and diet programs introduced during early childhood lead to a reduction in both the number and size of fat cells during the adult years. This emphasizes how important the formulation of right nutritional habits and good exercise programme are necessary in early life as well as throughout the life.

### 1.18 REASONS FOR SELECTING THE TOPIC

Prevention is the proven way to a healthy body. Lifestyle accounts for approximately seventy percent of an individual's total risk for overweight (the weight that exceeds the normal weight) and obesity (the excessive accumulation of fat) and genetics for the remaining thirty percent (**Meinz, 2004**). Over weight and Obesity have a negative effect on the overall health of a person. It is the result of energy imbalance by intake of too many calories and doing very little exercise and associated with increased risks of respiratory symptoms, like shortness of breath, wheezing and pulmonary functional abnormalities. The fat stored within the abdominal cavity and chest wall is likely to directly compress the thoracic cage, diaphragm and lungs.

Increased medical problems and mobility restrictions associated with overweight and obesity can have a direct bearing on physical, psychological well-being which can lead to many health problems besides depression, distorted body image, other related issues and strong effect on lipoprotein metabolism too. Increased weight is detrimental to high levels of triglycerides, elevated LDL cholesterol, and low HDL cholesterol. Conversely, weight loss is associated with a healthier lipoprotein profile in both men and women.

Regular physical activity plays an important factor in accomplishing and maintaining a healthy body weight for children and adults. Earlier studies revealed that aerobic training helps to make heart and lungs more stronger and much more efficient to function with improved body flexibility, conditioned muscles, proper use of fats and

effective burning of calories. Keeping the above concept in mind, the researcher has intended to find out the effect of varied frequencies of aerobic training on physical efficiency index, body composition and lipid profile among college men.

### **1.19 OBJECTIVES OF THE STUDY**

1. To find out the effects of varied frequencies of aerobic training for physical efficiency index among college men.
2. To find out the effects of varied frequencies of aerobic training for body composition among college men.
3. To find out the effects of varied frequencies of aerobic training for lipid profile among college men
4. To assess the magnitude of improvement of aerobic training on varied frequencies in the selected variables among college men.

### **1.20 STATEMENT OF THE PROBLEM**

The present study was formulated to find out the effects of varied frequencies of aerobic training on physical efficiency index, body composition and lipid profile among college men.

### **1.21 HYPOTHESES**

On the basis of available literatures and the scholar's own understanding of the problem, the following hypotheses were formulated:

1. There would be significant improvement on physical efficiency index, from the base line to post training due to the effect of varied frequencies of aerobic training among college men.
2. There would be significant improvement on body composition from the base line to post training due to the effect of varied frequencies of aerobic training among college men.
3. There would be significant improvement on lipid profile from the base line to post training due to the effect of varied frequencies of aerobic training among college men.

4. There would be significant differences among the experimental groups on physical efficiency index, body composition and lipid profile due to the effect of twelve weeks of varied frequencies of aerobic training among college men.

### **1.22 SIGNIFICANCE OF THE STUDY**

The present study was significant in the following aspects:

The study would be significant in assessing the effect of varied frequencies of aerobic training on physical efficiency index, body composition and lipid profile among college men.

1. This study would create significant health awareness among overweight and obese adolescents of both sexes.
2. The study would be significant in determining the best mode of aerobic training to develop and sustain the fitness level of college men.
3. This study would be helpful to many people to keep away medications to make themselves fit and also to maintain one's own physical health.
4. The findings of this study would be beneficial for future researchers to undertake similar studies considering various other factors.

### **1.23 DELIMITATIONS**

1. Sixty (N=60) undergraduate college men whose body mass index falling between 25.0 to 29.9 kg/m<sup>2</sup> (over weight) studying from various disciplines of Ganesh Educational institutions, Salem District, Tamil nadu, India during the year 2014-15 were randomly selected as subjects.
2. The age of the subjects was range between 19 to 21 years.
3. The subjects were divided at random into three groups of twenty (n=20) each, namely Aerobic training three days in a week (Group I), Aerobic training five days in a week (Group II) and control group (Group III).
4. The duration of the training period was restricted to twelve weeks
5. The dependent variables I) physical efficiency index II) body composition namely (a) Body mass index (b) percent body fat(c) Fat free weight and III) Lipid profile

such as (a) total cholesterol (b) high density lipoprotein (c) low density lipoprotein were selected for this study.

6. The data were collected prior to and immediately after the training period of twelve weeks.

## **1.24 LIMITATIONS**

This study was delimited to the following aspects.

1. The previous experiences, cultural influences, socio-economic status and various other physical activities on the subject's were not taken into account.
2. Hereditary and environmental factor, which contribute to both physical and mental efficiency were not controlled.
3. Variations in performance due to diet, climatic conditions, and other environmental factors that might influence the study were not considered.
4. Since the human elements are involved in the test administration even slight error in measurements and timings which might affect the results were also considered as limitations of the study.
5. No attempts were made to determine whether the subjects and other degrees of motivation during various stages of training and testing periods.
6. The fatigue factors of the subjects which might affect the performance in the tests were considered as limitations of the study.

## **1.25 DEFINITION OF IMPORTANT TERMS**

### **1.25.1 Training**

Training is defined as a systematic process of repetitive, progressive exercise which also involves the learning processes and has the ultimate goal of improving the systems and functions in order to optimize performance (**Arnhein, 1985**).

### **1.25.2 Exercise**

Exercise is a physical activity that is planned, structured and repetitive for the purpose of conditioning the body. It consists of cardiovascular conditioning, strength, resistance training and flexibility (**Robert, 1997**).



### **1.25.3 Aerobic exercise**

Aerobic exercise is any activity that is rhythmic in nature uses large muscle groups, maintained continuously, for a long period resulting substantial increases in heart rate and energy expenditure (**Wilmore and Costill, 1994**).

### **1.25.4 Walking**

Walking is a move at a regular pace by lifting and setting down each foot in turn, never having both feet off the ground at once ([www.oxforddictionaries.com](http://www.oxforddictionaries.com))

### **1.25.5 Over Weight**

Having more body fat than in optimally healthy where food supplies are plentiful and life styles are sedentary. ([www.wikipedia.com](http://www.wikipedia.com))

### **1.25.6 Physical Efficiency Index**

A very simple field test, called harward step test (HST) is used for measuring physical fitness (cardio vascular endurance) of human being by using a mathematical formula for determining an index number called physical efficiency index. ([www.wikipedia.com](http://www.wikipedia.com))

### **1.25.7 Body Composition**

Body Composition refers to the amount of lean body weight that a person possess including the skeleton, muscles, organs and other tissues and the amount of body fat, which is the amount of tissues contained to stored in the body as fat. (**Colfer and Hamilton et al., 1986**).

### **1.25.8 Skinfold caliper**

“An instrument used to measure body dimensions” (**Jensen and Hirst, 1989**).

### **1.25.9 Skinfold**

“A fold consisting of two layers of skin and subcutaneous structures can be called as skinfold” (**Karpovich and Sinning, 1971**).

### **1.25.10 Body Mass Index (BMI)**

According to **WHO (World Health Organisation)** Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults

### **1.25.11 Fat**

**Fox and Mathews, (1981)** says that, a compound containing glycerol and fatty acid. One of the basic fat stuffs.

### **1.25.12 Percentage of Body Fat**

Proportion of total weight that is the fat weight. (**Jackson, 1982**).

### **1.25.13 Fat- Free Mass**

**Fat free mass** (FFM) includes internal organs, bone, muscle, water and connective tissue. (**Wilmore, 1977**).

### **1.25.14 Biochemical**

Biochemical relates to the chemical processes and substances which occur within living organisms (**www.memidex.com**).

### **1.25.15 Total Cholesterol**

Total cholesterol refers to the total amount of cholesterol as measured in the blood stream. It is a direct cholesterol measurement that measures all cholesterol molecules in the blood, including low density lipoproteins (LDL), high density lipoproteins (HDL), very low density lipoproteins (VLDL) and triglycerides (TG).

### **1.25.16 High Density Lipoprotein**

High density lipoproteins are formed within cells to remove cholesterol from the cell, bringing it to the liver for disposal (**Grodner et al., 2012**).

### **1.25.17 Low Density Lipoprotein**

Low density lipoprotein forms from very low density lipoproteins (formed in the liver) because density is reduced as fats and lipids are released on their journey through the body. It carries cholesterol throughout the body to tissue cells for various functions (**Grodner and others, 2012**).