Chapter I

INTRODUCTION

Physical Education and Sports is a thirsty area which needs many kinds of training means and methods to improve the overall performance of the sportsperson. Athletes face many challenges throughout their quest for perfection. To achieve maximum performance, an athlete needs to invest approximately ten years of commitment and ten thousand hours of practice. To improve the sports performance the athlete needs to take part in systematic training by the way of scientific method of training. Therefore athletes or players need proper systematic training to improve their performance through different kinds of training (Gould & Carson, 2004).

In the field of sports, training is a process, which involves preparation of a sportsman to attain highest level of performance. To improve performance, one has to regularly and systematically perform a variety of training. Mere execution of exercises does not ensure improvement of performance. Actual effect of training depends upon several factors such as training loads, means of recovery, assessment of load and performance capacity, sports equipment, nutrition,

Sports’ training aims at improving sports performance through physical, physiological, psychological, social, intellectual and moral aspects thus contributing to development of all round personality of the sportsman. In other words, the performance of a sportsman improves as a result of the development of total personality. The aim of it is to prepare a sports person physically, physiologically and psychologically for a possible highest sports performance at the time of main competition, in a specific sport. In order to make a sports person capable of putting up optimal performance, systematic improvement of performance capacity and readiness performance are to be carried out.

The conditioning and coaching are two important words in sports training. Conditioning is a process of gradually preparing the body for strenuous physical activity for focusing attention on development of physical and motor fitness components and indirectly enhancing sports performance. Sports training are a process of sports perfection directed by scientific and pedagogic principles and aims at leading a sports person to high and top level performance in sports on an event by means of planned and systematic improvement of performance capacity and readiness of performance. Training is defined as a programme of exercises designed to improve the skills
and to increase the energy capacity of an athlete for a particular event (ACSM Fitness Book, 1992).

**Importance of Training**

Training is one of the most important ingredients in enabling the sports persons to achieve high performance. The main objectives of training are to increase the athlete’s physiological potential and to develop bio-motor abilities to achieve the highest standards. Different kinds of methodical training will enhance the motor abilities. Endurance is a basis for all sports and games. Continuous method, interval method, and fartlek method are major factors for developing endurance parameters like cardio respiratory endurance, speed endurance, muscular endurance will enhance the physiological qualities such as VO₂ max, breath holding time and decrease resting pulse rate.

The purpose of training is to reveal the genetic potential of the athlete and then to develop that potential without cashing damage (Talloh, 1998). Training is necessary for two basic reasons that to provide the knowledge and skills to use the performance appraisal system well (Maclean, 2001).

In the past, people were trained systematically. In recent years the athletes prepare themselves for a goal through training and they improve physiological goal and optimize athletic performance. The purpose of training is to increase athletes’ work and skill capabilities
and to develop strong psychological traits. Training is primarily a systematic athletic activity of long duration, which is progressively and individually graded. Training adaptation is sum of transformations brought about by systematically repeating exercise (Tudor O. Bompa, 1999).

Repeated days of training can be considered positive stress because training improves one’s capacity for energy production, tolerance of physical stress and exercise performance. The major physical changes associated with the training occur in the first six to ten weeks (Wilmore, Costil, & Kenney, 2008).

Physical Training entails exposing the organism to a training load or work stress of sufficient intensity, duration and frequency to produce a noticeable or measurable training effect that is to improve the functions for which one is training. Training increased the maximal oxygen uptakes as well as the percentage of that can be taxed during a workout. The intensity of load required to produce an effect increases as the performance is improved in the course of training. The training load is there for relative to the fitness of the individual. The fitter a person is, the more it will take to improve that fitness. Finally, it is a matter of time and motivation to continue when the elite athlete has to devote several hours a day to training.
Importance of Endurance Training

Endurance is the ability to engage in activity for a long time without fatigue. Endurance is the product of all psychic and physical organs and systems. Endurance is the ability of being able to maintain a high quality of work in the face of fatigue. All athletic skills and events require endurance to some extent; however the energy requirements of extremely brief skills such as a single punch are normally met with ease.

Endurance training at a prolonged and moderate intensity improves aerobic capacities. The best method to improve specific endurance for any sport is consider the ergo genesis of the sport between the anaerobic and aerobic components (Tudor O. Bompa, 1999).

The objective of endurance training is to develop the energy production systems to meet the demands of the event. In the human body, food energy is used to manufacture adenosine triphosphate (ATP) the chemical compound that supplies energy for muscular contraction. Since ATP is in very low concentrations in the muscle, and since it decreases only to a minor extent, even in the most intense voluntary contraction, tightly controlled energy pathways exist for the continual regeneration of ATP as muscular contraction continues. For continuous exercise, ATP must be re-synthesised at the same rate as it is utilized.
To develop or improve aerobic capacity, training should take place between 3 and 6 days a week. The total duration of work in each session might be anywhere from 10 minutes to an hour and more longer durations are inappropriate for athletes, unless they expect their competitive event to require more than 30-45 minutes of continuous activity (Fox, E.L., Bowers, R.W., & Foss, M.L., 1993).

The types of endurance are aerobic endurance (cardio respiratory endurance), anaerobic endurance, speed endurance and strength endurance (muscular endurance). A sound basis of aerobic endurance is fundamental for all events (Paul B Gastin, 2001).

Cardio respiratory endurance is developed using continuous and interval running. Continuous duration runs to improve maximum oxygen uptake (VO$_2$ max). Interval training is to improve the heart as a muscular pump.

Speed endurance is used to develop the co-ordination of muscle contraction. Repetition methods are used with a high number of sets, low number of repetitions per set and intensity greater than 85% with distances covered from 60% to 120% of racing distance. Competition and time trials can be used in the development of speed endurance.

Muscular endurance is used to develop the athlete's capacity to maintain the quality of their muscles' contractile force. All athletes need to develop a basic level of strength endurance. Examples of activities to develop strength endurance are - circuit training, weight
training, hill running, harness running and Fartlek (Mackenzie, B. 2000).

Types of Endurance Training

Continuous Training

Continuous training is a type of sports training that involves activity without rest. This type of training may be of high intensity, of moderate intensity with an extended duration, or fartlek training.

Continuous training means the person uses 60-80% of their energy for a period of at least 60 minutes at least four or five times a week. This method suits long distance runners as well as tennis players etc., because it means that their endurance levels will be increase, and it is the way which they would normally compete. Continuous training is a good way for an athlete to build up their cardio-vascular endurance levels. Continuous forms the basis for all other training methods both anaerobic and aerobic (Wilmore, Jack H. 1977).

Fartlek Training

Fartlek is a great training tool. Fartlek means ”speed-play” and is very effective in increasing a runner’s speed and endurance (Nicki Anderson, 2011).

Fartlek is a relatively unstructured type of continuous training that originated in Scandinavia. It is performed over natural terrain. A
typical session lasts about 45 min. The route is predetermined, but the pace is varied from fast bursts to jogging (or walking), according to the terrain, and the disposition of the runner. Depending on the precise composition, fartlek training can improve both the aerobic and anaerobic capacity of the athlete. Many coaches use fartlek training because it provides relief from highly structured types of training (Jesper Bondo Medhus, 2009).

Interval Training

Interval training is an excellent way to burn more calories, build endurance quickly and make workouts more interesting. Interval training involves alternating high intensity exercise with recovery periods and there are varieties of ways to set up interval workouts. One option is measured periods of work followed by measured periods of rest. An example would be 1 minute of high intensity work (such as a sprint), followed by 2 minutes of low intensity exercise (e.g., walking) and alternating that several times for 15-30 minutes (Paige Waehner, 2011).

Advantages of Fartlek Training

Fartlek running involves varying the pace throughout the run, alternating between fast segments and slow jogs. Fartlek are more unstructured. Work-rest intervals can be based on how the body feels. With fartlek training, the experiment with pace and endurance, and to experience changes of pace. Many runners, especially beginners, enjoy
fartlek training because it involves speed work. But it is more flexible. Another benefit of fartlek training is that it doesn't have to be done on a track and can be done on all types of terrains like roads, trails, or even hills. Fartlek training puts a little extra stress on our system, eventually leading to faster speeds and improving our anaerobic threshold (Christine Luff, 2010).

One of the main reasons for the success of fartlek training is that it can be adapted to the needs of the individual. Unlike continuous training, fartlek training can benefit participants of field games such as football, field hockey, ultimate Frisbee, lacrosse, basketball and rugby, as it develops aerobic and anaerobic capacities which are both used in these sports. To take this step further, athletes can make the most of the flexibility of fartlek training by mimicking the activities which would take place during their chosen sport or event. It improves aerobic capacity.

“Fartlek is a form of conditioning which puts stress mainly on the aerobic energy system due to the continuous nature of this exercise. The difference between this type of training and continuous training is that the intensity or speed of the exercise varies, meaning that aerobic and anaerobic systems can be put under stress. Most fartlek sessions last a minimum of 45 minutes and can vary from aerobic walking to anaerobic sprinting.” It works best when we have a group of motivated runners who understand the rules of this training
type. Then they will have a great time with activity that will bring all physiological benefits that would have achieved in a criterion (Jesper Bondo Medhus, 2009).

Fartlek is a form of road running or cross country running in which the runner, usually solo, varies the pace significantly during the run. It is usually regarded as an advanced training technique, for the experienced runner who has been using interval training to develop speed and to raise the anaerobic threshold. However, the 'average' runner can also benefit from a simplified form of Fartlek training, to develop self-awareness and to introduce variety into the training program. It is primarily a technique for advanced runners because it requires 'honesty' to put in a demanding workload, and also 'maturity' to not overdo the pace or length of the intervals. With these qualities, Fartlek makes for an excellent component of a distance runners training programme (Ian Kemp, 1997).

**Fartlek Training for Endurance Development**

Fartlek conditioning can be applied to any form of cardiovascular exercise, and it is also considered one of the greatest endurance exercises. Used primarily by long distance runners, fartlek training benefits are now being realized in the fitness community as well. Endurance exercises such as fartlek are an outstanding way to burn up some serious calories while improving our cardiovascular stamina.
Fartlek training differs from other training methods in that there are no predetermined intervals and there is no predetermined pace. It allows to run at any pace and distance we wish. We stagger high, medium, and low intensities for as long as we like. While it was developed by runners, we can utilize this technique with our favorite cardio exercise. This freedom also allows us to enjoy the training session more. Interval training is more structured and deliberate; whereas Fartlek conditioning let us explore our own ability level and aerobic capacity (Chris Gomes’, 2010).

Fartlek training can be a great way to increase running speed too, and it is excellent for endurance conditioning. It will also raise our anaerobic threshold, giving us the ability to train longer and harder. Fartlek training is differing with regular interval training that the participant alternates periods of high and low intensity (Todor O.Bomba, 1999).

**Advantages of Interval Running**

Interval running which means is a type of “physical training” and cardio workout that involves bursts of high intensity work. This high intensity work is alternated with periods of rest or low activity, the eponymous intervals. The term can refer to any cardiovascular workout that involves brief bouts at near-maximum exertion interspersed with periods of lower-intensity activity. Athletes often practice interval running on tracks, running hard at a certain pace for
a specified distance and jogging, walking, or resting for a set distance or time before the next speed burst. Interval training refers to the method of repeating stimuli of various intensities with a previously planned rest interval, during which the athlete does not fully regenerate. It should calculate the duration of the rest interval by heart rate method. The athlete could repeat the portions of distance either by time or precise distance (Todor O.Bomba, 1999).

**Interval Running for Endurance Development**

Interval training can be a useful training method for all wishing to improve conditioning and performance levels. Beginners can benefit from this type of training when starting a cardiovascular program. People with higher fitness levels can use this method to improve endurance levels. Interval training consists of mixing more intense sessions with less intense sessions of the same or similar exercise (Cyphers, Mari, 1991).

Interval training increased endurance that actually trains the heart to pump more blood to the muscles and it trains the muscles to extract that oxygen more efficiently, making all other workouts easier
to handle. Working at high intensities raises our lactate threshold and can improve more power and endurance performance (Paige Waehner, 2011).

Interval running enables the athlete to improve the workload by interspersing heavy bouts of fast running with recovery periods of slower jogging. The athlete runs hard over any distance up to 1 kilometer and then has a period of easy jogging. During the run, lactic acid is produced and a state of oxygen debt is reached. During the interval, the heart and lungs are still stimulated as they try to pay back the debt by supplying oxygen to help break down the lactates. The stresses put upon the body cause an adaptation including capillarisation, strengthening of the heart muscles, improved oxygen uptake and improved buffers to lactates. All this leads to improved performance, in particular within the cardiovascular system (Interval Running, 2010).

Fartlek and Interval Training for Cardio Respiratory Endurance Development

Regular exercise makes these systems more efficient by enlarging the heart muscle, enabling more blood to be pumped with each stroke, and increasing the number of small arteries in trained skeletal muscles, which supply more blood to working muscles (Rebeka J. Donatello, 2005).
Nearly all athletes require a basic level of cardiovascular endurance, if for no other reason than recovery between intense bouts of work. Traditionally, coaches have opted for long, slow, distance training at 70-80% maximum heart rate (Fox E.L., Bowers R.W., & Foss M.L., 1988).

Cardiovascular fitness also called cardio respiratory fitness is the ability of the lungs to provide oxygen to the blood and the heart to transport the oxygenated blood to the cells of the body. It is also the ability of the body to sustain an activity for an extended period of time (Cyphers, 1991).

Cardio respiratory endurance is considered the most important component of health-related fitness because the functioning of the heart and lungs is so essential to overall wellness. A person simply cannot live very long or very well without a healthy heart. Cardio respiratory endurance is developed by activities that involve continuous rhythmic movements of large muscle groups like walking, jogging, cycling and aerobic dance (Sparks Y., & Todd M., 1997).

The cardio respiratory system and aerobic energy systems become more efficient at delivering oxygen to the working muscles and converting carbohydrate and fat to energy. There are many different ways to train for improved aerobic endurance. The duration, frequency and intensity of each type of training vary and the training focuses on slightly different energy systems and skills and results in
different physical adaptations. Interval Training consists of short, repeated, but intense physical efforts (3-5 minutes followed by short rest periods). Fartlek Training combines some or all of the other training methods during a long, moderate training session. During the workout the athletes add short bursts of higher intensity work with no set plan; it’s up to how the athletes feel. (Elizabeth Quinn, 2009).

Cardiovascular system without an unacceptable loss of strength, speed, and power is interval training. Interval training mixes bouts of work and rest in timed intervals. It was control the dominant metabolic pathway conditioned by varying the duration of the work and rest interval and number of repetitions. The bulk of metabolic training should be interval training. Interval training need not be so structured or formal. It was demonstrated that this interval protocol produced remarkable increases in both anaerobic and aerobic capacity. Interval training was given cardiovascular benefit of endurance work without the attendant loss of strength, speed, and power (Cardiovascular System, 2010).

**Fartlek and Interval Training for Speed Endurance Development**

Speed endurance is the ability to maintain speed in the presence of fatigue without decelerating. So, athletes must train the ability to maintain high levels of speed, even when tired. As we can imagine, making improvements in speed endurance can have dramatic effects on the way our athletes perform and finish the event.
Think of our athletes when they are late in event and every athlete is
tired and we know that this is where some of the most critical moves
and decisions are made and events are won and lost (Speed
Endurance, 2010).

**Fartlek and Interval Training for Muscular Endurance Development**

Muscular endurance is a muscle’s ability to perform repeated
contractions over a period of time without fatigue. Muscular
endurance type activities depend on slow twitch muscle fibers for
optimal performance. Slow twitch fibers are the fibers of the muscle
responsible for maintaining repeated activity. Fast twitch muscle
fibers, the other type of muscle fiber, are able to exert a great amount
of force but only in short bursts.

Muscular endurance is a combination of strength and
endurance of muscles. Muscular endurance is the ability of a muscle
or a group of muscles to perform repeated muscular contractions
against resistance for an extended period of time. It is associated with
the muscle’s ability to continue to perform without fatigue. In order to
improve our muscular endurance, we should try some cardiovascular
exercises such as jogging, walking, biking, dancing or bicycling. Some
bodyweight exercises such as push-ups, chin-ups; triceps dips etc.
would improve the endurance and strength of upper body muscles.
Muscular endurance is related to the length of time a muscle can
perform repeated muscle actions against a sub-maximal resistance. It is determined by the maximum number of repetitions performed at a given percentage of a person’s one-repetition maximum (Muscular endurance, 2010).

Improving muscular endurance provides benefits beyond the strengthening of muscles. A program of endurance training will improve bone mass, increase strength of connective tissue, decrease the chance of injury and help muscles heal faster after injury. A regular program of muscular endurance training has short term and long-term benefits. Over long periods of time, muscular endurance training leads to adaptation of skeletal muscle. A component of muscle known as mitochondria increases in depth and ability to store blood glucose as a result of endurance training. This increase in depth and improvement in storage capabilities, improves the muscles’ ability to sustain exercise over long periods of time. Short-term benefits of endurance training include improved uptake of glucose fat burning capabilities.

Fartlek and Interval Training for Physiological Potential

VO₂ max refers to the maximum amount of oxygen that an individual can utilize during intense or maximal exercise. It is measured as “milliliters of oxygen used in one minute per kilogram of body weight.” This measurement is generally considered the best indicator of an athlete’s cardiovascular fitness and aerobic endurance.
Theoretically, the more oxygen that can use during high level exercise, the more ATP (energy) that can produce. This is often the case with elite endurance athletes who typically have very high VO\textsubscript{2}max values (Elizabeth Quinn, 2010).

Maintains that it is the ability of the body's cardio-vascular system to deliver oxygen to active tissues that is the key determinant, VO\textsubscript{2}max depends on increased blood volume, maximal cardiac output and better perfusion of blood into the muscles. The role in determining VO\textsubscript{2}max is that oxygen supply is the major influence in determining endurance performance as only weak relationships exist between oxidative enzymes and increase in VO\textsubscript{2}max. French researcher Veronique Billat has suggested the best way to convert interval training into performance increases is utilize vVO\textsubscript{2}max efforts in training to improve vVO\textsubscript{2}max, VO\textsubscript{2}max and lactate threshold and economy. While this training may cause lactate threshold to remain consistent the velocity at lactate threshold will increase due to improvements of vVO\textsubscript{2}max, furthermore training at vVO\textsubscript{2}max increases strength and power, strength boosts economy as when muscle fibers are stronger fewer are recruited to move at similar paces (Cameron Carter, 2010).

Breath-holding is an unstable state with changes occurring in many interrelated variables. Although for clarity it is simplest to consider each important variable separately, the variables may well
interact in ways that cannot yet investigate by experiment. Breath-holding has, however, two much less well-known but important properties. First, the central respiratory rhythm appears to continue throughout breath-holding. Humans cannot therefore stop their central respiratory rhythm voluntarily. Instead, they merely suppress expression of their central respiratory rhythm and voluntarily ‘hold’ the chest at a chosen volume, possibly assisted by some tonic diaphragm activity. Second, breath-hold duration is prolonged by bilateral paralysis of the phrenic or vagus nerves. Possibly the contribution to the breakpoint from stimulation of diaphragm muscle chemoreceptor is greater than has previously been considered. (Parkes M. J., 2005).

To properly measure resting heart rate, take pulse in a relaxed state such as lying in bed before falling asleep. Resting heart rates will fluctuate which is normal and over time after a few checks will have a good indication of what resting heart range is. Most people resting heart rate is between 60 and 80 bpm. Athletes may have a resting heart rate as low as 40 bpm. Exercise regularly will notice a 5 to 10 bpm decrease in resting heart rate. This is a good indication that improving the health and can feels better. As continue to train, heart will beat more slowly for any level of activity, including resting. Resting heart rate is a very good measure of cardiovascular conditioning. Another benefit to conditioning which lowers resting
heart rate is that may feel less irritable, less anxious, more relaxed and an increase in energy (Akanke Birmingham, 2007).

The parasympathetic division helps slow down heart rate and respiration. At rest, the heart is controlled by the parasympathetic division, which is why the average resting heart rate is 60 bpm or less. One of the explanations of why endurance athletes have such low resting heart rate following training is due to increased parasympathetic response Regular exercise can cause as much as a 20 to 30 bpm reduction on resting heart rate. This is due to greater parasympathetic control and improved myocardial efficiency (Scott O. Roberts, 2002).

**Need of the Study**

Keeping the above concept in views, the present study has been formulated to examine the relative effects of fartlek training and interval running on endurance related parameters such as cardio respiratory endurance, speed endurance, muscular endurance, VO₂ max, breath holding time and resting pulse rate. Endurance training is the foundation training for sportsperson to choose the specialized sports and specialized training. Hence, the researcher made an attempt to find out the relative effects of fartlek training and interval running on endurance related parameters.
Statement of the problem

The purpose of the study was to find out the relative effects of fartlek training and interval running on endurance related parameters.

 Particularly, the study was conducted to investigate if there were any significant differences in cardio respiratory endurance, speed endurance, muscular endurance, VO₂ max, breath holding time, and resting pulse rate, among the participants due to the effects of fartlek training and interval running respectively. As such, the study was focused on the following questions:

Research Questions

1. Would the fartlek training and interval running programme improve the selected dependent variables in the presence of pre and control group?

2. Would the fartlek training and interval running programme differ from each other and also with control group on selected dependent variables?

Assumptions

Validity of this study will rely on the following assumptions:

1. Participants had performed the fartlek training, and interval running protocol correctly.
2. Experimental groups which comprised fartlek training group and interval running group had performed the assigned training sessions separately, for three alternative days per week.

3. Participants did not perform any vigorous exercise other than regular activity during the course of study.

4. The test was conducted by standardized test items.

5. Participants complied with the best of their ability to the training and testing directions.

**Delimitations**

The following were the delimitations of the study

1. To achieve the purpose of the study, forty five male (n=45) athletes (runners) studied in the Department of Physical Education, Health Education and Sports, the M.D.T. Hindu College, Tirunelveli, Tamilnadu, were randomly selected as subjects.

2. The age of the subjects were ranged from 18 to 21 years.

3. The selected subjects were divided into three groups namely fartlek training group (FTG), interval running group (IRG), and a control group (CG) with 15 subjects each. The participants had no prior structured training in fartlek training and interval running.

4. The duration of training period was restricted into 12 weeks and the number of sessions per week was confined into three.
5. The selected criterion variables were
   a. Cardio Respiratory Endurance
   b. Speed Endurance
   c. Muscular Endurance
   d. VO₂ Max
   e. Breath Holding Time
   f. Resting Pulse Rate

6. The data were collected on selected criterion variables, two days prior to and immediately after the training period.

Limitations

The following limitations were not considered while interpreting the result of the study

1. The environmental conditions and the level of acclimatization were not considered.

2. The results couldn’t generalize to other populations except 18 to 21 years.

3. The researcher couldn’t control the subjects outside activities, food habits, physical activity, and social habits.

4. Though the subjects were motivated verbally, no attempt was made to differentiate motivation level during the period of training and testing.
Hypotheses

It has been scientifically accepted that any systematic training over a continuous period of time would lead to produce changes on athletic qualities. Based on this concept and research questions the following research hypotheses were formulated and it was tested at 0.05 level of confidence.

1. There would be significant improvement on selected endurance related parameters due to the effects of fartlek training and interval running.

2. There would be significant differences on selected endurance related parameters among the experimental and control groups.

Significance of the study

1. The primary motto of the research is to support the coaches and Physical Education professionals to train their athletes and players based on this new concept to develop their performance.

2. The result of the study may be beneficial to the professional athletes, coaches, Physical Educationist and sports persons.

3. Based on the result of the study suitable training programme could be designed and implemented for the benefits of the runners.
4. This study may be useful guideline for the students to improve their level of performance.

5. The study may be useful to regain and improve their previous performance level.

6. This study may be useful for Physical Educationists and coaches to decide the training load during the tapering period.

Definition of the Terms

Training

Training is the planned and systematic realization of measure -- training contents and training methods-- for the durable attainment of goal --training goals-- in and through sport (Hohmann, Lames, & Letzelter, 2002).

Training has been defined as systematic process of repetition progressive exercise and acclimatization.

Endurance

It is the capacity to do an activity with desired quality and speed under condition of fatigue. Endurance enables the athlete to do activity efficiently without getting tired and to recover quickly from
fatigue and during activity. It involves performing a task to exhaustion (Hardayal Singh, 1995).

**Fartlek Training**

Fartlek is a great training tool. Fartlek training -- the word means "speed-play" in Swedish -- has been around for about 50 years and is very effective in increasing a runner's speed and endurance (Nicki Anderson, 2011).

**Interval Running**

Interval running which means is a type of “physical training” and cardio workout that involves bursts of high intensity work. This high intensity work is alternated with periods of rest or low activity, the eponymous intervals. The term can refer to any cardiovascular workout that involves brief bouts at near-maximum exertion interspersed with periods of lower-intensity activity (Todor O.Bomba, 1999).

**Cardio Respiratory Endurance**

The ability of lungs and heart to take in and transport adequate amount of oxygen to working muscles, allowing activities that involves large muscle masses (running, swimming, bicycling) to be performed over a long period of time (Hardayal Singh, 1995).

According to More House and Miller investigated “Cardio-respiratory endurance is the ability to carry a work load for a relatively
prolonged period.” The endurance is that enables the heart, blood, vessels and lungs to receive oxygen and take it to the muscular and to do it as often and effortless as possible (Harrison H. Clarke & David H. Clarke, 1987).

**Speed Endurance**

Speed endurance is the ability to execute cyclic or acyclic movements at high speed under condition of fatigue (Bompa, 1994).

**Muscular Endurance**

Muscular endurance is the ability of a muscle or group of muscles to sustain repeated contractions against a resistance for an extended period of time (Meyors Carlton, 1974).

**VO₂ Max**

VO₂ max is the maximal volume of oxygen that one can consume during exhaustive work and is measured by slowly and systematically increasing work intensity until exhaustion is reached.

VO₂ max is defined as the highest rate at which oxygen can be taken up and utilized during exercise by a person (Hardayal Singh, 1991).

**Breath Holding Time**

Breath holding time has been defined as an individual’s ability to hold the breath a voluntary forced maximum inhalation without
inhaling or exhaling during the period of holding the breath (Laurence E. Morehouse & Augustus T. Miller, 1976).

Breath holding time has been defined as the duration of time through which one can hold his or her breath without inhaling or exhaling (Robson, 1972).

Resting Pulse Rate

The heart rate or heart frequency is defined as the frequency of heart beats in one minute, when a player is in resting conditions. The time from the end of one heart contraction to the end of the next contraction is a complete heart beat or pulse or cardiac cycle. The complete cardiac cycle takes less than one second (about 0.8 seconds) in a normal adult at rest is shortened by exercise (Hardayal Singh, 1991).

Summary of the Chapters

This dissertation consists of five chapters. The title was introduced in the first chapter and the introduction, statement of the problem, research questions, assumptions, hypotheses, delimitations, and limitations, significance of the study and definition of the terms were discussed in the chapter one. The next chapter describes the source of review of related literature. The third chapter described with the selection of the subjects, selection of the variables, Selection of Tests, Competency of the Tester, Instrument reliability, Reliability of
data, Orientation of the subjects, Pilot study, Training Programme, Collection of Data, Administration of tests, Statistical Procedure. The chapter four consists of analysis and interpretations of the data and summary, conclusions and recommendation were presented in chapter five.