CHAPTER - I

INTRODUCTION

1:1 SPORTS PERFORMANCE

"The important thing in the Olympics is not to win but to take part. The important thing in life is not to triumph but to struggle. The essential thing in life is not to have conquered but fought well"

-Pierre De Coubertin

This earlier philosophy of sports participation has undergone a change since life of people, their philosophy and way of living are undergoing changes. Now an individual participates in sports in order to win and even his countrymen induce the sportsmen to win as sports has become a prestigious aspect to prove their superiority over other nations and societies.

Sports is a world wide phenomenon today. In no period of the world history sport was so popular, organised and important as today. There are numerous federations which organise sports competitions every year at various levels and also encourage participation in sports by providing technical and material facilities.
In performance sports, competitions provide the means by which one can show one's worth by competing successfully. Consequently sports competitions have triggered off a vigorous competition in research on sports physiology, sports psychology, sports training, sports nutrition and sports medicine. Competitive sports have brought into sharp focus a number of means for improvement and achieving high level performance. Everywhere new efforts are on to set up research laboratories so that ways and means could be found out to access and accelerate human performance in sports.

Arthur Jones (1977) has defined sports performance as a unity of execution and result of sports action or a complex sequence of sports action measured or evaluated according to agreed and socially determined norms. It's further exploration and determination need an integrated effort of various science disciplines and theory and methods of specific sports.

Sports performance not only denotes the psychomotor capacity of an individual sportsman but also gives expression of the overall efficiency of a nation and society. The countries which win greater number of medals in Olympics have better political, social and cultural conditions which are indispensable for producing world champions.
PREREQUISITES OF HIGH LEVEL SPORTS PERFORMANCE

A number of factors are responsible for high level sports performance and many authors have attempted to identify the factors in different ways. In modern days highly competitive sports essentially require a very effective and specific selection of participants, improved training procedures, advanced techniques, modern equipments, congenial environment and suitable diet.

Sports technology has so advanced into the sports area for enhancing performance. Science and technology has brought wonders and its application in the field of sports has been miraculous. To bring success, scientific methods are used to coax every centimeter, every fraction of a second and every ounce of energy out of an athlete who is considered to be almost a machine.

There are a number of important performance prerequisites for good performance in a sport. Some of the factors are aerobic capacity, the ability to use anaerobic reserves, mobility, agility, balance, speed, strength, power, endurance, skills, tactics, intelligence, coordination, good eye sight, peripheral vision, reaction time, perceptual ability, motivation, concentration, dedication, adequate rest, food, sleep, coaching facilities,
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specific physical preparation and countless physiological and psychological factors.

Hardyal Singh (1982) describes that the sports performance is the result and expression of the total personality of the sportsman. Certain personality traits, beliefs and values, motives and interests are indispensable for successful performance in a sport. The role of technique and co-ordinative abilities is self evident. Tactical Knowledge, tactical abilities are of high importance in team and combative sports. The physical fitness abilities form the sound base for achievement and execution of high level sports performance. Also the constitutional factors like body weight, height, physique, body proportions, stability of the musculo-skeletal system play a vital role in performing better way.

Krheger (1983) adds that a sportsman's performance depends to a great extent on nothing more than his state of mind. There may be other factors to consider as well his strength of body, his level of skill, the play arises between him and his opponents. These all have their effect on the final outcome. But they are secondary in importance to the sportsman's will to win, which is the heart of all competition and the impetus for all athletic genius. The way an athlete finds to deal with the tension, anxiety and depression involve in the performance in the competition.
According to Gurdial Singh (1986) to win in international sports, a superb physical fitness and best training of the individual are important factors. Philosophers, psychologists and teachers all testify to the three areas of human development that are critical to growth; the physical, the mental and the emotional. Kriese (1989) describes that a player must also develop his whole person in order to develop his game. He must be physically capable of skill, mentally recognise and have confidence in that capability.

1:3 CHARACTERISTICS OF FOOTBALL PLAYERS

1:3.1 PHYSICAL FITNESS FACTORS

Top soccer teams tend to have an average age of about 25 years with a typical standard deviation of 2 years or so. As per the study of Bell and Rhodes (1975) the height of players vary from 173 cm to 180 cm, goalkeepers the tallest and midfielders as shortest. Soccer players tend to be well developed in muscularity especially in the thigh and this produces a characteristic body shape. Coehrane and Pyke (1976) rated the somatotyping of the soccer players as 3:5:3 emphasizing a tendency towards mesomorphy.

In sports activities strength of muscle is necessary to enable a player to perform more easily and
effectively. Strength deserves considerable attention for football players. They need to produce power when kicking a ball for long distance or shooting at the goal. Thomas Reilly (1990) insists that strength in lower limbs is of obvious concern in football. Quadriceps and hamstring muscles are most used muscles for jumping, kicking and tackling. Upper body strength is employed in throw-in and the strength of the neck flexors is important for heading the ball forcibly.

Good muscular strength reduces the number and severity of injuries and delays muscular fatigue. It increases confidence in athletic ability, because it enhances better technique, power and speed of movement. Football players must work with strength training programme as it brings about beneficial changes on the adaptation process. Oberg, et al. (1986) had proved the implication of the positive relation between leg strength and kick performance. The vertical jump has been employed as measures of explosive leg strength. Coehrane and Pyke (1976) in their study found out that the mean value for the Australian world cup team in vertical jump is 50 c.m.

An essential for successful performance in many motor activity is speed. In football the lighter team wins because it is the faster team. The frequency of sprints in football players is 11% of their total movement in a full
The frequency of sprints tends to be greater in strikers and midfielders than on backs. They tend to sprint often to collect the ball or to defend the ball.

Reilly and Thomas (1976) have expressed that the football players change activity 5 to 6 seconds on average and have brief rest averaging 3 seconds every 2 minutes. Sprints average about 15 metres and occur every 90 seconds or so whilst players run at a cruise or sprint once every 30 seconds. Also everytime a player kicks the ball or dribbles the ball, his reaction time, quick movement and power are important factors.

Endurance enables the individual to sustain moderate contraction of the skeletal muscles over a comparatively longer period of time. In this type there is an adjustment in the circulatory-respiratory system to prolong action. Football is a game of 90 minutes in which players have to move around 9 to 13 km as per the studies by Reilly and Thomas (1976) on English team. On average the overall distance covered by players during a match consists of 25% walking, 37% jogging, 20% cruising submaximally 11% sprinting and 7% moving backwards. The overall distance covered with ball possession falls 4%.

An ability to sustain runs and recover quickly to take up a position to receive the ball from a teammate in possession, increases the options available to the player.
with the ball. The ability to generate movement of the ball is influenced by fitness as well as tactical sense. At high standards of play, fatigue is noticeable in the second half of the game. It is reasonable to expect that an elevation on aerobic power and capacity will help to sustain a high work rate throughout the game. A diet rich carbohydrate and suitable training contribute to maintain a high workrate throughout 90 minutes play.

Agility involves co-ordinating quickly and accurately the big muscles of the body in a particular activity. One's level of agility is probably a result of innate capacity, training and experience. In football the need for this skill is quite obvious with the ability to get past the defenders. Comparably the goal keepers need to react quickly.

Football players must manage both his body and the ball with his feet and have to move with varied speed and direction. Agility is highly dependent upon or inter-related with speed, strength, balance and co-ordination. Barrow and Mc Gee (1971) state that acquisition of agility is not only important to the success in games and sports requiring quick changes of direction and dodging, but also for safety outside the play situations. Instructions and opportunities to participate in activities requiring fast
starts, stops and changes of direction should be included in daily programme.

A high level of flexibility fosters a saving in energy during vigorous movement because of this better mechanical advantage. Because of this better physiological and mechanical adjustment of the joint and muscles the individual may be less vulnerable to injury. Flexibility plays its part in maintaining good posture and it is related to such components as endurance, speed and agility.

Barrow and Mc Gee (1971) recommend that a best fitness programme for a player's physical development should include both strength exercises and flexibility exercises. One most important and distinguishing quality top players have is flexibility strength. Strong muscles will not hamper flexibility if they are developed through exercises employing a wide range of motion. Muscle strength and joint flexibility are important safety factors in football.

Body composition is an important aspect of fitness for football as superfluous body fat act as dead weight in activities where body mass must be lifted repeatedly against gravity during play. Generally the amount of fat in an adult male in his mid twenties is about 16% of body weight.

Reid and Williams (1974) had made observations on professional football players in which the percentage of
fat lies between 9% to 19%. Bowers and Fox (1992) consider fat free body weight to be positively related to athletic performance because a large fat free weight means a large muscle mass. Large muscular forces are important in football.

1:3.2 **CARDIO-PULMONARY FACTORS**

Any form of physical activity is directly related to energy supplying systems which in turn is the cardio-pulmonary capacity in work for longer duration. Studies on cardio-pulmonary changes and effects on sportsmen have been valued at high rate among sports trainers and coaches. The status of sportsmen are determined by many cardio-pulmonary factors such as heart rate, oxygen uptake, vital capacity, tidal volume and work capacity.

Heart rate is an index of the physiological strain incurred by the footballer during match play. It has been observed by Johnson and Nelson (1988) that resting heart rate is indicative of physical fitness from the standpoint that resting heart is lowered as a result of conditioning. The resting pulse rate of a trained individual decreases reflecting a stronger contraction of the heart and a more forceful expulsion of blood with each contraction.

Heart rates of top football players at rest tend to be much lower than the average of 72 beat/min found in
general population. Balanescu, et al. (1968) in their study observed a mean value of resting heart rate of Romanian players as 52. The heart rate accelerates with increasing exercise intensities to raise cardiac output so that the circulatory system can meet the needs of the active muscles for oxygen. Because of the relatively shorter recovery periods of football the heart rate stays out on elevated level.

The heart rate response to submaximal exercise is used for estimating VO₂ max. and for measuring the physical working capacity PWC 170. Quick recovery from strenuous exercise may be important in football which throws intermittent efforts interspread with short rests. Thomas (1975) had assessed the fitness of football players through Harvard step test and his study showed an index of 117 for them.

Van Gool, et al. (1983) through their study found the mean heart rate during exercise as 155 + or - per minute for backs, 170 + or - 9 beats per minute for the midfield players and 171 + or - 13 for the forwards. This suggests that the strain on the circulatory system during football play is relatively high. Exercising at this intensity should provide a good training stimulus.

Vital capacity, the volume of gas that can be forcibly expired after a maximum inspiration represents the
approximate usable capacity of the lungs. The maximum rate at which air can be breathed in and out per minute should be high in football players to furnish the oxygen transport system with the necessary supply of air throughout 90 minutes of play. Reilly (1974) in his study had observed the mean value of vital capacity of 5.9 liters for English players.

Work capacity or aerobic capacity is usually assessed by measuring maximal oxygen consumption ($V_{O_2}$ max). The assessment of oxygen consumption in relation to athletic performance is a well-established and valuable practice. Improved aerobic capacity through conditioning reflects changes in the ability of muscle to produce ATP. The oxygen required for the breakdown of any particular carbohydrate or fat will require a specific amount of oxygen. At rest we consume oxygen at a rate of 2 or 3 liters per minute and during maximal exercise according to Bowers and Fox (1992) the rate increases to 3 to 6 liters per minute.

The average value of $V_{O_2}$ max. for top level football players tends to be high, supporting the belief that there is a large contribution from aerobic power to play the game. Astrand and Rodahl (1977) reported that football players have 58.6 ml. kg./min. as their mean $V_{O_2}$ max. It is likely that $V_{O_2}$ max. of football players improve significantly on the pre-season period when there is an
emphasis on aerobic training. Although VO$_2$ max. indicates the maximal ability to consume oxygen in strenuous exercise, it is not possible to sustain exercise for very long at an intensity that elicits VO$_2$ max.

The oxygen uptake is totally dependent upon the maintenance of a free airway and the proper diffusion of gas from the alveoli to the pulmonary capillaries and then to the cells throughout the body. Total lung capacity is the entire volume of air that can be contained in all the air passages. In normal persons the volume of air in the lungs depends primarily on body size and build. A well-developed athlete may have a vital capacity as great as 30% to 40% above normal person.

Tidal volume is the amount of air breathed in and out in ventilation as defined by Guyton (1986). This is less during rest and enlarges considerably during exercise. Training improves the efficiency of breathing. The trained individual reduces the rate of breathing and increases the depth. Clarke (1975) explains that the trained individual is able to extract a greater proportion of oxygen from the air he breathes than the untrained person. In short there is an increased aeration as a result of training.
1:3.3 **SKILL PERFORMANCE**

In the development of the game of football, skills have come into play an increasingly vital role in the quest for victory. Top level teams perfect the skills and change them into a highly refined and sophisticated art and are constantly searching for better training. There are a number of skills involved in the game of football like dribbling, kicking, ball control, volleying, trapping and heading which play vital role in the success of modern football. Each skill is having its own importance and applications to different situations. Skills are indispensable for maximum use of the motor abilities. Perfection of these skills and execution of them successfully are having direct impact on the total performance in the game.

1:4 **SPORTS TRAINING**

According to Harre (1982) sports training is a process of athletic improvement which is conducted on the basis of scientific principles and through systematic development of mental and physical efficiency which enables athletes to produce outstanding athletic performance. Training should be concentrated mainly on the development of the kind of condition that is required for the specific event concerned. Coaches have to use a variety of physical exercises and forms of workout especially in training
programmes in order to develop the essential prerequisites of high athletic efficiency.

A rational technique enables the athlete to make economical and optimum use of his physical condition. The sportsman learns the technique and gets a mastery of it under condition specific to his event. The development of technique and condition are two aspects of training that should always go hand in hand. Tactical training must be made part and parcel of all other facets of the training programme because the athlete must acquire those skills and abilities which will enable him to put into practice tactics that can win events. During training, the athlete must be able to think and act, able to apply tactical ideas with imagination, able to develop new techniques and able to plan and analyse.

1.4.1 TRAINING SEASONS

Bowers and Fox (1979) had divided the year round training programmes of athletes into three phases namely pre-season, in-season and off-season. Pre-season training phase is the period eight to ten weeks prior to competition in which training programmes are designed to increase to a maximum the capacities of the energy systems that are predominant when performing a specific event. In-season training phase is the period where the athlete achieves top
form and maintains it as long as required. High amount of training is devoted to the tactical and strategical preparation. The in-season or competition season is characterised by a high frequency of competitions which should be in order of increasing difficulty.

Off-season phase of training programmes are usually non specific. This season is relatively shorter than other seasons and aims at complete physical and physiological recovery. The volume and intensity in this season should be such that it guarantees active recovery as well as it is sufficient to maintain the training state.

1:4:2 Pre-season Training

Hardayal Singh (1984) had stated that the pre-season training is the base creation for better performance in the competition. The various performance factors are developed sequentially in this period. The preparatory period is characterised by increase of volume of load as compared to the intensity of the load.

According to Patsy Neal (1969) the pre-season training is the time to perfect skills, work on fundamentals, ponder strategy and to strive for high level of conditioning for a specific sport. The pre-season training programme is a stepped up programme of conditioning with emphasis on strengthening the muscles involved in the
sport and improving the players' endurance. This programme should lead to a gradual improvement in physical fitness with the peak being reached during the season.

Thomas Reilly (1990) had considered the pre-season training as highly important as it includes programmes of fitness training which improve the aerobic power and endurance capacities of players. Coaches should have a more circumspect approach towards pre-season conditioning and introduce a balanced programme of exercises.

Kriese (1989) had insisted that a good pre-season training programme should develop muscular endurance which will enable the body to recover much faster after a strenuous programme allowing an athlete to compete day after day with the same level of excellence. It is essential for a player to follow a good flexibility programme every day to relax the body to guard against injuries and to alleviate soreness from previous performance. A comprehensive and thorough programme of physical training will enhance a player's performance, increases confidence, improves techniques production and develops his athletic ability to its maximum potential.

Hardayal Singh (1984) had divided the pre-season training into three phases having different aims and contents. The first phase is aimed to increases the load taking ability of sportsmen to regain the previous training
state and to develop the general phase for future performance. The volume of training is sharply increased but the intensity is increased very gradually. In this phase, more stress is made on the development of general and overall body strength, general and basic endurance. The technique training aims at relearning of skills and learning of new skills. Very less work needs to be done on tactics in this phase, because tactics depend largely on conditioning and technique efficiency. Theoretical sessions should be held for informing rules, latest tactics, system followed and various ways and means.

During the second phase, the performance factors which are directly related to specific event are given more stress like endurance and leg strength of a footballer. Harve (1982) has stated that the volume of general exercises should be reduced in favour of the most effective special exercises. The technique should be stabilised mainly by work outs specific to competition. The volume and intensity of the load is further increased. The volume of tactical training also increases but it is less compared to conditioning and technique. In addition to theoretical knowledge individual, positional and fundamental tactics are started.

The third phase aims at direct preparation of the sportsmen for the competition period and at maintenance of
the previously developed training state. Integration of all
the performance factors is done so that the sportsman can
participate in the competitions with success. The volume of
load is gradually reduced and there is a rapid increase in
intensity of load. In technique training automisation of
the skills is done and the ability to apply learnt skills
under difficult and competition situation is developed. In
addition to theoretical sessions, group and team tactics are
developed. The volume of tactical training is increased
considerably.

Matweyew (1981) had insisted that the pre-season
training should be done in meso-cycles. Each meso-cycle
should aim at the improvement of only 2-3 factors and at the
maintenance of other factors. The meso-cycle system must
be set up according to the aim of the training, available
time, the state of performance and with the special features
of the particular sport.

The load dynamics in the preparatory period is
arranged in such a way that the volume increasing initially
and intensity increasing in the end. It is further
emphasised that to develop load tolerance a training period
of one or two weeks must be devoted to threshold loads so
that the adaptation processes are generated with sufficient
intensity.
1:4.3 FREQUENCY AND DURATION OF PRE-SEASON TRAINING

Bowers and Fox (1992) recommend for endurance activities like football, the frequency of training should be between four to five days per week and duration twelve to sixteen weeks. Two sessions per day are often necessary to allow for their large volume of training.

1:4.4 INTENSITY OF THE TRAINING

To determine the proper intensity level of a training programme, there is no ideal way which is best suited to the trainees and to the demands of an effective conditioning programme.

However for endurance programme Bowers and Fox (1992) recommended, a starting point at a level sufficient to raise the heart rate to 80 percent to 85 percent of the maximal level using Karvonon method. The Karvonon method of determining the training heart rate (THR) consists of calculating a heart rate reserve HRR

\[ HRR = HR_{\text{max}} - HR_{\text{rest}} \]

Training heart Rate (THR) 80% = (.80 \times HRR) + HR_{\text{rest}}

A reasonable estimate can be made in the field by counting the pulse of the athlete following an all out run lasting about two minutes. If the above method is not convenient, this may be made from the following equation

\[ \text{Maximum Heart Rate} = 200 - \text{age} \]
DeLorme and Watkins (1948) had developed a concept of repetition maximum (RM) method for determining the intensity of strength training. A repetition maximum is defined as the maximal load a muscle or muscle group can lift a given number of times before fatiguing. For example if a person can lift a particular weight eight times and no more before fatiguing, that weight is an 8 RM load. A 1 RM load is the maximal amount of weight that a person can lift only one time. According to DeLorme and Watkins, the best suitable starting load for strength training is 2 sets of 10 RM load.

In recent studies it has been proved that weight training programme involving 12 repetitions of 80 percent maximum load increased strength significantly and 20 repetitions of 50 percent maximum load increased endurance significantly.

William, D. Mc Ardle, et al. (1986) had specified a running speed method for determining intensity for speed training. In this method, for 50 yards distance 1.5 second is added to the runners best time, for 100 yards and 200 yards the training times can be 3 and 5 seconds respectively more than the athletes' best time for the particular distances.

Bowers and Fox (1982) had suggested a heart rate method, a heart rate of 180 to 190 beats per minute during
the work interval which indicates that the work is sufficiently intense. Yet another method, repetition method is based on the number of repetition possible per work out, for example the number of 50 yards runs in the work out should be between six to eight. The intensity is such that the athlete is not exhausted but unable to run any additional repetition.

Harre (1979) had recommended an intensity of 10-15 repetitions of flexibility exercises to develop dynamic flexibility. Also Static flexibility should be improved with flexibility exercises in which joints are slowly moved to its maximum limit and held for 4-8 seconds to start with.

1:5 THE PRESENT STUDY

Historically many sports physiologists have not been attracted to examine football in detail and to study the game in the laboratory. Nevertheless there has been considerable interest among players and coaches in fitness for football and its development. Some of the investigations are made by Fordy (1969), Reilly and Thomas (1976), Losado (1980), Van Gool, et al. (1983), Reilly and Bell (1984), Ekblar (1986) and Oberg, et al. (1986). There are not many comparative studies on football players at the pre-season stage and during the season.
There is no definite formula for training and success in any given sport at various levels. A deeper understanding of the physiological basis of the sport will help to determine the extent to which the champions' practices should be generally adopted. Reilly (1979) has framed a relative proportion of training time devoted to different components in football training as follows:

- Warming up-10%  
- Calisthenics-5%
- Running-15%  
- Circuit training-5%
- Skills practice-20%  
- Drills-15%
- Games-20%  
- Recovery-10%

White, et al. (1988) had prepared a pattern of pre-season training schedule of English league team as follows.

<table>
<thead>
<tr>
<th>Days</th>
<th>Game related training (min.)</th>
<th>Fitness/conditioning (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>75</td>
<td>115</td>
</tr>
<tr>
<td>Tuesday</td>
<td>85</td>
<td>65</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Recreation</td>
<td>-</td>
</tr>
<tr>
<td>Thursday</td>
<td>90</td>
<td>105</td>
</tr>
<tr>
<td>Friday</td>
<td>Game preparation</td>
<td>-</td>
</tr>
<tr>
<td>Saturday</td>
<td>Game day</td>
<td>-</td>
</tr>
<tr>
<td>Sunday</td>
<td>Rest</td>
<td>-</td>
</tr>
</tbody>
</table>
A well planned and regulated training regime only can bring the player to his peak performance level by developing physical and physiological conditions. Hence the investigator has attempted to frame a specific pre-season training package for training the football players at college level. The exercise programmes and the load pattern are based on a critical approach to training by outlining the physiological demands of football.

1:6 STATEMENT OF THE PROBLEM

The purpose of this study was

i) To determine whether the specific pre-season training package programme would have greater effect than the traditional method of training programme on the improvement of selected physical fitness and cardio-pulmonary variables and skill performance of college level football players.

ii) To determine whether the specific pre-season training package programme improves the selected physical fitness and cardio-pulmonary variables and skill performance of the college level football players at the end of the 4th week, 8th week and 12th week.
1:7 HYPOTHESIS

It was hypothesised that

i) Specific training package programme may significantly develop the selected physical fitness and cardio-pulmonary variables and skill performance of football players after four weeks, eight weeks and twelve weeks of training.

ii) Traditional method of training programme may not significantly develop the selected physical fitness and cardio-pulmonary variables and skill performance of football players after four weeks, eight weeks and twelve weeks of training.

iii) The specific training package group may significantly develop the selected physical fitness and cardio-pulmonary variables and skill performance of football players than the traditional method of training group and control group after 12 weeks of training.

1:8 SIGNIFICANCE OF THE STUDY

1. This study would help to evolve a comprehensive pre-season training programme for enhancing the performance of college level football players.

2. This study may guide the football coaches and trainers to follow a suitable training schedule.
3. The result of this study would be useful as guidelines for the physical education teachers and coaches to frame various programmes to suit the players of different levels.

4. The study may guide the football players to follow a suitable systematic training programme which will develop their athletic ability, improve their techniques, increase confidence, reduce injuries and thereby enhance their performance.

1.9 DELIMITATIONS

1. This study was delimited to 45 men football players of the age group of 18 to 25 years who had participated in the Bharathiar University inter-collegiate tournament during the year 1994-95.

2. This study was confined to the pre-season period only and for 12 weeks of training.

3. This study was delimited to the physical fitness variables of speed, endurance, leg strength, agility, flexibility, explosive power, percent body fat and lean body weight, cardio-pulmonary variables of physical working capacity, VO₂ max., tidal volume, total lung capacity, forced vital capacity, forced expiratory volume and maximum voluntary ventilation and skill performance of dribbling, ball control, kicking and general playing ability.
1:10 LIMITATIONS

Certain factors like personal habits, lifestyle, daily routine, diet and climatic condition which might have an effect on the result of the study could not have been taken into consideration.

1:11 DEFINITION OF TERMS

1:11.1 SPEED

Speed is the rate of which a person can propel his body through space. For the purpose of this study, time taken for 50 yards run has been used.

1:11.2 STRENGTH

Strength is a force that muscle or a group of muscles can exert against resistance in one maximum effort. For the purpose of this study, leg strength was measured.

1:11.3 AGILITY

Agility is the physical ability which enables the individual to rapidly change body position and direction in a precise manner.

1:11.4 ENDURANCE

Endurance is the result of a physiological capacity of the individual to sustain movement over a period of time,
In the present study, circulatory respiratory endurance was the ability to run 12 minutes run.

1:11.5 **FLEXIBILITY**

Flexibility is the range of movement in a joint. In the present study, the range of movement of trunk has been studied.

1:11.6 **POWER**

Power is the capacity of an individual to bring into play maximum muscle contraction at the fastest rate of speed. For the purpose of this study, leg explosive power was measured through vertical jump.

1:11.7 **PHYSICAL WORKING CAPACITY**

Physical working capacity is the maximum level of work of which an individual is capable or his capacity to supply oxygen to the working muscle. In the present study, a person's working capacity is measured in a bicycle ergometer at 170 beat/min. heart rate.

1:11.8 **LEAN BODY WEIGHT**

When the weight of body fat is subtracted from the total body weight, the remaining weight is called as lean body weight.
1:11.9 \textbf{VO}_2 \text{ MAX.}

VO_2 max. is referred to the maximal volume of oxygen consumed per minute during exercise. The VO_2 max. is the single most valid measure of the aerobic energy system.

1:11.10 \textbf{TOTAL LUNG CAPACITY}

Total lung capacity is the maximum volume to which the lungs can be expanded with the greatest possible inspiratory effort (5000 ml). It is equal to the vital capacity plus the residual volume.

1:11.11 \textbf{TIDAL VOLUME}

Tidal volume is the volume of air inspired and expired with each normal breath and it amounts to about 500 ml. in the average young adult.

1:11.12 \textbf{FORCED VITAL CAPACITY}

Forced vital capacity is the amount of air that person can exhale with maximum expiratory effort as rapidly and as completely as possible after maximally inspiring to the total long capacity.
1:11.13 **FORCED EXPIRATORY VOLUME**

Forced expiratory volume is the volume of a maximally fast exhalation from a point of maximal inspiration in one second.

1:11.14 **MAXIMUM VOLUNTARY VENTILATION**

Maximum voluntary ventilation is the maximum volume of air that is moved in and out of the lungs per unit and in the present study for a period of 15 seconds. The mean value ranges from 100 to 180 liters per minute.

1:11.15 **PRE-SEASON TRAINING**

Bowers and Fox (1986) had stated that the period eight to ten weeks prior to competition is considered as pre-season. Training programmes in this period should be designed to increase a maximum capacities of the energy systems that are predominant when preparing for an event. Another important factor to be considered during this phase of training is the learning of strategies and skills specific to the sport.
1:11.16 SPECIFIC TRAINING PACKAGE

Specific training package means a systematic scientific programme of conditioning exercises, physical activities, drills and tactical maneuvers designed to improve the physical fitness, techniques and playing ability of the players.