CHAPTER I

INTRODUCTION

Sports Training is the basic form of preparation of sportsmen. Sports training is a pedagogical process, based on scientific principles, aiming at preparing sportsmen for higher performances in sports competitions.

Sports Training is done for improving sports performance. The sports performance is not the product of one single system or aspect of human personality. The total personality of a sportsman has to be improved in order to improve his performance.

Completive Sports is becoming a highly technical job. A lot of research is being done by the western countries on the scientific basis of performance in sports. As a result of more research new techniques are being adopted for training high level sportsmen.

In recent years the dramatic changes that have taken place has brought about some revolution in performance. These recent changes in conditioning methods are based on and have been motivated careful observation and scientific research. The changed programme has produced valid and precise information on the relative effectiveness of different training methods. As a result we currently know much better then ever before about the functioning of the body systems during training and competition. We have learned more about the effects of diet, drugs, attitude, warm up and other influencing factors. In recent years,
we have gained new knowledge about almost every aspect of conditioning and performance\textsuperscript{1}.

The efficiency of athletes can be boosted up through proper training and conditioning. The condition of training has different aspects including the varied physical and physiological factors.

The use of scientific method or technique has helped to develop every new and effective training method one such method of training is package of trainings which has now come to be used by sports coaches in different parts of the world.

1.1 SPORTS TRAINING

Sports training are a planned and controlled process in which, for achieving a goal, change in complex sports motor performance ability to act and behaviors are made through measures of content, methods and organization\textsuperscript{2}.

Sports training is a pedagogical process, based on scientific principles, aiming at preparing sportsmen for higher performances in sports competitions.

The physical fitness or condition is the sum total of five motor abilities namely strength, speed, endurance, flexibility and coordinative abilities. These five motor abilities and their complex forms are the basic requirement for human motor actions. There fore, the sports performance in all sports depends to a great extent on these abilities.

1.2. AIMS OF PHYSICAL TRAINING

The improvement and maintenance of physical fitness or condition is perhaps the most important aim of sports training.

Physical training aims at improving the performance of sports persons. The sports performance depends on several factors. The performance of a sports person primarily depends on his performance capacity which is a complex of five groups of factors. All these factors, therefore, are the principal aims of physical training.

The constitution or physique is almost completely genetically determined and hence cannot be improved by training. But the other four groups of factors which are physical fitness or condition, technical skill, tactical efficiency and education are trainable to a greater or lesser extent. The above mentioned four factors, therefore, are generally considered to be the aims of sports training.

The basic method of training has not changed much but it is developed on more intelligent science based systems that involve higher quality and regular and prolonged application\(^3\).

1.3. TRAINING LOAD

Load is one of the control importances in sports training. Without load through physical exercises performance cannot be improved, stabilized and maintained. Stagnation of load results in stagnation of performance. Load

always causes physical and psychic changes or disturbances. Load is not always given for improvement but also for maintenance and stabilization of performance capacity. Load is also given sometimes for the purpose of acceleration the recovery process. Harre (1989), therefore states that load can be of two types Fatigue producing and non fatigue producing.

1.4 FACTORS OF LOAD

Factors of load are different parameters of training and competition demands. These are also referred to as components of load. The factors of load enable us to quantify load and there by help in measurement and assessment of load which is indispensable for control and regulation of load and training. There are four factors of load.

1.4.1. Physical Exercise

Physical exercises are the principal means of training. These physical exercises are classified in to general, special and competitive exercises. The exercises are used to assess the load more accurately.

1.4.2. Movement Quality

The quality of movement execution in several sports has an effect on the load. The movement quality is the product of motor co-ordination. High degree of movement quality indicates high co-ordination along with the required aspects of mental load, example concentration, attention, perception etcetera. The load can be increased considerably by increasing the degree of difficulty of movement execution.

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1.4.3. Load Intensity

Intensity of load is the degree of effort being made by the sportsman while doing an exercise. The degree of effort is always considered in relation to time. It is also equated with the amount of force or energy being spent in relation to time. The load intensity can be further divided into movement intensity and load density.

Movement intensity is the speed or force with which a single movement is done. The load density is understood to the duration of recovery between two repetitions or series of repetitions.

**TABLE I**

<table>
<thead>
<tr>
<th>Sports exercise</th>
<th>Intensity</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parameter</td>
<td>Unit of measurement</td>
</tr>
<tr>
<td>Running, Walking etc.</td>
<td>Speed</td>
<td>m/sec, Km/hr</td>
</tr>
<tr>
<td>Jumps and Throws</td>
<td>Distance, Height</td>
<td>Metre, cm, Metre, cm</td>
</tr>
<tr>
<td>Weight training</td>
<td>Resistance, Speed</td>
<td>Kg, Repetitions/Time</td>
</tr>
<tr>
<td>Free hand Exercises</td>
<td>Speed</td>
<td>Repetitions/Time</td>
</tr>
</tbody>
</table>

The intensity of load is usually expressed in percentage of the maximum passable intensity. Exercise with maximum intensity leads to improvement of speed abilities, speed endurance, maximum strength and explosive strength. Exercise with lower intensity results in the improvement of different types of endurance. Exercise with very low intensity does not lead to any improvement but is good for active recovery. Load intensity has inverse relationship with load volume. Higher load intensity is possible only with lower load volume and vice versa.

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1.4.4. Load Volume

The volume of load is the total amount of work done through an exercise or in a training session. For improvement of maximum strength a certain minimum duration of muscle contraction with maximal intensity is indispensable. For improvement of basic endurance the load phase must be more than 30 minutes in duration. For the improvement of different performance factors, different load volume with and optimum load intensity is required.

Load volume can be further divided into movement duration and movement frequency. For example in interval and repetition method, the movement duration is the duration of a single repetition or movement. The frequency of movement is the number of times a movement or an action has been done. The total volume of load over longer periods (months or a year) has direct and positive relationship with performance improvement.

Optimum volume of load in single training session is often nor enough to start the adaptation process. A certain optimum quantity of load volume achieved over a number of training sessions is required to start the process of adaptation which will result in increases of performance capacity. Load volume has also important relationship with health and general conditioning of various organs and systems\(^6\).

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1.5 TYPES OF TRAINING

Success in competitive sports and games can be attributed to many factors; training being one of the most important factors. Different training methods have been commonly used to improve physical fitness and its related standard of performance of athletes. The training methods which have been used by the athletes for higher performance are interval training, fartlek training, circuit training, weight training, plyometrics training, continuous method, variable pace method, technique training, speed training, Resistance training etcetera.

1.5.1. Interval training

Interval method is perhaps the most versatile method for improving endurance of various types. In interval method, the exercise is done at relatively higher intensity with intervals of incomplete recovery.

In interval method, work should be done with sufficient speed and duration so that the heart rate goes up to 180 beats per minute. After this there should be a recovery period and when their heart rate comes down to 120-130 beats per minute the work should be started again. The training load in interval method can be controlled by repeatedly checking the heart rate. The effect of interval method is determined by the variable methods, they are as follow as:

Speed of work, Duration of work, Duration of recovery, Number of repetitions and Nature of recovery.\(^7\)

Interval methods are used by the sports experts’ to develop Explosive strength, Strength endurance, Speed endurance, Acceleration speed etcetera.

1.5.1.1. Intensive Interval method

(To improving explosive strength)

Scholish (1988) recommends the following load factors for this method when weight trainings are to be used:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>approximately 70-80%</td>
</tr>
<tr>
<td>Repetitions</td>
<td>8-12</td>
</tr>
<tr>
<td>Recovery</td>
<td>90-180 sec between the sets</td>
</tr>
<tr>
<td>Speed of movement</td>
<td>Explosive</td>
</tr>
</tbody>
</table>

1.5.1.2. Extensive interval method

(To improve strength endurance)

According to zaciorski 1971 and Harre 1986 the load parameter should be as follows:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>approximately 30-40%</td>
</tr>
<tr>
<td>Repetition/duration</td>
<td>20-30/ sec</td>
</tr>
<tr>
<td>Set</td>
<td>3-6</td>
</tr>
<tr>
<td>Recovery</td>
<td>120-180 sec. (station training) 60-120 sec. (set or circuit training)</td>
</tr>
<tr>
<td>Speed of movement</td>
<td>smooth and continuous.</td>
</tr>
</tbody>
</table>
1.5.1.3. Intensive Interval method

(To improve strength endurance)

According to Zaciorski 1971 and Harre 1986 the load parameter should be as follows:

- **Intensity**: 50-65%
- **Set**: 3-6
- **Duration of a set**: 20-45 sec
- **Speed of movement**: Explosive
- **Recovery**: 60-90 sec. (station training)
  
  10-30 sec. (set or circuit training)

1.5.1.4. Intensive Interval method

(To improve speed endurance)

The load parameter to improve speed endurance is as follows:

- **Intensity**: very high maximum
- **Distance**: 40 - 60m
- **Repetitions**: 3-4 series of 4-5 repetitions
- **Recovery**: 20-30 sec, between repetitions,
  
  3-5 min between series

1.5.2. Plyometric Training

Soviet researchers in the early 60’s revealed that through specific drills they observed an increase in explosive reactive movement inherent in sprinting. Initially, U.S.A. coaches implemented plyometric training for jumpers only. However, presently it is believe that almost every athlete, regardless of event, can benefit from bounding, leaping and jumping drills.
Through rapid eccentric – concentric contractions, while involving strength reflex, this neuromuscular responsive drills aids in converting strength to explosive reactive action; Plyometrics also assist in developing efficiency in the neuromuscular system and is extremely valuable to sprint starting and the initial acceleration phase.

Basically, there are two types of jumps, the short jump and long jump. The short jump will improve the start and acceleration phase. The long jump will develop speed and endurance⁸.

Before performing lower extremity plyometrics, the individual must be able to squat his body weight, perform a standing long jump equal to his height and balance on a single leg with his eyes closed. It should be noted that the subject should have adequate strength to participate in the training programme. The training should be given in progressive manner. Do not be in a hurry. The exercise should be given in increasing levels of difficulty depending on the level of athlete and their aptitude for learning.

1.5.3. Weight Training

Strength is a most important factor for speed improvement. A periodic increase in weight resistance will develop both strength and speed. Weight training exercises for strength will produce an enlargement of fibers, while exercise of endurance increase the number of capillaries. Athletes should be instructed to lift weight slowly. Initial weight training requires the use of moderate weight until a base is established⁹.

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⁹ Kevin M. White, Sprint-Track Technique, PP.75-76.
The order of strength training exercises is critical in two respects. First, the larger muscle group should be exercised before the smaller ones. Otherwise, overloading the large muscles is difficult because the smaller muscle groups fire more quickly. Second, no two exercises should train the same group of muscles consecutively, for the muscles will have too little recovery time. Starting weights may be based on percentage of either the athletes’ body weight or his or her best performance in each exercise. Strength training emphasizes either body development (Hypertrophy) or strength, depending upon the weight and number of repetitions of exercises\(^\text{10}\).

The organization of strength training comprises of two things (A) method of arrangement of strength exercises, (B) loading procedure during a strength exercise.

1.5.4. Fartlek Method

Fartlek is a Swedish word which means ‘speed play; in stricter sense it is a variation of variable pace method. In fartlek the change of pace or speed is not preplanned. The sportsman can change the speed on his own during the activity, according to the terrain, surrounding and his feelings. Therefore, this method requires more self discipline in order to be effective. The heart rate normally ranges between 140 – 180 beats per minute. The total duration or volume ranges from about 15 minutes to one hour depending on the dynamics of speed. This method can be used to improve aerobic or anaerobic capacity or both at the same time.

Fartlek is a valuable training method because it allows a wide range of intensities, while also helping prevent the stress injuries that can come from training on pavement or running track. At the same time, it gives a more

relaxing, psychological setting and a chance to avoid the monotony of the track. It is more difficult for less experienced athletes, however, because they tend to turn it into a long, easy run with a few short accelerations.\(^1\)

1.5.5. Circuit Training

Circuit training is probably the most common training regime used by a wide range of sports and activities in order to improve performance. A circuit consist of a number of different stations at which the athlete performs a given exercise as many times as possible within a given time period. When the time is completed the individual moves on to next station and performs a different exercise for a similar period of time and so on around the various stations.\(^2\)

It is a very popular and effective variation for the improvement of strength endurance. In circuit training several exercises are done one after other. Completing of one set of each exercise in rotation is called one round. There are normal three or more rounds in circuit training. In circuit training there are generally 5 - 12 exercises. It can be done according to continuous or interval method.\(^3\)

1.5.6. Continuous method

In this method an exercise is done for longtime without any break or pause. Because of the long duration of work the intensity is low. The continuous method has four variations which are slow continuous method, fast continuous method, variable pace method, and fartlek method.

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\(^1\) Bowerman and Freeman, *High Performance Training for Track and Field*, P.11.
**Slow continuous method:** - In this method the speed or pace of exercises is determined according to heart rate. For trained sportsperson the heart rate during the exercise should be from 140 – 160 beats per minute. The volume in terms of total duration should not be less than 30 minutes, and endurance athletes can go up to 2 hours or even more.

**Fast continuous method:** - In this variation the work is done at fast but unchanging pace for durations without any break. Heart rate is normally between 160-180 beats/minutes. Total volume or duration should not be less than 20 minutes for trained sports persons.

**Variable pace method:** - In this method the exercise is done continuously but with changing pace or speed. The heart rate normally ranges between 140-180 beats/minute. The total duration or volume ranges from about 15 minutes to 1 hour. It can be used by trained sportsman only.

**Fartlek Method:** - It is a variation of variable pace method. In fartlek change of pace or speed is not pre-planned. The sportsman changes the speed on his own during the activity, according to the terrain, surrounding and his felling. The heart rate fluctuates between 140-180 beats / minute.

1.5.7. Repetition Method

Harre (1986) suggests two variation of this method which can be effective for cyclic sports.

1. Repetitions with high speed over distance which are 2/3 to double of competition distance. Example: tempo runs up to 300 meters in track and field.
2. Repetitions with maximum speed over distance which are 10-20% longer than the competition distance.

This method is required number of repetitions are to be done with complete recovery in between the repetitions. If the speed is low, then shorter recovery period are needed and the repetitions can be arranged in series of 2-4 repetitions.

1.5.8. Speed training

Factors determining various speed abilities are reaction ability, acceleration ability, locomotor ability, movement speed, and speed endurance.

Reaction speed: It is the ability to react effectively and quickly to a signal. In sports reaction ability is required to react quickly and effectively to various signals and changing situations. Reaction time is most commonly taken as a measure of the reaction ability. The reaction ability can be developed by the following methods:

1. Playing different types of games in which quick reaction are frequently required.

2. The sportsman should react repeatedly and with maximal effort to a signal.

Example: sprint starts arranged in series of 3-4 with full rest in between.

3. The sportsman should react repeatedly to a signal but with increasing speed and should also do the same with different
speeds. It is the ability to achieve high speed of locomotion from a stationary position or from a slow moving position.

**Acceleration speed:** - It is the ability to achieve high speed of locomotion from a stationary passion or from a slow moving passion. For the direct improvement of acceleration ability short sprints are the best means. For improving acceleration ability the following load parameters are suggested:-

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>-maximum or near maximum</td>
</tr>
<tr>
<td>Duration</td>
<td>-the duration of the sprint should be from 4-6 see.</td>
</tr>
<tr>
<td></td>
<td>-It can be less for children.</td>
</tr>
<tr>
<td>Distance</td>
<td>-Depend on the nature of sport.</td>
</tr>
<tr>
<td>Repetitions</td>
<td>-should be arranged in series of 3-4 repetitions</td>
</tr>
<tr>
<td>Recovery</td>
<td>-Full recovery in between the series.</td>
</tr>
</tbody>
</table>

It can be measured by conducting short sprint (20-60m)

**Locomotor ability:** - It is the ability to maintain maximum speed of locomotion for maximum duration possible. Gundlach (1969) found that in track and field sprint it can last from 20-45 metres. Maintenance of maximum speed is differs from persons to person, depending their age and performance level. The following load parameters are suggested for the improvement of locomotor ability:-

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>-maximum or near maximum</td>
</tr>
<tr>
<td>Duration</td>
<td>-6-9 sec</td>
</tr>
<tr>
<td>Distance</td>
<td>-Will differ according to the suggested duration of sprint.</td>
</tr>
<tr>
<td>Repetitions</td>
<td>-5-10. if distances are shorter, these can be managed in series of 2-3 repetitions.</td>
</tr>
<tr>
<td>Recovery</td>
<td>-Full recovery.</td>
</tr>
</tbody>
</table>
Locomotor speed can be measured by testing the time of 30m sprint from flying starts.

**Movement Speed:** - It is the ability to complete the movement in correct sense within shortest duration. Example: clearing the hurdle or clearing the starting block etc. It can be improved by the following methods:-

1. Repeating the movement with maximum speed.
2. Practicing the movement under easier conditions.
   Example: use of jump boards for long jump.
3. Practicing with a faster rhythm.

**Speed endurance:** - It is the ability to do sports movements with high speed under conditions of fatigue. Speed endurance is a combination of speed and endurance abilities. The methods for the improvement of speed endurance are as follows:-

1. Repetition method
2. Intensive interval method.

Speed endurance can be measured by the following test:-

1. 300-400 sprint
2. 40 sec. sprint
3. 10 X 50m sprint with 30 sec rest in between repetitions.
1.5.9. Flexibility Training

Flexibility can be defined as the ability to execute movements with greater amplitude or range. In common usage flexibility is often equated with stretchability, elasticity, suppleness, mobility, etc. Stretchability, elasticity, mobility and suppleness are a part and parcel of flexibility as these represent different capacities which enable the person to execute movements with greater amplitude. Flexibility is measured by determining the range of movement possible at a joint.

Importance of flexibility:
- Flexibility has important interrelationship with other performance factors.

1. Flexibility is a necessary prerequisite for maximal development of movement force and speed
2. Good flexibility helps in achieving higher movement economy
3. Flexibility is indispensable for prevention of injuries.

Improvement of flexibility:
- For the improvement of flexibility, stretching exercises are used. These exercises can be done according to the following three methods:

1. Ballistic method: In this method a joint is stretched rhythmically to its maximum range. The stretching movement is done with a swing, more over, in this method there is a higher risk of injury because of high chances of over stretching the muscle. It is suitable for the development of dynamic flexibility.
2. Slow stretch and Hold method: In this method the joint is slowly stretched to the maximum limit and is hold there for a few seconds before returning to the original position. For the
best effect the joint must be hold in a state of maximum stretch form 3-8 second. This method avoids the stretch reflex. This method can improve passive flexibility.

3. Post isometric stretch: - In this method a muscle is first contracted iso – metrically for 6-7 sec. The iso metric contraction should be maximal. After this the muscle is gradually stretched to its maximum limit and is hold in this position for 8-10 sec. this procedure is to be repeated 4-8 times for each muscle group.

Additional information: - The best age for the development of flexibility is before puberty. For good effect each muscle group must be stretched at least 10-15 repetitions. Flexibility training should aim at optimum flexibility not maximum flexibility. Stretching exercises should be done when the sportsman is fresh. Flexibility exercises can be done daily or even twice a day for faster improvement of flexibility.

1.5.10. Agility Training

The term agility has been gradually replaced by the term coordinative abilities. The agility or coordinative abilities are primarily dependant on the motor control and regulation processes of central nervous system.

Coordinative abilities are understood as relatively stabilized and generalized pattern of motor control and regulation process. These enable the sportsman to do a group of movement with better quality and effect.

Importance of coordinative abilities: - The movement quality depends to a great extent on coordinative abilities. The rhythm, flow, accuracy,
constancy, amplitude of a movement are expressions of motor coordination. The speed of learning of skill and its stability is directly dependent on the level of various coordinative abilities.

Some examples of coordinative abilities exercises are:

1. Practice with opposite side, hand and foot
2. Movement executions with changed rhythm
3. Change in the surface, change in the height, weight, size, shape, pressure of the equipment
4. Running and throwing
5. Ball bouncing and walking on a balance beam,
6. Reaction exercises
7. Agility runs etcetera

1.6. EFFECTS OF TRAINING ON PHYSIOLOGICAL VARIABLES

The physiological variables which were selected for this study are resting pulse rate, anaerobic power and cardio-respiratory endurance. The pulse rate is one of the important parameter that belongs to the circulatory system of the body. The reading of pulse per minute will indicate the functioning of the circulatory system of the body. Twelve minute run and walk parameter is directly connected with the pulmonary and circulatory system of the body. The distance covered by a sportsman within twelve minute is directly proportional to the efficiency of pulmonary and circulatory systems of the body. The anaerobic power is directly connected with explosive strength endurance; particularly for the runners, anaerobic power is the power generated by the legs when moving the body. Margaria kalamen anaerobic power test will indicate the leg power ability of the body.
1.6.1. Training and pulse rate

During ventricular contraction blood is ejected into the arteries with a pressure and this pressure wave is transmitted throughout the arterial system which can be left easily in superficial arteries. The number of pressure wave per minute felt in the arteries is called pulse rate.\(^{14}\)

Due to aerobic training the basal heart rate is decreased. This adaptation results because of increased vagal tone and decreased sympathetic activity of the heart. Training leads to decrease the resting pulse rate. Normally, it is about 70-80 beats per minute. Some of the endurance athletes with very strong and efficient hearts have heart rates as low as 45 beats' per minutes. Women have heart rate 5 -10 beats more than a man. Good cardio respiratory condition is indicated by pulse rate of 60 for women and 50 for men. Normally, pulse rate and heart rate remain the same.

1.6.2. Training and cardio respiratory endurance.

Cardio respiratory endurance is considered to be the ability of the circulatory system to supply oxygen to the cells to sustain the oxidative energy demands of the body and to remove the waste materials of the metabolism. Most physiologists agree that gas transport, especially oxygen is the primary determinant of the cardio respiratory endurance. Gas transport depends on cardiac output, and the oxygen carrying capacity of the blood, that is hemoglobin and the number of red blood cells per unit of blood. Thus, one reason for developing cardio respiratory endurance is to improve the circulation to the muscular being exercised.\(^{15}\)

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\(^{15}\) Robert N. Singer, *Physical Education Foundation*.(Ed.) (Holf ; Rincheart and Winston, 1976), P.212.
Aerobic training generally leads to certain changes in cardio respiratory system as well as muscular system which increase the cardio respiratory endurance of an athlete. Due to training the stroke volume is increased from 70ml to 120ml. maximum cardiac output value reaches as high as 40 liters per minute as compared to 25 liter per minute in untrained persons. Due to training number of erythrocyte is increased; hence the amount of Hemoglobin will also be increased, which help to transport the Oxygen to all the cells.

1.6.3. Training and anaerobic power

Anaerobic power is the capacity of the individual to bring into play maximum muscle constraints at the fastest rate of speed\(^\text{16}\)

Anaerobic capacity is the capacity of organism to work in the absence of oxygen. In the absence of oxygen the energy production for the muscle contractions can take place in two ways: -

(a) Through splitting of ATP and CP (i.e. Phosphogens). This mechanism of energy production is called alactacid mechanism as it not leads to formation of lactic acid

(b) By glycolysis of muscle glycogen (i.e. carbohydrate). This is called lactacid mechanism as it results in the formation of lactic acid\(^\text{17}\).

The capacity of the alactacid mechanism is also called as anaerobic power. Due to intensive interval training, the anaerobic power of an athlete is increased. It has been observed that about 25% increase in ATP, CP stores occurs with anaerobic enzymes, that is phosphofructokinase and


lactatedehydrogenase. The phosphagens stored in the muscles is only sufficient for activities with maximal intensity for speed or power performance.

Explosive strength always finds expression in motor movements that, it is a form of dynamic strength. Explosive strength performances are markedly influenced by the level of motor co-ordination required for a movement, example, inter and intra muscular co-ordination exercise with changed resistance and intensive interval method, improve explosive strength.

1.7. EFFECTS OF TRANING ON MOTOR ABILITY COMPONENTS

The motor ability components which were selected for this study are speed, leg explosive power (which comes under strength), Agility and flexibility.

Motor ability has been defined as the present acquired and innate ability to perform motor skills of a general or fundamental nature exclusive of highly specialized sports and gymnastic techniques. It further implies that a valid measure of it must avoid highly specialized skills as revealed in dance or sports.

The physical fitness or condition is the sum total of five motor abilities namely strength, speed, endurance, flexibility and coordinative abilities. These five motor abilities and their complex forms are the basic pre requisites for human motor action.

1.7.1 Training and speed

Speed is the performance prerequisite to do motor actions under given conditions in minimum of time.
From general point of view we can have five types of speed abilities; they are reaction ability, movement speed, acceleration ability, locomotors ability and speed endurance. Speed performance is commonly improved not directly by improving the functioning of central nervous system but indirectly by improving the various factors on which the speed performance depends. The various factors are mobility of the nervous system, explosive strength, technique, biochemical reserves, metabolic power, flexibility and psychic factors.

Acceleration has been shown to be a very important factor. Research by susanka et-al, shows that the most of the world’s best men achieved their greatest velocity in the locomotors between 50 and 60 meters. Women and weaker male athletes reach maximum velocity earlier between 40 and 50 meters.

50 meters run performance is considered to be the speed ability of the body. Good sprinters normally have a higher percentage of fast twitch fibers than the long distance runners; whose muscles tend to contain more, slow twitch fibers. Training called intensive interval training, repetition run, weight training, polymeric training, and flexibility training can improve 50 meters run performance.

1.7.2 Training and leg explosive power

Leg explosive power usually comes under the motor ability component called strength. Strength is the ability to overcome resistance or do act against resistance. In sports movements, strength always appears in some combination with duration and speed of movements that is, in combination with endurance and speed abilities. The strength ability can be divided in to three types. They are Maximum strength, Explosive strength and Strength endurance. Maximum strength is the ability to overcome or to act against
maximal resistance. Explosive strength is a combination of strength and speed abilities. Strength endurance is the ability to overcome resistance or act against resistance under conditions of fatigue.

**Explosive strength**: - It can be defined as the ability to overcome resistance with high speed. Explosive strength can be further sub-divided into start strength, strength speed (power) and speed strength. Start strength, is the ability to develop maximal muscle force during the starting phase of the movement. Example: Sprint start, weight lifting etcetera. Strength speed is the ability to overcome heavy resistance with high speed. Example: throws, jumps etcetera. Speed strength is the ability to overcome lower resistance with high speed. Example: Team games.

Leg explosive power is a motor ability which comes under the motor ability component of strength speed (power). The leg explosive power is measured by the standing long jump test.

The leg explosive power can be improved by weight training, polymeric training and flexibility training. Particularly competition exercise with changed resistance and intensive interval method of weight training can improve the explosive power rapidly. Example: various types of jumps with additional resistance. Example - weight jackets of 3-5% of body weight; short sprint on slope with inclination of not more than 10%.

1.7.3 Training and Agility

Agility is one of the important components of physical fitness. Agility is the ability to change the direction of movement. It quickly involves the elements of speed, strength, and co-ordination.
According to Bosco and Gustafson\(^\text{18}\) Agility terms are of three main types:

1. Changes of direction in running
2. Change of body position
3. Change of direction of body parts.

Agility is the ability to changes direction and position quickly without loss of balance. It is increased through participation in a varied assortment of activities.

Specific agility training would involve quick change of position and direction in rapid success. Some examples of agility exercises in connection with track events are, reaction exercises, agility runs, and exercise on balance beam against time etcetera. Agility can be measured by clocking the timing for 4 X 10 yards shuttle run.

1.7.4. Training and Flexibility

Flexibility can be defined as the ability to execute movements with greater amplitude or range. Flexibility depends partly on energy liberation process and partly on the co-coordinative processes of the Central Nervous Systems.

Flexibility has important inter-relationship with other performance factors. Flexibility is a necessary prerequisite for maximal development of movement force and speed. Flexibility allows movements with minimum of

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muscle tension and internal resistance. Flexibility is indispensable for prevention of injuries.

Sit and reach test is one among the tests which are used to measure the flexibility. For the improvement of flexibility stretching exercises are used. This exercise can be done according to Ballistic method, slow stretch and hold method and post-isometric stretch method.

1.8. EFFECTS OF TRAINING ON SPEED PARAMETER

The speed parameter which were selected for this study are 30 metres run performance from crouch start (Reaction speed with acceleration speed), 30 metres run performance from flying start (Locomotor speed or maximum speed) and 300 metres run performance (speed endurance)

As per the books’ namely, science of sports training’ written by Hardayal singh and Level I/II sprint & Hurdles events textbook released by International Association of athletics Federation for coaches education & Certification system\(^\text{19}\), the researcher had selected the following speed parameter which were treated as variables for study.

30 metres run performance from crouch start is one of the speed parameter which indicate the reaction speed with acceleration speed ability, of an individual; 30 metres run performance from flying start, indicate, the locomotor speed or maximum speed of an individual; and 300 metres run performance is one among the speed parameter which indicate the speed endurance of the performer.

1.8.1. Training and 30 metres run performance from Crouch start.

The time at 30 metre is seen as a critical indicator of the quality of the acceleration phase and is sometimes used as a predictor for overall performance. For example 4.00 sec. for 30 metres run is equal to 10.4 sec. for 100 metres run\textsuperscript{20}.

Research at various major championships has shown that reaction speed at the start of the race is a contributing factor to overall performance. Reaction time, tend to increases with the distance of the race. An example of maximum consistency of reaction time was achieved by the 1972 Olympic champion Borzov who recorded the time of .120 seconds in the preliminary heat, semifinal and final.

Acceleration has been shown to be very important factor. Susanka et al study shows that most of the world’s best men achieved their greatest velocity in 100 metres between 50 and 60 metres. Women and weaker male athletes reach maximum velocity, earlier between 40 and 50 metres.

Examples for acceleration training from schobest (1991) are as follows:-

2x 20m - 3 x 30m - 1 x 40 m - 1 x 50 m - 1 x 60 m from couch start; with 5-6 minutes rest each time and a set rest of 10 - 15 minutes.
5 x 30 m - 3 x 50 m - 2 x 60 m. from standing start; with 3-5 minutes rest after each effort.

1.8.2. Training and 30 metres run performance from flying start.

30 metres run performance from flying start is one of the speed parameter which indicate the maximum speed or locomotor speed ability. It is

\textsuperscript{20}IAAF Global Athletics Development Programme, P32
the ability to maintain maximum speed of locomotion for maximum duration possible. According to Gundlach (1969) the speed ranges from 99-100% of maximum during the phase of maximum locomotion speed. He found that in track and field sprint it can last from 20-45 metres\(^2\). Examples for maximum speed trainings are as follows:

- 2 x 100 meters acceleration with walking recovery
- 5 x 2 x 30 m flying starts with 5 min. rest per effort and 10 min. rest per set.

### 1.8.3. Training and 300 metres run performance.

300 metres run performance is a speed parameter; which indicate the speed endurance of an athlete. Speed endurance is an ability to do sports movements with high speed under condition of fatigue, speed endurance is a combination of speed and endurance abilities, speed endurance depends considerably on anaerobic capacity, technique and psychic factors. Examples for speed endurance trainings are as follows: -

- Extensive tempo run (less than 70% of maximum speed) insets.
- Minute runs (e.g. 3-4-5-5-4.3 minutes) continuous run
- 3minutes continuous run e.g. 10 x 3 minutes with 2 minutes jogging recovery.
- Hill runs over 150 m plus.
- Flying runs (sprint with flying start over 80-50m)
- Fartlek
- Interval sprint (e.g. 10 x 100 m with jogging recovery)\(^2\)

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\(^2\) IAAF *Level I/II Sprint and Hurdles Events Text Book*, P47.
1.9. TRAINING AND 100 METRES RUN PERFORMANCE

Sprint training requires the same training consistency that any other event requires. Sprinters are not picked by size or body build but by raw speed. A good start is essential to successful sprinting. Usually the medium block setting results in the fastest time for the entire race. However, individual anthropometric and strength measures are the deciding factors for setting the block.

The commands of the starter are, ‘on your mark’ and ‘set’ and then the gun is fired. At the ‘set’ command, the sprinter raises into the starting position. The hips should be about 4 inches higher than the shoulders, and the angle at the knee should be about 100 degrees. When the gun is fired, the athlete should concentrate on getting the back leg forward and down. The chest is driven upward and out. While the athlete is leaving the blocks, the hips are kept relatively level. He should not rise or fall while starting.

Relaxation is extremely important in sprinting. All great sprinters have it, and it can be taught. The shoulders and the hands need to be relaxed, for they can cause the runner to tense the upper body. Tense shoulder and hands cause the arms to move more slowly, consequently slowing down the leg speed. One good exercise for learning to relax while sprinting is running 150 metres (sprint - float. sprint).

Finally, the sprinter should finish strongly, learning to reach out for the tape with a properly timed lean or lunge. Some runners use a quick dip toward the tape, other lunge toward it, while still others lunge and at the same time turn the shoulder for additional reach towards the tape.

\[23\] Bowerman and Freeman, *High Performance Training for Track and Field*. P.46.
Frank Dick Suggests the following fitness characteristics for the sprinter (giving a basic for training emphases)\(^{24}\)

**General Conditioning:**
- Aerobic endurance
- Strength endurance
- Mobility (flexibility)
- Maximum strength

**Special Conditioning:**
- Speed endurance
- Speed
- Elastic strength
- Special strength: relative to event
- Special endurance: 200 m and 400 m

**Competition - Specific conditioning:**
- Sprint technique
- Starting technique
- Time trials
- Baton speed technique

The direct competition (peaking) phase is three successive micro-cycles (accumulation, intensification and transformation) lasting for a total of 4 weeks. The accumulation micro-cycle is primarily recovery from previous competition. Although the volume of training rises, the intensity is generally low. The intensification micro-cycle (14 days) requires very high intensity

training. The athlete will need one week of transformation training to recover from the intensification process and rise to a higher performance level. This micro-cycle, ending with a day of rest followed by the major competition, uses a low training load and short intensive training sessions mixed with easier session to peak the sprinter.

1.10. PERIODISATION

The process of preparing the sportsmen to give his best performance in a particular competition is called periodisation. The term periodisation simply means dividing the training process into periods of time with different training emphases, goals, and lengths. Each period prepares the athletes for the next, a more advanced training period, until the athlete peaks at the most important competitions of the year.

1.10.1. Types of Periodisation

Periodisation is classified into single or multiple periodisation according to the number of macro-cycles in a training year. When there is only one macro-cycle in one year it is called single periodisation. In case there is more than one macro-cycle in a training year, it is called multiple periodisation.

A macro-cycle consists of preparatory period, competitive period and transition period.

Preparatory period: - The duration of preparatory period can be from 6 weeks to 7 months. The preparation period prepares the athlete for competition. In traditional term, it includes the preseason training.

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**Competition Period:** - The duration of the competition period can be from 6 weeks to 5 months. This period includes the athlete competitive season. The meets are chosen to prepare the athlete to perform the peak.

**Transition period:** - The duration of the transition period is normally from 4 – 6 weeks. The transition period acts as a bridge between competition and start of the next preparation period. It allows the athlete to recover from the physical and psychological stress of competition.

Each training period consists of one or more phases or meso-cycles. For example the preparation period includes two phase. The first phase emphasizes general conditioning, while the second phase emphasizes the special conditioning needed for the event. The meso-cycles are normally 3 to 6 weeks.

The meso cycle consists of a number of micro-cycles and a typically micro-cycle lasts for 1 week. A training session is a single workout with a single training focus. Each session includes number of training units. A training unit is a single component of the training session.

**1.11. PACKAGE OF PHYSICAL TRAINING**

Package of physical training is a method of physical conditioning that consist of various training methods like Extensive interval run, intensive interval run, weight training, fartlek training, repetition method, technique training, plyometric training, circuit training, slope or hill running etcetera. It provides a means of achieving optional fitness in a systematized controlled fashion. The intensity, load and vigor of package of physical training are indeed challenging and enjoyable to the performer. The package of physical training contain all the above said training method with a required
intensity and load which are needed to achieve a optimum performance depending upon the particular periodisation.

1.12. CRITERIA FOR SELECTING A PACKAGE OF PHYSICAL TRAINING

To prepare a package of physical training for preparatory and competitive period, the research scholar first analysed what are the variables, components, and speed parameters that has to be developed and by considering the requirements, the investigator has devised the packages of physical trainings, for preparatory period as well as for competitive periods.

The research scholar also consider the aim and objectives of the training programme, the number of athletes to be involved, their age, sex, experience, facilities and equipments at hand as well as the amount of time that can be spared.

In order to find out the effects of varied packages of physical training for preparatory and competitive periods on selected motor ability components, physiological variables, speed parameters and 100 metres run performance, the research scholar has designed totally six types of packages of physical trainings. Three types of packages of physical trainings were designed for preparatory period and remaining three types of packages were designed for competitive period.

Training programmes of package I preparatory period and package I competitive period, consist of required physical training exercises depending upon the periods, but the exercises were progressively and systematically designed with required intensity and required volume, where the intensity and volume were allowed to change.

Training programmes of package II preparatory period and package II competitive period, consist of required physical training exercises depending
upon the periods, but the exercises were designed with the intensity of 90% and above and required changes in volume.

Training programmes of package III preparatory period and package III competitive period consist of required physical training exercises depending upon the periods, but the exercises were designed with more than 90% intensity and fixed high volume.

1.13. STATEMENT OF THE PROBLEM

1. The purpose of the study was to find out the effect of varied packages of physical training for preparatory and competitive periods on selected motor ability components, physiological variables, speed parameters and hundred metres run performance among school level boys between 14 to 19 years age group.

2. The purpose of the study was also to find out the differences among the effects of varied packages of physical training for preparatory and competitive periods on selected motor ability components, physiological variables, speed parameters and hundred metres run performance among school level boys between 14 to 19 years age group.

1.14. HYPOTHESES

1. It was hypothesised that there would be significant improvement due to package I, Package II and package III preparatory period physical trainings on selected motor ability components, physiological variables, speed parameters and hundred metres run performance among school level boys between 14 to 19 years age groups.
2. It was hypothesised that there would be significant improvement due to package I, Package II and package III competitive period physical trainings on selected motor ability components, physiological variables, speed parameters and hundred metres run performance among school level boys between 14 to 19 years age groups.

3. It was hypothesised that there would be significant differences among the effect of package I, Package II and package III preparatory period physical trainings on selected motor ability components, physiological variables, speed parameters and hundred metres run performance of school level boys.

4. It was hypothesised that there would be significant differences among the effect of package I, Package II and package III competitive period physical trainings on selected motor ability components, physiological variables, speed parameters and hundred metres run performance of school level boys.

1.15. **SIGNIFICANCE OF THE STUDY**

The findings of the study would be significant in the following ways:

1. The findings of the study may be helpful for the physical education teachers and coaches to identify the suitable packages of physical training for the athletes to improve their performance.
2. The findings of the study may add quantum of knowledge in the area of training programme for different training periods.
3. The research findings may add extra knowledge in the field of exercise physiology and training methods.
1.6. DELIMITATIONS

1. Eighty boys under the age group of fourteen to nineteen years were selected as subjects at random from the high schools and higher secondary schools of Puducherry region.

2. The study was restricted to the following motor ability components

   1. Speed
   2. Leg Explosive power
   3. Agility
   4. Flexibility

3. The study was limited to the following physiological variables

   1. Resting pulse rate
   2. Anaerobic power

4. The selected speed parameters where as follows

   1. 30 metres run performance from flying start
   2. 30 metres run performance from crouch start
   3. 300 metres run performance

5. The selected performance variable for the study was.

   1. 100 metres run performance.

6. The above mentioned eleven variables were measured and analysed for both preparatory and competitive periods.
1.17. LIMITATIONS

The following aspects were considered as limitations of this study

1. The following factors like food habits, life style, daily routine works, the changes in the climatic conditions like temperature, atmospheric pressure, humidity, were not taken into consideration.

2. The factors such as rest, food intake, body condition, body temperature and emotional changes would alter the pulse rate, hence they were considered as limitations for the study and no attempt was made to control them.

3. The level of motivation of the students was not taken into consideration while evaluating their performance.

1.18. DEFINITIONS OF THE TERM

1.18.1. TRAINING

Training has been defined as a programme of exercise designed to improve the skills and increase the energy capacities of an athlete for a particular event\textsuperscript{26}.

Training as a medication of general and special exercise which are performed to bring the athlete to his peak condition at the time of competition\textsuperscript{27}.

Sports training is a pedagogical process, based on scientific principals, aiming at preparing sportsmen for higher performances in sports competition.

\textsuperscript{26} Edward L. Fox, \textit{Sports Physiology}, (Philadelphia : Saunder College Publishers, 1984), P. 401

1.18.2. Speed

Speed is the performance prerequisite to do motor actions under given conditions in minimum of time\(^\text{28}\) (Theiss and Schnabel – 1987)

Speed of movement is a prized quality in athletics. Speed of movement shall be defined as the rate at which a person can propel his body or parts of his body through space\(^\text{29}\)

From general point of view we can have fire types of speed abilities: reaction ability, movement speed, acceleration speed, locomotor ability and speed endurance

1.18.3 Explosive power

It is the capacity of an individual to bring into play maximum muscle contraction at the fastest rate of speed\(^\text{30}\)

Explosive power is the ability to release maximum muscular force in the shortest time as in executing a standing broad jump\(^\text{31}\)

Explosive power or strength speed is the ability to overcome heavy resistance with high speed

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1.18.4 Agility

Agility or Co-coordinative abilities are understood as relatively stabilized and generalized patterns of motor control and regulations process. These enable the sportsman to do a group of movements with better quality and effect\(^{32}\) (Harre – 1986; and Meinel and Schnabel – 1987)

1.18.5. Flexibility

Flexibility can be defined as the ability to execute movements with greater amplitude or range. Flexibility is measured by determining the range of movement possible at a joint\(^{33}\).

Flexibility can be called as mobility; flexibility determines the body's range of motion. Flexibility work is needed to keep the muscles loose through their full range of motion\(^{34}\)

1.18.6 Resting pulse rate

The number of beats of a pulse per minute or the number of the beats of the heart per minute\(^{35}\)

\(^{32}\) Hardayal Singh *Science of Sports Training*, P.164
\(^{33}\) Hardayal Singh *Science of Sports Training*, P.156
\(^{34}\) Bower and Freeman, *High Performance Training for Track and Field,* P.9
1.18.7. Anaerobic power

Anaerobic power is the ability to overcome heavy resistance with high speed; here, the energy for the muscle contraction is primarily obtained through the break down of phosphagens. (ATP and CP)\(^{36}\)

1.18.8. Cardio-respiratory endurance

Cardio-respiratory endurance is the ability to do movements involving large number of muscles, at a slow pace for prolonged period e.g., jogging, walking at moderate speed.\(^{37}\)

1.18.9 Preparatory period

The duration of preparatory period can be from 6 weeks to 7 months. The preparation period prepares the athlete for competition. In traditional term, it includes the preseason training.

1.18.10. Competitive period

The duration of the competition period can be from 6 weeks to 5 months. This period includes the athlete’s competitive season. The meets are chosen to prepare the athlete to perform the peak.

1.18.11. Load Intensity

Intensity of load is the degree of effort being made by the sportsman while doing on exercise. The degree of effort always considered in relation to time or repetitions.


1.18.12. Load volume

The volume of load is the total amount of work done through an exercise or in a training session. The total amount of work done always considered in relation to distance or number or kilogram or total hours.