CHAPTER - I

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In the present millennium, modernization, automation and mechanization have made man more sedentary than ever before. Everything is in his easy reach without stress and strain because of rapid urbanization. While comparing the new millennium men with their ancestors, they are healthier but are quickly and highly prone to diseases. The new millennium man is highly influenced by modernization and in one way or the other is suffering from one or more aliments due to diseases. Thus his fitness is impaired both physically and mentally and men are lacking stamina and flexibility. The reason is lack of physical exercise and awareness about health in general\(^1\).

By nature human beings are competitive and ambitious for excellence in all athletic performances. Not only every man but also every nation wants to show his / its supremacy by challenging the other man/nation. This can be made possible through scientific, systematic and planned sports to identity and nature human potentialities. The success or failure of an

individual athlete depends upon the blending of physical ability, conditioning, training, mental preparation and the ability to perform well under pressure\(^2\).

Sport is as old as human society itself. It is an institution, which has its own traditions and values. Being an institutionalized and competitive activity, it involves vigorous physical exertion and the use of relatively complex physical skills by individuals whose participation is motivated by a combination of intrinsic satisfaction associated with the activity itself and external rewards earned through participation.

Sport as an activity offers an opportunity for self-knowledge, self-expression, and fulfillment; personal achievement, skill acquisition and demonstration of ability; social interaction, enjoyment, good health and well-being. It promotes involvement, integration and responsibility in society and contributes to the development of society, especially when sports activities have been accepted as an integral part of the culture of every society in every nation\(^3\).


Performances in sports competitions at various levels have become a sign of prosperity and also developments and innovations in the field of sports have become vital. High-level research in the field is going on to explore the possibilities of investigating the ingredients responsible for the enhancement of sports performance and facilitating the talent selection for competitions. New incentives, sufficient infrastructure and standardized sports equipment are being provided by the agencies interested in the development of sports to see their Nations at the top of the medal winning countries in world competitions. A lot of research is being done on all aspects of sports performance. Numerous physical educationists and sports scientists are engaged in finding new dimensions for talent selection for better performance. It is due to their sincere efforts, that the records of performances in games and sports are being broken day by day and new records are being established.

Sport is a worldwide phenomenon today. The unprecedented popularity and better organization of sports activities and competitions would have been impossible without the recognition of the importance of sports and sports competitions by men all over the world. The world has realized

the importance of sports for modern civilization. The main objective of physical education is to promote physical fitness, which in turn would promote health and happiness.

Sports performance is indeed an aspect of complex human performance, which has several dimensions. Hence several disciplines of sports science are required to work in a coordinated manner to explore the nature of sports performance and the process of improving sports performance. These disciplines include Sports Medicine, Sports Physiology, Sports Training, Sports Bio-Mechanics and Sports Psychology. All these disciplines of sports science have their own specified areas of study and focus on specific aspects of sports performance and sports training\(^5\).

Sports in the present world have become extremely competitive. It is not the mere participation or practice that bring out victory to an individual. Therefore, sports life is affected by various factors, like Physiology, Biomechanics, Sports Training, Sports Medicine, Sociology and Psychology etcetera. Coaches, trainers, physical education personnel's and doctors are doing their best to improve the performance of the players of

their country. Athletes/players of all countries are also trying hard to bring laurels/medals for their countries in International competitions⁶.

In this world of competition, sports have become highly competitive. Physical fitness is basic for achieving good performance in sports. Achieving physical fitness as well as maintenance of it is the key concern of every sportsman⁷.

Medallist performances no longer occur at random or as a result of chance alone. International level sports performances in various game and sports are influenced by many factors such as level of physical, physiological, psychological, technique and tactical abilities⁸.

Now a day’s sports activity are classified into several areas such as performance sports, physical education, rehabilitation sports, fitness and leisure sports and adventure sports. Performance sports aim at high sports performance and for that, the physical and psychic capacities of sportsmen are developed

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⁷ Baljeet Singh, et.al, “Yogasanas And Physical Fitness Of College Level Players in Relation to Sports Performance”, *Journal of sports and sports Sciences*, 27:3 (July, 2004), 44.

⁸ Kalpana Debnath and G.S Bawa, “Physique, Composition And Somato Type Of Female National Gymnasts, Swimming And Track Sprinters” *Journal of sports and sports sciences*, 27:4 (October, 2004), 5.
through various training means and methods. Most physical movements incorporate the elements of force, quickness, duration, complexity and a range of motion to a certain extent. Further, we can distinguish individual motor aspects and physiological components such as strength, speed, endurance and coordination. So training is no more amateur job. The athlete can be perfected through the physiological components, commonly known as biomotor abilities before passing the skills. Out of all the biomotor abilities, strength and power are the most critical for many sports. All team sports and speed power dominant sports rely on solid strength and power development. Understanding the mechanics and physics of strength training and incorporating those principles into the training programme will give the athletes a competitive edge⁹.

The systematic approach has proved successful for athletes and coaches of many countries. This comprehensive method works equally well for endurance athletes of all levels, from the beginner to the elite athlete. There are many benefits to be repeated by training in this systematic way, like variety, completeness adjustability, and regard for specific individual needs and differences. The structure provides a framework

around which is a sound, physiologically correct plan can be charted out\textsuperscript{10}.

Training is a programme of exercises designed to improve the skills and increase the energy capacity of an athlete for a particular event. In sports, the word 'training' is generally understood to be a synonym for doing physical exercise. In a narrow sense, training is doing physical exercises for the improvement of performance or general fitness\textsuperscript{11}.

Sport training is a basic preparation for better performance through physical exercise. It is based on scientific principles and aims at education and performance enhancement. Sports activities consist of motor movement and action and their success depends to a great extent on how correctly they are performed. Techniques of training and improvement of tactical efficiency play a vital role in a training process\textsuperscript{12}.

Sport training is a process of preparing sportsmen, for higher performance in sports competitions. It is a systematic


process extending over a long period. High performances can be achieved by a scientific use of training\textsuperscript{13}.

The science of sports training is relevant not only in performance sports but is equally important for other areas of sports also such as, physical education, rehabilitation, physical fitness and leisure sports. In these areas, the training is mainly directed towards the development of fitness and health. The science of sports training contributes tremendously towards the achievement of aims in these areas of sports. The recent trends in the development of sports sciences indicates that in the near future the subject matter of sports training will be expanded to include the problems and tasks of training in all the areas of sports and health\textsuperscript{14}.

Sports training are done for improving sports performance. The sports performance, as any other type of human performance, is not the product of one single system or aspect of human personality. On the contrary, it is the product of the total personality of the sports person. The personality of a person has several dimensions e.g. physical, physiological, social and psychic. In order to improve sports performance, the social


\textsuperscript{14} Hardayal Singh, p.3.
and psychic capacities of the sports person also have to be improved in addition to the physical and physiological ones. In other words, the total personality of a sportsman has to be improved in order to enhance his performance. Sports’ training, therefore, directly and indirectly aims at improving the personality of the sportsman. No wonder, therefore, sports training is regarded an educational process.\[15\]

Training is a systematic athletic activity of long duration, progressively and individually graded aiming at modeling the human physiology and functions to meet demanding tasks.\[16\]

Though many methods prevail to develop power and speed the role of Maximal Resistance Training and Plyometric Training with varying intensities is accepted as the most effective. Power Training is now a popular activity utilized by both men and women of all ages as an attempt to improve physical condition.

The physical capacities of strength, power and speed are important qualities for many sports. Maximum strength and power clearly discriminate athletes of different performance levels in such games as Basketball, Volleyball, Swimming and sprint running.

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Power is an essential quality in many sports and games for it represents the effective combination of strength and speed. Increase in strength or speed will increase power, and when power increases, more work can be done in less time\textsuperscript{17}.

Muscular power is related to muscular strength. One may possess adequate strength, but may not be able to deliver the generated force judiciously on time, and at the particular point of action to advantage. Power is the application of force, per unit time or per unit area of surface. The nature of power application determines the effectiveness of the execution of the skill\textsuperscript{18}.

Power represents one of the main components of athletic fitness requiring extreme and rapid force production. It may be the factor most indicative of success in sports.

Power refers to the explosiveness of body movement or the rate at which force is produced. As such, it involves two elements: strength to produce the force and speed to increase the rate at which it is applied. Thus, power can be increased either by improving strength or speed of movement or by both\textsuperscript{19}.


Most sports require power, muscular endurance or both. The level of maximum strength affects both power and muscular endurance. Power cannot reach high standards without a high level of maximum strength because power is the product of speed and maximum strength\textsuperscript{20}.

Strength and power are the most critical for many sports. All team sports and speed-power dominant sports rely on solid strength and power development. Understanding the mechanics and physics of strength training and incorporating those principles into our training program will give our athletes a competitive edge\textsuperscript{21}.

The quest for optimal power training has led to the development of various training methods. Traditionally, heavy resistance training techniques have been used to improve strength and subsequently, performance. These techniques have typically used weights of 60 to 90 percent of one-repetition maximum for repetitions four to six in number. More current thought combines a variety of training modalities, including plyometrics, dynamic weightlifting and combinations of these, to enhance power components.


\textsuperscript{21} \textit{Ibid}, p.315.
The term 'resistance training' is also referred to by many as strength training and involves the use of barbells, dumbbells, machines and other equipment for the purpose of improving fitness, appearance, and/or sports performance.

Resistance training should be an important component of all fitness programmes from more for strength and power athletes to more for individuals who exercise for the health benefits. Of course, athletes in sports requiring strength and power, such as weigh lifting; bodybuilding and sprinting must emphasize resistance training. However many other athletes also benefit from strength training, especially those in sports requiring a high level of muscular endurance22.

Strength is the neuromuscular capability to overcome an external and internal resistance. The maximum strength that an athlete can produce depends on the biomechanical characteristics of a movement, and the magnitude of contraction of the muscles involved. In addition, the maximum strength is also a function of the intensity of an impulse23.

23 Tudor, O.Bompa, p.320.
Selecting a strength-training method has to relate to the type of strength sought. Consequently there are training methods to develop maximum strength, power or muscular endurance. Although athletes can develop maximum strength through static, iso-kinetic, or electrical simulation methods, the maximum strength method using free weights or other instruments is still the most common. The main element of progression is the intensity of stimulation realized through the load increment\(^24\).

The main characteristic of a maximum strength-training program is involving exercise of all or at least most of the neuromuscular units. Everyone aiming to develop maximum strength must, therefore, frequently employ maximum and super maximum stimuli.

Among the sports requiring maximum strength development are weight lifting, shot put, discuss and hammer throw. Others sports requiring power or muscular endurance may benefit from maximum strength development\(^25\).

Resistance training is an accepted training method for athletes in a variety of sports. With the proper exercise

\(^{24}\) \textit{Ibid}, p.337.

\(^{25}\) \textit{Ibid}, p.324.
prescription, training goals such as increased muscle strength, muscle hypertrophy, improved body composition and improved sports performance may be achieved.

The importance of resistance training to sports performance has been supported by studies which have demonstrated that resistance training in the form of weight training and more recently, plyometric training have enhanced some competitive performances. Most typically this has been reported as an improvement in vertical jumping ability. Many studies have reported that resistance training has enhanced muscular strength, but failed to induce changes in dynamic sporting performance\textsuperscript{26}.

Plyometrics is the term now applied to exercises that have their roots in Europe, where they were first known simply as jump training. Interest in this jump training increased during the early 1970s as East European athletes emerged as powers on the world sport scene. As the Eastern block countries began to produce superior athletes in such sports as track and field, gymnastics and weight lifting the mystique of their success began to center on their training methods.

The actual term ‘plyometrics’ was first coined in 1975 by Fred Wilt, the American Track and Field coach. The elements ply and metric come from Latin roots for “increase” and “measure” respectively, the combination thus means ‘measurable increase’.27

Plyometrics became known to coaches and athletes as exercises or drills aimed at linking strength with speed movement to produce power. Presently many coaches and athletes have successfully used plyometric type exercises chiefly as a method of training to enhance performance through it has potential benefits in improving strength and overall conditioning of the athletes also.

Plyometric training can take many forms, including jump training for the lower extremities and medicine ball exercises for the upper extremities. Jump training exercises were classified according to the relative demands they placed on the athlete. All the exercises are progressive in nature, with a range of low to high intensity in each type of exercise. The classification of exercises are jumps in place; standing jumps; multiple hops and jumps, bounding, box drills and depth jumps.

Plyometrics exercises utilize the force of gravity (e.g. you step off a box) to store energy in the muscles (potential energy). This energy is then utilized immediately in an opposite direction (e.g. immediately you jump up upon landing), so the natural elastic properties of the muscle will produce kinetic energy. Elastic strength is the ability of the muscles and connective tissues (muscle sheath and tendon tissues) to exert a force rapidly in order to produce maximal power in linear, vertical, lateral or combination movements.

The ability to apply force rapidly (reactive force) is the major goal of plyometric training. Plyometrics are used to apply an overload to the muscles with speed – strength as a goal. The speed-strength ability is known as power. Plyometrics should not be considered an end in itself, but as part of an overall program (stretching, running, strength training nutrition, etc). After an athlete has begun a proper strength and conditioning program, plyometrics are used to develop speed-strength.\footnote{S. Thirumalaikumar, “Plyometrics”, Journal of Physical Education and Sports, 13, (August 2002), 17.}
Plyometric exercise has been advocated for sports that require power and the ability to jump vertically, plyometrics train muscles to switch rapidly from eccentric to concentric movements. This shortens the amortization phase, which is the delay between eccentric and concentric movements and allows more work to be done in less time.

Plyometric exercises develop fast muscle fibre. It is based on the understanding that a concentric (shortening) muscular contraction is much stronger if it follows an eccentric (lengthening) contraction of the same muscle immediately. It's a bit like stretching out a coiled spring to its fullest extent and then letting it go: immense levels of energy are released in a split second as the spring recoils.

Plyometric exercises develop this recoil. Muscle fibres store more elastic energy and transfer it more quickly and powerfully from the eccentric to the concentric phase.

Many athletes have used Plyometric type exercises successfully as a method of training to enhance power. In order to realize the potential benefits of plyometric training the stretch – shortening cycle must be invoked. This requires careful attention to the technique used during the drill or exercise. The rate of stretch rather than the magnitude of stretch is of primary
importance in plyometric training. In addition, the coupling time or ground contact time must be as short as possible.

The organization of Maximal Resistance Training and Plyometric Training is based on the power and speed develop concept. Most exercises are specific to leg and hip action because these muscle groups are the center of power for athletic movement and have major involvement in virtually all sports. Thus, the training program should begin with specific goals keeping in mind time frames, or cycles. The Maximum Resistance Training and Plyometric Training Program accomplish the specific goals through the manipulation of four variables: intensity, volume, frequency and recovery.

Intensity, the qualitative component of work an athlete performs in a given time, is also an important component of training. The more work the athlete performs per unit of time, the higher the intensity. Intensity is a function of the strength of the nerve impulses the athlete employs in training. The strength of a stimulus depends upon the load, speed of performance, and the variation of intervals or rest between repetitions. The last, important element of intensity is the psychological strain of an exercise. Muscular work and the involvement of central nervous
system involvement through maximum concentration determine the intensity during training or competition.

Intensity varies according to the specifics of the sport because the level of intensity varies in most sports and games. So, it is important to establish and use varying degrees of intensity in training. Several methods are available to measure the strength of the stimuli and thus the intensity.

Intensity of loading is characterized by the strength of the stimulus or by the concentration of work executed per unit of time within a series of stimuli. Intensity for endurance or speed is calculated according to the speed in Maximum Strength or the frequency of movement. For strength exercises, the amount of resistance is measured and for jumping or throwing, the height or distance is measured.

In the interest of stability of performance especially in technical events with beginners, the intensity must be low enough to permit efficient execution of the technique in question. On the other hand, in those events demanding maximum and elastic strength, one must work through a particular extent of loading in the competition specific range of intensity in order to

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stabilize athletic technique corresponding to the demands of competition\textsuperscript{30}.

Intensity is the pace at which physical activity is done or the effort involved in performing a given task is undertaken. An activity can be carried out with different intensities, which have different effects on the organism. Thus, the exercise load must have some minimum intensity in order to have some effect on the organism. With the improvement in training state, the effective zone of intensity shifts to higher levels.

Volume is the total work performed in a single work out session or cycle, such as the total distance covered, or total number of repetitions or the total duration of the activity. Like intensity, the volume should also be optimum in order to have some effect on the organism.

Volume and intensity have high relationship, because athletic exercise usually involves both quantity and quality. Therefore, it is difficult to differentiate between them in training. For instance, when a swimmer sprints, the distance and time of the event represent volume and the velocity of performance indicates intensity. Placing different relative degrees of emphasis

on these components in training yields different effects on the body's adaptation and training status. The higher the intensity and the longer it is maintained the higher the energy requirements and the more the stress on the central nervous system and athlete's psychological sphere.

Frequency is the number of times an exercise is performed (repetitions) as well as the number of times exercise sessions take place during a training cycle.

Recovery or Rest play a vital role in all Training, recovery between workouts must be lot in that depending on training. Usually, it is 5 to 10 seconds rest between repetitions and 2 to 3 minutes between sets. Recovery may be varied according to the sports and the time of the year in which practices is given.

Any physical activity leads to anatomical, physiological, bio-chemical and psychological changes. The efficiency of a physical activity results from its duration, distance and repetitions (volume); load and velocity (intensity); and the frequency of performance (density). When planning the dynamics of training, these aspects, referred to, as the variables of training deserve consideration. All these variables are to be

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31 Tudor O.Bompa., p.87.
modeled according to the functional and psychological characteristics of competition. Throughout the training phases preceding a competition the trainer has to define which component to emphasize to achieve the planned performance objective. As a rule, intensity is to be stressed for sports of speed, power and volume, for endurance sports. Finally, for sports requiring intricate skills, training complexity is primary\textsuperscript{32}.

Physical fitness as a term refers to the total dynamic physiological state of the individual. There are a number of fitness components i.e. agility, flexibility, endurance, strength, power, speed and maintenance of body weight. Most sports of course require a contribution from a number of components of fitness in varying degrees\textsuperscript{33}.

Resistance training is an anaerobic form of exercise. This training programme can be used to enhance the ability of the body to perform at very high force and / or power outputs for a very short period of time to improve the ability of the body to perform repeated bouts of maximal activity\textsuperscript{34}.

\textsuperscript{32} Ibid, p.79.


\textsuperscript{34} Thomas R.Baechle, p.131.
One of the anaerobic systems is called lactic acid system or anaerobic glycolysis. It re-synthesis ATP from energy released during the breakdown of glycogen (Sugar) to lactic acid. Accumulation of the latter in the blood and muscle cause temporary muscular fatigue. This system then is used predominantly during activities that require between one and three minutes to perform-running 800 meters would be a good example. In order to attain proper physical fitness the individual should make use of the energy available in the body in a proper manner. Participation in physical activities involves to a large extent the use of aerobic and anaerobic power. The energy for our body is got through metabolism.

Maximal Resistance Training and Plyometric Training have become very popular in developing explosive power.

Explosive strength (or) power is seen in quick movement when body weight is propelled either upward (or) forward it is characterized by one short burst of energy and is seen in such tests as the standing long jump and vertical jump. It has been known for a long time that the amount of energy transformed in muscular exercise is proportional to the oxygen consumption.
Heart\textsuperscript{35} has suggested that the better explosive power of a student helps him in better performance, explosive power is largely dependent upon the regulatory process of the neuromuscular system and these processes are best trainable before the age of puberty.

Elastic strength is the contractive /expansive elements in the muscles or muscle fibres. Certain parts of the muscles are non contractile and thus result in what is known as the series elastic component. The stretching of the series elastic components during muscle contraction produces an elastic potential energy similar to that of a loading spring. When this energy is released it augments to some degree the energy of contraction generated by the muscle fibres. This action is seen are plyometric movements. The recovery of stored elastic energy occurs during the concentric or over coming phase of muscle contraction which is triggered by the myotatic reflex.

The advantages of elastic strength are:

1) The quick mobilization of greater innervations activity.

\textsuperscript{35} Heart, M.E and Stay, S.I, "Relationship Between Physical Fitness and Success", \textit{Research Quarterly}, 48.787 (December, 1977), 217.
2) The recruitment of most, if not all, motor units and their corresponding muscle fibre.

3) An increase in firing rate of the motor neurons.

4) Elastic strength training develops the nervous system so that it will react with maximum speed to the lengthening of the muscle. In turn, it will develop the ability to shorten (contract) rapidly and with maximum force\textsuperscript{36}.

One important bio-motor ability required in sports is Speed or the capacity to travel or move quickly. Mechanically, speed is expressed through a ratio between space and time. The term speed incorporates three elements; reaction time, frequency of movement per time unit and speed of travel over a given distance\textsuperscript{37}.

Speed is one of the most important physical qualities required for successful performance in jumps, especially in the horizontal jump and in the pole vault. The amount of speed required is slightly different in the event due to differing emphasis in the take off. It is said that sprinters are born not

\textsuperscript{36} Tudor O Bompa, pp. 185-186.
\textsuperscript{37} \textit{Ibid.}, p.368.
made but it is certainly true that natural ability always plays a major role in sports events.

Speed is a determining factor in explosive sports (e.g. Sprints, Jumps and most field sport) while in the endurance events its role as a determining factor appears to get reduced with increased distance\textsuperscript{38}.

Speed is the product of two factors, stride length and stride frequency. Increasing either factor automatically increases a runner’s sprinting speed. From the training point of view, it appears that increasing the leg strength can increase the stride length. Though stride frequency is an inborn quality, it might be possible to improve it slightly through training. It appears that this improvement also brings about a corresponding shortening of stride length. In stride frequency time becomes our concern. When we reduce the time necessary to apply force at take off and eliminate wasted time in the air, the stride frequency will improve\textsuperscript{39}.

\textsuperscript{38} Frank W.Dick, p.193

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

The ability to reproduce periods of high intensity exercise consistently can be termed anaerobic or ‘speed’ endurance – it is different from the stamina like ability to keep going for a long period of time and also different from basic speed.

**STATEMENT OF THE PROBLEM**

The present study was designed to compare the effect of power training programmes of varying intensities on selected power and speed related parameters, such as Anaerobic Power, Explosive Power, Elastic Power, Speed, Stride Length and Speed Endurance of College men.

**HYPOTHESES**

It has been scientifically accepted that any systemic training over a continuous period of time would produce changes in athletic qualities. Based on this concept, the following hypotheses were drawn.
1) There would be significant improvement on selected Power related parameters due to the effect of power training.

2) There would be significant improvement on selected Speed related parameters as on the effect of power training.

3) There would be significant differences on the selected power related parameters among the experimental groups.

4) There would be significant differences on the selected speed related parameters among the experimental groups.

DELIMITATIONS

The study was delimited to the following factors.

1) To achieve the purpose of the study, forty men students studying Bachelor of Physical Education Health Education and Sports in H.H. The Rajah's College, Pudukkottai during the year 2003-2004 were selected as subjects.

2) The age of the subjects ranged from 18 to 21 years.
3) The subjects were divided at random into four groups of ten each (n=10). Group I underwent Maximal Resistance Training with 60% Intensity, Group II underwent Maximal Resistance Training with 80% Intensity, Group III underwent plyometric Training with 60% Intensity and Group-IV underwent plyometric Training with 80% of Intensity.

4) The duration of the training period was restricted to twelve weeks and the number of sessions per week was confined to three.

5) The dependent variables Anaerobic Power, Explosive Power, Elastic Power, Speed, Stride Length and Speed Endurance were selected for this study.

6) The selected criterion variables for the study were assessed by the following standardized test items. Anaerobic Power was assessed by Margaria – Kalamen Anaerobic Power Test, Explosive Power was assessed by Vertical Jump Test, Elastic Power was assessed by Bunny Hop Test, Speed and Stride Length were assessed by 50mts Run, Speed Endurance was assessed by 150mts Run.

7) The data were collected prior to and immediately after the training period.
LIMITATIONS

The following limitations were considered while interpreting the results of the study.

1) The previous experience of the subjects in the field of sports and games, which might influence the training and data was not considered.

2) Psychological factors, food habits, rest period, life style etc., could not be controlled.

3) The weather conditions such as atmospheric temperature, humidity and meteorological factors during testing and training periods were also not considered.

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

5) Since the manual operation was made during 50 meter and 150 meter run, the time was recorded in one tenth of a second.
DEFINITION OF OPERATIONAL TERMS

Training

Training is a pedagogical process, based on scientific principles, aiming at preparing sportsmen for higher performance in sports competitions\(^40\).

Power

Power is the function of force and velocity and it can be defined as the rate of performing work when expressed by the formula.

\[ \text{Power} = \frac{\text{Force} \times \text{Velocity of Work done}}{\text{Time taken}} \]

Maximal Power Training

Maximal Power Training involves performance of dynamic weight training at the load which maximizes mechanical power output\(^42\).

\(^{40}\) Hardayal Singh, p.15.


Maximum Resistance

Maximum resistance is defined as the greatest force the neuromuscular system is capable of exerting in a single maximum voluntary contraction\(^{43}\).

Plyometric Training

Plyometric Training refers to exercises that enable a muscle to reach maximal strength in as short a time as possible\(^{44}\).

Intensity

Intensity refers to the amount of stress placed upon muscles, connective tissue and joints\(^{45}\).

In strength Training, intensity is expressed in load of 1 RM\(^{46}\).

The Intensity of plyometric drills is related to the maximum number of food contacts in the surface\(^{47}\).

\(^{43}\) Frank W. Dick, p.176.
\(^{44}\) Thomas R.Baechle, p.319.
\(^{45}\) Ibid, p.322.
\(^{46}\) Tudor O. Bompa, p.393.
\(^{47}\) Thomas R. Baechle, p.322.
**Anaerobic power**

Anaerobic power is the amount of work performed using primarily an aerobic energy system\(^ {48} \).

**Explosive power**

Explosive Power is the ability of a muscle or a group of muscles to release maximum force in the shortest possible time, in an explosive manner, projecting the body or an object\(^ {49} \).

**Elastic power**

The ability of the muscles to exert force quickly to overcome resistance with a high speed of contraction\(^ {50} \).

**Speed**

The capacity of moving a limb or part of the body's lower system or the whole body with the greatest possible velocity\(^ {51} \).

\(^ {48} \) *Ibid*, p.248.


\(^ {50} \) Hardayal Singh., P.86.

\(^ {51} \) Frank W.Dick., p.193.
Stride Length

Stride length is measured as the distance taken between toe to toe. The average stride length was calculated by dividing the 50 meters by the number of strides taken to cover 50 meters.

Speed Endurance

Speed Endurance is measured by timing a maximum effort sprint, from a standing or crouch start, over 150 metres. The average velocity is calculated by dividing distance by time\textsuperscript{52}.

SIGNIFICANCE OF THE STUDY

1) The ultimate goal of research in Physical Education is to help coaches and physical educators train their athletes and players based on new concepts to improve their performance.

2) The study would add new knowledge in the area of sports Training.

3) The results of the study may be useful to the professional colleagues of Physical Education and Sports in the following ways.

i. To study the effect Maximal Resistance Training and Plyometric Training on power and speed related parameters.

ii. To study the effect of varied intensities in power training.

4) The study would provide guidance to Physical Educators and coaches to prepare training schedules.