CHAPTER – I

INTRODUCTION

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 identify and nurture 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\(^1\).

Over the years physical fitness has become the well-built foundation of a structure that supports many concrete blocks on it which represents all the activities that make life worth living: intellectual life, spiritual life, family life and social life.

One of the most beautiful, valuable and incalculable things that God has created on earth is human life. Hence, as part of that amazing creation, it is the responsibility of the humans to protect and maintain human life in order to achieve higher goals and objectives, to live a happy and meaningful life. This can be made possible by paying attention to betterment that includes health and fitness and for the same purpose scientists, researchers and health experts have devoted their precious time to the field of health and fitness.

In the modern society, life has become so complex due to various reasons. The modern way of life lowered people’s biological fitness levels. They lead sedentary life, as machines have made their life easy and comfortable. Without adequate physical exertion man has become a storehouse of unreleased tensions. Modern man in the electronic and computer age tends to become complacent and forget the need by physical training for his survival. The modern man, due to his luxurious, easy and comfortable life, has become an easy prey to various fatal diseases.

The greatness of a nation is dependent to a large extent on the total body fitness of each of its citizen. Total fitness includes
physical, mental, emotional, social and spiritual aspects. Physical educators are mainly responsible for promoting the physical aspect of the total fitness in harmony with all the other aspects of fitness.

Fit people make a fit nation. The term fitness includes physical fitness, physiological fitness, mental fitness, cardiovascular fitness, social and spiritual fitness. Physically fit people are able to withstand fatigue for larger periods and are better equipped to tolerate physical stresses.

The Sports, depending upon the aim to be achieved, can be classified into various areas: school sports, rehabilitation sports, recreation and fitness sports, industry sports and performance sports. Each area of sports caters to different section of the society and has different aims. The sports area which has gained immense importance in recent times, and has made sports more popular and has contributed much towards the development of organized sports science is the performance sports.

Sports in the present world have become extremely competitive. It is not the mere participation or practice that
brings 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 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 competitions.

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.

Performance outcomes are more likely to be achieved with what is done prior to and during a competition. They have been

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planned, practiced and shown to be successful. In contests, an athlete should never use new approaches, techniques, or strategies without first being tested, refined, and trained. An athlete should compete with only what is known and has been practiced\(^4\).

Performance sports aims at high sports performance and for that, the physical and psychic capacities of sportsman are developed to extreme limits. This normally doesn’t happen in other areas of human activity. As a result, performance sports yield valuable knowledge about the limits to which human performance and various performance factors can be developed. It also leads to discovering of means and methods of improving various physical and psychic capacities (performance factors) to exceptionally high levels. This knowledge can be fruitfully applied to other areas of sports and human activity.

Performance is the combined result of the coordinated exertion and integration of a variety of functional genetic factors which probably play a major role in a person’s performance capacity. It appears that up to 70 percent of an individual’s

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maximal force, power or capacity is a matter of genetic factors\textsuperscript{5}. The environment and geographic location also have a considerable role over the performance. Adding to this, the performance of an individual depends upon the physical and motor fitness qualities in which a definite improvement can be achieved by appropriate training.

At present, sports activities 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 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 edge\textsuperscript{6}.

The word “training” has been a part of human language
since ancient times. It denotes the process of preparation for
some task. These processes invariably extend to a number of
days and even months and years. The term ‘Training’ is widely
used in sports. There is however, some disagreement among
sports coaches and also among sports scientists regarding the
exact meaning of this word. Some experts, exceptionally
belonging to sports medicine, understand sports training as
“basically doing physical exercises”. Several terms are used in
training. For example Strength training, Interval Training,
Technical and tactical training and these training reflect this line
of thinking\textsuperscript{7}.

\textsuperscript{6} S. Sethu, Effect of Maximal Power Training on Speed, Explosive power
and Leg Strength", \textit{Journal of Studies in Physical Education and Sports

\textsuperscript{7}Hardayal Singh, \textit{“Science of Sports Training"}, (New Delhi: D.V.S
The major objective in training is to cause biological adaptations to improve performance in a specific task, to enhance physiological improvement effectively and bring about a change. Specific exercise and overload must be followed, by exercising at a level above normal. A variety of training adaptations take place in the body that makes it to function more efficiently. Numerous training procedures are in practice to improve each and every physical and motor fitness.

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 sports persons.

Sports training are a systematic process extending over a long period. For best results the system of training has to be based and conducted on scientific facts and lines.\(^8\)

Though many methods prevail to develop strength and speed, the role of Weight Training, Plyometric Training, and

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\(^8\) Hardayal Singh pp 13-14
Combined Weight and Plyometric Training are accepted as the most effective. Weight Training and Plyometric Training are now popular activities utilized by both men and women of all ages as an attempt to improve physical condition.

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

Resistance training should be an important component of all fitness programmes, more for strength and power to athletes than to individuals who exercise for health benefits. Of course, athletes in sports who require strength and power, such as weight 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 endurance⁹.

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Weight training is the use of systematic exercises with weight and it is used merely as a mean to increase resistance of the muscle contraction. The primary objective is not to learn to lift as much weight as possible, but to increase strength and power for application to some other sports.

The essentials of weight training (Strength training) and regularity and gradual increase in training intensity (principles of over loading) is supported by good nutrition and adequate rest. Unlike endurance training, weight training does not spend many calories. As such, its role of reducing body weight is limited; on the other hand, it reduces weight due to muscle hypertrophy. Strength training does not mean one will lose flexibility or become muscle bound. Studies on Olympic athletes have shown that only the gymnasts have better flexibility than the weight lifters. Weight training does not slow down muscular movement. It has also been established that increase in muscular speed (Explosive Power) accompanies an increase in muscular strength.  

It is generally agreed and accepted that muscles increase in size through weight training that strength is increased, that chemical changes take place and to some extent perhaps that the speed of muscular contraction is also increased\textsuperscript{11}.

Strength is the neuromuscular capability to overcome 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 impulse\textsuperscript{12}.

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


\textsuperscript{12} Tudor O. Bompa, \textit{“Periodization: Theory and Methodology of Training”} (4\textsuperscript{th} edn), (Champaign, Illinois: Human Kinetics Publishers, 1999), p.320.
very short period of time to improve the ability of the body to perform repeated bouts of maximal activity\textsuperscript{13}.

Among the sports requiring maximum strength development are weight lifting, shot put, discuss and hammer throw. Other sports requiring power or muscular endurance may benefit from maximum strength development\textsuperscript{14}.

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


\textsuperscript{14} Tudor O. Bompa, p.324.
reported that resistance training has enhanced muscular strength, but failed to induce changes in dynamic sports performance\textsuperscript{15}.

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’\textsuperscript{16}.

Plyometrics refers to a type of intense training that may be understood by an athlete who wants to improve speed power. This type of training also refers to very fast, explosive excision (normally performed with body weight) to improve power output and neutral activation of the muscles (the ability for a muscle to contract quickly). Basically plyometrics relies on an element of physiology called the stretch-shorten cycle (ss&c). This stretch-shorten cycle means that the muscle is rapidly stretched and then contracted which increases the force applied on the muscle. Receptors within the muscle called muscle spindles react to this


\textsuperscript{16} Thomas R. Baechle, p.319.
sudden stretching by sending a signal to the brain saying this stretching is potentially dangerous that the brain contracts the muscle to stop the stretching. This serves to protect the stretch and prevent against any possible injury. The pre-stretch of the sac must be used by 0.2 of a second or otherwise same type of bounce or any possible advantage gained by sac is lost. So recapping, the sac is initiated by the muscle spindles which detects a stretch and responds by causing the muscle to contract.

Plyometric type exercises have been used successfully by many athletes as a method of training to enhance power. In order to realise 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 challenge to one as coach or athlete is to select or create an exercise that is specific to the event and involves the correct muscular action. As long as one remembers specificity to ensure there is a pre stretch first then the only limit is ones imagination.
Plyometric exercise and weight training can be combined in complex training sessions to further develop explosive power.

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 programme (stretching, running, strength training nutrition, etc). After an athlete has begun a proper strength and conditioning programme, plyometrics are used to develop speed–strength.\textsuperscript{17}

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 programme should begin with specific goals keeping in mind time frames, or cycles. The Maximum Resistance Training and Plyometric Training Programme accomplish the

specific goals through the manipulation of four variables: intensity, volume, frequency and recovery.

Improved ranges of movement can be achieved and maintained by regular use of mobility exercises. If an athlete ceases mobility training, his/her ranges of movement will decline over a period of time to those maintained by his/her other physical activities.

When training ceases, the training effect will also stop. It gradually reduces at approximately one third of the rate of acquisition. Athletes must ensure that they continue strength training throughout the competitive period, although at a much reduced volume, or else newly acquired strength will be lost.

The effects of a long period of inactivity on physical fitness comes from a UK case study of an Olympic rower, who took more than 20 weeks to fully recover his fitness after an eight-week lay-off.

Although the athlete in question took the time off in response to the need for a physical and mental break rather than
because of illness and injury, this case study has clear implications for injured athletes.

The athlete, an elite heavyweight male rower and current Olympic champion, allowed himself the luxury of eight weeks of inactivity after competing in the Sydney Olympic Games in September 2000. His fitness was assessed by means of a lab-based incremental rowing test on four separate occasions: eight weeks before the Olympics; after eight weeks of inactivity; after eight weeks of retraining; and after a further 12 weeks of training.

The key findings were as follows: After eight weeks' detraining

- $V_{O2}^{max}$ had decreased by 8%. After eight weeks of retraining it had increased by only 4%, returning to just below pre-Olympic values after a further 12 weeks;
- Power at peak oxygen consumption fell from a pre-Olympic value of 546W to 435W - a reduction of 20%. After eight weeks' retraining it had increased by 15%, resuming pre-Olympic values after a further 12 weeks;
- Power at reference blood lactate concentrations declined by 27%, but returned to just below or just above pre-Olympic levels after 20 weeks' retraining.
Any physical activity leads to anatomical, physiological, biochemical 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 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{18}.

Speed and strength are integral components of fitness found in varying degrees in virtually all athletic movements. Simply put the combination of speed and strength is power. For many years coaches and athletes have sought to improve power in order to enhance performance. Throughout this century and no doubt long before, jumping, bounding and hopping exercises have been used

\textsuperscript{18} Tudor, O. Bompa, p.79.
in various ways to enhance athletic performance. In recent years this distinct method of training for power or explosiveness has been termed plyometrics. Whatever may be the origin of the word, the term is used to describe the method of training which seeks to enhance the explosive reaction of the individual through powerful muscular contractions as a result of rapid eccentric contractions.

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.

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{19}.

\textsuperscript{19} Tudor O.Bompa, pp. 185-186.
Strength endurance is used to develop the athlete’s capacity to maintain the quality of his muscles’ contractile force. All athletes need to develop a basic level of strength endurance. Examples of activities to develop strength endurance are - circuit training, weight training, hill running, harness running, Fartlek etc.

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\(^\text{20}\).

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 find out the Effect of Isolated and Combined Weight and Plyometric Training and Detraining on selected Strength and Speed Parameters such as Arm Strength, Leg Strength, Explosive Strength, Strength Endurance, Speed, Stride Length, Stride Frequency and Speed Endurance of College men.
HYPOTHESES

It has been scientifically accepted that any systematic 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 strength and speed related parameters due to the effect of Isolated and Combined Weight and Plyometric Training.

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

3) There would not be significant reduction of performance on selected strength and speed related parameters among the experimental groups after the first two cessations of detraining period.

4) There would be significant reduction of performance on selected strength and speed related parameters among the experimental groups after the third and fourth cessations of detraining period.
DELIMITATIONS

The study was delimited to the following factors.

1) To achieve the purpose of the study, forty five men students studying Bachelor of Engineering in Sudharsan Engineering College, Sathiyamangalam, Pudukkottai District Tamilnadu, India, during the year 2005-2006 were selected as subjects.

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

3) The subjects were divided at random into three groups of fifteen each (n=15). Group I underwent Weight Training, Group II underwent Plyometric Training, Group III underwent Combined Weight Training and Plyometric Training.

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 experimental groups underwent detraining programme for forty days with four cessations with an interval of ten days.
6) The dependent variables Arm Strength, Leg Strength, Explosive Strength, Strength Endurance, Speed, Stride Length, Stride Frequency and Speed Endurance were selected for this study.

7) The selected criterion variables for the study were assessed by the following standardized test items. Arm Strength was assessed by Dip Strength Test, Leg Strength was assessed by 25 Meters Hopping Test, Explosive Strength was assessed by Vertical Jump Test, Strength Endurance was assessed by Sit-Ups, Speed, Stride Length, and Stride Frequency were assessed by 50mts Run, Speed Endurance was assessed by 150mts Run.

8) The data were collected on selected criterion variables at prior and immediately after the experimental period as pre and post tests respectively.

9) During the detraining period, the data were collected on selected criterion at the end of every ten days (four cessations).
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, lifestyle 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

Arm Strength

Arm strength is the maximum force that can be generated with the arms\textsuperscript{21}

Explosive Strength

The ability to release maximum muscular force in the shortest possible time as in executing a standing broad jump.\textsuperscript{22}

Leg Strength

Leg strength is the maximum force that can be generated with the legs.

Plyometric Training

Plyometric Training refers to exercises that enable a muscle to reach maximal strength in as short a time as possible\textsuperscript{23}.


\textsuperscript{22} Ibid, p.236.

\textsuperscript{23} Thomas R.Baechle, p.319.
**Speed**

The capacity of moving a limb or part of the body’s lower system or the whole body with the greatest possible velocity\(^{24}\).

**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\(^ {25}\).

**Strength Endurance**

The ability of a muscle or group of muscles to overcome resistance or to act against resistance for longer duration under conditions of fatigue or tiredness\(^ {26}\).

**Stride Frequency**

Stride frequency is the number of strides taken per unit of time. The average stride frequency was calculated by dividing the number of strides taken by the time to run 50 meters.

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\(^{26}\) Hardayal Singh., p.86
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.

Training

Training is a systematic process of repetitive progressive exercise or work out involving the learning process and acclimatization.  

Weight Training

Using various methods or equipments that provide an external force against which to exercise.

SIGNIFICANCE OF THE STUDY

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

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28 Tudor O. Bompa, p 394.
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 of weight training and plyometric training on strength and speed related parameters.

ii. To study the effect of combined weight and plyometric training in strength and speed related parameters.

iii. To study the detraining effect of isolated and combined weight and plyometric training on strength and speed related parameters.

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