CHAPTER I
INTRODUCTION

Performance can be increased or improved to a great extent only by causing biological adaptation and this is possible only through systematic and scientific training. Specificity of exercises and overload principle should be followed in order to enhance the functioning efficiency of the various systems of the body. Numerous training procedures are in practice to improve each and every motor fitness ability at various levels.

According to Fox (1984) sports training is a programme of exercise designed to improve the skills and increase the energy capacities of an athlete for a particular event. These basic training procedures will serve better when utilized with modifications suited to individuals or a group dealt with. The training programme should look into improving the performance of the athletes and at the same time should prevent injury from taking place.

Sports’ training is a basic preparation for better performance through physical exercise. It is based on scientific principles of aiming 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 (Fox, 1984).

The main components which influence the physical performance of an athlete are strength, speed, agility, endurance, power and coordinative abilities. Action potential depends on natural abilities and at the same time fundamentals act as the foundation for excellence.

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, consider these aspects, referred to as the variables of training. Model all these variables according to the functional and psychological characteristics of a competition. Throughout the training phases preceding a competition, define which component to emphasize to achieve the planned performance objective. As a rule emphasize intensity for sports of speed and power and volume for endurance sports (Tudor O.Bompa, 1999).

As a prime component of training, volume is the quantitative prerequisite for high technical, tactical, and physical achievements. Volume implies the total quantity of activity performed in training.
Volume also refers to the sum of work performed during a training session or phase.

As an athlete becomes capable of high levels of performance, the overall volume of training becomes more important. For elite athletes, there are no shortcuts for the high quantity of work they must perform. A continual increase in training volume is probably one of the highest priorities of contemporary training. High training volume has a clear physiological justification: athletes cannot physiologically adapt without it. An increasing volume of work is paramount in training for any aerobic sport or event. A similar increase is also necessary for sports requiring the perfection of technical or tactical skills. Only a high number of repetitions can ensure the quantitative accumulation of skills necessary for qualitative improvements in performance (Tudor O. Bompa, 1999).

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. 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 (Tudor O.Bompa, 1999).

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 stabilize athletic technique corresponding to the demands of competition (Frank, 1980).
Volume and intensity have high relationship, because athletic exercise usually involves both in 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 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 stress on the central nervous system and athlete's psychological sphere (Tudor O. Bompa, 1999).

Density refers to the relationship, expressed in time, between working and recovery phases of training. An adequate density ensures training efficiency and prevents the athletes from reaching a state of critical fatigue or exhaustion. A balanced density may also lead to achieving an optimal ratio between training sessions and recovery (Tudor O. Bompa, 1999).

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 (Thomas, 1994).
The athlete expresses force through the body's lever system by converting chemical to kinetic energy and by neuromuscular coordination. In all physical activities, the athlete expresses this force against external force (resistance). Resistance may take the shape of weights, throwing implements, water, air, the athlete's own body weight, momentum, and so on (Frank, 1980).

Dynamic resistance is nothing but, when the body or object provides resistance through a range of motion. In training, we can use manual resistance, free weight equipment or resistance machines to provide dynamic resistance (Thomas, 1994).

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 (J Bloomfield, 1994).

There is a variety of methods that can be used to enhance muscular strength. These include the use of free weights, pneumatic resistance systems, variable resistance machines, heavy eccentric training, isometric training and accommodative resistance training.
Over the past 20 years, the use of resistance training has progressed from an activity performed by relatively few strength athletes to a permanent feature of the training routines of most sportspersons. Although there is a variety of resistance training methods one can use to enhance muscular power.

Plyometrics is not a new concept. It has been used for improving performance for years. It is just recently that it has gained wide attention. The word Plyometrics has been in use since the 1960's. Plyometric training is based on using movements that are similar to the type of movement that would be done in a particular sport or activity to improve performance. Several studies have demonstrated that a combination of Plyometrics and weight training is far more effective in improving speed and strength (power). Benefits of plyometric training as follows:

- Improves muscle response time
- Increases muscle performance
- Tones muscles
- Improved balance and posture
- Increases flexibility, reducing capability for injury

Plyometrics, employed to develop power and explosive responsiveness, uses the Stretch-Shorten Cycle (SSC). The whole idea is to develop the most amount of force in the shortest possible time.
When a muscle is flexed or shortened, it’s under tension and will react with a more powerful and explosive contraction due to stored elastic energy. Unlike most other aerobic exercises, gravity becomes a major factor in the workout routine. Strength and flexibility are prerequisites for Plyometric training. The laws of Physics apply. A one-g force is equal to your weight. Two or more g’s of force may be exerted by an individual during a jump. For example, a 250-pound (114 kg) individual would subject forces equal to or greater than 500 lbs (227 kg) of pressure on hip, knee and ankle joints. A 100 (45 kg) pound person would experience force equal to or greater than 200 pounds (91 kg). It’s obvious that too much Plyometric training can be damaging to joints, as is the case with all types of exercise.

As is the case in all other types of training, technique is the key. In this case, as they say in piloting, landing is the most important of all. When the body meets the ground is where the potential for damage is highest. Land like a cat. The joints should not be stiff. Allow the legs to act as a shock absorber. The best way to land is to pretend that you are jumping off of a step behind someone and you don’t want them to hear you land. This is true for running as well. Use the body’s natural ability the absorb shock. If you hear a lot of noise when you run or land from a jump, remember that energy was used to create that noise and your body was the instrument. Keep it quiet. Some
people advocate landing on the ball of the foot and some on the full foot (Plyometrics is not, 2012).

High load weight training and plyometric training each result in physiological and adaptations which help develop athletic power. Athletes need to incorporate both weight and plyometric training to develop muscular power for athletic performance. One method of combining weight and plyometric training is "complex training".

Complex training involves alternating biomechanically similar high load weight training and plyometric exercises, set for set, within the same workout. Complex training is a convenient and perhaps optimal training strategy for the development of sport specific athlete power. Examples of complex training include combining the bench press with the medicine ball (MB) power drops or combining the squat with depth jumps (William P. Ebben and Douglas O. Blackard, 1997).

Complex training may also be performed with explosive Olympic lifts such as the snatch, clean and jerk. Lifts such as the power clean, hang clean, push press, power pull, and power shrug may also be combined with plyometrics to create high velocity and biomechanically specific training complexes. Two biomechanically similar exercises performed in a complex can be described as a "complex pair". When three biomechanically similar exercises are performed in a complex, the term "complex triad" may be applied. During complex training, the
high intensity weight training set complements for the subsequent plyometric exercise for optimal adaptations.

The mechanisms responsible for the potential effectiveness of complex training are not well understood and require further research. Sport scientists, strengthen and conditioning specialists, athletic trainers, and coaches have employed complex training believing this to be an effective method of athlete power development. Complex training has been recommended for a variety of team and individual sports, for injury rehabilitation and athlete reconditioning. Some complex training recommendations can be made based on established principles of strength and conditioning (William P. Ebben and Douglas O. Blackard, 1997).

Complex training should follow a periodized model which requires the athlete to possess functional strength and or participate in a preparatory "base strength" cycle. Athletes should begin with low intensity plyometric drills during the "strength/power cycle". Eventually athletes can incorporate sports specific complex pairs or triads during the "pre-competition" cycle.

Plyometric exercises must be performed with the "all out" effort and limited repetitions to ensure high work intensity. Between five and ten repetitions should be used for Olympic style weight training and it's variations. Through the course of a periodized program, as the
load of the weight training exercises increases, repetitions should decrease as does the volume of the weight and plyometric exercises/allowing for reduced fatigue and athlete recovery.

The plyometric component of the complex should include between 10 to 15 reps during the "strength/power" cycle, and 8-12 reps during the "pre-competition" cycle. During the "competition" cycle, the plyometric component should include 5-8 reps. The principle of variation is also considered when utilizing complex training. Complex training during the "pre-competition" and "competition" cycles offers an alternative method for maintaining/developing power. There are numerous combinations of weight and plyometric exercises which may be employed.

Incorporating plyometrics with Olympic style weight training, in a complex fashion offers increased variation within the conditioning program. Complex training exercises need to be biomechanically and velocity specific to the sport. Multiple joint, total body, Olympic style exercises are consistent with the biomechanics of many sports. The high intensity of complex training is consistent with the velocity requirements of sports requiring power. Sports specific complexes are a form of "functional training" and offer increased generalized ability to sport specific activity. There are many possible combinations of biomechanically similar Olympic style lifts which can be paired with
plyometric exercises (William P. Ebben and Douglas O. Blackard, 1997).

The principle of recovery is also important to consider when implementing a complex training program. Complex training is efficient since weight in plyometric training are performed on the same day and within the same training facility. Decreased volume associated with a periodized program reduces fatigue and allows the athlete to focus on work performance and recover from the previous training cycles. Recommended recovery between complex training exercise sessions is at least 48 hours and no more than 96 hours of recovery between exercising the same muscle groups.

Consequently, complex training should be performed 2-3 times per week. Rest interval between sets of complex training exercises should allow for the replenishment of anaerobic energy stores. Rest between sets should range between 2-5 minutes. Zero-thirty seconds of rest should be given between biomechanically similar exercises in the complex. The minimal rest between complex exercises is important so that the plyometric portion which follows can maximally impact the muscle. Recommendations for "complex training" typically indicate high intensity weight training exercise followed immediately by biomechanically similar plyometric exercises. For example, a "complex pair" would include one set of hang cleans followed by one set of depth jumps.
A "complex triad" could include performing high intensity weight training exercise such as the push press, followed by sports specific lighter load exercise such as the jump squat, followed by a plyometric exercise such as double leg vertical power jump. Complex training should be performed prior to single joint isolation exercises to ensure a high work intensity of "multi-joint" complex pairs. There are many possible combinations of weight and plyometric exercises which can be used in complex training. For complex training to be effective, the plyometric portion of the complex must be biomechanically similar to the preceding weight training exercise (William P. Ebben and Douglas O. Blackard, 1997).
Statement of the Problem

The purpose of the study was to find out the effect of plyometric training, weight training and combination of training on selected physical and physiological variables of volleyball players.

Research Questions

1. Would the plyometric training, weight training and combination of training programmes improve the selected physical variables while the presence of covariate (control)?

2. Would the plyometric training, weight training and combination of training programmes improve the selected physiological variables while the presence of covariate (control)?

3. Would the plyometric training, weight training and combination of training programmes differs each other and also with control group while improving the selected dependent variables?

Assumptions

Validity of this study will rely on the following assumptions

1. The subjects made an honest effort to comply with the intervention protocol according to their specific training.

2. The subjects performed the assigned three different training sessions separately, for three alternative days per week.
3. The subjects complied with the best of their ability to the training and testing direction.

4. The subjects were tested accurately by the standardized test items.

5. The selected tests were reliable and valuable for assess the selected variables.

6. Subjects were not performed any vigorous exercise during the course of study.

**Hypotheses**

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

1. There would be a significant improvement on selected physical and physiological variables (speed, explosive power, muscular endurance, agility, resting pulse rate, and breath holding time) due to the effect of plyometric training, weight training and combination of training programmes.
2. There would be significant differences on selected physical and physiological parameter among the plyometric training, weight training and combination of training programmes and control groups.

**Delimitations**

The study was delimited to the following factors.

1. Only sixty college men volleyball players were selected as subjects at random from the Kanyakumari District, Tamilnadu, India.

2. The selected subjects were divided into four groups of fifteen each. Group I underwent plyometric training, Group II underwent weight training, Group III underwent combination of plyometric and weight training were given for 12 weeks for three alternative days in a week and Group IV acted as control.

3. The age of the subjects ranged from 17 to 22 years.

4. The plyometric training, weight training and combination of training were selected as independent variables for this study.

5. The physical parameter was delimited to speed, explosive power, muscular endurance and agility.

6. The physiological parameter was confined to resting pulse rate and breath holding time.
7. As per the available literatures, the standardized tests were used to collect relevant data on the selected dependent variables.

8. The level of significance was fixed at .05 levels, which was considered to be appropriate.

9. The data was collected on selected criterion variables one day prior and immediately after the training period.

**Limitations**

The following limitations will not be considered while interpreting the result of the study

1. The study was conducted over the course of twelve weeks and was not able to control for variations in the environmental conditions and the level of acclimatization.

2. Only 17 to 22 age men participants were included in the study, therefore, results cannot be generalized to other populations.

3. The background of the previous training was not taken into consideration.

4. Rest periods were not standardized for all subjects.
5. The researcher may not control all outside activities, food habits, physical activity and social habits of the participants.

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

**Significance of the Study**

1. This study was examining the effect of plyometric training on physical and physiological parameter among the men volleyball players. The results from this study might also be able to provide comparisons on the structure of plyometric training and improvement for the selected variables.

2. This study was examining the effect of weight training on physical and physiological parameter among the men volleyball players. The results from this study might also be able to provide comparisons on the structure of weight training and improvement for the selected variables.

3. This study was examining the effect of combination of plyometric and weight training on physical and physiological parameter among the men volleyball players. The results from this study might also be able to provide comparisons on the
structure of combination of plyometric and weight training and improvement for the selected variables.

4. The ultimate aim of research in physical education is to help coaches and physical educators to train their sport persons based on new concepts in improving their performance.

5. This study would highlight the importance of combination of plyometric and weight training for volleyball players.

6. A unique aspect of this work is that it includes recommendations for the practical use of research findings.

7. The study would add knowledge in the area of sports training.

Definition of the Operational Terms

Training

Training is a pedagogical process, based on scientific principles, aiming at preparing sportsman for higher performance in sports competitions (Singh, 1991).

Plyometric Training

The term plyometric can be used to include depth jumping, hopping and bounding drills. They are dynamic measurements which use gravitational force on the body and the contractibility and elasticity of muscle tissue to increase the force or stress on related muscles (Wilf and Evelyn Freeman, 1984).
Plyometrics are exercises that force a rapid lengthening of muscle prior to contraction, to result in increased force output during contraction.

**Weight Training**

Weight training is a common type of strength training for developing the strength and size of skeletal muscles. It uses the weight force of gravity (in the form of weighted bars, dumbbells or weight stacks) to oppose the force generated by muscle through concentric or eccentric contraction. Weight training uses a variety of specialized equipment to target specific muscle groups and types of movement.

A person's capacity to use muscular activity (enhanced by the use of weights) to exert resistance on external forces in order to overcome these forces.

**Complex Training**

One method of combining weight and plyometric training is "complex training". Complex training may best be performed with explosive Olympic style lifts and plyometrics. Complex training involves alternating biomechanically similar high load weight training and plyometric exercises, set for set, within the same workout. Complex training is a convenient and perhaps optimal training strategy for the development of sport specific athlete power.
Speed

Speed is defined as the ability to move the entire body rapidly from one place to another (Perry Johnson and Donald Stelberg, 1971).

Explosive Power

It is capacity of the individual to bring into play maximum muscle contraction at the fastest rate of speed (Barrow M and Rose Mary Mc Gee, 1973).

Muscular 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 (Ted and Andrew, 1991).

Agility

Agility is generally defined as “the ability to change directions quickly and effectively while moving as nearly as possible at full speed”.

Resting Pulse Rate

The number of times heart contracts in each minute while the body is at rest (Wibom et al, 1992).
Breath Holding Time

It is the duration of time through which one can hold his breath without inhaling or exhaling after a deep inhalation (Strukic, 1981).