

CHAPTER – I

INTRODUCTION

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1.1. INTRODUCTION

Sports offer many opportunities for people to make the best use of their abilities, to become part of a cooperative team effort, to experience the joy, and sometimes the misery, of winning and losing. In ancient times, our ancestors exhibited extraordinary talents in terms of physical activity. Accompanied by fierce competition, the arena of sports and games has evolved to assume professional dimension. Somehow or other, irrespective of age, the human race is involved in different kinds of sports either for recreation or for competition. In the present world, Sports have become extremely competitive. It is not mere participation or practice that makes an individual victorious. Qualitative sports life is affected by various factors like physiology, biomechanics, sports training, sports medicine, sociology and coaching, computer application and psychology and so on.

To achieve top level performance in the international arena one must have a fitness regimen and systematic execution. To win medals, in the Olympics, there should be spotting of talent, systematic and scientific method of training, competitive exposure, etc. It is not only because of training, but also because of psychological, and physiological aspects that goals are achieved. Experts in the field of sports have put their mind into it and made tremendous efforts to find out ways and means to achieve top level performance.

1.2 NATURE OF THE GAME

Volleyball is a sport played by two teams consisting of 12 players each on a playing court, divided by a net. The object of the game is to send the ball over the net in order to ground it on the opponent's court and to prevent the same effort by the opponent. The team has three hits or contacts to return the ball.

To play volleyball one has to be good at vertical jump, known as explosive power. A volleyball match can be played for five sets which means a match can last about 90 minutes, during which a player can perform 250 -300 actions dominated by

the explosive type of strength of the leg muscles. The total number of actions as jumps takes up around 50-60% high speed movements and change of direction in space about 30% and as falls about 15%. The spike and block actions are dominated by the corresponding explosive type of strength which is referred to as a player's vertical jump which is usually the key to winning point (Stojanovic, Radmila Kostic 2004).

Volleyball is a dynamic and fast-paced game. The purpose of strength training for volleyball players is not to build big muscles, but to develop the physical attributes necessary to improve a player's performance. So, strength training is very important to volleyball players and it should not be developed independently of other abilities such as agility, quickness and endurance. When watching a great volleyball player, the one word that comes to the mind is "quick". Everything the player does is short and quick. There are no long drawn out motions like sprinting in other sports. There is simply a succession of explosive bursts that keeps the ball in play and controls the flow of the game. The quickness that must be focused on, when training a volleyball player is not only quickness from side to side and front to back, but also quickness from up to down. Unique from other sports, volleyball players must be able to quickly change direction from the upward motion of a vertical jump to the downward motion of a point-saving dig *or vice versa*. One of the most crucial phases of volleyball is how players perform at the net. To be successful, teams must be able to control play at the net both offensively and defensively. Since this is the case, two of the most valued traits in a volleyball player are height and jumping ability. Both of these traits allow players to greatly influence the game because they can more easily go where the ball is inevitably going up, Since there is no way to train height (yet), the focus of training falls squarely on jumping ability. Developing an athlete's jumping skills allows them to elevate quicker and higher in order to take better shots by themselves and to block more of their opponent's shots. Since the same skills that send an athlete up also create quick first steps improving jumping skills will also positively influence other areas of a volleyball player's performance!

Participation requires expertise in many physical skills and performance is often dependent on an individual's ability to jump and land. The incidence of injury in

volleyball is similar to the rates reported for sports that are considered more physical contact sports.

The sport of volleyball has continued to enjoy popular in participation since its inception over one hundred years ago. Volleyball has become one of the most widely played participant sports in the world with over 200 million players (Aagaard et al., 1997; Briner and Kacmar, 1997). The number of participants rivals the number of soccer participants (250 million) reported by the Federation International de Football Association (Dvorak et al., 2000). Another indication of the worldwide appeal of all forms of volleyball was the inclusion of beach volleyball as an Olympic sport in 1996. The potential reasons for the popularity of volleyball are that the sport requires a minimal amount of equipment and that individuals can participate throughout their lives at a variety of skill levels. Women's athletics is one segment of the sporting community that has seen particular support for volleyball.

The predominant requirement for success in a large number of athletic skills is explosive power. For the lower body, this is perhaps best exemplified by the vertical jump. During vertical jumping, the muscles about the hips, knees, and ankles act rapidly and with great force in an attempt to produce the greatest possible velocity of the body as it leaves the ground; the jump height is ultimately determined by the takeoff velocity. This article addresses the factors that contribute to vertical jumping ability and describes the training strategies that have been shown to be effective in achieving maximal jump performance.

1.3 SPORTS TRAINING

Sport training is a physical, technical, moral and intellectual participation of an athlete with the help of physical exercises. It is a planned process for the participation of athlete and players to achieve top level performance (Hardayal singh, 1984).

Training is much like constructing a multi-storey building. One needs materials for the building such as aerobic, anaerobic running, comprehensive conditioning, flexibility, etc. Several kinds of materials like training intensities and modalities should be utilized in an on-going process to complete the goal of finished

buildings or competitively fit athlete. Depending on the progress in the construction plan, the relative mix of all these materials will vary. As a training season develops, compressive conditioning work for strength of endurance will gradually form a transition into an emphasis on power with a substitution of intensity of volume in determining the total load.

1.3.1 PURPOSE OF SPORTS TRAINING

The purpose of the training programme is to produce metabolic, physiological and psychological adaptation that allows the sportsperson to achieve top level performance (Hardayal singh, 1983). When the training increases the demand for aerobic energy, the number and size of muscle mitochondria will increase so that in these chemical factories where aerobic metabolism takes place becomes larger and more numerous. These will help athletes to provide more energy from aerobic metabolism. There are three steps of adaptation: the first involves creating the need for more aerobic energy. Training must be sufficient in both duration and intensity to accomplish. The second step is to provide nutrients to build and repair mitochondrial tissues. Third is that the athlete must be given enough rest to regain the energy as super compensation. There are different types of training by which one can attain the required development. Each training has its own specific effect.

1.3.2 TYPES OF TRAINING

In developing the physical, motor and performance related components in volleyball generally players are treated with varied forms of training such as resistance training, plyometric training, interval training, harness running, that is speed based training and combination of training. Of these, the training modules used in the present study are explained briefly as follows.

1.3.2.1 RESISTANCE TRAINING

Resistance training is a form of exercise for the development of strength and size of skeletal muscles. Resistance training, also known as weight training or strength training, is for everyone. According to the American Sports Medicine

Institute (ASMI) resistance training is a “specialized method of conditioning designed to increase muscle strength, muscle endurance, and muscle power”. Resistance training can be performed in a variety of ways; with resistance machines, free-weights (dumbbells and barbells), rubber tubing, or own body weight, as in doing pushups, squats or abdominal crunches.

1.3.2.1.1 BENEFITS OF RESISTANCE TRAINING

As the goal of resistance training, the ASMI says, is to “gradually and progressively overload the musculoskeletal system so it gets stronger”. Regular resistance training will strengthen the bones, and strengthen the muscles. According to Keith Cinea, any fitness programme should include resistance training, along with aerobic exercise and flexibility training. Aerobic workouts, which strengthen the cardiovascular system, focus primarily on the large muscle groups of the lower body. Strength training offers a way of balancing that out by challenging all the major muscle groups, including those in the chest, arms, back and abdomen. According to medical research, generally the resistance training strengthens the muscular system, strengthens the skeletal system, and improves bone density (decreases the chance of osteoporosis) and increases metabolism. So a well -planned resistance training program should be a part of everyone’s health, fitness and lifestyle regardless of age, gender or goals.

In particular, resistance training improves the functional performance of the neuromuscular system, the system of muscles and nerve pathways that directs and controls movement. Resistance training produces increased strength, superior movement performance and general fitness, including enhanced function of the respiratory, cardiac and metabolic systems. Other improvements include an increase in muscle mass, strengthening of connective tissue and supportive tissue as well as improvements in posture and physique. Structuring a resistance training program with Burke Spencer’s Fitness Partner encourages the lifetime physical activity in students ages 8+ to improve neural motor skills and strength, to improve bone development by

increasing bone density, to improve the strength of bone connective tissue to strengthen the heart muscle and to improve muscle energy capacity.

1.3.2.2 PLYOMETRIC TRAINING

For many years coaches and athletes have sought to improve power in order to enhance performance. Throughout this century and no doubt during the times before, jumping, bounding and hopping exercises were especially used in various ways to enhance athletic performance. In recent years this distinct method of training for power or explosiveness has been termed Plyometrics. Plyometrics by definition is, a type of exercise using explosive movements to develop muscular power, esp. bounding, hopping and jumping. It is a term that describes exercises that help to bridge the gap between strength and speed, and refers to human movement that involves an eccentric muscle contraction immediately and rapidly followed by concentric contraction. When a muscle is lengthened, energy is released as heat, but some energy is stored in the muscles and tendons to be used in its subsequent contraction. The goal is to decrease the amount of time it takes for the muscle to contract in a movement. Again the focus is on time. If the muscle is stretched for too long, useable energy is lost as heat.

Santana Juan Carlos (2000), plyometric training, termed as “explosive-reactive” is a power training, which involves powerful muscular contractions in response to a rapid stretching of the involved musculature. These powerful contractions are not a pure muscular event; they have an extremely high degree of central nervous system involvement. The event is a neuromuscular event. It is a combination of an involuntary reflex (i.e. a neural event), which is then followed by a fast muscular contraction (i.e. voluntary muscular event). The main objective in plyometric training is to improve quickness through strength. The fast twitch or white fiber is responsible for explosive type of muscular contraction. Chu (1996) states “Plyometric has undergone a considerable metamorphosis over the past few years. New ideas and techniques will lead the reader into the second generation of plyometric training.

1.3.3 COMBINED RESISTANCE AND PLYOMETRIC TRAINING

According to Hakkinen et al., (1998) the strength training in combination with some explosive types of exercises be recommended as a part of overall physical training to maintain the functional capacity in middle-aged and elderly people. For explosive muscle performance, the underlying factors are muscle fiber type, muscle hypertrophy and enzymatic and neural adaptations. It is also important to investigate the impact of power-type strength training on the low back and leg muscles and joints, as well as the injury risks and adherence, and motivation to training. For being effective in improving the explosive muscle performance, training programs should be designed so as to motivate, easy to achieve, effective concerning the time spent in exercises, low in expenses, and they should give consideration to the exercise history and present exercise activity, health status and musculoskeletal symptoms and diseases of the individual.

Combining both resistance strength training and plyometric explosive power training is to use the combination of resistance and plyometric exercises to effectively engage the nervous system and activate more fibers (Beachle & Earle, 1994). Ebban (2002) states that resistance training followed by plyometric training alternates bio-mechanically similar to high load weight training exercises with plyometric exercises. This type of training describes a power-developing workout that combines weights and plyometric exercises. About ten years ago, these workouts were greeted with great acclaim as research indicated that they could significantly enhance fast twitch muscle fiber power and, therefore, produce dynamic sports performance. The logic behind this pair of exercise is that the resistance work gets the nervous system into full action so that type II b fibers are available for the explosive exercise; hence a better training benefit of complex training programme can be used in the general, specific and competitive phase of training.

1.3.4 COMPLEX TRAINING

It is a highly effective form of physical training that combines both resistance strength training and plyometric explosive power training. The idea is to use the

combination of resistance and plyometric exercises to superbly engage the nervous system and activate more fibres. Complex training describes a power-developing workout that combines weights and plyometric exercises. About 10 years ago, these workouts were greeted with great acclaim as research indicated that they could significantly enhance fast twitch muscle fiber power and, therefore, dynamic sports performance. According to Beachle & Earle (1994) complex training is a combination of high intensity resistance training followed by plyometric exercises. Ebban states that complex training alternates bio-mechanically similar high load weight training exercises with plyometric exercises.

1.3.4.1 COMPLEX TRAINING THEORY

The proposal of the theory underpinning complex training is for training the neuromuscular system specifically for maximum power output and force development and for maximizing the involvement of the fastest muscle fibres. According to Ebban and Watts (1998) “High load of weight increases motor neuron excitability and reflex potentiation, which may create optimum entry conditions for subsequent plyometric exercises. Also the fatigue associated with high load weight may force more motor units to be recruited during the plyometric phase for the possible enhancing of the training state.

1.3.4.2 COMPLEX TRAINING: RESISTANCE EXERCISE FOLLOWED BY A MATCHED PLYOMETRIC EXERCISE

Complex training is a workout comprising of a resistance exercise followed by a matched plyometric exercise e.g. squats followed by squat jumps; bench press followed by plyometric press up. The logic behind these matched pair of exercise is that the resistance work gets the nervous system into full action so that more type IIb fibers are available for the explosive exercise, hence a better training benefit of complex training programme can be used in the general, specific and competitive phase of training. Ebban (2002) in his recent literature review has stated that complex training has investigated both the acute and long term effects of this conditioning approach. Complex training describes a power-developing workout that combines

weights and plyometric exercises. About 10 years ago, these workouts were greeted with great acclaim as research indicated that they could significantly enhance fast twitch muscle fiber power and, therefore, dynamic sports performance. The two benefits from traditional strength work are increased neural activity and increased muscle mass (hypertrophy).

Many athletes include plyometric exercises in their training programs and are well aware of their benefits. However it is slightly less known that the combination of traditional strength with power and plyometric exercises together results in greater Type II b recruitment and consequently greater improvements in power and rate of force development. One of the most effective ways to build power is with plyometrics, a form of exercise involving explosive movements, such as jumping over or onto a high box. Including such exercises in a triathlete's routine is quite effective, but the problem is that it takes more time than most of us have available. When one is already swimming, cycling, running and lifting weights, adding one or two more workouts to the week is close to impossible.

The answer is to combine plyometrics and weights into one session. This is known as "complex training." Not only does training save time, it also magnifies the effect of plyometrics. This is because lifting weights stimulates the nervous system to activate more muscle fibres for a couple of minutes following an exercise. And recruiting large numbers during plyometric exercise means great power generation. So by combining two in one workout time radically improves power. Quality of training is the key to gaining both strength and power. By combining weights and plyometrics into a single workout and limiting the number of exercises to only multi-joint movements that most closely simulate the movements of volleyball and swimming, one can dramatically improve both strength and power. Complex training is a workout comprising a resistance exercise followed by a matched plyometric exercise e.g. squats followed by squat jumps, bench press followed by plyometric press up. The logic behind these matched pair of exercises is that the resistance work gets the nervous system into full action so that more Type II b fibres are available for the explosive exercise, hence a better training benefit. During complex training one

should not learn new exercises or work on technique since complex training is a very intense form of exercise, one must rest properly before, after and during the complex training workout one should rest at least 48 hours between complex training workouts and rest 2-5 minutes, or longer, between exercise pairs.

The strength exercise is performed first followed by the plyometric exercise for improving the training benefit by getting the nervous system and muscle fibers primed to perform the explosive plyometric exercise better.

Complex training describes a power-developing workout that combines weights and plyometric exercises. About 10 years ago, these workouts were greeted with great acclaim as research indicated that they could significantly enhance fast twitch muscle fiber power and, therefore, dynamic sports performance.

1.3.5 MUSCULAR FITNESS PARAMETERS

Muscular Strength

Strength is the ability of the individual to exert force against an object. It is the ability to overcome resistance or to act against resistance. Muscle strength is what happens when the nervous system communicates a message to the muscle fibers to contract so as to produce force. Often the force produced by a muscle contraction is against resistance. Strength should not be considered as a product of only muscular contractions. It is in fact a product of voluntary muscular contractions caused by the neuromuscular system. The abdominal strength is very much useful in the field of sports and games. When an individual possess a high degree of abdominal strength, he will be able to perform any type of activity such as running, jumping and throwing. The abdominal strength helps to maintain the body postures, thereby involving in many activities in the field of sports and games. Lifting a load or moving an inanimate or animate object essentially depends on the abdominal muscular strength.

Strength is the most important element in motor performance. Strength is a consistent differentiator of ability to make and to achieve success in sports. Young athletes develop strength through natural, unbroken movements such as jumps, throws

and other body weight exercises. Proper strength training serves not only to improve overall performance, but also to secure the body and help the athlete avoid injury.

Lower body Muscular Strength

The legs are the primary source of power in many sports. In the great majority of situations they function as part of a closed kinetic chain which means that one leg is always in contact with the ground. Without functional leg strength the athlete can not have speed, strength, power, or suppleness to perform. We must think of the legs as a functional unit of the whole kinetic chain. "Function is a miraculous and complex combination of systems that are linked and react with each other. In order to understand function as a whole, the parts and components of function must be appreciated". (Gary Gray, 2001) The leg muscles work together to reduce and produce force in the most effective manner for the required activity.

Abdominal Muscular Strength and Endurance

When planning an exercise programme for overall health and wellness, all health-related components of fitness should be included. This should include a programme to enhance muscular fitness (muscular strength and muscular endurance.) Unfortunately, in today's world, with all of its modern conveniences, we can accomplish most of our daily tasks with a minimum level of effort. Thus, in general, our muscular development tends to be lower than standards required for optimal health. If we are interested in the many benefits of muscular fitness, we must make a conscious effort to develop both muscular strength and muscular endurance. Although the concepts of muscular strength and muscular endurance are closely related, it is important to distinguish between the two. Muscular strength is defined as the maximum amount of force a muscle can produce in a single effort. It is generally measured by a single maximal contraction. Muscular endurance, on the other hand, is defined as the ability of a muscle to exert a sub-maximal force repeatedly over time. It is generally measured by lifting a given amount of weight as many times as possible. Depending on desired outcome, one can specify one's training regimen to make one's programme strength- or endurance- oriented or a balance of both. Keep in mind that

these two components are closely interrelated and there is some overlap. This means that some improvement will be seen in each component even if the concentration is on only one.

Muscular Power

Muscular power is the ability to release maximum force as fast as possible. It is a maximum muscular contraction against a resistance in a minimum amount of time. $\text{Power} = \text{Force} \times \text{Velocity}$. It is a compound element of motor fitness. It needs specific muscular strength, speed of limb movement and skill in integrating and co-ordinating the action. Increased velocity of parts of the body is related to improved neuromuscular initiation, co-ordination and precision of movement patterns. When a highly skilled level is attained, further performance improvement is primarily attributable to the increase in strength. Muscular power exists in its own right. Strength and power are separate entities.

Successful sporting performance at elite levels of competition often depends heavily on the explosive leg power of the athletes involved. Many team sports also require high levels of explosive power, such as Basketball, Volleyball, Netball and the Rugby and Football codes for success at elite levels of competition. Explosive power comes from the development of speed strength and pure strength. Power represents the amount of work a muscle or muscle group can produce per unit of time (Shorten, 1994). Until recent years power as it relates to sports performance has been the subject of limited research, but in the last decade or so researchers have realized the importance of training for power in a wide variety of sporting activities (Clutch et al, 1983).

Vertical and horizontal jumping, in its many different forms, requires high levels of explosive muscular power. Brukner and Kahn (1997) note power as the equivalent of explosive strength. According to Brukner and Kahn (2001), Power is the equivalent of explosive strength. Young and Bilby (1993) used the term "speed-strength" synonymous with power. Paavolainen et al, (1999), suggested that muscle power is the ability of neuromuscular system to produce power during maximal

exercise when glycolytic and oxidative energy production is high and muscle contractility may be limited.

Leg Explosive Power

The strength of the muscles in the limbs in moving and supporting the weight of the body repeatedly over a given period of time in terms as dynamics strength, sometimes, has been called velocity or speed. The important aspect of this factor is the requirement that the muscular force, which must be repeated as many times as possible. Explosive strength and dynamic strength involve movement of the body or of its limbs.

Aerobic Capacity

Maximum oxygen uptake ($\text{VO}_2 \text{ max}$) refers to the highest rate at which oxygen can be taken up and consumed by the body during intense exercises. Traditionally, the magnitude of an individual's $\text{VO}_2 \text{ max}$ has been viewed as one of the most important predictors of endurance. The ability of the cardio respiratory system to transport oxygen to the exercising muscles refers to the central component of $\text{VO}_2 \text{ max}$. The role of the central component is for oxygen to be transported from the atmosphere and delivered to the muscles where it is utilized during mitochondrial respiration to produce ATP. The major limitations in oxygen delivery are pulmonary diffusion, cardiac output, blood volume and flow. In aerobic work, oxygen is obtained from the air and is transferred from the lungs to the blood and then to the muscles via the circulatory system. Maximal oxygen uptake or maximal aerobic power ($\text{VO}_2 \text{ max}$) is the indicator of aerobic fitness. As $\text{VO}_2 \text{ max}$ increases, the level of aerobic fitness also increases which refers to individual aerobic capacity. An individual who is fit will have a cardio-respiratory system that is capable of meeting the demands of the tissues under conditions of intense exercise.

Anaerobic Capacity

Anaerobic capacity is the total amount of energy obtainable from the anaerobic energy systems. That means the combined amount of output for the ATP,

phosphocreatine and lactic acid systems within a certain period of time. A simple, less scientific method for measuring this capacity is to run as far as you can at a near-maximal pace. The further you can run at a fast pace the more anaerobic enzymes your body is capable of producing and utilizing and the better able you are to buffer lactate.

Anaerobic capacity is one of the three primary focuses of the Personal Evolution training protocols, along with strength and power. The better able your combined anaerobic energy systems are at utilizing energy and recovering, the higher the intensity you are able to maintain. For example; a 400 meter runner needs to perform at nearly 100 percent for over 40 seconds when competing at elite level. This is extremely taxing on the anaerobic energy systems and requires a highly conditioned state. By increasing anaerobic capacity the 400 meter runner is able to buffer more lactate at a faster rate, produce and use more anaerobic enzymes and continue turning body fuels into useable energy for immediate access.

1.3.6 SPORTS PERFORMANCE

One of the greatest pleasures in the sports is exposure to performance at its highest level. There is something almost artistic about an athletic that is well beyond the normal and demonstrates exceptional grace speed, and control while performing a skill. Getting to the highest level requires skill attainment, mental toughness, years of purposeful practice and dedication.

Successful sports performance at the highest levels of competition often depends mainly on explosive leg power of the athletes involved. In many individual sports such as track and field events, gymnastics and diving ability to use high levels of strength as quickly and as explosively as possible is essential to perform at a elite level. Many team sports also require high levels of explosive power, such as basketball, volleyball and football for achieving success at elite levels of competition.

The ultimate aim of sports training is to achieve top level performance and win medals in the Olympics. Serious athletes do not need reminding of the importance of sports conditioning. It is also that known it is not enough nowadays simply to put in hundreds of hours of basic training - be it on the bike, on the track, in the pool or on the court.

One's best gains in performance will be achieved when key parts of one's training closely mimic what one does when one competes. The more specific one's training, the greater will be the impact on one's performance

In many individual sports such as Track and Field events, Gymnastics and Diving the ability to use high levels of strength as quickly and as explosively as possible is essential to perform at elite levels. Many team sports also require high levels of explosive power, such as Basketball, Volleyball, Netball and the Rugby and Football codes for success at elite levels of competition. Until recent years, power as it relates to sports performances has been the subject of limited research, but in the last decade or so researchers have realized the importance of training for power in a wide variety of sporting activities.

Vertical and horizontal jumping, in its many different forms, requires high levels of explosive muscular power. The double legged volleyball spike jumps and block jumps are very different in technique, but fundamentally they are similar. Basketball players typically jump from one leg to perform a lay up, and from two legs to rebound jump. Again both are very different styles of jumping which are fundamentally similar in their movement patterns. Different jumping styles also involve very different approaches and run-ups which increase or decrease the velocity of the movement performed, depending on the type of jump. It has been suggested that different styles of jumping require different strength properties and that training for one type of jumping technique will not necessarily improve performance in another style of jumping.

There have been many research studies that have investigated leg power as it relates to vertical jump and about how to develop leg power through various weight

training and plyometric training techniques. Data has been produced for many elite individual and team sport athletes for physical and physiological characteristics, including standing vertical jump scores, related to specific sports performance. There is limited research available, however, comparing athletes of different sporting disciplines in vertical jump ability, in an attempt to explain why athletes in some sports perform better at vertical jump than athletes in other sports.

To compete at one's very best one needs to build the appropriate strength, power and speed elements into one's conditioning regime. That is what gives one the extra edge one needs, to excel at one's sport. All players want more of it, whether they are 100m sprinters or marathon runners. After all, it is highly frustrating to lose a track event in the last two meters, or a marathon in the last two hundred yards.

However, it is often assumed that those blessed with great speed or strength are born with a higher percentage of fast-twitch muscle fibers, and that no amount of speed work (or neural stimulation) will turn a cart-horse into a race horse.

In fact, fast-twitch fibers are fairly evenly distributed between the muscles of sedentary people, with most possessing 45-55% of both fast- and slow-twitch varieties. That means few of us are inherently destined for any particular type of sports activity, and how we develop will depend mostly on two factors:

1.3.6.1 SKILL PERFORMANCE

Overall Playing Ability

One of the greatest pleasures in the sports is exposure to performance at its highest level. There is something almost artistic about an athletic that is well beyond the normal and demonstrates exceptional grace speed, and control while performing a skill. Getting to the highest level requires skill attainment, mental toughness, years of purposeful practice and dedication.

Successful skill performance at the highest levels of competition often depends heavily on ability to use high levels of strength as quickly and as explosively. Many team sports also require high levels of explosive power, such as Volleyball,

Basketball, Netball and the Rugby and handball. Until recent years, power as it relates to sports performances has been the subject of limited research, but in the last decade or so researchers have realized the importance of training for power in a wide variety of sporting activities.

To compete at one's very best in volleyball; one needs to build the appropriate serving, spiking and blocking, individual defensive skills, individual tactics, offensive combination and defensive combination. However, it is often assumed that those blessed are born with a higher percentage of fast-twitch muscle fibers, great speed or strength, and having trained and mastered in skills.

1.4 OBJECTIVES OF THE PRESENT STUDY

The following are the objectives of the present study.

1. To study the individualized training effect of Combination of Resistance Training followed by Plyometric Training in the Same Session, Complex Training of Resistance Exercises followed by a Matched Plyometric Exercises in the same session, Resistance Training for first six weeks followed by Complex of Resistance Training with Matched Plyometric Training for another six weeks in the same session and control group on selected Muscle fitness parameters, physiological and skill performance variables of male Volleyball players.
2. To compare the effects of three methods of complex training, namely combination of resistance training followed by plyometric training in the same session, complex training of resistance exercises followed by matched plyometric exercises in the same session and resistance training for first six weeks followed by complex of resistance training with matched plyometric training for another six weeks in the same session and Control group on selected muscle fitness parameters, physiological and skill performance variables of male Volleyball players.

1.5 STATEMENT OF THE PROBLEM

The purpose of this study was to determine the effect of varied training modalities of complex training, combined resistance training and plyometric training programme on muscle fitness parameters, physiological variables and skill performance of male volleyball players.

1.6 HYPOTHESES

The hypotheses for this investigation were as follows:

1. In studying the individualized effect, it was hypothesized that Combination of Resistance Training followed by Plyometric Training in the same session, Complex Training of Resistance Exercises followed by Matched Plyometric Exercises in the same session and Resistance Training for first six weeks followed by Complex of Resistance Training with Matched Plyometric Training for another six weeks would have significant improvement from base line to post treatment on selected Muscle Fitness Parameters, physiological, skill performance variables of male Volleyball players.
2. It was hypothesized that there would be significant differences among the three modalities of training namely, Combination of Resistance Training followed by Plyometric Training in the same session, Complex Training of Resistance Exercises followed by Matched Plyometric Exercises in the same session and Resistance Training for first six weeks followed by Complex of Resistance Training with Matched Plyometric Training for another six weeks and Control Group on selected Muscle Fitness Parameters, physiological, skill performance variables of male Volleyball players.
3. It was hypothesized that Complex training of Resistance exercise followed by a matched plyometric exercise would be expected to provide a superior training stimulus for developing selected Muscle Fitness Parameters, physiological,

skill performance variables of male Volleyball players than Combination of Resistance Training followed by Plyometric Training in the same session.

4. It was further hypothesized that Resistance Training for first six weeks followed by Complex of Resistance Training with Matched Plyometric Training for another six weeks would have better improvement on selected Muscle Fitness Parameters, physiological, skill performance variables of male Volleyball players compared to Combination of Resistance Training followed by Plyometric Training in the same session and Complex Training of Resistance Exercises followed by Matched Plyometric Exercises in the same session.
5. It was hypothesized that interventions used in the present study of Combination of Resistance Training followed by Plyometric Training in the same session, Complex Training of Resistance Exercises followed by Matched Plyometric Exercises in the same session and Resistance Training for first six weeks followed by Complex of Resistance Training with Matched Plyometric Training for another six weeks would have significant development on selected muscle fitness variables, physiological and skill performance variables as compared to Control group.

1.7 SIGNIFICANCE OF THE STUDY

The present study is significant in the following aspects.

1. The salient feature of the applications of various Complex training modules used in the present study towards the development of selected Muscle fitness parameters, physiological and skill performance variables of male Volleyball players are specifically with Complex Training. Generally Complex Training modules accommodate all types of muscles during the course of training. It helps the players to have the uniqueness in musculature and uniform development in Muscle fitness parameters, physiological and skill performance variables.
2. The interventions such as Combination of Resistance Training followed by plyometric training in the same session, Complex training of Resistance exercise followed by a matched plyometric exercise, Resistance Training for first six weeks followed by Complex of Resistance Training with Matched Plyometric Training for another six weeks used in the present study are scientifically structured one. Hence it is believed that players treated with these training modules can be benefited in time with regard to the development of muscle strength, muscle endurance, muscle power, aerobic capacity, anaerobic capacity, skill performance of passing ability, serving ability and overall playing ability of male volleyball players.
3. The present study will provide a scientific base and guidance to the physical educationists, coaches, sports scientists, exercise physiologists and fitness leaders to design the combined training programme using the Complex training modules in the present study with the view to develop variables related to muscle fitness parameters, physiological and skill performance variables.
4. One of the basic objectives of the present study is to extract the full potentials from the players with the feasible means and methods. Having the usage of full potential abilities, low achievers can be easily made as high achievers. It helps them play matches that are at par with competition successfully.

5. Finding of this research study will give a basic knowledge to the trainers and fitness leaders to envisage and conduct further research in various training methods, training programmes, training intensity and training load to enhance the performance of volleyball players.
6. Generally there is a chance to occur injuries for players during the course of training itself, since the given training is a progressive nature with rest. But in the case of effect of Complex training, the mode of training is alternative form of slow and fast exercises. The Complex training of slow form of training provides recovery and maintains the resultant effect. Such an astonishing nature of Complex training helps to reduce the rate of incidence in the occurrence of injuries during the course of training. By this, the players can be benefited to continually participate in the training instead of drop out from the training due to injury.
7. The result of this study will add to the quantum of knowledge in the areas of training methods, fitness and wellness, exercise physiology and exercise science.
8. The periodical evaluation of players on criterion measures helps the players to know their level of progress over the period of time. It helps them to motivate themselves to actively participate in the training programme.
9. Further the results on periodical evaluation on criterion measures helps the physical trainers and coaches to find out the status of players at varied intervals.

1.8 DELIMITATIONS

The present study was delimited in the following aspects.

1. Subjects of the present study were the participants of Acharya Nagarjuna University inter-collegiate volley ball tournament.

2. The total numbers of subjects were delimited to eighty with equal number of twenty in each group.
3. The muscle fitness parameters were delimited to muscle strength, abdominal muscular strength and endurance, muscle power.
4. The physiological parameters were delimited to aerobic capacity and anaerobic capacity.
5. The skill performance variables were delimited to passing ability, serving ability and overall playing ability.
6. The training programme was delimited to weekly three days for a period of 12 weeks.

1.9 LIMITATIONS

The study was limited in the following aspect.

1. The influence of certain factors like life style, daily routine work, diet and other factors on the results of the study were not taken in to consideration.
2. No attempt has been made to control the factors like air resistance, intensity of light atmosphere and temperature during training and testing period.
3. The educational and socio-economic back grounds of the subjects were not taken into consideration.
4. The knowledge of previous experience in training were not taken into consideration
5. The subjects were motivated verbally during training periods. Due to lack of time no special motivational was given.
6. The psychological stress and other factors, which affect the metabolic function were not taken into consideration

1.10 DEFINITION OF TERMS

Training

Training has been explained as a programme of exercises designed to improve the skills of sport and increase the energy capacities of an athlete for a particular sport.

Resistance Training

It is a form of exercise for the development of strength and size of skeletal muscles. It is a common type of resistance training which is one form of strength training. It can provide significant functional benefits and improvement in overall health and well being.

Plyometric Training

Plyometrics by definition is a type of exercise using explosive movements to develop muscular power, especially bounding, hopping and jumping; which may be a narrow interpretation. Plyometrics or ‘Shock method training’ is the term now applied to exercise that have their roots in Russia, where they were first known simply as jump training drills. The actual term “Plyometrics” was first coined in 1975 by FRED WILT, one of American’s forward thinking track and field coaches.

Complex training

Complex training is the use of heavy resistance training followed immediately by a plyometric activity with a biomechanically similar movement pattern.

Combined Training

It is highly effective form of physical training that combines both resistance training and plyometric training,

Volleyball

Volleyball is sport played by two teams consisting of 12 players each on a playing court divided by a net. The object of the game is to send the ball over the net

in order to ground it on the opponent's court, and to prevent the same effort by the opponent. The team has three hits or contacts to return the ball.

Skill Performance

The ability of the player to execute the various techniques of the fundamental volleyball skills, efficiently, and accurately, according to the game situation.

Service

The service is the act of putting the ball into play by the back-right player, placed in the service zone.

Passing

Passing is also called reception. The pass is the attempt by a team to properly handle the opponent's serve or "free ball". Proper handling includes not only preventing the ball from touching the court, but also making it reach the position where the setter is standing quickly and precisely. The skill of passing involves fundamentally two specific techniques: underarm pass, or bump, where the ball touches the inside part of the joined forearms, at waist line; and overhand pass, where it is handled with the fingertips above the head.

Overall Playing Ability

The ability of the player to execute various techniques and tactics of volleyball skills, like serving, passing, attacking, and blocking efficiently and accurately, during the game situation.