Chapter I

INTRODUCTION

Exercise has long been accepted as an intervention to improve physical health and well being. The athletes' quest for excellence necessitates to cope with tough training programmes and perform well in competitions on a regular basis. Athletes have been trying to get the most out of their training. However, it was not until the last few decades, that levels of sport performance have exhibited a spectacular increase. Records that once were imaginary can now be regularly reached. At the same time, the amount of training of modern competitors is considerably higher than that of the past. This would not be possible without the concurrent evolution in training methodology. The necessity of superior performances in competition has impelled coaches to introduce increasingly effective and sophisticated training methods.

Several sciences have contributed to the understanding of the effects of exercise on the body, and together have formed a science of their own, the science of training. The latter focuses on sports performance and aims to understand, measure and improve the effects of exercise on the body and minimize the prevalence of injury. During competition, the participant is expected to withstand several stressful stimuli, while
performance can be influenced by numerous internal factors (e.g. physiological, biochemical, technical and tactical) and/or external factors (e.g. climatic, travelling, financial). Training has to be structured in a way that simulates these conditions and prepares for the actual event. For optimal performance, therefore, competitors must be experts in the technical side of their event, be psychologically prepared to handle the enormous stress of critical situations, and be free from injury; they must also be physically ‘fit’.

Physical fitness is served by individual sciences such as paediatric and adult physiology, biochemistry, biomechanics and sports medicine and it can be defined as the individual’s ability to meet the demands of a specific task. It primarily consists of elements of aerobic and anaerobic fitness, muscular strength and flexibility. Regardless of the performance level, sex and age, all competitors use one or more of these elements of fitness during their daily practice. The fitness requirement for each sport varies according to the nature and demand. Consequently, training programmes have to address the most important elements of physical fitness in each sport.
Training

Training planning has existed, though in a crude form, since ancient times and was used for the Olympic Games or military purposes. The Greek athlete Milon from the city of Croton was the first known competitor who, perhaps unwittingly, implemented the principle of periodization as early as the 6th Century BC. He determined the training cycles by carrying a bull calf on his back each day until the animal reached maturity. As levels of a particular fitness component increase, a higher quality of exercise stress is needed to create overload and lead to physiological adaptations.

Traditionally, coaches and trainers have planned conditioning programmes for their teams by following regimens used by teams that have successful win-loss records. This type of reasoning is not sound because win-loss records alone do not scientifically validate the conditioning programs used by the successful teams. In fact, the successful team might be victorious by virtue of its superior athletes and not its outstanding conditioning program. Without question, the planning of an effective athletic conditioning program can best be achieved by the application of proven physiological training principles. Optimizing training programs for athletes is
important because failure to properly condition an athletic team results in a poor performance and often defeat. To improve performance of kabaddi players combined effect of strength and plyometric training was administered in this study.

**Kabaddi**

Kabaddi is basically an outdoor team game, played in the tropical countries of Asia. This indigenous game of India was adopted by other countries in Asia viz. Pakistan, Nepal, Bhutan, Bangladesh, Sri Lanka, Maldives, Malaysia and more recently by Japan and China. The excitement and thrill provided by the game has made it very popular and Kabaddi is rightly called the 'Game of the masses', since spectators totally involve themselves and give the players a great deal of encouragement. The game requires no equipment whatsoever, and the rules of the game are very easy to comprehend. This is the reason for the popularity of the game in rural areas, since rural youth in India can ill-afford the sophisticated equipment demanded by other sports.

The game demands agility, muscular co-ordination, breath holding capacity, explosive power, upper and lower body strength, speed, aerobic and anaerobic endurance, flexibility, core strength, quick response and a great deal of presence of mind. Kabaddi was probably invented to develop defensive
responses by an individual against group attacks and a group’s responses to an individual attack. This is the only combative sport in which offence is an individual effort whereas defence is a group effort. For an individual to face up to seven opponents and remain unscathed is no mean achievement. This calls for tremendous fitness of body and mind and the ability to concentrate as well as anticipate the opponent’s moves. This can only be achieved with a lot of tactical preparation and manoeuvering.

Since the inception of kabaddi in Asian games Indian men and women were champions till date. In 1990 Beijing Asian games and in 2010 Guangzhou Asian games men and women kabaddi events were added in Asian games. To continue the winning streak preparation of players is essential. The players require strength and power to excel in the game. So players require great strength to stop and push the offensive and defensive players. Similarly, they require speed and power which they can execute during the ride and catching. So combining the strength and plyometric exercises during a training regimen can maximize the players performance in the competition.
**Strength training**

*Strength* is the ability of the neuromuscular system to produce internal tension (*in the muscles and connective tissues that pull on the bones*) to overcome an external force. Whether the external force demands the neuromuscular system to produce stability, endurance, maximal strength, or power, internal tension within the muscles is what leads to force production. The degree of internal tension produced is the result of *strength adaptations*. The specific form of strength or internal tension produced from training is based on the type and intensity of training used by the players.

Resistance training programs have traditionally focused on developing maximal strength in individual muscles, emphasizing one plane of motion (*typically the sagittal plane*). Because all muscles function eccentrically, isometrically, and concentrically in all three planes of motion (*sagittal, frontal, and transverse*) at different speeds, training programs should be designed using a progressive approach that emphasizes the appropriate exercise selection, all muscle actions, and repetition tempos. Because muscle operates under the control of the central nervous system, strength needs to be thought of not as a function of muscle, but as a result of activating the neuromuscular system. Strength
gains can occur rapidly with strength training in the beginning clients and can increase with a structured, progressive resistance training program. One factor in increased strength is an increase in the number of motor units recruited, especially early in a training program. Using heavier loads increases the neural demand and recruitment of more muscle fibers until a recruitment plateau is reached, after which further increases in strength are a result of fiber hypertrophy.

Strength cannot be thought of in isolation. Strength is built on the foundation of stabilization requiring muscles, tendons, and ligaments to be prepared for the load that will be required to increase strength beyond the initial stages of training. Whereas stabilization training is designed with the characteristics of type I slow-twitch muscle fibers in mind (slow-contracting, low tension output, and resistant to fatigue), strength training is designed to match the characteristics of type II muscle fibers (quick-contracting, high tension output, prone to fatigue). Thus acute variables (sets, reps, intensities, etc.) are manipulated to take advantage of the specific characteristics of each fiber type. The majority of strength increase will occur during the first 12 weeks of resistance training from increased neural recruitment and muscle hypertrophy. Intermediate and advanced lifters will find
it necessary to carry out a more demanding program in terms of training volume and intensity by following a sound periodized schedule.

**Plyometric training**

Plyometric exercise is a popular form of training used to improve athletic performance. It involves a stretch of the muscle-tendon unit immediately followed by a shortening of the muscle unit. This process of muscle lengthening followed by rapid shortening during the stretch-shortening cycle (SSC) is integral to plyometric exercise. The SSC process significantly enhances the ability of the muscle-tendon unit to produce maximal force in the shortest amount of time. These benefits have prompted the use of plyometric exercise as a bridge between pure strength and sport-related power and speed (Chu 1983).

As plyometric training techniques have evolved, the description of this training and the related terminology have undergone a metamorphosis. Because the term *plyometrics* is a later creation in American training literature, much of the early physiological research on this type of training described it by other names. The term used by researchers in Italy, Sweden, and the Soviet Union for the type of muscle action involved was the *stretch-shortening cycle*. Coaches in these countries simply
referred to the use of such exercises in their training programs as jump training. Based on original forms of training described by Yuri Verkhoshansky, the Russian national jump coach for track and field, plyometrics were originally developed as a shock method of training. Verkhoshansky believed that in order for athletes to develop a higher level of muscle performance, they needed to be presented with a stimulus that was unique and different from their usual training methods.

Plyometric exercises have been described as activities that involve maximal effort, such as high-intensity depth jumps. On the other hand, plyometric exercises have also been described as any movement that involves the stretch-shortening cycle, whether that movement requires maximal or submaximal effort. Fred Wilt, an American track and field coach from the University of Iowa, was credited with coining the term *plyometric*. Based on its roots, the word seemed to aptly describe exercises consisting of hops, jumps, and bounds used largely by track and field athletes to improve performance in their events (Chu & Myer 2013).

The focus and application of plyometric training have evolved in recent years. In athletic conditioning programs, plyometric exercises are now often performed at a submaximal
level and are directed at the achievement of proper biomechanical technique in sport. Training in this manner has been effective in improving performance (Chu & Myer 2013).

**Combined training of strength and plyometric training**

Athletes looking to increase their strength and power often incorporate both weight-training and plyometrics into their workout programs. Scheduling the weight-training and plyometric workouts appropriately is essential to maximize the effectiveness of specific sports training. To build strength with the weight-training session and explosive power with the plyometrics, players need to give the muscles an adequate amount of rest between each workout. The days off between workouts are when the muscles heal, recover and adapt. The schedule of training and competing might push athletes beyond their physiological and psychological limits. To recuperate the physiological and psychological parameters of athletes they concentrate on recovery patterns with optimal level which might enhance human performance (Bompa 1999).

The combined training involves the completion of a strength training prior to plyometric training. This type of training stimulates the neuromuscular system. That is, it activates both the muscular fibers and the nervous system, so
that slow-twitch fibers behave like fast-twitch fibers (Chu 1998). In addition, resistance training increases motor neuron excitability and reflex potentiation, which may lead to better training conditions for subsequent plyometric exercises. The combined training demonstrates the necessity of a multi component conditioning program for enhancing performance.

The coaches and trainers designed various training packages to improve strength and power simultaneously among athletes. Now they found a way to improve both strength and power of athletes by incorporating both type of training in a combined form which is more versatile than training performed separately. Many published studies cite the advantages of, and strategies for, combining weight training and plyometric training for explosive power and improved performance (Adams et al. 1992; Bauer, Thayer & Boras 1990; Blakey & Southard 1987; Chu 1998; Clutch et al. 1983; Ford et al. 1983).

**Statement of the Problem**

The kabaddi coaches face several problems while preparing their team for university competition. Among which the duration for preparing their team for university competition is very little is a common problem faced by coaches. In order to
prepare their team to their expected standard they opt for combined training which simultaneously improve strength and power or strength and endurance etc. Therefore, the purpose of this study is to examine the combined effect of strength and plyometric training on body composition and physical fitness variables of male kabaddi players.

**Delimitations**

The study was delimited to the following factors.

1. To achieve the purpose of the study, forty eight (48) male inter collegiate kabaddi players were selected from affiliated colleges of Acharya Nagarjuna University.

2. These players were classified into two groups namely strength and plyometric training group and Control group, each group constitutes of 24 subjects.

3. These player’s age 24.26 ± 4.58 years, weight 73 ± 6.50 kg and height 173.25 ± 6.85 cm.

4. The study was further delimited to ten weeks of combined training of strength and plyometric training performed for 3 days per week (*Monday, Wednesday and Friday*).
5. The criterion variables selected for the study were body composition (*percent body fat, lean body mass, fat mass*) and physical fitness variables (*speed, agility, explosive power, maximum muscular strength of upper body, maximum muscular strength of lower body, endurance, flexibility, muscular endurance of abdominal muscles*).

6. The subjects percent body fat, lean body mass and fat mass was measured through skinfold caliper.

7. The subjects physical fitness variables selected for the study were tested by 50 dash dash, T – test, vertical jump test, 1RM bench press, 1RM leg press, Cooper’s 12 minutes run and walk test, sit and reach test and sit ups.

8. All testing took place at the same time of the day to control the circadian variation in selected physical fitness variables.

**Limitations**

1. The heterogeneous character of the subjects in hereditary and environmental factors was considered as limitation.

2. The disparity prevailed in internal and external factors during testing periods could not be controlled.
3. The training was administered separately in their respective college campus, among them few were day scholars and few were hostellers which could not be controlled.

**Hypotheses**

On the basis of the literature reviewed, and available research finding, experts, opinion and scholars, own understanding of the problem, the following hypothesis was formulated.

- It was hypothesized that ten weeks of combined strength and plyometric training will not have desirable changes on body composition of male kabaddi players.
- It was also hypothesized that ten weeks of combined strength and plyometric training will not have desirable changes on physical fitness variables of male kabaddi players.

**Definitions of the Terms**

*Exercise*

Exercise is a single acute bout of bodily exertion or muscular activity that requires an expenditure of energy above
resting level and that in most, but not all, cases results in voluntary movement.

Any and all activity involving generation of force by the activated muscle. Exercise can be quantified mechanically as force, torque, work, power, or velocity of progression.

*Training*

A consistent or chronic progression of exercise sessions designed to improve physiological function for better health or sport performance.

*Exercise intensity*

A specific level of muscular activity that can be quantified in terms of power (*energy expenditure or work performed per unit of time*), the opposing force (*e.g. by free weight or weight stack*) isometric force sustained, or velocity of progression.

*Free weight*

An object of known mass, not attached to a supporting or guiding structure, which is used for physical conditioning and competitive lifting.

*Strength training*

Strength training has two different, sometimes confused meanings - a more broad meaning that refers to any training that uses a resistance to the force of muscular contraction
(better termed strength training), and elastic or hydraulic resistance, which refers to a specific type of strength training that uses elastic or hydraulic tension to provide this resistance (Nieman, 2011).

**Plyometric training**

Plyometric training aimed at linking strength with speed of movement to produce power (Chu 1998).

**Body Composition**

The partitioning of body mass into fat free mass (weight or percentage) and fat mass (weight or percentage).

**Body Height**

The maximum distance from the floor to the vertex of the head, when the head is held in the Frankfort Plane and a gentle traction force is applied (Duquet & Carter, 2009).

**Body mass**

The force of gravity acting on the mass of the body (Duquet & Carter, 2009).

**Skin fold fat thickness**

The most widely applied field technique used to estimate body density, relative body fat, and fat-free mass. It involves measurements with caliper of the skinfold fat at one or more sites.
Percent body fat

The ratio of fat mass to total body mass expressed as a percentage.

Lean body mass

The sum of the body’s fat-free mass and essential fat is lean body mass.

Fat mass

The absolute amount of body fat is fat mass.

Physical fitness

Physical fitness refers to the capacity of an athlete to meet the varied physical demands of their sport without reducing the athlete to a fatigued state (Davis et al. 2000).

Speed

Speed is movement distance per unit time and is typically quantified as the time taken to cover a fixed distance.

Agility

Agility is the ability to stop, start and change the direction of the body or body parts rapidly and in a controlled manner.
Power

Power is the rate at which work is performed or the rate of the transformation of metabolic potential energy to work and/or heat.

Strength

Strength will be employed to identify the maximal force or torque that can be developed by the muscles performing a particular joint movement.

The maximal force or torque a muscle or muscle group can generate at a specified or determined velocity.

Flexibility

The ability of a joint to move through its full range of motion, is another physical fitness test indicative of general fitness and functional ability. The assessment of flexibility should only be undertaken after a suitable warm up, and should identify those areas needing attention (Birch, MacLaren, & George 2005).

Muscular endurance

Muscular endurance relates to the muscle’s ability to continue to perform without fatigue (Nieman 2011).
Maximum muscular strength

Maximum force that a muscle can exert in a single voluntary contraction is maximum muscular strength.

Significance of the Study

1. Strength is the basis of high-level performance in most sports. Speed, endurance, power, agility and quickness are some of the most significant, and visible, components that required for kabaddi players to excel in competition. This study would reveal the importance of carefully designed combined strength and plyometric training programs in improving overall performance of male kabaddi players.

2. The present study would exemplify the importance of combined strength and plyometric training which can be administered to active and inactive individuals those wishes to reduce percent body fat and fat mass.

3. Endurance plays a vital role in modern kabaddi game. This study would show the effectiveness of combined strength and plyometric training in enhancing endurance.

4. In the game of kabaddi, sprinting of players is determined by leg strength, power and agility. In the present study the
influence of combined strength and plyometric training on speed, power and agility would be revealed.

5. A kabaddi player tries to stop, hit and lift the players with hand and moves along with the defence player during a hold. This clearly shows that they require maximum strength on upper and lower body. Present study would be useful in determining the efficiency of strength and plyometric training on upper and lower body maximum strength of kabaddi players.

6. In the game of kabaddi, back flexibility and core strength influences speed, power and agility. In the present study the influence of combined strength and plyometric training on back flexibility and core strength would be revealed.

7. The finding of the study may add to the quantum of knowledge in the area of training methods and results of the study may be of great value for designing suitable training program for the movement of performance abilities.