INTRODUCTION
Chapter I

INTRODUCTION

The human body is an amazing machine. All human movements, from the blinking of an eye to the running of a marathon, depends on the proper functioning of skeletal muscles. Whether it is the strained effort of a sumo wrestler or the graceful pirouette of a ballet dancer, physical activity can be accomplished only through muscle force.

In the never-ending quest for performance perfection, many athletes devote as much time as possible to training, believing that the more they train better will be their performance. The skill levels of athletes in various sports improve from year to year. Athletic records reach new heights, and the margin between success and failure in the world of sport becomes smaller. Consequently, both coaches and athletes look for that slight edge that might ensure victory by adapting various branches of sports science.

Handball

Handball is a modern ball game which belongs to the family of team sports. It combines the best features of different branches of sport, that is, the advantages of physical abilities, technical skills and tactical knowledge.

All human creations are subject to constant change, the game of handball is not an exception. The technical abilities have been improved, tactical systems refined, and laws of the game adapted to a more modern
concept. Since 1952 indoor handball has been gaining more and more ground. Indeed, handball became a universal sport and its popularity has increased quite obviously. The game is characterised by two alternating sides the attack and the defence with the purpose to score or obstruct the goal.

The *attack* starts the moment the team gains possession of the ball and lasts until they lose it. During this period the attackers try to score in the different phases of the attack by employing individual, group or team technical-tactical elements of attack.

The *defence* starts the moment the team loses possession of the ball and lasts until they gain it back. During this period, the defenders try to obstruct the opponent’s scoring attempts in the different phases of the defence by employing individual, group or team technical-tactical elements of defence.

For the sake of effectively accomplishing the duties of attack and defence within the limitations of the rules, the movement repertoire of handball developed and this demonstrates a logically structured hierarchy. As the well built pyramid consists of blocks put together accurately, so too is handball made up of tightly linked movement elements from its base to its peak.

The *movement elements* are the smallest units of the game, that is, a recognisable line of movement in which a player's rationalised activity manifests itself. According to the characteristics of the activity then, this
movement can be a basic displacement, a technical procedure or a tactical manoeuvre.

The *physical basics* are natural human movement elements of running, jumping, throwing and these ensure the fundamental conditions for playing the ball or obstructing its advance. On these basic movements then, the characteristic technique is built up, specialised for the attack and for the defence.

**Training**

Traditionally, coaches and trainers have planned conditioning programs 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 sports performance of handball players different types of training are administered, among which plyometric and speed, agility and quickness (SAQ) training were administered in this study.
**Plyometric training**

To any sport that requires powerful, propulsive movements, such as football, volleyball, sprinting, high jump, long jump, and basketball, the application of plyometric or explosive jump training is applicable (McArdle, Katch & Katch, 2001). Plyometrics has been a very popular training technique used by many coaches and training experts to improve speed, explosive power output, explosive reactivity and eccentric muscle control during dynamic movements (Coetzee, 2007). It is considered a high-intensity, physical training method, consisting of explosive exercises that require muscles to adapt rapidly from eccentric to concentric contractions (Chu, 1998). Plyometric training has widely been used to enhance muscular power output, force production, velocity, and aid in injury prevention (Robinson *et al.*, 2004; Potash & Chu, 2008).

**Speed Agility and Quickness (SAQ) training**

Speed, agility and quickness training has become a popular way to train athletes. Whether they are school children on a soccer field or professionals in a training camp, they can all benefit from speed, agility and quickness training. This method has been around for several years, but it is not used by all athletes primarily due to lack of education regarding the drills. Speed, agility and quickness training may be used to increase speed or strength, or the ability to exert maximal force during high-speed movements. It manipulates and capitalizes on the stretch-shortening cycle while bridging the gap between
traditional resistance training and functional-specific movements. Some benefits of speed, agility and quickness training include increases in muscular power in all multiplanar movements, brain signal efficiency, kinesthetic or body spatial awareness, motor skills and reaction time (Brown, Ferrigno & Santana, 2000).

Speed, agility and quickness training can cover the complete spectrum of training intensity, from low to high intensity. Every individual will come into a training program at a different level; thus training intensities must coincide with the individual’s abilities. Low intensity speed, agility and quickness drills can be used by everyone for different applications. No significant preparation is needed to participate at this level of speed, agility and quickness training. Higher intensity drills require a significant level of preparation. A simple approach to safe participation and increased effectiveness is to start concurrent strength training program when starting speed, agility and quickness training (Brown, Ferrigno & Santana, 2000).

Speed, agility, and quickness are some of the most significant, and visible components of athletic success. An improvement in the ability to react quickly, apply significant force rapidly in the appropriate direction, and to redirect that force if needed is the ultimate goal of a program to improve speed, agility, and quickness. A carefully designed program that addresses these factors of athleticism significantly improves overall performance and reduces the risk of injury. Speed, agility, and quickness all involve learned motor skills.
Although the magnitude of proficiency will vary with each individual, learning the efficient and effective execution of these skills can improve overall athletic ability (Brown, Ferrigno & Santana, 2000).

**Statement of the Problem**

Most of the investigation attempts to assess the value of physical exercises and drills training programme as a means of altering physical efficiency and sports performance ability. The activities generally involve high-energy expenditure and are commonly believed to be effective in contributing to physical efficiency and sports performance ability. The review of literature reveals scarcity of studies investigating the influences of plyometric (PLYO) and speed, agility and quickness (SAQ) training programmes on the elements of physiology and physical fitness.

The purpose of the study was to investigate the effects of PLYO and SAQ training on selected physiological and physical fitness attributes of male handball players.

**Objectives of the Study**

The specific objectives of the present study were:

- To study overall effectiveness of specific PLYO and SAQ trainings on selected physiological and physical fitness attributes of male handball players.
➢ To compare the effectiveness of PLYO and SAQ training on selected physiological and physical fitness attributes of male handball players.

➢ To suggest effective training programme to handball players.

**Delimitations**

1. In this study thirty (30) male handball players volunteered to participate as subjects in the study. Moreover, during the course of the study no players withdrew and all players completed this study.

2. The subjects confined to this study were selected from Sports Authority of India, Sports Training Center (STC), Sarurnagar, Hyderabad, Andhra Pradesh, during the academic year 2011 – 2012. The mean age of the subjects was 21.33 ± 2 years.

3. The subjects considered in this study were classified into three groups, namely: PLYO, SAQ and control (CON) groups. Each group consisted of 10 players.

4. The experimental groups confined to this study were subjected to 6 weeks of respective PLYO and SAQ training programmes.

5. The criterion variables selected for the study were physiological variables *(percent body fat, lean body mass, anaerobic capacity, fatigue index, aerobic capacity)* and physical fitness variables *(speed, vertical explosive power, horizontal explosive power, agility, flexibility, muscular endurance)*.
6. During the period of training, all subjects confined to this study have undergone handball practice in the evening sessions, and in the morning sessions the experimental groups performed respective training while control group remained passive.

7. The subjects had breakfast between 09:15 and 09:30am, lunch at 13:00 hours and dinner at 20:30 hours respectively. The subjects had no caffeine from start to end of the study.

8. All testing took place at the same time of the day to control the circadian variation in physiological and 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. In SAQ training the intensity of the activity was not fixed, however the activities are performed at high intensity tempo which was also not fixed.
Hypotheses

On the basis of the literature reviewed, available research findings, expert’s opinion and scholar’s own understanding of the problem, the following hypotheses were formulated.

1. It was hypothesized that PLYO and SAQ training would have significant influence on selected physiological and physical fitness attributes of male handball players.

2. It was also hypothesized that significant variations would exist between the effectiveness of PLYO and SAQ training on selected physiological and physical fitness attributes of male handball players.

Definition of the Terms

*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).

*Motor fitness*

Motor Fitness refers to the ability of an athlete to perform successfully at their sport. (Davis *et al*., 2000).
**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).

**Body composition**

The relative proportion within a sportsperson’s body of bone, muscle and fatty tissue (Davis et al., 2000)

Body composition analysis provides an evaluation of percentage body fat and fat-free mass (Birch, MacLaren, & George, 2005).

**Skinfold measure**

The subcutaneous fat is the largest depot of body fat, measurement of these fat depots may be useful in estimating the total body fat. The skinfold method measures a double fold of skin and subcutaneous fat by means of calipers which should apply a constant pressure over the measurement site (Birch, MacLaren, & George, 2005).
**Percent body fat**

Percent body fat is the percentage of total weight represented by fat weight, and it is the preferred index used to evaluate a person’s body composition.

**Lean body mass**

Body composition refers to the body’s relative amounts of fat and lean body tissue or fat-free mass (e.g., muscle, bone, water). Body weight can be subdivided simply into two components: fat weight (the weight of fat tissue) and fat free weight (the weight of the remaining lean tissue).

**Anaerobic capacity**

Anaerobic capacity may be defined as the maximal amount of ATP formed by the anaerobic processes during a single bout of maximal exercise.

**Fatigue index**

It indicates the rate at which power output declines for an athlete.

**Aerobic capacity**

It is the maximal capacity for oxygen consumption by the body during maximal oxygen consumption, and cardio respiratory endurance capacity (Wilmore & Costill, 1994).
The VO\textsubscript{2max} provides a quantitative statement of an individual’s capacity for the aerobic energy transfer (McArdle, Katch & Katch, 1991).

Cardiorespiratory endurance is the ability of the lungs and heart to take in transport adequate amount of oxygen to working muscles which allow activities involving large muscle groups to sustain for long period of time (Fox, Bowers & Foss, 1993).

\textit{Speed}

The ability to perform a movement within a short period of time (Birch, MacLaren, & George, 2005).

Speed is the maximum rate at which a person is able to move his /her body (Davis \textit{et al.}, 2000).

\textit{Power}

Power is a skill-related component of physical fitness that relates to the rate at which one can perform work (Nieman, 2011).

\textit{Agility}

Agility is the physical ability that enables a person rapidly to change body position and direction in a precise manner (Davis \textit{et al.}, 2000).
**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).

**Plyometric training**

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

**SAQ training**

Speed, agility and quickness are some of the most significant, and visible components of athletic success. An improvement in the ability to react quickly, apply significant force rapidly in the appropriate direction and to redirect that force if needed is the ultimate goal of a program to improve speed, agility and quickness.
Handball

Handball is characterized by two alternating sides: the attack and the defence with the purpose to score or obstruct the goal.

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 are required for handball players to excel in competition. This study would reveal the importance of carefully designed PLYO and SAQ training programs in improving overall performance of male handball players.

2. The present study would exemplify the importance of PLYO and SAQ training which can be administered to active and inactive individuals who wish to reduce their body weight.

3. This study would show the level of alterations elicited on repeated sprint ability of handball players due to PLYO and SAQ training programs.

4. Aerobic capacity plays a vital role in modern handball game. This study would show the effectiveness of PLYO and SAQ training in enhancing aerobic capacity.
5. In the game of handball, linear speed of players is determined by leg strength, power and flexibility. In the present study the influence of PLYO and SAQ training on speed, power and flexibility would be revealed.

6. Handball players make body feints and change direction frequently during a game. Present study would be useful in determining the efficiency of PLYO and SAQ training on agility of handball players.

7. The findings of the present study would show whether PLYO and SAQ training impacts core strength of handball players.

8. This study would distinguish PLYO and SAQ training impact on physiological and physical fitness of handball players.

9. The findings of this study may also in general assist the physical education teachers, coaches, and experts in the assessment of performance status of their players.

10. 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.
Outline of the study

This work investigates the effect of PLYO and SAQ training on selected physiological and physical fitness attributes of male handball players. The following chapters outline the steps taken to answer the research objectives. The second chapter summarizes the review of literature; the third chapter outlines the experimental design of the study, and materials and methods used; the fourth chapter reports the data analysis, results obtained, and discussion on findings of the study; and the fifth chapter includes the brief summary and conclusions of the study and recommendations for the further outlook.