Chapter I

INTRODUCTION

Ever since sport began, 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 is used in 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 formed 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 a competition, the participant is expected to withstand several stressful stimuli, while performance can be influenced by numerous internal factors and/or external factors. Training has to be structured in a way that stimulates 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 exercise physiology, biochemistry, biomechanics, psychology 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. For example, in an endurance event such as the marathon, aerobic capacity is the most important element for success, where anaerobic power predominates in sprinting events such as 100 metres. Consequently, training programmes have to address the most important elements of physical fitness for each individual sport.

Since the ancient times planning of workouts has existed though in a crude form, and it was used for the Olympic Games and 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.

Periodisation training is designed to help an athlete peak at the right time. It calls for varying the training stimuli (i.e. training volume, intensity factors, and exercise) over periods of time to allow for a proper progression in
the exercise stress and planned periods of rest (Kraemer et al., 2007). The basic concept of periodisation is that variation in training is needed to optimise both performance and recovery.

The linear model is attributed to the work of the eastern bloc countries in the 1950’s when the weightlifting strength and conditioning coaches found that decreasing the volume and increasing the intensity in the weeks leading towards competition elevated performance (Kraemer et al., 2007). In the linear model of periodisation each training phase is designed to emphasis a particular adaptation, with the overall goal of providing a consistent increase in stimulus to overload the muscular and neuromuscular systems, resulting in adaptations which will increase overall physical performance (Bompa & Haff, 2009). Performance gains are typically related to changes in more than one physiological system. Training programmes must train each physiological system with specific sport performance goals in mind (Baechle & Earle, 2000).

As early as the middle of the 19th Century appeared the first studies on human muscular performance, published in the then popular Philosophical Magazine. However, the modern practice of periodization can be traced to the 1950s and early 1960s when East European coaches observed that their athletes could not withstand the enormous training load to which they where subjected. In contrast, coaches observed that focusing on just a few important competitions was far more effective than preparing the athlete for a year-round competition programme. This anecdotal evidence was later supported
by some scientific data, suggesting that athletes who trained using periodized models attained superior levels of performance than those who used non-periodized models (Fleck, 1999).

Hockey has been classified as a goal-striking invasion game (Hughes & Bartlett, 2002) and it originated in primitive form, thousands of years before the first Olympic Matches in 776 B.C. After that, the match evolved through roman-influenced Europe and developed derivatives in Germany (Kolbe), Holland (Het Kolven), France (Hocquet) and Ireland (Hurling). The first hockey association was formed in 1873 and international field hockey contests were played by men as early as 1895 (Anders & Myers, 1999; Reilly & Borrie, 1992).

Field hockey is a very popular game played in more than 118 countries by men and woman of all ages (Anders, 2008). Hockey is played between two teams of eleven players, including a goalkeeper. The field of play is rectangular (90m long and 55m wide) and a match consists of two, thirty-five minute halves. The object of the match is to hit the ball (approx 9 inches in diameter) into the opponents goal using specially shaped sticks that are 36-42 inches in length. A significant rule of hockey is that for a goal to be scored the ball must touch an attacking player’s stick inside of the attacking circle (a 16yard semi-circle around the goal). Additionally, penalty corners, which are a significant goal scoring set-piece opportunity are awarded for infringements by the defenders inside the circle. These two factors make getting the ball into the circle a significant objective for the attacking team.
The positions of hockey can be divided into five categories; goalkeepers, fullbacks, halves, inside forwards and strikers and each have specific roles and activities. Although there are many options, a typical team formation is a goal keeper, two fullbacks, three halves, two inside forwards and three strikers. Hockey has had two significant modifications. In the 1970’s the playing surface changed from grass to artificial turf which altered the pace and style of the game considerably. More recently, rule changes have also been introduced to modify the pattern of the game. The two most significant changes (mid-1990s) have been to allow unlimited substitutions (*a maximum of 16 players can play in each match and can rotate as frequently as they like*) and the removal of the offside rule (*which has created attacking space and led to more goals being scored per match*). These changes were initiated to promote fast-paced, continuous play.

There are many factors that contribute towards success in team sports. Foremost among these is game technical skill and the cognitive ability to make correct decisions. In addition, players must possess certain physical qualities. They require high aerobic and anaerobic power, good agility, joint flexibility and muscular development, and be capable of generating high torques during fast movements (Reilly, Bangsbo, & Franks, 2000). The predominant metabolic pathways during hockey match-play are aerobic and the metabolic responses are broadly analogous to those encountered in endurance exercise (Reilly *et al.*, 2000). Although aerobic metabolic pathways provide the dominant energy route, anaerobic activity is highlighted
during the more crucial moments of the match and contributes directly to winning possession of the ball and to the scoring or conceding of goals. Hockey is referred to as an intermittent sport due to the pattern of repeated short bursts of high intensity activity interspersed with active and passive recovery. Such a pattern requires lactate removal and rapid regeneration of phosphocreatine (PCr) stores to allow for sustained performance (Tomlin & Wenger, 2001). Muscle strength is relevant to striking the ball and to tackling and tolerating physical impacts with other players. Anaerobic power is also important in accelerating the body during short movements and changing direction quickly. Players who can sustain a high work-rate throughout a match gain an advantage over equally skilled players whose energy can approach depletion towards the end of a game or after a series of high intensity efforts, resulting in reduced performance (Reilly et al., 2000).

In India hockey was introduced in 19th century during the British rule. During their period India quickly learned this game and established itself as one of the popular game. The efficiency of Indian team was tested in 1928 Amsterdam Olympics, where Indians won first Olympic hockey gold medal. This winning line was continued in Olympics and created a record of 8 gold, 1 silver and 2 bronze medals. The nation was pride of performance established in world arena. Thereby, Hockey is considered as national sports of India. The present scenario is that India after 1980 failed to regain its spot in Olympics podium because of several modifications in the game. In order to regain its supremacy talent identification and establishment of hockey
academies around the nation was carried out. The RDT hockey academy at Anantapur, Andhra Pradesh, India was launched to identify future stars and nurtured them right from young age. This academy is initiated to work at grass root level which reaps progressive development of the young players through time.

Field hockey places high demands on a player’s aerobic and anaerobic energy systems (Boyle et al., 1994), as the players cover an average distance of 8,000 – 10,000m during a match depending on the playing position (Konarski et al., 2006). Boyle and their colleagues (1994) further emphasize the physiological demands of the game by indicating that hockey players reach near maximal heart rate levels during matches. According to Elferink-Gemser and his colleagues (2004), the players are required to perform a range of technical skills such as sprinting and turning with the ball under control, passing the ball from one player to another and scoring goals, whilst anticipation and decision-making are seen as some of the tactical qualities of the game. Enumerative field hockey can be described as a fast, technical team sport (Anders, 2008) and requires well-developed physiological, tactical, technical and psychological skills.

When looking forward to making improvements in the area of physical fitness within the sport of hockey, research angles such as that taken by Elferink-Gemser et al., (2007) and Polman et al., (2004) could be of great use. Elferink-Gemser et al., (2007) measured physiological, technical, tactical, and psychological characteristics of thirty elite and thirty five sub-elite players on
three occasions, separated by intervals of one year, with the aim of identifying performance characteristics that could help predict future elite hockey players. By identifying the most important performance characteristics within physiology, coaches will know more of where to aim their focus with fitness training. Polman et al., (2004) compared the efficacy of three different fitness programmes with three groups of female soccer players over a twelve week period. This type of research could prove valuable, as by testing different types of programmes, more information will be available for coaches on what could work for their players. Coaches of hockey however must keep in mind that although they are working with a team/group of athletes, each player is an individual and he/she may have different areas of weakness in their physical performance. Dick (2002) stresses that, “The coach must view the development of fitness as unique to athlete and situation”. Coaches of hockey must be able to cater for the individual, and also respect the varying strength and conditioning needs of different playing positions.

There are a myriad of ways coaches influence the improvement of athletes. Wang and McJunkin (2005) discuss the important role that coaches play in the overall development of an athlete’s ability, physical well being, mental maturity, discipline and sportsmanship. It is crucial for coaches to provide quality coaching to athletes from a young age so they can obtain a positive experience through athletic activities. Wang and McJunkin (2005) put emphasis on a number of standards of physical preparation and conditioning including; utilizing research based conditioning principles to
prepare participants for the demands of sport, designing programmes of training, conditioning, and recovery that properly incorporate physiological and mechanical principles, teaching proper nutrition relevant to managing health, body weight and optimal physical performance, and demonstrates knowledge of the use and supplements that provides athletes with appropriate and accurate information to maintain healthy sport participation. An information resource specific to hockey that focuses on this area of the sport would be invaluable for hockey coaches and athletes at all levels, and would certainly be of great use in bringing the sport of hockey forward.

In RDT hockey academy, training for successful competition has become virtually a year-round endeavour. To assist in better preparation, a competitor's year may be divided into phases such as preparatory, competitive and transition respectively. A number of studies have described the effects of seasons or periods of competition, training, detraining and reduced training on aspects of physical fitness. In this study a pioneering attempt made to evaluate changes on selected physical fitness and physiological variables of RDT hockey academy players of different ages.

**Statement of the Problem**

Increasing endurance capacity can led to several positive effects on field adaptations such as increased distance covered, intensity of play, number of sprints performed and number of ball involvements. Similarly, increasing parameters of strength and power can influence performance through
increasing ability to sprint, jump, hitting, passing and pushing the ball during the game. These variables should be assessed at different time points across the season to evaluate training, monitor fitness and to provide details of any seasonal variation in fitness. There is an anecdotal perception that fitness fluctuate during a periodized training year. This study would enable better understanding the seasonal profile of RDT academy players could give the coach and trainer a better working knowledge which enhances the playing ability of hockey player.

The purpose of the study is to investigate the changes on selected physical fitness and physiological profiles during two years of systematic hockey training program in RDT Hockey Academy Ananthapur.

**Objectives of the Study**

The primary research objectives are the following:

1. To compare the effectiveness of systematic hockey training on selected physical fitness and physiological profiles among high school players of different age groups.

2. To identify the changes elicited for two periodized years of systematic hockey training on selected physical fitness and physiological profiles of RDT academy hockey players.

3. To estimate the variation on selected physical fitness and physiological profiles from phase to phase of two periodized training years.
Delimitations

1. Twenty (20) male hockey players were selected and segregated into two groups as juniors (10 to 12 years; N=9) and seniors (14 to 16 years; N=11) based on their chronological age. These players were selected as subject from RDT Hockey Academy, Ananthapur, Andhra Pradesh, India.

2. The physical fitness and physiological profiles selected as criterion variables for the study were speed, agility, power, abdominal muscular endurance, arm-shoulder muscular endurance, flexibility, aerobic capacity and resting heart rate.

3. This study is delimited to testing at four points during the periodized training year; at the beginnings of general preparation (T1), at the beginning of specific preparation (T2), at the beginning of pre competitive phase (T3) and at the beginning of competitive phases of training (T4).

4. The subjects underwent morning practice between 6:30am and 8:30am and evening practice between 04:30pm and 06:30pm regularly right from the start of general preparation to end of competitive season.

5. The subjects had breakfast between 09:15 and 09:30am, lunch between 13:00 to 14:00 and supper between 20:00 to 21:00 hours respectively. The subjects had no caffeine from start to end of the study.

6. All testing took place at the same time of the day to have control over circadian variation.
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 selected subjects played practice matches during evening hours daily which could not be measured which may be a limiting factor. So quantification of training is done during morning conditioning hours during two periodized training years.

4. In this study, there is no control group that can assess morphological growth and maturation so as to nullify the influence of these factors on the development of fitness, and it is considered as a limitation of the study.

Hypotheses

Based on the objectives of the study the following hypotheses were formulated.

1. It was hypothesized that significant difference on selected physical fitness and physiological profiles would exist between junior and senior academy players at different phases of training during two periodized years of systematic hockey training.

2. It was also hypothesized that there would be significant difference on the changes elicited for two periodized years of systematic hockey training on selected physical fitness and physiological profiles at each phase for both junior and senior academy hockey players.
3. Furthermore, it was hypothesized that there would be significant variation on selected physical fitness and physiological profiles from phase to phase during two periodized training years for both junior and senior academy hockey 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 undue fatigue (Davis, *et al.*, 2000).

*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, *et al.*, 2000).

*Agility*

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

*Strength*

The ability of the muscle to exert force (Nieman, 2011).

*Power*

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

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

**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).

**Aerobic capacity**

It is the maximal capacity for oxygen consumption by the body during maximal oxygen consumption, and cardiorespiratory endurance capacity (Wilmore & Costill, 1994).

The VO$_2$max provides a quantitative statement of an individual’s capacity for the aerobic energy transfer (Mc Ardle, 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 (Nieman, 2011).

**Resting HR**

Resting heart rate (RHR) refers to the number of times the heart beats in one minute while at rest.
Significance of the Study

1. Performance of a hockey player greatly depends on their physical fitness, physiological, psychological and technical abilities. Hockey requires various levels of aerobic, anaerobic, speed, power, agility, and strength capacities in order to excel in the game. Hockey players who aim to become elite usually train year-round with carefully designed training programs. Competition naturally provides the best test for athletes. However, it is difficult to isolate various components of performance during competitions. In addition, the modification of training program may be required prior to the competitions according to athlete’s current physical status in order to reach the best performance in the upcoming competition. Furthermore, the long-term high-intensity training may result in insufficient recovery, which may lead to chronic fatigue, staleness of performance, and even overtraining. The monitoring of physical and physiological capacities during the entire training period is essential for hockey players for following reasons:

- To study the effect of a training program.
- To motivate the players to train more.
- To give players objective feedback.
- To make players more aware of the aims of the training.
- To evaluate whether a player is ready to compete.
- To determine the performance level of a player during a rehabilitation period.
➢ To plan short-and long-term training programs.
➢ To identify the weakness of a player.
➢ To determine if the recovery is sufficient.

2. Regular physical exercise is an important factor to reduce the indexes of cardiovascular risks. However, the regular practice of physical exercise and the improvement in aerobic capacity result in resting heart rate alterations. Hockey players with high levels of aerobic condition have a lower resting heart rate occurs as a result of different phases of training. Heart rate is good indicator of cardiorespiratory fitness. This enables coaches to use resting heart rate to monitor fatigue and recovery of hockey players resulted from training.

Outline of the Study:

This work investigates the changes on selected physical fitness and physiological profiles during two years of systematic hockey training program in RDT Hockey Academy Ananthapur. 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.