Chapter I

INTRODUCTION

Physical training entails exposing the organism to a training load or work stress of sufficient intensity, duration and frequency to produce a noticeable or measurable training effect, that is, to improve the functions for which one is training. To achieve such a training effect, it is necessary to expose the organism to an overload (i.e., a stress) that is larger than the one regularly encountered during everyday life. It is a common conception in training environments that "to build up, one must first break down." Admittedly, exposure to the training stress is associated with some catabolic processes, such as break down of glycogen, followed by an overshoot or anabolic response that causes an increased deposition of the molecules that were mobilized or broken down during training. As to the effect on other cellular components, this is the best an imprecise statement.

Today, the molecular mechanisms involved in training responses have started to emerge, but the pictures are still far from complete. As a basis for studying the training process, however, one can safely state that all cells and tissues of the body, regardless of the presence or absence the training, are subject to some kind of continuous exchange and remodeling. On the cellular level, molecules have a restricted lifetime and are constantly replaced by new molecules of the same kind or by another isoform of the same molecules if so demanded by current activity level. (Astrand,2003)

1.1 FOOTBALL

In today's techno-scientific age, the world has undergone a complete change in all aspects due to innovation and research. Thus, in the field of Football also there has been a dramatic change with the help of scientific training and coaching. The players are being trained on scientific guidelines with highly sophisticated means, for effective improvement enabling the coaches to derive optimum performance within legitimate time span. The players during training are being exposed to such exercises that are helpful and beneficial for achieving the higher standards. Training denotes the process of preparing one for some task. Sports training are undertaken for improving sports performance.

1.2 FITNESS FOR FOOTBALL

The game of Football demands a high level of fitness that will enable the players to run strongly, to move quickly off the mark in any direction to control, to pass accurately and to tackle efficiently throughout the game. Football requires a high standard of physical fitness along with skills. Since the game of Football is played for 90 minutes (if necessary an extra period of 30 minutes for the match ends in a draw in knock out tournament) it demands a high level of physical fitness and the training programme should be planned accordingly. The player in good physical condition is generally throughout to have the ability to do sustained work over a longer period.

Hence speed, power, strength, endurance, agility, cardio respiratory endurance are essential qualities required to be developed by all players. For good performance in any sports the standard of fitness is basic a requirement.

1.3 IMPORTANCE OF MOTOR FITNESS VARIABLES

The performance variables are highly important in the achievement of outstanding results in sports performance. However, one of the performance variables like speed as an innate quality, proper and scientific training tends to improve most of the performance variables. In the case of majority of sports events and competitions it is the performance of the performance variables such as speed, power, strength, endurance, agility and cardio respiratory endurance, that often decide the fate of the event. High-level performance of a Football player may be depending upon its physical capabilities supported by other factors. In most of advanced and developed countries, the awareness of the fitness, motor learning and skill development among children in early age itself are very much scientific to realize their dreams of high achievements in sports. High level of general fitness with motor abilities like speed, power, strength, endurance, agility, cardio respiratory endurance, jumping activity etc., are essential qualities required to be developed by Football performance. Football, at any age, is a physical game. It involves running. It involves twisting and turning. It involves jumping, kicking, and tackling. In addition, as young players mature, the stresses and strains of the competitive environment become greater and greater. Football is fitness dominating sports along with technical and tactical skills. Physical fitness is used to denote the sum five components. I.e. strength, speed, endurance, flexibility endurance and their complex form. Skill related physical fitness is more a comprehensive term, which includes all the fitness components including additional five motor components i.e., power, speed, agility, balance and reaction time, which are important mainly for success in sports.

1.4 SAQ TRAINING (Speed, Agility, Quickness)

There is nothing more exhilarating than a player who explodes through a defensive gap, chests, turns and side steps to avoid desperate, defensive lunges and fires the ball home or when a centre-half defies gravity by jumping into the air, hanging there long enough to intercept a crossed ball with his head before redirecting into a supporting mid fielder's feet for a swift, defensive counter attack. Soccer is the greatest game in the world. These wonderful acts of speed, agility and quickness are what make the difference between winning and losing, often thought to be god given gifts and therefore neglected on the training field. They are admired and believed to be essential for success within the game by players, managers, coaches and trainers. The SAQ programme for Soccer is the first ever Soccer specific programme designed to develop these key skills. The programme also has other significant benefits such as improving eye, hand and foot co-ordination, strength and explosive power, as well as being full of variety and great fun. The secret lies in the SAQ continuum and the use of progressive sequential learning techniques breaking down complex sports science and making it easy to understand its practical use. The end result is the development of multi-directional, explosive speed specifically for Soccer. The programme can be adopted to meet the needs of both squad training and of individual players with in the squad who requires position- specific development. It also provides an ideal opportunity for children as young as six, up to including the most senior professional players to learn and improve. The programmes has evolved from a foundation of years of practical experience out on the training field of world Soccer, taking to world cup coaches, premiership managers, elite and amature players through to the little league players and school kids. This is what makes it so unique and in demand throughout the world. Many of Europe's top clubs now include SAQ training as part

of their everyday session, because it adds a new dimension to their preparation and also produces demonstrable results on the playing field. (Bloomfield, 2007).

1.5 CONCEPT OF SAQ TRAINING

Speed has long been considered as just one single entity how fast an object goes from point, A to point B. Only recently has speed been specified and broken down into stages such as acceleration, the planning out phase, deceleration, etc. Much of this research has been carried out by sports coaches involved in straight line running, so that the jumping training and zig-zagging speed necessary in Soccer has been somewhat neglected. Those involved with the development of SAQ programme have sought to fill this void so as to develop all types of speed. Particularly for team sports such as Soccer, SAQ programmes break speed down into three main areas of skills, speed, agility and quickness. Although these may appear to be quite similar they are in fact very different in terms of how they are trained, developed and integrated into a player's performance. When the skills are successfully combined and specialist SAQ equipment is utilized, they provide the coach with the tools to make a good player into an outstanding one. It is remarkable what players can achieve with an SAQ programme. (Polman 2007).

1.6 COMPONENTS OF SAQ TRAINING

1.6.1 Speed

A crucial part of any player's game is the ability to cover the ground efficiently and economically over the first few yards and then to open up stride length and increase stride frequency when working over 40-50 yards. Speed means the maximum velocity a player can achieve and maintain. It can also be measured by the amount of time it takes a player to cover a particular distance. Most humans can only maintain maximum velocity for a short period of time of over a limited distance.

Training to improve maximum speed requires a great deal of focus on correct running mechanics. Stride length and frequency, the leg cycle and hp height/position. Drills such as the dead leg run and stride frequency drills that are used to help develop an economical running technique can all be easily integrated in a training session. The best sprinters spend very little time in contact with the ground and what contact they do make is extremely efficient and powerful focusing on the mechanics of running helps to control this power and use it efficiently and sparingly. Training is also crucial for an athlete / player to attain their maximum speed. Many athletes can only reproduce top speeds for a few weeks of the year, but the inclusion and practice of correct running mechanics on the training field will greatly benefit players in the game situations. How often have you seen a player run as if they were playing kettledrum – that is with poor arm mechanics'? Running like this will have a detrimental effect on the overall technique and most importantly the speed at which the player travel. (Halil 2009).

1.6.2 Agility

Agility is the ability to change direction without the loss of balance, strength, speed or body control. There is a direct link between improved agility and the development of an individual's timing, rhythm and movement. Agility should not be taken for granted and can actually be taught to individual players. Training ensures that a player develops the best offensive and defensive skills possible with the greatest quickness, speed and control and the least amount or wasted energy and movement. Agility also has many other benefits for the individual, helping to prevent niggling injuries and teaching the muscle how to fire or activate properly and to control minute shifts in ankle knee, hip, back shoulder and neck joints for optimum body alignment. Another very important benefit of agility training is that it is long lasting. Unlike

speed, stamina and weight training it does not have to be maintained to retain indelible mark programming the body is memory of muscular movement patterns. (Mario 2011).

1.6.3 The Elements of Agility

There are four elements to agility as are Balance, Co-ordination, Programmed agility, Random Agility. Within each of these there is also speed, strength timing and rhythm.

1.6.4 Balance

Balance is a foundation of athleticism. Here the ability to stand, stop and walk is developed by focusing, on the centre of gravity and it can be taught and retained relatively quickly. Examples include standing on one leg, walking and standing on a balance beam. Standing on an agility disc walking backwards with your eyes closed and jumping on a mini trampoline and then freezing. It does not take for long to train balance it only requires a couple of minutes two are three times a week, with the emphasis placed early in the morning, and early in a training session when the players are fresh and alert. This is when the nervous system and muscle are more receptive patterns of movement used in balance. Co-Ordination is the goal of mastering simple skills under more difficult stresses, co-ordination work is often slow and methodical with an emphasis on correct biomechanics during athletically demanding movement. Training can be done by breaking a skill down into its component parts then gradually bringing them together. Co-ordination activities include foot work drills, tumbling rolling and jumping. More difficult examples are waking on a balanced beam while playing catch: running along a line while a partner lightly pulls and pushes in an attempt to move the player off the line: and jumping on and off an agility disc while holding a jelly ball. (Mario 2011).

1.6.5 Programmed Agility

The third element of agility training is called programmed agility. This is when a player has already experienced the skill or stress that is to be placed on them and is aware of the pattern and sequence of demands of that experience. In short the player has already been programmed. Programmed agility drills can be conducted at high speed but must be learnt at low, controlled speeds. Examples are Zig-Zag cone drills shuttle run and 'T' cone drills all of which involve change of direction along a known standardized pattern. There is no spontaneity. Once these types of drills learnt and performed on a regular basis, times and performances will improve and advances in strength explosion. Flexibility and body control will be experienced. This is true of players of any ability. Random agility : The final element and the most difficult to master. Prepare for and perform is random agility. Here the player performs tasks with unknown patterns and unknown demands. The coach incorporates visual and audible reactive skills so that the player has to make – split – second decisions with movements based upon the various stimuli. The skill level is now becoming much close to actual game like situations. Random agility can be trained by games like tag read and react (tennis drills drops and dodge) dodge ball and more specific training such as jumping and landing followed by an immediate unknown movement demand from the coach. Agility training is challenging fun and exciting. There is the opportunity for tremendous variety and training should not become boring or laborious. Agility is not just for those with elite sporting abilities try negating through a busy shopping mall. (Mario 2011).

1.6.7 Quickness

When a player accelerates a great deal of force has to be generated and transferred through the foot to the ground. This action is similar to that when you roll

a towel up (the leg) hold one end in your hand and flick it out to achieve a cracking noise from the other end (the foot). The act of acceleration occurs in a fraction of a second and takes the body from a static position to motion. Muscles actually lengthen and shorten instantaneously that is an 'eccentric followed by a concentric' contractions. This process is known as the stretch shortening cycle (SCC) action. SAQ training concentrates on improving the neuro-muscular system that improves on this process.

1. 7 CIRCUIT RESISTANCE TRAINING

The caloric cost of exercise can be increased to bring about improvements in more than one aspect of fitness by modifying the standard approach to resistance training. This approach, called circuit resistance training, (Heward, 2010) or Circuit resistance training, de-emphasizes the brief intervals of heavy-local muscle overload, providing for a more general conditioning to improve body composition, muscle strength and endurance, and cardiovascular fitness (Ballor, 1987). With this approach, a person lifts a weight between 40 and 55 percent of the1-RM. The weight is then lifted as many times as possible for 30 seconds. After a 15-second rest, the participant moves to the next resistance exercise station and so on to complete the circuit. Between 8 and 15 exercise stations are usually used. (A modification that appears to result in similar energy expenditures during CRT is to employ exercise-to-rest ratios of 1:1 with either 15- or 30-second exercise periods). The circuit is repeated several times to allow for 30 to 50 minutes of continuous exercise. As strength increases, a new 1-RM is determined and the weight lifted is increased accordingly at each station. (Ballor 1989).

This modification of standard resistance training is an attractive alternative for those desiring a generalized conditioning programme. Medically supervised

programmes of Circuit Resistance Training also have been effective for coronary-prone, cardiac, and spinal-cord-injured patients who desire a well-rounded fitness programme using resistance exercises. It also may provide supplemental off-season conditioning for athletes involved in sports that require high levels of strength, power, and muscular endurance. (Cooney, 1986) Circuit resistance training is a method of dynamic resistance training designed to increase strength, muscular endurance, and cardio respiratory endurance (Gettman and Pollock 1981). Circuit resistance training compares favourably with the traditional resistance training programmes for increasing muscle strength, especially if low-repetition, high-resistance exercises are used (Gettman et al. 1978; Wilmore et al. 1978). A circuit resistance training programme usually has 10 to 15 stations per circuit. The circuit is repeated two to three times so that the total time of continuous exercise is 20 to 30 min. At each exercise station, a resistance that fatigues the muscle group in approximately 30 sec is selected (as many repetitions as possible at approximately 40% to 55% of 1-RM). A 15 to 20 sec rest period between exercise stations is included. Circuit resistance training is usually performed 3 days/wk for at least 6 week. This method of training is ideal for subjects with a limited amount of time for exercise. Subject can add aerobic exercise stations to the circuit between each weightlifting station (i.e., super circuit resistance training) to obtain additional cardio respiratory benefits (Heyward, 2010).

1.7.1 Resistance Training Programmes

Before designing a resistance training programme for the subject, review training principles and determine how each of these principles can be incorporated into the subject's program. The training program needs to be individualized by varying the combination of intensity, duration, and frequency of exercise.

1.7.2 Principles to Resistance Exercise

To develop effective resistance training programmes, subject must apply each of the training principles. This section reviews some of the more pertinent training principles and outlines how these principles are applied to the design of resistance training programs.

1.7.3 Specificity Principle

The development of muscular fitness is specific to the muscle group that is exercised, the type of contraction, and training intensity. To increase the dynamic strength of the elbow flexors, for example, subject must select exercises that involve the concentric and eccentric contraction of that particular muscle group. For strength, the person performs exercises at a high intensity with low repetitions; exercising at a low intensity with high repetitions stimulates the development of muscular endurance. Strength and endurance gains are also specific to the speed and range of motion used during the training. With isometric training, strength gains at angles other than the training angle are typically 50% less than those at the exercised angle. Similarly, as previously noted, strength gains in isokinetic training may be limited to velocities at or below the training velocity (Lesmes et al. 1978; Moffroid and Whipple 1970).

1.7.4 Overload Principle

To promote strength and endurance gains, it is necessary to exercise the muscle group at workloads that are greater than normal for the subject. The exercise intensity should be at least 60% of maximum to stimulate the development of strength. Subject may achieve more rapid strength gains, however, by exercising the muscle at or near maximum (80% to 100%) resistance. To stimulate endurance gains, intensities as low as

30% of maximum may be used; however, at low intensities the muscle group should be exercised to the point of fatigue.

1.7.5 Progression Principle

Generally, throughout the resistance training programme, subject must periodically increase the training volume, or total amount of work performed, to continue overloading the muscle so that the person can make further improvements in strength and muscular endurance. The progression needs to be gradual because doing too much too soon may cause musculoskeletal injuries and excessive muscle soreness. Typically subject progressively overloads muscle groups by increasing the resistance or amount of weight lifted. To the training stimulus, they will be able to perform more repetitions at the prescribed resistance. Thus, the number of repetitions a subject is able to perform will indicate when it is necessary to increase the resistance throughout the training programme. In addition to increasing resistance, subject may progressively overload muscle groups by increasing the total number of repetitions performed at a selected intensity, altering the speed of movement (slow, moderate, fast pace), and varying the duration of rest periods between sets of exercises (Ratamess et al. 2009).

1.7.6 Additional Principle

Individuals with lower initial strength will show greater relative gains and a faster rate of improvement in response to resistance training than those starting out with higher strength levels (principles of initial values and interindividual variability). However, the rate of improvement slows, and eventually plateaus, as subjects progress through the programme and move closer to their genetic ceiling (principle of diminishing returns). Additionally, when the individual stops resistance training, the physiological adaptations and improvements in muscle structure and function are

reversed (principle of reversibility). Using periodization techniques, one can lessen the effects of detraining on athletes and maintain strength gains during the competitive period by manipulating the intensity and volume of the resistance training exercise (Wathen. D. 1994).

1.8 GENERAL PROCEDURES FOR TRAINING PROGRAMS

Resistance training programme developed for an older man with no previous weightlifting experience: The primary goal for this programme is to develop adequate muscular fitness so that the subject can retain functional independence. This program follows the guidelines suggested by ACSM (2010) for designing resistance training programmes for older adults. During the first four weeks of training, low-intensity (30% to 40% 1-RM), high-repetition (15 to 20 repetitions) exercises familiarize the subject with weightlifting exercise and reduce the chance of injury and excessive muscle soreness. The subject gradually increases the resistance so that by the end of this phase, the exercise intensity is 50% 1-RM. After eight week, the intensity starts at 50% 1-RM and gradually increases to 75% 1-RM. The subject does one or two sets of 10 to 15 repetitions for each exercise. To overload the muscles during this phase, he increases the resistance gradually, but only after he is able to complete 15 or more repetitions at the prescribed relative intensity. This programme includes multi-joint exercises using exercise machines only (no free weights). The subject exercises two times a week, allowing at least two days of rest between each workout. The second programme is for a 25 yr old woman whose primary goal is to improve muscle strength. This subject is an experienced weightlifter. Results from her 1-RM tests indicated that her upper body strength (particularly the shoulder flexor and forearm flexor muscle groups) is below average. Therefore, two exercises are prescribed for each of the weaker muscle groups. The strength of all other muscle

groups is average or above average; therefore, only one exercise is prescribed for each of these muscle groups. Given her initial strength levels and weightlifting experience, the prescription is for three sets of each exercise; and the exercise intensity is set at 70% to 80% 1-RM to maximize the development of strength. The subject completes about eight repetitions at the prescribed intensity for each microcycle. She devotes 50 to 60 min, 3 days/wk, to her workouts. (Fleck and Kraemer 2004).

1.9 DEVELOPING A RESISTANCE TRAINING PROGRAMME

In consultation with the subjects, the primary goal of the programme should be identified. (i.e., strength, muscular endurance, muscle size or muscle toning) and it must be ascertained from the subjects how much time they are willing to commit to this programme. Based on the subject's goal, time commitment and access to equipment, determine the type of resistance training program (i.e., dynamic, static, or isokinetic) must be determined. Using results from the subject's muscular fitness assessment, identify specific muscle groups that need to be targeted in the exercise prescription. In addition to core exercises for the major muscle groups, exercises must be selected for those muscle groups targeted in step. For novice weightlifters, the exercises must be so ordered that the same muscle group is not exercised consecutively. Based on the subject's goals, appropriate starting loads, repetitions, and sets for each exercise must be determined. Guidelines must be set for progressively overloading each muscle group. The third example illustrates an advanced resistance training programme developed for an experienced weightlifter (28 yr old male with superior strength) whose long-term goal is competitive bodybuilding. He engages in a high-volume undulating periodized training program. The intensity (70-85% 1-RM) and moderate repetitions (6 to 12 reps) vary systematically throughout each macro- and microcycle to maximize the development

of muscle size. To achieve a high training volume, he performs three exercises for each muscle group and three or four sets of each exercise. To effectively overload the muscles, he performs three exercises for each muscle group consecutively (tri-sets) with little or no rest between the sets. He lifts weights 6 days/wk, splitting the routine so that he is not exercising the same muscle groups on consecutive days. With this routine, each muscle group is exercised two times a week. Several excellent references deal with the design of advanced resistance training programmes (Fleck and Kraemer 2004; Kraemer and Fleck 2007; National Strength and Conditioning Association 2008; Stone, Stone, and Sands 2007).

1.10 PLYOMETRIC

Plyometrics refers to exercises that enable a muscle to reach maximal strength in as short a time as possible. Such exercises usually involve some form of jumping, but other modes of exercise exist. The elements ply and metric come from Latin roots for “increase” and “measure”, respectively; the combination thus means “measurable increase” (Chu, D1984). Plyometric exercises utilize the force of gravity to store energy in the muscles (potential energy). This energy is t hen utilized immediately in an opposite reaction, so the nature elastic properties of the muscle will produce kinetic energy (Asmussen, E, and F. Bonde 1974; Chu.D (1984)). Elastic strength is the ability of muscles and connective tissues (muscle sheath and tendinous tissues) to rapidly exert a force in order to produce maximal power in linear, vertical, lateral, or combination movements (Chu.D., L.Plummer 1984).

Plyometric exercises are especially useful in sports that require speed- strength (Lundin, P.A1989, .Matveyev., 1983). Speed strength is the ability to exert maximal force during high-speed movements. Sports that require speed-strength include, throwing, and sprinting; volleyball, baseball, football, basketball and diving (which

require maximal jumping ability); blocking and tackling in football; and racket sports, baseball and softball (which require swinging movements). Plyometric for the upper body include medicine ball throws, catches, and several types of push-ups. In depth jumps, forms of plyometric characterized by a shock intensity level have been shown to increase leg power and strength either on their own or in conjunction with resistance training (Blattner, S., and L.Noble.,1990, Chu, D.1992, O' Connell, A., and E.Gardner1972, Pothemus, R.E., Burkhardt, M.Osina, and M.Patterson.,1980).

In depth jumping may not improve vertical jumping ability Herman, D. (1976), however. In depth, jumps are performed by stepping off a box and jumping immediately upon landing. The ability to rapidly apply force (reactive force) is the major goal of plyometric training. Plyometrics are used to apply an overload to the muscles with speed strength as a goal. Plyometrics should not be considered an end in themselves, but part of an overall program (stretching; running, strength training, nutrition, etc.).

1.11 MECHANICS OF PLYOMETRIC EXERCISE

To stand on a box, step off, and upon landing (with the knees flexing), immediately jump as high as possible. As soon as the balls of the feet touch the floor, the knees are quickly flexed, resulting in a rapid eccentric action of the quadriceps and hip extensors. A rapid deceleration (eccentric action) of a mass followed by a rapid acceleration (concentric contraction) of the mass in another direction (wathen.D. 1993) is the basis of plyometric training. The rapid eccentric movement evokes the stretch reflex, or stretch-shortening cycle, which results in greater concentric contraction of the same muscles. The main mechanism of the stretch reflex is the muscle spindle. Muscle spindles are sensory mechanisms located within intrafusal muscles that run parallel with extrafusal muscle fibers (Fleck, S., and W.Kraemer.,

1987). Muscle spindles are sensitive to the rate and magnitude of a stretch. A sensory neuron from the muscle spindle innervates with a motor neuron in the spinal column. The motor neuron than causes a contraction in the muscle (extrafusal fibers) that was previously stretched. This process protects the muscle from excessive rapid stretching and injury.

The rate of the stretch is vital to plyometric training (Astrand, P., and K.REdahl.,1970, O' Connell, A., and E.Gardner,1972). A high stretch rate results in greater muscle tension and concentric contraction. Training movements that incorporate rapid eccentric movement (during sprinting, bounding, in-depth jumps, or lateral hops, for example), produce greater eccentric and concentric actions while one performs the exercise during a sport activity.

A countermovement uses a rapid eccentric response followed immediately by a rapid concentric contraction. As the rate of stretch increases, one's absolute performance in these tests improves. The static squat jump will reveal the shortest jump and the approach jump the highest. The static squat jump does not utilize a countermovement (the countermovement involves the rapid eccentric response during the flexion of the ankles, knees, and hips) and the approach jump utilizes a more forceful countermovement than the countermovement only. Because plyometrics are active drills that produce high muscle tension (eccentric), the stretch reflex will produce a greater force than a concentric contraction from a static position not preceded by a stretch (Aura, O., and J.T. Vitasalo.,1989, Bobbert, M.F.1990, Bosco, C., J.T. Vitasalo, P.V. Komi, and P. Luhtanen.,1982, Cavagna, G.A.,1977, Chu, D.,1992,Hakkinen,K.,and P.V.Komi,1985, Verkhoshanski, y., and V.Tatyan.,1983).During the stretch-shortening cycle (the result of the stimulation of the stretch reflex), the muscles and tendons elongate. It is during the elongation that the elastic tendencies of the muscle develop stored energy. If the eccentric response is

followed immediately by a concentric contraction, the force produced by the concentric contraction will be increased (Lundin, P.A.1989). Speed strength is thus increased.

The three main components of a plyometric drill are the eccentric phase, the amortization phase, and the concentric contraction. The amortization phase is the period of time from the initiation of the eccentric phase (touching the surface) to the initiation of the concentric contraction (start of the upward motion of the jump). As a result, the muscles in the leg become like a rapidly stretched rubber band. The ‘‘stretched rubber band” will result in a greater ability to develop power. In other words, the muscles are being trained to become more explosive. To take advantage of the stretch reflex, keep the amortization phase as brief as possible (Chu.D.1983). Remember, the rate of stretch is more important than the magnitude. Greater power is produced when the depth of the countermovement is short and rapid rather than large and slow.Besides in-depth jumps, there are other types of plyometric drills with various intensity levels and directional movements. Jumping, hopping, skipping, and even running involve some degree of a stretch-shortening movement, in that all of them utilize a countermovement of varying degree. Examples of the countermovement in sports are a basketball player preparing to jump up for a rebound, a volleyball player preparing to jump up for a spike, a high jumper preparing to jump over the bar, and a wrestler preparing for the drop step. Plyometric training is similar to progressive resistance training in that both incorporate overload principles. Drills should progress gradually from basic to difficult and from low to high intensity. Form and technique should be emphasized at all stages of the program.

1.12 PROGRAM DESIGN

1.12.1 Equipment and Facilities. Use of the following guidelines to select appropriate equipment and facilities for plyometric training will enhance effectiveness and safety (Gambetta, V1988).

1.12.2 Proper footwear. Footwear with good ankle and arch support, good lateral stability, and a wide, nonslip sole is required. A cross training shoe is ideal because it helps prevent ankle rollover. Shoes with a narrow sole and poor upper support (such as running shoes) may create ankle problems (Allerheiligen, B. Poke 1992), especially with lateral movements.

1.12.3 Resilient surface. To prevent injuries, the landing surface must possess good shock-absorbing properties. The best surface is a good grass field; the next-best surfaces are well-padded artificial turf and wrestling mats. Such surfaces as concrete, tile, and hardwood are not recommended, because they lack shock-absorbing properties (Allerheiligen, B. Poke 1992).

1.12.4 Proper, sturdy equipment. Boxes used for box jump and in-depth jumps must be sturdy and should have a nonslip top.

1.12.5 Sufficient training area. The amount of space needed depends on the drill. Long-response drills may require a straightaway of 100 meters. For most of the bounding and running drills, at least 30 meters of straightaway are required. For some of the vertical and in-depth jumps, only a minimum surface area is needed, but adequate height (3 to 4m) is required.

1.12.6 Procedures. As with any training program, begin exercise sessions with a warm-up period that includes general warm-up, stretching, and specific warm-up.

It is easiest to think of a training program in 1-week units of time. The three basic features of a program, which determine the overall overload of the weekly training period, are frequency, volume, and intensity. (Overload refers to a greater than normal stress placed upon a muscle.) Alterations in any one of these may require adjustment to one or both of the others. Additional factors to consider are progression, recovery periods, and direction of motion.

1.13 FREQUENCY

Frequency is simply the number of plyometric workouts per week. The usual range is one to three sessions, with two being the norm for most off-season sports, including football, and two to three for track and field. In season, one session/week is appropriate for football players and two or three for track-and-field athletes. The intensity of the daily workouts (practice, strength training, running, and plyometrics) may affect the number of workouts needed each week. Football players may not perform plyometrics in season because of the overall volume and intensity of practices. Three days of low-intensity drills may result in lower overall weekly training effect than 2 days of high-intensity drills. In any case, do not perform drills for the same body area 2 days in succession.

1.14 VOLUME

Volume is normally expressed as the number of foot contacts (each time a foot, or feet together, contact the surface) per workout. Volume should be 80 to 100 foot contacts/session for beginners, 100 to 120 contacts/session for intermediate-level athletes and 120 to 140 contacts/session for advanced athletes. If intensity is high, volume should be low or medium. Volume may also be expressed as distance (i.e., 600 m).

1.15 INTENSITY

Intensity refers to the amount of stress placed upon muscles, connective tissue, and joints. Skipping places low stress on the muscles and joints whereas in-depth jumps place high stress on the muscles and joints. Generally speaking, as intensity increases, volume should decrease. In the early phases of training, both intensity and volume may increase, but once high- intensity drills form the base of the program, volume should decrease. The intensity of plyometric drills is related to a number of factors:

- Whether one or two feet make contact with the surface. Alternate leg bounds, which may emphasize a greater vertical than horizontal component, result in a large force when the athlete lands.
- The direction of the jump (vertical or horizontal).
- Horizontal speed.
- How high the center of gravity of the body is raised above the ground. The higher the center of gravity, the greater the force will be upon landing.
- Whether, and how much, external weight (in the form of weight vests, ankle weights, and wrist weights) is added to the body. Only experienced athletes should use such weights.

Because drills can vary so much in intensity, owing to these factors and other aspects of the drills themselves, careful consideration must be given to choosing optimal drills during a training cycle.

1.16 PROGRESSION

Assuming that the athlete has a proper strength and conditioning base, plyometric training should progress from low-intensity, in-place exercises to medium-intensity and then higher-intensity levels (Allerheiligen, B. Poke 1992). Details of

progression are discussed in a later section, after the various types of exercises have been defined.

1.17 RECOVERY

Because plyometric drills involve maximal efforts, adequate recovery between repetitions, sets, and workouts is required. Recovery for in-depth jumps may consist of 5 to 10seconds of rest between repetitions and 2 to 3 minutes between sets. Drills should not be thought of as conditioning exercises but as speed-strength training. Recovery between workouts must be adequate (2 to 4 days depending on the sport and time of year); other-wise, overtraining or injury may occur.

1.18 DIRECTION OF MOTION

Football Players require speed and power not only in the vertical plane but also in horizontal (straight ahead), lateral, and diagonal directions as well. Sports that are horizontal and/or lateral in execution include football, baseball, and sprinting. Sports that involve horizontal movement but also emphasize vertical movement include basketball and volleyball. The long and triple jumps are a combination of horizontal and vertical movement.

Some sports utilize lateral movement or change of direction and include various degrees of horizontal and vertical components. . Football Players involved in pushing, throwing, and swinging movements of the upper body benefit from plyometric drills for the upper body.

1.18.1 Safety

Because plyometric training emphasizes technique and form, it is advisable to have strength and conditioning professional present to monitor and correct technique. Injuries occur when training procedures are violated and may be the result of an

insufficient strength and conditioning base, inadequate warm-up, improper progression of lead-up drills, inappropriate volume or intensity for the phase of training, poor shoes or surface, or simple lack of skill. Injuries may occur in the joints of the back, knees, hips, and ankles (Allerheiligen, B. Poke 1992). Although injuries may occur as a result of plyometric training, evidence exists that preseason plyometric training does not result in injury (Blattner, S., and L.Noble 1990).

Individual and Sport Specificity - A program should also take into consideration the athlete's sport. Large football players, for example, may be susceptible to injury because of the nature of their sport. During practice and competition they are constantly being placed in a variety of body positions that expose them to great stress and torque on the ankles, knees, and low back. This and the violent physical con- tact in general may require that these athletes refrain from performing high-intensity and shock drills.

1.18.2 Progressive Overload

Plyometrics is a form of progressive resistance training and thus must follow the principles of progressive overload. Progressive overload is the systematic increase in frequency, volume, and intensity by various combinations. There may be times when two of these variables may be increased or when one is increased and one or both of the others are decreases. As stated previously, as intensity increases, volume decreases, generally.The method of progressive overload is dependent upon the sport and training phase. Normally, except for some track athletes, frequency will stay the same during a training phase. An off-season plyometric program for football, for example, may be performed twice a week.The program may progress from (a) low to moderate volume of low-intensity plyometrics for two weeks, to (b) low to moderate volumes of moderate intensity, to (c) low to moderate volumes of high

intensity. This is only a sample of the many possible combinations for different sports. In plyometric training the emphasis is on power development in which overloads are implemented.

1.19 STATEMENT OF THE PROBLEM

The purpose of the study was to find out the effects of SAQ training, circuit resistance training and plyometric training on selected motor fitness variables namely muscular strength, muscular endurance, speed, speed endurance, leg explosive power, agility and cardio respiratory endurance among inter collegiate men football players.

1.20 DELIMITATIONS

The study was delimited in the following aspects.

1. This study was conducted only on sixty college men students from KLN College of Information Technology, Madurai, Tamil Nadu, India.

2. The selected subjects were divided in to four equal groups of fifteen subjects each namely SAQ training group, circuit resistance training group, plyometric training group and control group.

3. Among motor fitness variables, the following variables namely muscular strength, muscular endurance, speed, speed endurance, leg explosive power, agility and cardio respiratory endurance were selected as criterion varaibles.

4. The selected criterion variables namely muscular strength, muscular endurance, speed, speed endurance, leg explosive power, agility and cardio respiratory endurance were measured by using pushups, bend knee sit ups, 50

mts run, 150 mts run, vertical jump, shuttle run and cooper's 12 min run/ walk test respectively.

5. The SAQ training, circuit resistance training and plyometric training were selected as independent variables, and performed period of 12 weeks, three alternative days in a week.

6. The age group of the subjects was ranged from 18 to 24 years.

1.21 LIMITATIONS

The study was limited in the following aspects.

1. While conducting this study, the following external factors like air resistance, atmospheric conditions and diet of the subjects etc., were not be taken into consideration.

2. The back ground of the previous training of the students were not considered.

3. Socio-economic and cultural status of the students were considered as limitation.

4. The food habits of the subjects were not controlled by the investigator and it was considered as limitation.

1.22 HYPOTHESES

The following hypothesis were made,

1. It was also hypothesized that there may be a significant improvement on selected motor fitness variables due to SAQ training, circuit resistance training and plyometric training.

2. It was hypothesized that there may be a significant difference among SAQ training, circuit resistance training, plyometric training and control groups after experimental period on selected motor fitness variables.

1.2 3 SIGNIFICANCE OF THE STUDY

The aim of research in the field of physical education is to help the physical educators and coaches to gain additional knowledge in the area of training methods. The present investigation has the following significant contribution.

1. This study would help to find out the effects of SAQ training, circuit resistance training and plyometric training on selected on selected motor fitness variables.

2. The contribution of the study would bring out new and useful training method for the advancement of performance in the field of sports and games.

3. The results of the study might be helpful for the budding researchers in future to develop more studies about various training methods.

4. The study would provide scientific base and guidance to the physical educationist, coaches, and athletes to identify which method of training is best suited to develop motor fitness variables and influenced which variables.

1.24 OPERATIONAL DEFINITIONS OF TERMS

1.24.1 Training

It is a programme of exercise designed to improve the skills and increase the energy capacity of an athlete for a particular event (Fox 1979)

1.24.2 SAQ Training

The SAQ Programme for Soccer is the first ever Soccer-specific programme designed to develop these key skills. The programme also has other significant benefits such as improving eye hand and foot coordination, strength and explosive power, as well as being full of variety and great fun.

1.24.3 Circuit Resistance Training

The caloric cost of exercise can be increased to bring about improvements in more than one aspect of fitness by modifying the standard approach to resistance training. This approach, called circuit resistance training

1.24.4 Plyometric Training

Plyometric training refers to exercise that enable a muscle to reach maximal strength in a short time as possible. (Gambetta, Vern 1988)

1.24.5 Speed

Speed may be defined as the ability of an individual to perform successful movements of the same pattern at a faster rate. (Barrow, Harold M. 1979)

1.24.6 Explosive Power

It is a combination of strength and speed ability. It can be defined as the ability to overcome resistance with high speed. (Hardayal Singh 1991)

1.24.7 Agility

It is the ability to change direction of body or body parts swiftly and accurately.

1.24.8 Cardio Respiratory Endurance

Ability of heart, lungs and circulatory system to supply oxygen to working muscles efficiently. (Heyward 2010)

1.24.9 Muscular Strength

It may be defined as the ability of a muscle or muscle group to perform repeated contractions against a resistance to sustain contraction for an extended period of time with less discomfort and more rapid recovery.