

# **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 at 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 RESISTANCE TRAINING**

Resistance training is well known for improving athletic performance. The critical component to optimal RT is the design of the program in addition to the motivation and dedication of the athlete to follow the program consistently.

A resistance training program is a composite of several variables that interact with each other to provide a stimulus for adaptation. Program design emphasizes the manipulation of these variables to target specific goals and minimize boredom that could accompany training with little variation. Because there are infinite ways to vary programs, many programs can be successful provided that they adhere to general training guidelines. Basic resistance training guidelines were initially established by the American College of Sports Medicine (ACSM 1988) since then; the ACSM has expanded these initial guidelines by providing progression recommendations for strength, power, hypertrophy, and endurance training in healthy young and older individuals. These guidelines and the finer points of program design are discussed in a way to allow the coach/athlete a framework to build a template.

## **1.2 INDIVIDUALIZATION OF RESISTANCE TRAINING PROGRAMS**

The most effective RT programs are individualized to the athlete's needs and goals. Training goals serve the basis of the program, and most athletes' programs are based on multiple goals. Goals, in addition to needs of the sport, are obtained by performing a needs analysis. A needs analysis consists of answering questions based upon goals and desired outcomes, assessments, access to equipment, health, and the demands of the sport.

## **1.3 THE IMPORTANCE OF TRAINING STATUS**

Program design differs based on one's level of training. Training status ranges on a continuum from beginner to elite strength/power athlete. Factors to consider include the athletes history of lifting weights (months and years of experience), level of conditioning (magnitude of strength, power, endurance, and hypertrophy), and sports participation (RT is encountered in several sports and can pose an adaptive stimulus to an athlete

independent of weight lifting). Training status is a culmination of these factors and can pose difficulty for the coach to determine in some cases. For example, some individuals have lifted weight for several months to years and only experienced small improvements whereas some individuals with little experience have adapted quickly due to genetics or prior sports participation. Therefore, some difficulty can be encountered in classifying athletes on this continuum. Notwithstanding, a beginner is one who has no or very little experience lifting weights and has a large potential window of adaptation. An intermediate (moderately trained) individual is one who has at least 4-6 months of progressive resistance training experience and has attained some notable increases in strength. The key is progressive resistance training experience and not merely working out below one's threshold level of adaptation. An advanced individual is one with at least 1 year of consistent progressive resistance training and has experienced a substantial level of adaptation. Those who truly excel in resistance training may attain elite status in which they rank very highly in one or more components of fitness. Skill level increases as one progresses from beginner to intermediate to advanced. Training status identification helps determine the rate and magnitude of progression. Untrained individuals respond favorably to any program, thereby making it difficult to evaluate the effects of different resistance training programs at this stage. Resistance-trained individuals have a slower rate of progression than untrained or moderately trained individuals (Kraemer 2004).

In the ACSM's 2002 position stand, several studies were reviewed and it was estimated that strength increases 40% in untrained, 20% in moderately trained, 16% in trained, 10% in advanced, and 2% in elite athletes over training periods ranging from 4 weeks to years. Progression in any fitness component becomes more difficult with training. Because of these trends, it was proposed that resistance training program

design be prescribed in an orderly manner from a general to specific progression (ACSM, 2002).

#### **1.4 RESISTANCE TRAINING PROGRAM**

The resistance training program is a composite of several variables that include (a) muscle actions used, (b) intensity, (c) volume. (d) exercises selected and workout structure, (e) the sequence of exercise performance, (f) rest intervals between sets (g) repetition velocity, and (h) training frequency. Altering one or several of these variables will affect the training stimuli and increase motivation.

All exercises consist of concentric, eccentric, and/or isometric, muscle actions. Each dynamic repetition consists of eccentric, concentric, and may include isometric, muscle actions muscle actions. Physiologically, eccentric actions provide greater force per unit of muscle cross sectional area (CSA), involve less motor unit activation per unit force, require less energy expenditure per level of tensions, result in higher levels of muscle damage, and are more conducive to muscle growth than concentric or isometric, muscle actions. (ACSM 2009, Kraemer 2004) They are important to mediating neuromuscular adaptations to training. Dynamic strength improvements are greatest when eccentric actions are emphasized (Dudley, 1991). Because dynamic repetitions consist of concentric phases, very little manipulation of these muscle actions occurs. However, each concentric or eccentric phase can be altered by manipulating the loading, volume, velocity, and rest interval length. Some advanced forms of training involve prioritizing the eccentric phase. With traditional RT, most of the effort is applied at the concentric sticking region of exercise. The sticking region is the point where bar velocity is minimal. Mechanically, the lifter is in a disadvantageous position when heavy loading is used or fatigue ensues. Weight selection targets the concentric

sticking region because any more will result in failure, so this limiting factor is present when full range of motion repetitions are used. As a consequence, the eccentric phase may not receive optimal loading. Accentuated eccentric training can provide some additional benefits to the lifter. Acutely, concentric strength is enhanced and it is thought that accentuated eccentric training may reduce neural inhibitions leading to greater concentric strength. For the bench press, lowering a heavier weight than one's concentric 1 RM (105% of 1 RM) yields a greater 1 RM bench press than lowering the concentric 1 RM load (Doan 2002). This was studied by using hooks that became unloaded at the end of the eccentric phase. concentric 1 RM performance was enhanced by up to 7 kg (Doan 2002). Techniques to enhance eccentric training include heavy negatives, forced negatives, and unilateral negatives. Isometric, muscle actions exist in many forms during resistance exercise. Stabilizer muscles contract isometrically to maintain posture and stability during an exercise. Isometric, muscle actions occur in between eccentric and concentric actions for the agonist muscles. The action may be prolonged if a pause is instituted. Gripping tasks require isometric muscle actions. Isometric muscle contraction of finger, thumb, and wrist muscles is paramount to gripping the weights, especially during pulling exercises. Grip strength training greatly depends upon isometric muscle actions. Lastly, isometric muscle actions can serve as the primary mode of exercise in a specific area of the range of motion. Exercises such as a leg lift and plank are predominantly isometric muscle. Strong contraction of the trunk is needed to offset the effects of gravity. Another example is the overhead squat. The upper body and trunk isometrically contract to maintain the overhead bar position. The top position of the pull-up exercise can be held for a specific length of time. This involves isometric muscle contraction of back and arm musculature and may be used to

enhance range of motion -specific strength and endurance. Lastly, functional isometric muscle training can be used.

The ACSM recommends isometric muscle actions be included in resistance training programs targeting strength, hypertrophy, and endurance (ACSM, 2009). Two types of exercises may be selected: single- and multiple-joint. Single-joint exercises stress one joint or major muscle group whereas multiple-joint exercises stress more than one joint or major muscle group. Both single- and multiple-joint exercises are effective for increasing muscle strength and can be considered sport-specific depending on the athlete. Single-joint exercises, e.g., triceps pushdown, lying leg curl, are used to target specific muscle groups, and may pose a lesser risk of injury due to the reduced level of skill and technique involved. Multiple-joint exercises, e.g., bench press, shoulder press, and squat, are more neutrally complex and are regarded as most effective for increasing strength because of the lifting of a larger amount of weight (Fleck SJ 1997). Multiple-joint exercises may be sub classified as basic strength or total-body lifts. Basic strength exercises involve at least two to three major muscle groups whereas total-body lifts (Olympic lifts and variations) involve most major muscle groups and are the most complex exercises. These are the most effective exercises for increasing power because they require explosive force production and fast bodily movements.

Muscle mass involvement is important when selecting exercises. Exercises stressing multiple or large muscle groups produce the greatest acute metabolic responses (Ballor D L 1987). Large muscle mass, multiple-joint exercises such as deadlifts, jump squats, and Olympic lifts augment the acute testosterone and growth hormone response to resistance exercise more than the bench press and shoulder press (Kraemer W J 2003). The ACSM recommends unilateral and bilateral single - and multiple-joint

(free weight and machine) exercises be included, with emphasis on multiple-joint exercises for maximizing muscle strength, size, and endurance in novice, intermediate, and advanced individuals (ACSM 2009). However, the ACSM recommends the use of predominately multiple - Joint exercise for novice, intermediate, and advanced power training (ACSM 2009). Alterations in body posture, grip, and hand width / foot stance and position changes muscle activation to some degree and alters the exercise. Many variations or progressions of single and multiple – joint exercises can be performed

### **1.5 EXERCISE ORDER AND WORKOUT STRUCTURE**

The number of muscle groups trained per workout needs to be considered. There are three basic workout structures to choose from: (a) total-body workouts, (b) upper /lower-body split workouts, and (c) muscle group split routines. Total-body workouts involve performance of exercises that work all major muscle groups (1-2 exercises for each major muscle group or several exercises that stress most major muscle groups). They are common among athletes and Olympic weightlifters. With weightlifting, the Olympic lifts and variations are total body exercises. The first few exercises in sequence are Olympic lifts (plus variations) and the remainder of the workout may be dedicated to basic strength exercises. Upper/lower-body split workouts involve performance of upper-body exercises only during one workout and lower-body exercises only during the next workout. These are common among athletes, power lifters, and bodybuilders. Muscle group split routines involve performance of exercises for specific muscle groups during a workout (e.g., a "back/biceps" workout where all exercises for the back are performed then all exercises for the biceps are performed). These are characteristic of bodybuilding programs. Compound split routines involve training more than one muscle per group

workout. Isolated split routines involve training only one muscle group per workout. Many times these are used within double splits where the lifter may train twice per day. For compound split routines, lifters use different strategies for muscle group organization. Agonist antagonist (chest/back), synergist (chest, triceps), and unrelated muscle group (shoulders, calves) structures may be used. All of these structures can improve performance. Goals, time/frequency, and personal performance. Goals, time / frequency, and personal preferences will determine which structure(s) is selected by the coach or athlete. The major differences between structures are the magnitude of specialization present during each workout (related to the number of exercises performed per muscle group) and the amount of recovery in between workouts. One study reported similar improvements in untrained women between total-body and upper/lower-body split workouts (Berger1963). In the elderly, similar improvements in lower-body strength between total-body and lower-body workouts (of equal volume and intensity) were shown (Berning 2008).

### **1.5.1 Total-body workout**

1. Large muscle exercises should be performed before smaller muscle exercises.
2. Multiple-joint exercises should be performed before single-joint exercises.
3. For power training: total-body exercises (from most. to least complex) should be performed before strength exercises, e.g., most complex is the snatch (because the bar must be moved the greatest distance and related lifts, followed by cleans, and presses.
4. Rotation of upper- and lower-body exercises or opposing (agonist-antagonist relationship) exercises can be employed (see the Sidebar: Sample Push-Pull Exercise Pairings). The rationale is to allow muscles to rest while the



opposing muscles are trained. This strategy is beneficial for maintaining high training intensities and targeted repetition numbers.

5. Some exercises targeting different muscle group can be staggered in between sets of other exercises to increase workout efficiency.

### **1.5.2 Upper/lower-body split**

1. Large muscle exercises should be performed before small muscle group exercises.
2. Multiple-joint exercises should be performed before single-joint exercises.
3. Rotation of opposing exercises may be performed.

### **1.5.3 Split routines**

1. Multiple-joint exercises should be performed before single-joint exercises.
2. Higher intensity exercises should be performed before lower intensity exercises.

The sequence can proceed from heaviest to lightest exercises.

Some exceptions exist to the preceding guidelines for hypertrophy and muscular endurance training. Training to maximize hypertrophy should include strength training. Training to maximize hypertrophy should include strength training so the exercise sequencing recommendations apply. However, muscle hypertrophy is predicated upon mechanical and circulatory factors. Strength training maximizes the mechanical factors whereas training in a fatigued state may potentiate circulatory factors that induce muscle growth. The exercise order may vary considerably. Some bodybuilders use a technique known as pre exhaustion. Pre exhaustion is a technique that requires the lifter to perform a single-joint exercise first

to fatigue a muscle group. A multiple-joint exercise is performed after. One example is the sequence of dumbbell fly's and tosses. When one examines the bench press, often the triceps brachial may be the primary site of fatigue.

## **1.6 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) 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 the 1-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, ( Ballor, 1989). 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.

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 favorably 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 three days/wk for at least six wk. 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 SUPER CIRCUIT RESISTANCE TRAINING**

Use of circuit resistance training for the development of aerobic fitness, as well as muscular strength and tone, has received much attention. Circuit resistance training usually consists of several circuits of resistance training with a minimal amount of rest between the exercise stations (15 to 20 sec). Alternatively, instead of rest, the subjects can perform 1 to 3 min of aerobic exercise between each station. The aerobic stations may include activities such as stationary cycling, jogging in place, rope skipping, and stair climbing bench stepping, and rowing. This modification of the circuit is known as aerobic circuit

resistance training. Gettman and Pollock, (1981) reviewed the research dealing with the physiological benefits of circuit resistance training. Because it produces only a 5% increase in aerobic capacity as compared to a 15% to 25% increase with other forms of aerobic training, Gettman and Pollock, 1981 concluded that circuit resistance training should not be used to develop aerobic fitness. Rather, it may be used during the maintenance stage of an aerobic exercise programme.

## **1.8 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. An ergonomic model of training is described in which the demands of the game and the fitness profile of Football players are played in perspective. (Fahey, et al 1997). Athletes training are a multi-sided process of expedient use of aggregate factors (mean, methods and conditions) so as to influence the development of an athlete and ensure necessary level of preparedness.

## **1.9 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 fairly 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 in 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 would 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 developed by all players. For good performance in any sports the standard of fitness is basic requirement

### **1.10 IMPORTANCE OF MOTOR FITNESS VARIABLES**

The motor fitness variables are highly important in the achievement of outstanding results in sports performance. Though one of the motor fitness variable like speed as an innate quality, proper and scientific training tends to improve most of the motor fitness variables. The majority of sports events and competitions it is the performance of the motor fitness 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 is 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 yearly 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 and balance etc., are essential qualities to require to be developed by Football performance.

### **1.11 STATEMENT OF THE PROBLEM**

The purpose of the study was to find out the Effects of circuit resistance training and super circuit resistance training on selected motor fitness variables among college football players

### **1.12 OBJECTIVES OF THE STUDY**

1. To find out the individual effects of circuit resistance training on selected motor fitness variables of college football players.
2. To find out the individual effects of super circuit resistance training on selected motor fitness variables of college football players.
3. To find out the superiority effects of circuit resistance training and super circuit training on selected motor fitness variables of college football players

### **1.13 HYPOTHESES**

1. It was hypothesized that the circuit resistance training may produce significant improvement on the selected motor fitness variables namely, speed, speed endurance, muscular endurance, cardio respiratory endurance, flexibility agility and leg explosive power of college football players.
2. It was hypothesized that the super circuit resistance training may produce significant improvement on the selected motor fitness variables namely speed, speed endurance, muscular endurance, cardio respiratory endurance, flexibility agility and leg explosive power of college football players.

3. It was hypothesized that the circuit resistance training alone may produce significant improvement on the selected motor fitness variables, greater than that of super circuit resistance training
4. It was hypothesized that the super circuit resistance training alone may produce significant improvement on the selected motor fitness variables, greater than that of circuit resistance training.

#### **1.14 SIGNIFICANCE OF THE STUDY**

The present study may be considered significant because of the following benefits.

1. Physical educationists and sports scientists have been constantly examining sports performance in relation to the individual fitness standards.
2. The findings of the study provides on opportunity to find out the effects of circuit resistance training and super circuit resistance training among college football players.
3. The result of this study would add to the quantum of knowledge in the areas of training methods, fitness and wellness, coaching field in football.

#### **1.15 DELIMITATIONS**

The study was delimited to the following aspects:

1. The study was delimited forty five football players of inter collegiate level only.
2. The age of the selected players were ranged from 18 to 24years.
3. The selected criterion variables were delimited to motor fitness variables namely speed, speed endurance, muscular endurance, cardio respiratory endurance,

flexibility, leg explosive power and agility. The experimental group I, in which the first group (n=15, CRT Group) performed the circuit resistance training, the second one (n=15, SCRT) performed the super circuit resistance training and third group was the control (n=15, CG group).

4. The training period was delimited twelve weeks.
5. The data were collected prior and after twelve weeks of training programme.

### **1.16 LIMITATIONS**

The study was limited in the following aspects and these limitations would not be taken into consideration for deriving the result:

1. The influence of certain factors like style, daily work, diet and other factors on the result of the study were not taken into consideration.
2. No attempt has been made to control the factors like air resistance, intensity of light, atmosphere and temperature during training and testing period.
3. The knowledge of the subjects in exercise science and their previous experience in doing physical activities were not taken into consideration.
4. Since the subjects were motivated verbally during testing and training periods no attempt was put to differentiate their level of motivation.
5. The psychological stress and other factors, which affect the metabolic function were not taken into consideration.
6. The heredity of the subjects and its influence on the selected criterion variables were not taken into consideration.



## **1.17 OPERATIONAL DEFINITIONS OF TERMS**

### **1.17.1 Circuit resistance training**

Circuit training is a form of conditioning combining resistance and high-intensity aerobics. It is designed to increase strength, muscular endurance, and cardio respiratory endurance.

### **1.17.2 Super Circuit resistance training**

Super circuit resistance training consists of several resistance exercises with a one minute rest between the exercise stations, alternatively instead of rest the subjects performed one minute of aerobic exercise between each station. The aerobic stations included jogging in a place.

### **1.17.3 Speed**

Speed is a combination of reaction time and movement time: Reaction time is the time it takes a subject to respond to a stimulus (such as a goalie responding to a shot in football or the starters' gun). Movement time is the time it takes to perform a movement

### **1.17.4 Speed Endurance**

Speed endurance is the ability to sustain a physical activity, perform repetitive sub maximal contraction or exert a force for a prolonged period.

### **1.17.5 Muscular Endurance**

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

### **1.17.6 Leg Explosive Power**

Explosive power is the combination of strength and speed abilities. It can be defined as the ability to overcome resistance with high speed.

### **1.17.7 Agility**

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

### **1.17.8 Cardio Respiratory Endurance**

It is the ability of heart, lungs and circulatory system to supply oxygen to working muscles efficiently.

### **1.17.9 Flexibility**

Flexibility is the range of motion around a joint. Good flexibility in the joints can help prevent injuries through all stages of life

### **1.17.10 Independent Variables**

“Main variable is one under consideration that is manipulated by the researcher with subjects randomly assigned to various groups or testing conditions”.

### **1.17.11 Dependent Variables**

“A dependent variable is that condition that is observed and measured that is expected to be affected in some way as a result of the manipulation of independent variable”.