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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 tissue 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. (Per-Olof Astrand, 2003)

Strength and conditioning training programs attempt create systematic processes for eliciting physiological adaptations over time (American College of sports medicine 1978, Atha 1981, Fleck, S.J.1988, Kraemer 1989). The magnitude of change depends on how much adaptation potential exists in the person undergoing training—that is, how much adaptation has already occurred within his or her physiological system. A genetic ceiling exists for every physiological function within each person. Furthermore, performance gains in many sports are typically not related to the change in only one physiological system. The concept of total conditioning addresses this need to train each of the physiological systems related to sport performance (Fry, A.C.1991, Hoffman J.R.1991). In short, each athlete brings to a strength and conditioning training program his or her own genetic predisposition, potential for improvement, and willingness to put forth the effort required for developing his or her physiological potential through the program. If the athlete has not been involved in any prior training
program, positive changes will be observed with almost any training program owing to the athlete’s large “adaptational window.” However, if continued change is desired for a particular variable once training adaptations have used up a large portion of the adaptational window, the exact nature of the training stimulus become all the more important. Adaptational changes to a training program are dynamic and related to the athlete’s stage of physical development. Furthermore, training programs can be ineffective owing to their inability to elicit an adequate stimulus for change in a particular physiological system.

From a physiological point of view, it is much easier to maintain a performance level when training elite athletes than to improve an area that is already using a high proportion of the adaptational window. This is especially true when improvement is desired over short periods of training, such as 8 to 10 weeks (Hoffman, J.R., 1990, Moritani 1979). Elite athletes have to train very hard in order to make small gains in performance. This is achieved by improving the physiological adaptations in the body by small but significant adaptation changes. The smallest differences in performance can make the difference between winning and losing a championship (Fleck, S.J., and W.J. Kraemer. 1982, Hoffman 1990)

Training must be carefully planned and its effects understood and evaluated. An athlete’s body can be over trained and pushed into physiological states in which adaptation to the training is ineffective or in which risks of injury and illness can produce major setbacks (Brown, R.L., 1983, Budgett, R. 1990, Dudley 1985)

1.1 SPORTS TRAINING

Sport training is a systematic process extending over a long period. For the best result the system of training has to be based and conducted on scientific facts and lines. Where it is not possible to do that, the training has to be based on the results of successful practice which has withstood the test of time. Sports training aims at improving the performance of sports persons. The sports performance depends on several factors. The performance of a sports man primarily depends on his performance capacity, such as speed, strength and endurance. All these factors therefore are the principle aims of physical training. Sport training is a physical, technical, moral and
intellectual participation of performance with the help of physical exercises. It is a planned process for the participation of athlete and players to achieve top-level performance. Training is much like constructing a multi storey building. Several kinds of materials like training intensities and modalities should be utilized in an ongoing process to complete the goal of finished buildings or competitively fit athlete. Depending on the progress in the construction plan, the relative mix of all these materials will vary. As a training season develops, compressive conditioning work for the strength of endurance will gradually form a transition into an emphasis on par with a substitution of intensity of volume in determining the total load (Bomba T., 2005).

1.2 BASIC PRINCIPLES OF TRAINING PROGRAM

A number of basic training principles apply to all types of exercise programs, whether they are designed to improve cardio respiratory fitness, muscular-skeletal fitness, body composition, flexibility, or balance.

1.2.1 Specificity of training principle

The specificity principle states that the body's physiological and metabolic responses and adaptations to exercise training are specific to the type of exercise and the muscle groups involved. For example, physical activities requiring continuous, dynamic, and rhythmical contractions of large muscle groups are best suited for stimulating improvements in cardio respiratory endurance; stretching exercises develop range of joint motion and flexibility; and resistance exercises are effective for improving muscular strength and muscular endurance. Furthermore, the gains in muscular fitness are specific to the exercised muscle groups, type and speed of contraction, and training intensity.

1.2.2 Overload training principle

To promote improvements in physical fitness components, the physiological systems of the body must be taxed using loads that are greater (overload principle) than those to which the individual is accustomed. Overload can be achieved through increases in the frequency, intensity, and duration of aerobic exercise. Muscle groups
can be effectively overloaded through increases in the number of repetitions, sets, or exercises in programs designed to improve muscular fitness and flexibility.

1.2.3 Principle of progression

Throughout the training program, you must progressively increase the training volume, or overload, to stimulate further improvements (i.e., progression principle). The progression needs to be gradual because "doing too much, too soon" may cause muscular-skeletal injuries and is a major reason why some individuals drop out of exercise programs.

1.2.4 Principle of initial values

Individuals with low initial physical fitness levels will show greater relative (%) gains and a faster rate of improvement in response to exercise training than individuals with average or high fitness levels (initial values principle). For example, during the first month of an aerobic exercise program, the VO2max of a client with poor cardio-respiratory endurance capacity may improve 12% or more, whereas a highly trained endurance athlete may improve only 1% or less.

1.2.5 Principle of inter individual variability

Individual responses to a training stimulus are quite variable and depend on a number of factors such as age, initial fitness level, and health status (i.e., inter individual variability principle). You therefore must design exercise programs with the specific needs, interests, and abilities of each client in mind and develop personalized exercise prescriptions that take into account individual differences and preferences.

1.2.6 Principle of diminishing returns

Each person has a genetic ceiling that limits the extent of improvement that is possible due to exercise training. As individuals approach their genetic ceiling, the rate of improvement in physical fitness slows and eventually levels off (i.e., diminishing return principle).
1.2.7 Principle of reversibility

The positive physiological effects and health benefits of regular physical activity and exercise are reversible. When individuals discontinue their exercise programs (detraining), exercise capacity diminishes quickly; and within a few months most of the training improvements are lost (i.e., reversibility principle). Today the people of every country are more concerned with physical fitness than ever before as it has become the vital part of winning sports competitions.

1.3 RESISTANCE TRAINING

One could classify resistance training as an anaerobic form of exercise. Many of these different training programs can be used to enhance the ability of the body to perform at very high force and/or power outputs for a very short period to improve the body’s ability to perform repeated bouts of maximal activity (Kraemer, W.J. 1983, 1988, MacDougall 1986). Heavy resistance training reduces mitochondrial density in the trained muscles, a change that parallels and is thus attributable to increases in muscle size (Luthi, J.M. 1986, MacDougall 1979). The increase for protein also indicates decreased capillary density. However, decreases in mitochondrial and capillary densities do not result in reduced ability to perform aerobic exercise.

Power lifters and Olympic weightlifters show significantly lower capillary densities when compared with control subjects, whereas body builders have capillary densities similar to non-athletes. Bodybuilding workouts typically elevate blood lactate concentrations to above 20mmol/L; this may help get rid of the lactic acid by various mechanisms, making enhanced capillary supply a positive training effect to help in the clearance of lactic acid from the exercising muscle tissue (Dudley, G.A. 1988, Schantz, P.G. 1986). The type exercise protocols used by body builders may differentially influence cellular adaptations. Such changes may be advantageous for sports such as 800-m races and wrestling that develop large accumulations of lactic acid. There are many conflicting reports on enzyme changes with resistance training. Further study of enzyme changes with resistance training. Further study of enzyme changes with resistance training that use single fiber analysis schemes to delineate the subtle changes.
that may occur in specific fiber types are needed. Heavy resistance training induces increases in energy substrate levels and their availability in muscle (Tesch, P.A. 1987).

After 5 months of training, ATP, creatine phosphate, creatine, and glycogen increased in the triceps brachii (Dudley, G.A.1988). Prolonged heavy resistance training may also increase capacity for intramuscular lipid storage. These changes are related to the specific type of resistance training program used, whether it is low-volume, with 5RM (repetition maximum) and long rest periods, or high-volume, with 10RM and short rest periods. Initial gains in muscle strength during the first few weeks of training do not show a concomitant increase in muscle size or muscle cross-sectional area (Sale, D.G.1987, 1988). The quality of the muscle – specifically, the type of muscle proteins that make up the myosin filament – changes, but not enough protein is accumulated in the cells to create increases in muscle fiber size. Within several weeks, however, myofibril proteins start to be added to the muscle fibers, and increases in muscle fiber size are observed at about 8 to 12 weeks of training. Increases in muscle strength from pre training values can range from 7% to 45%, the figure for a given person dependent in large part upon the starting level of strength. If a person is untrained, almost any program will bring gains, but the rate of increase declines as training continues. Thus, the design of effective exercise prescriptions becomes increasingly important. The majority of investigations have used untrained subjects and thus large window of adaptation would be expected and therefore a large increase in strength following just about any training program. If the learning effects are not removed with repeated test familiarization and practice tests, as much as 50% of the strength gain may reflect the acute learning effects (subject improves performance because he or she learns what to do and how to produce force) and not be true physiological gains related to muscle tissue adaptations over the long-term training program. Hoffman et al. (Hoffman, J.R. 1990) found that in highly trained college football players, some protocols demonstrated no significant changes during a 10-week training program. These points to the importance of understanding the training level of athletes when evaluating changes in strength with training.

In addition, gender effects also account for the absolute magnitude of strength gains (Falkel, J.E.1985, Hoffman, and T.1979). The effects of training are related to the
type of exercise used, its intensity, and its volume (number of sets x number of repetitions). With trained athletes, a higher volume of exercise is typically needed in order for the adaptations to continue to improve (although over training is also possible). The use of both eccentric and concentric components in machine stack plate or free weight resistance exercise may result in optimal improvement in strength and muscle size—an important consideration when examining goals and matching them with resistance training equipment. Multiple sets of an exercise and maximum voluntary contractions are needed when training athletes with progressive resistance training (Kraemer, W.J. 1988). Carefully manipulating intensity and volume is where the “art” of the profession comes in.

1.4 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 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 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).

1.5 DEVELOPING RESISTANCE TRAINING PROGRAMMES

Before designing a resistance training programme for the subject, training principles have to be revived. Further, how each of these principles can be incorporated in to the subjects programme should be determined. The training program needs to be individualized by varying the combination of intensity, duration, and frequency of exercise.

1.6 APPLICATION OF TRAINING 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.
1.6.1 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).

1.6.2 Additional principles

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).

1.7 PROCEDURES FOR TRAINING PROGRAMMES

The primary goal for this programme is to develop adequate muscular fitness so that the subject can retain functional independence. This programme follows the guidelines suggested by ACSM (2010) for designing resistance training programmes for older adults. During the first four week 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, three days/wk, to her workouts.

1.8 RESISTANCE TRAINING PROGRAMME

Based on the subject's goal, time commitment and access to equipment, determine the type of resistance training programme (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 must be identified. 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 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 six 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.

1.9 RESISTANCE TRAINING PROGRAMMES FOR CHILDREN

Children and adolescents can safely participate in resistance training if special precautions and recommended guidelines are carefully followed. Because children are anatomically and physiologically immature, high-resistance training programmes are not typically recommended for them. Most experts agree that to lessen the risk of injury to developing bones and joints (e.g., epiphyseal growth plate fractures), exercise intensity should not exceed 80% 1-RM, which equates to eight to fifteen repetitions per set. Faigenbaum and colleagues, (1999) reported that high-repetition-moderate-intensity training (one set, 13-RM to 15-RM) was more effective than low-repetition-high-intensity training (one set, 6-RM to 8-RM) for improving the strength and muscle endurance of children (5-12 yr) during the initial training phase (8 wk). Strength gains in resistance-trained children result from neural adaptations (e.g., increased activation of motor units and coordination) rather than from hypertrophy (Guy and Micheli 2001). In addition, resistance training positively affects the bone mineral density of the femoral neck in adolescent girls aged 14 to 17 yr (Nichols, Sanborn, and Love 2001).

There is no evidence that children lose flexibility when they resistance train (Guy and Micheli 2001). Resistance training is safe and beneficial for youth, especially when the established training guidelines are followed. These guidelines are based primarily on recommendations outlined in the Canadian Society for Exercise Physiology.
1.10 RESISTANCE TRAINING PROGRAMMES FOR ADULT

Resistance training provides many health benefits, especially for older adults. The primary goal of the resistance training programme is to develop sufficient muscular fitness so that older adults may carry out activities of daily living without undue stress or fatigue and may retain their functional independence. In addition to increasing strength and muscular endurance, resistance training may improve the performance of functional tasks such as lifting and reaching, rising from the floor or a chair to a standing position, stair climbing, and walking (Henwood and Taaffe 2003; Messier et al. 2000; Schot et al. 2003; Vincent et al. 2002). Besides, the postural sway and balance of older, osteoarthritic adults improved by participation in either long-term resistance training or aerobic walking (Messier et al. 2000).

Improved strength and balance may help prevent falls and injuries to older adults. The ACSM (2010) recommends moderate-intensity (rating of perceived exertion [RPE] = 5-6) to vigorous-intensity (RPE = 7-8) exercise at least two days/wk to improve the muscular fitness of older adults. At least one set of 10 to 15 repetitions for 8 to 10 different exercises each workout should be prescribed. Vincent and colleagues (2002) noted long-term (6 mo) improvements in the strength and muscular endurance of older adults (60-83 yr) who participated in either a low-intensity (one set at 50% 1-RM) or a high-intensity (one set at 80% 1-RM) resistance training programme three days/wk. Likewise, Hunter and colleagues, (2001) reported that isometric and dynamic muscle strength gains are similar for older adults (>60 yr) engaging in either a nonperiodized, high-intensity programme (two sets at 80% 1-RM, 3 days/wk) or an undulating periodized (UP) programme varying training volume each day (two sets at 50%, 65%, or 80% 1-RM, three days/wk). Some evidence suggests that training one, two, or three days a week at 80% 1-RM produces similar strength gains in older (65-79 yr) adults (Taaffe et al. 1999). In addition to the general guidelines for designing resistance training programmes for healthy adults, the following guidelines and precautions are recommended for older adults: During the first eight weeks of training, minimal resistance must be used for all exercises. Older adults must be instructed about proper weightlifting and breathing techniques. Trained exercise leaders who have experience working with older adults should closely supervise and monitor the
subject's weightlifting techniques and resistance training program during the first few exercise sessions. Multijoint exercises rather than single joint exercise must be prescribed. Exercise machines to stabilize body position and to control the range of joint motion must be used. Using free weights must be avoided with older adults. Each exercise session should be approximately 20 to 30 min and should not exceed 60 min. Older adults should rate their perceived exertion during exercise. Ratings of perceived exertion should be 5 or 6 (moderate) or 7 or 8 (vigorous).

1.11 AEROBIC TRAINING

Endurance training and resistance training provide a continuum of modalities that affect various physiological systems (Clausen, J.P. 1977, Kraemer, W.J. 1982, Patton 1980). The magnitude of change in any program depends on the athlete’s pretraining level and the characteristics of the program (Lesmes, G.R. 1978, Lortie, G. 1984). As with resistance training, endurance training requires proper progression, variation, specificity, and overload if physiological adaptations are to be effected (Sjodin, B. 1985). A multitude of adaptation is needed, from the cellular to the organism level (Saltin, B. 1969).

Over the past three decades, volumes of information have been produced on endurance exercise and its subsequent training adaptations. Aerobic metabolism plays a vital role in human performance and is basic to all sports, if for no other reason than recovery. Metabolically, the Krebs cycle and electron transport chain are the main pathways in energy production. Aerobic metabolism produces far more ATP energy than anaerobic metabolism and uses fats, carbohydrates and proteins. Many sports involve interactions between the aerobic and anaerobic metabolic systems and thus require appropriate training. Proper conditioning of the aerobic system is vital to the ability of the player to sustain such activity and adequately recover. It appears that every athlete needs to have a basic level of cardiovascular endurance, which can be achieved using a wide variety of training modalities and programs. The traditional modality has been the long, slow distance run. For the strength-and-power athlete, however, this may be irrelevant or even detrimental to power development; adequate gains in aerobic fitness can be accomplished with interval training when appropriate and needed (Dudley, G.A. 1985, Hickson, R.C. 1980.). The old concept of an aerobic
base for purposes of recovery in anaerobic sports is somewhat misunderstood in that athletes can gain aerobic training adaptations with a variety of training programs. One of the most commonly measured adaptations to endurance training is an increase in maximal cardiac output (Scheuer, J.1977.). As the intensity of exercise increases, the oxygen consumption rises to maximal levels. When the demands increase to where the oxygen consumption can no longer increase, maximal oxygen uptake has been achieved. Endurance training can improve an athlete’s aerobic power 5% to 30%, depending on the starting fitness level. Greater improvement can usually be attributed to exceptionally low starting levels. Metabolic changes include increased respiratory capacity, lower blood lactate concentrations at a given sub maximal exercise intensity, increased mitochondrial and capillary densities, and improved enzyme activity.

Although maximal oxygen uptake may not change with endurance training in athletes year to year, improvement in the oxygen cost of running does improve; several studies have shown a progressive improvement in the economy of running in elite endurance athletes. Long-term endurance training may be more involved with improving the athlete’s running economy than with improving the maximal ability to extract and utilize oxygen (i.e., VO2 max). Runners may not improve their VO2 max but performance may be better due to enhanced running economy (Kraemer, W.J.1986). The intensity of training is one of the most important factors in improving and maintaining aerobic power. Short, high-intensity bouts of interval sprints can improve maximal oxygen uptake if the interim rest period is also short. Callister et al. (1988) showed that long rest periods used with sprints improve sprint speed without significant increases in maximal aerobic power. Therefore, longer training sessions result in lesser degrees of aerobic improvement as less activity is performed per unit of time. Physiological adaptations vary according to age and gender (Drinkwater 1973, Vogel, J.A.1986). Maximal aerobic power decreases with age in adults. On the average, age for age, the aerobic power values of women range from 73% to 85% of the values of men. However, the general physiological response to training is similar in men and women. The differences in aerobic power may be caused by several factors, including women’s higher percentage of body fat and lower blood hemoglobin values and men’s larger heart size and blood volume.
1.12 CROSS TRAINING

Cross training refers to training for concurrent improvement in more than one type of physical activity (e.g. running and swimming) or more than one type of fitness (e.g. Strength and endurance). Because cardiovascular adaptations to endurance training are similar regardless of the physical activity used to stress the cardiovascular systems, some carryover in cardiovascular improvement occurs across different types of endurance exercise.

For this reason, cross training is a useful technique to prevent cardiovascular de-conditioning in injured athletes who wish to abstain from activities that involve their injured body parts. On the other hand, because muscular adaptations to training are specific to the muscles involved in the activity, little carryover in muscular improvement occurs across activities that employ different groups of muscles or different types of exercise. For these reasons, upper extremity exercise are not a useful technique to prevent de-conditioning in lower extremity muscles, and anaerobic exercises are not a useful technique to prevent aerobic de-conditioning. Adaptations to one to one type of exercise may even interfere with the training effects of another type of exercise. For example, strength training decreases capillary density in muscle, whereas endurance training increases capillary density in muscle. The above considerations explain why swim training improves swimming performance more than it improves running performance and cycle training improves cycling performance more than it improves running performance.

1.13 STATEMENT OF THE PROBLEM

The purpose of the study was to find out the isolated and combined effects of circuit resistance and aerobic training on performance parameters of college men.
1.14 OBJECTIVES OF THE STUDY

1. The first objective of the study was to evaluate the training effects of isolated circuit resistance training on performance parameters of college men.

2. The second objective of the study was to evaluate the training effects of isolated aerobic training on performance parameters of college men.

3. The third objective of the study was to evaluate the training effects of combined circuit resistance and aerobic training on performance parameters of college men.

4. The fourth objective of the study was to evaluate the superiority training effects of selected training interventions of college men.

1.15 HYPOTHESES

1. Hypothesized that isolated circuit resistance training may produce significant improvement on performance parameters namely speed, cardio respiratory endurance, muscular strength endurance, muscular strength, leg explosive power and agility of college men.

2. Hypothesized that isolated aerobic training may produce significant improvement on performance parameters namely speed, cardio respiratory endurance, muscular strength endurance, muscular strength, leg explosive power and agility of college men.

3. Hypothesized that combined circuit resistance and aerobic training may produce significant improvement on the performance parameters namely speed, cardio respiratory endurance, muscular strength endurance, muscular strength, leg explosive power and agility of college men.
1.16 DELIMITATIONS

The study was delimited to the following aspects.

1. The study was delimited to one hundred and twenty (N-120) men from Sri VenkateswaraOriental College, Tirupati, Sri VenkateswaraArts College, Tirupati and Sri GovindarajaSwamyArts college, Tirupationly.

2. The age of the selected students ranged from 18 to 22 years.

3. The selected students divided into four equal groups consist of each thirty students (n-30).

4. The training interventions were delimited only twelve weeks, for each week three alternative days.

5. The speed, cardio respiratory endurance, muscular strength endurance, muscular strength, leg explosive power and agility were delimited as performance parameters.

1.17 LIMITATIONS

The study was limited in the following aspects and these limitations are not taken into consideration of the result.

1. The influence of certain factors like daily work, diet and other factors on the result of the study was 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 dependent variables were not taken into consideration.

1.18 SIGNIFICANCE OF THE STUDY

This study would be very much useful and suitable for college level students. The study would be of great significance because it would provide an opportunity to the physical educationists, coaches and students as they would be able to scientifically understand and assess the changes in the performance parameters due to the isolated and combined circuit resistance and aerobic training.

The findings of the study would enrich the physical education profession with better insight into methods to enhance performance parameters changes of college men students. If the study is successfully completed, it would be scientifically accepted that the circuit resistance and aerobic training not only develops internal organs like respiratory system, nervous system, excretory system but also muscular system and endocrine system.

1.19 OPERATIONAL DEFINITIONS OF THE TERMS

The terminology anticipated to frequent this study is here under defined and explained to avoid misinterpretation and misapprehension.

1.19.1 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, 1984).

1.19.2 Circuit Resistance training

Circuit Resistance training is defined as a training aid to different sports using the weight or similar apparatus in a circuit manner, (Hardayalsingh 1991)
1.19.3 Aerobic Training

Aerobic exercise is exercise that involves or improves oxygen consumption by the body. Aerobic means “with oxygen”, and refers to the use of oxygen in the body’s metabolic or energy generating process, (Shaver 1991).

1.19.4 Speed

Speed as the capacity of the individual to perform successive movement of the same pattern at a fast rate, (Barrow, 1973).

1.19.5 Cardio respiratory endurance

Ability of body to take in and distributes adequate amounts of oxygen to working muscles during physical activities, Shaver (1982).

1.19.6 Muscular strength 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.

1.19.7 Muscular strength

It may be defined as the maximum amount of force that a particular muscle or group of muscle can exert against a resistance.

1.19.8 Leg Explosive power

Explosive power is defined as the capacity of the individual to release maximum force in the shortest period of time (Hardayal Singh, 1991)

1.19.9 Agility

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