CHAPTER - I

INTRODUCTION
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Middle childhood’s slow, steady growth occurs until the onset of puberty, which occurs during the late middle childhood or in early the adolescence. Children gain an average of 7 pounds in weight and 2½ inches in height, per year. They have growth spurts, which are usually accompanied by an increase appetite and the intake of food. Conversely, a child’s appetite and the food intake decrease during the period of slower growth. Body composition and body shape remains relatively constant during the middle childhood. During the pre adolescence and early adolescence (9 to 11 years in girls, 10 to 12 years in boys), the percentage of body fat increases in preparation for the growth spurt that occurs during adolescence. This increase of the body fat occurs earlier in girls than in boys and the amount of increase is greater in girls. During the middle childhood, children may become more concerned about their physical appearance. Girls especially may become convenient that they are overweight and may become voracious eaters. During the middle childhood, children's muscle strength, motor skills, and stamina increases. Children acquire the motor skills, necessary to perform complex movements allowing them to participate in a variety of physical activities. For females, most physical growth is completed by 2 years after menarche. The mean age of menarche is 12½ years. For girls the onset of puberty is associated with an increase in the body fat that may result in a decline in physical activity performance. In addition, the increase in the body fat and decrease in muscle flex may result in less fluid movements during the growth spurt and may
increase the risk of overuse injuries in girls. Such a nature when added to their sedentary life they are foster to have the unwanted changes in their physical and physiological aspects. The result of this is that, the children now a days become the owners of very deadly diseases namely diabetics and hyper tension in the very early stages rather than they get these in their later stages. Having the facts in the mind, needs girls during the year pre adolescence age need to undergo physical training with the aim to have the fitness they want at that stage. (Clarkie 1993).

Generally physical fitness can be achieved by a scientific and systematic usage of the training means. Training means are various physical exercises and other objects, methods and procedures which are used for the improvement, maintenance and to gain the recovery of performance capacity and performance readiness. Any material or immaterial object, method or measure that leads to achieve the aims of training can be called as a training means. Physical exercises are the principal means of training. The other means are used in addition to physical exercises to increase the total effect of physical exercises. These means can be used along with the physical exercises or separately as per the requirement. Each training means has its own specific effect on the performance capacity. Physical exercises have a direct effect on performance capacity. Typical training programs comprise numerous specific training activities and techniques. Although selecting the proper individual activities is important for combining these activities in a complementary fashion so that the result is an optimal overall training program which is crucial. Based on these, to provide the need based training for the development of physical and physiological fitness of girls during the period of pre
adolescence, periodized based training program instituted in testing the effect of resistance, aerobic and aerobic and resistance concurrently. Thus the present study was titled as the effect of periodized aerobic training, periodized resistance training and periodized concurrent aerobic and resistance training individually on selected physical, physiological and haematological variables of pre adolescent girls.

1.1 Training

The word ‘Training’ has been a part of human language since ancient times. It denotes the process of preparation for same task. This process invariably extends to a number of days and even months and years. The term ‘Training’ is widely used in sports. Some experts especially belonging to sports medicine understand sports training as basically doing physical exercise. Training aims at improving the fitness of persons.

1.1.1 Principles of Training

The very purpose of the training program is an aid in the development of acceptable levels of health – and health related physical fitness and promote the acquisition of basic movement skills. To achieve these things, training should have some basic principles. Of these the most basic principle of training is overload. Most physiological systems can adapt various functional demands that would exceed these encountered in our normal daily life. Training often systematically exposes to selected physiologic systems to intensities of work or function that exceeds to those which the system is already adapted. To avoid excessive overload due to physiologic systems cannot adapt to stresses to extreme consistency refers to most physiologic systems require exposure to
overloading activities three times a week or more. The required frequency of
training however depends on the season, the athlete, activity and the specific
component of fitness. There is no substitute for consistency in a training
programme. The athlete might participate in the endurance training six times a
week and resistance training three times a week. Specificity means the effects
of training are highly specific to the participation physiologic system
overloaded, to the particular muscle groups used, and to the particular muscle
fibers performing the work progression is the successful training program plan
for a steady rate of progression over a long period. The athlete has to improve
over several years of participation; the training program must progress so that
the appropriate physiologic systems continue to be overloaded. However, too
rapid an increase of the training stress may lead to exhaustion and impaired
performance. Individuality means factors such as age, sex, maturity, current
fitness level, years of training, body size, somato type and psychological
characteristics should be considered by the coach in designing each athlete’s
training regime. In large groups in which absolute individuation of training
programs may be impractical, the coach should strive for individualization by
homogeneously grouping athletes.

1.2 Periodization

Periodization is an organized approach to training that involves
progressive cycling of various aspects of a training program during a specific
period of time. The roots of periodization come from Hans Selye’s model,
known as the General Adaptation Syndrome, which has been used by the
athletic community since the late 1950s (Fleck, 1999). Selye identified a
source of biological stress referred to as eustress, which denotes beneficial
muscular strength and growth, and a distress state, which is a stress that can lead to tissue damage, disease, and death.

1.2.1 History of Periodization

Over 2000 years ago, the ancient Greeks were the first to use periodization training, although their periodization plans were very simple (they simply increased their total training load over time, using heavier and heavier weights and resistances, for example, to train strength athletes who were preparing for the Olympic games). After the Greeks, periodization training theory entered a 1990 year lull, only to be revived earlier this century. Russia during the Russian Revolution since that time, the Russians have literally led the world in the development of periodization theory. The Russians have also enjoyed one key advantage over other countries; they have actually tested various periodization schemes with large numbers of their international athletes and have accumulated an extensive amount of practical information about periodizing training properly.

The earliest periodization training schemes utilized by the Russians in the 1920s and 1930s were logical but pretty basic; their exercise scientists theorized that training should be divided into what they called, general, preparatory and specific phases. The general state of training, often lasting for about two months or so was supposed to develop the heart and lungs, the preparatory training, also two months in duration, sought to boost muscle strength and endurance and the specific period about eight months prepared an athlete for individual sporting event by emphasizing extensive practice of the precise movements involved in the sport.
1.2.2 Need of Periodization

Periodization is a method for structuring training programs using cycles of stimulating loads, maintenance loads, detraining loads and rest to elicit improvements in fitness and performance. It allows for planned variation in training program, while maintaining a coherent structure. It results in increases recovery and recuperation potential and shows measurable progress in strength gains. Periodizing the training is the key. Instead of doing the same routine month after month, you change your training program at regular intervals or “periods” to keep your body working harder, while still giving it adequate rest. Thus alter the strength-training program by adjusting the following variables: the number of repetitions per set, or number of sets of each exercise, the amount of resistance used, the rest period between sets, exercises or training sessions, the order of the exercises, or the type of exercises and the speed at which you complete each exercise. Periodization is most widely used in resistance program design to avoid over-training and to systematically alternate high loads of training with decreased loading phases to improve components of muscular fitness (e.g. strength, strength-speed, and strength-endurance).

1.2.3 Cyclical Nature of Performance and Rationale for Periodization

Summarizes the results of selected studies aimed at identifying the minimum number of sessions required weekly to maintain initial strength gains. Early studies found frequencies of once every 2 weeks and less to be adequate, but there were faults in the study design during the training phase. For example, recorded strength increases at the end of the training phase that was probably due to learning. Hence, the subjects did not experience any
strength decrements while training once can be better understood among the following lines. (a) Periodization serves to modify the training intensity and volume so that the training confirm to the athlete’s innate cycle. Hence the training is made easy during a period when the athlete is at risk of fatigue, training is heavy when he is fresh; and training tapers off to allow him to recover in time for a major competition. (b) The high-volume, low-intensity phase at the beginning of each cycle is thought to be a major contributing factor to the success of the periodized model because it prepares the athlete to better tolerate the higher intensities later in cycle, increases aerobic capacity, and beneficially alters body composition. (c) The low-volume high-intensity phase towards the end of the cycle reduces the risk of overtraining. In non-cyclical, monotonous programs, it is possible that the continuous use of the same set and repetition routine leads to overtraining. (d) The variations within the course of each cycle prevent the staleness that may be responsible for the differences in strength gains as well as differences in the final maximum power output between athletes. Varying the volume and intensity forces the neuromuscular system to adapt to the training to the training load. Poliquin believes that strength training programs lose their efficacy after only 2 weeks because of the body’s rapid adaptation to a fixed training stimulus. Although can occur rapidly, a period of 2 weeks is probably an underestimation.

1.2.4 Training basics in Periodization

Part of a periodized plan is decreasing quality and quantity and goes through a period of active rest resulting in a greater state of readiness to handle a higher training load. Including rest periods in training program is especially beneficial when training with high intensity and / or high volume.
Improvements in fitness (as measured by increased strength or endurance) occur during the rest period, not during the training itself. Positive physiological adaptations to training result from correctly timed alternations between stress and regeneration. After a controlled training overload, there is a period when the body adapts to the overload and works to reestablish homeostasis. After it has adapted to the overload, the body is capable of doing more work for an equivalent homeostatic displacement. The basic aim of training, therefore, is to apply a series of stimuli that will displace the homeostasis of the body's functional systems and provides a stimulus for adaptation and super compensation. If the training stimulus is too small in either intensity of duration, little or no adaptation will take place. However, if the stress is too severe, the adaptation will be delayed or even prevented.

1.2.5 Periodized Strength Training

The concept of periodized strength training has been utilized by the athletic community at least since the late 1950s. Periodized strength training refers to varying the training program at regular time intervals in an attempt to bring about optimal gains in strength, power, motor performance and / or muscle hypertrophy. A goal of periodized strength training is to optimize training during short (e.g. weeks, months) as well as long periods of time (e.g. years, a lifetime, or an athletic career). The training variables that can be manipulated in an attempt to optimize the training program include number of sets performed of each exercise, number of repetitions per set, exercises performed, number of exercises performed per training session, rest periods between sets and exercises, resistance used for a set, type of muscle action.
performed (e.g. eccentric, concentric, isometric), and number of training sessions per day and per week.

The term intensity is frequently used when describing weight-training programs to refer to the weight lifted of repetition maximum weight used to perform a certain number of repetitions (repetition maximum, RM). The highest intensity that can be used is a one repetition maximum weight. A weight allowing the performance of more than one repetition of an exercise is thus a lower training intensity. The term training volume will be used in reference to the total number of repetitions per set, and number of repetitions implies a higher training volume. Unfortunately, despite the virtually limitless combination of these training variables, the majority of studies examining the effectiveness of periodized training have focused on strength/ power gains and manipulated only training intensity and training volume.

1.3 Aerobic fitness

Aerobic fitness is a complex of physical fitness. It involves the interaction of physiological processes in the cardiovascular, respiratory, and muscular systems including the capacity of the lungs to take up oxygen, the capacity of the blood in the lungs to pick up oxygen, the capacity of the tissues to extract the oxygen from the blood and used it to generate energy in the form of ATP via in the oxygen system.

Aerobic fitness is probably the single important health component of physical fitness. Aerobic fitness represents the ability of the cardiovascular and respiratory system to accommodate the oxygen needs of the muscular system over a sustained period of time, as in endurance events such as distance
running, swimming and bicycling. A number of other terms are associated with aerobic fitness – cardiovascular endurance cardiovascular fitness, cardio respiratory fitness, aerobic endurance and physical working capacity and have the same essential meaning.

1.3.1 Aerobic Exercise

Aerobic exercise is defined as any activity that uses large muscle groups, rhythmically, for a continuous period. The most common forms of aerobic exercise are walking, jogging, swimming and cycling. The selection of exercise mode should be based on the subject's past exercise experience, budget, current fitness level and desires. Walking has become one of the most popular forms of aerobic exercise. Walking is being hailed as perhaps the safest and most effective form of aerobic exercise for anyone, young or old. Medical and fitness experts routinely encourage people to get cut and walk as a way to improve their cardiovascular endurance, recover from injury, prevent heart disease, and lose weight. Walking is less intense than jogging or running. Longer sessions can be maintained with less likelihood of injury.

Before starting a walking program, or any exercise program for that matter, individuals should remember three important points (i) the need to be patient (improvement in the fitness level will not happen overnight), (ii) improvements in fitness come in small increments (the most rapid improvements happen in the first months), and (iii) the need to make small and infrequent increases in the program. (i.e. increases in time, duration, frequency and intensity).
1.3.2 Metabolic Adaptations of Aerobic Exercise Training

Aerobic exercise training induces intracellular changes that enhance a muscle fiber's capacity to aerobically generate ATP. Metabolic Machinery an increase in Mitochondrial size and number in aerobically trained skeletal muscle improves its capacity to generate ATP by oxidative phosphorylation. Enzymes a two fold increase in the level of aerobic system enzymes compliments the increase in mitochondrial size and number. These adaptations likely to allow the athlete to sustain a high percentage of aerobic capacity during prolonged exercise without accumulating blood lactate. Fat catabolism Regular aerobic exercise profoundly improves ability to oxidize fatty acids, particularly triacylglycerols stored within active muscle during steady rate exercise. Carbohydrate catabolism Aerobically trained muscle exhibits an enhanced capacity to oxidize carbohydrate. Muscle fiber type and size endurance training produces aerobic metabolic adaptations in both muscle fiber types. This enhances each fibers existing aerobic capacity and lactate threshold level without modifying muscle threshold level without modifying muscle fiber type. Selective hypertrophy also occurs in the different muscle fiber types in specific overload training. Highly trained endurance athletes have larger slow twitch fibers than fast twitch fibers in the same muscle.

1.3.3 Cardiovascular Adaptations

Endurance training produces significant dimensional and functional cardiovascular adaptations because of the intimate linkage of the cardiovascular system to aerobic processes. Heart size aerobic training normally enlarges the heart by increasing left ventricular cavity size and by
inducing a slight thickening of its walls. Cardiac enlargement of this type, termed eccentric hypertrophy, improves intensity, myocardial structure returns to control levels. Plasma volume only four training sessions can increase plasma volume upto 20%. This adaptation enhances circularly and thermoregulatory dynamics and facilitates oxygen delivery to muscle during exercise. The rapid increase in plasma volume with aerobic training also contributes to training induced eccentric hypertrophy. Stroke volume the endurance athlete's heart has a considerably larger stroke volume during rest and exercise than an untrained person of similar age. For trained and untrained individuals, the greatest increase in stroke volume in up light exercise occurs in the transition from rest to moderate exercise. Further increases in exercise intensity increase stroke volume only minimally. Heart rate a proportionate reduction in heart rate during sub maximal exercise accompanies the large stroke volume of elite endurance athletes and stroke volume increase of sedentary subjects. The larger stroke volumes account for the lower exercise heart rates. The heart pumps a large quantity of blood with each beat, then adequate blood (oxygen) delivery to the active muscles requires only a small heart rate increase and vice versa for a heart with a relatively small stroke volume. Cardiac output an increase in maximum cardiac output represents the most significant change in cardiovascular function with aerobic training. Maximum heart rate may decrease slightly with training, so the heart's increased out flow capacity results directly from improved stroke volume. Oxygen extraction aerobic training increases the maximum quantity of oxygen extracted from arterial blood during exercise. A more effective distribution of cardiac output to working muscles and enhanced capacity of muscle fibers to
metabolize oxygen produce the increase in a \( \text{Vo2} \) difference. Blood pressure aerobic exercise training decreases systolic and diastolic blood pressures during rest and sub maximal exercise. Systolic and diastolic blood pressures generally decline approximately 6 to 10 mm hg with regular aerobic exercise for previously sedentary adult men and women of all ages.

1.4 Resistance training

Resistance training is an important tool for achieving a complete healthy life. Resistance training is not just for people who are athletes, want to build or tone muscle, or are using resistance training to achieve a better-looking body. Resistance training does improve the look and tone of the body but it is now known to be more than just a specialized exercise activity. According to the American Sports Medicine Institute (ASMI), resistance training is a “specialized method of conditioning designed to increase muscle strength, muscle endurance, and muscle power”. Resistance training can be performed in a variety of ways; with resistance machines, free-weights (dumbbells and barbells), rubber tubing, or your own body weight, as in doing pushups, squats, or abdominal crunches. The goal of resistance training, the ASMI says, is to “gradually and progressively overload the musculoskeletal system so it gets stronger”. Regular resistance training will strengthen the bones, building and strengthening the muscles. Keith Cinea, a certified strength and conditioning specialist and educational program coordinator for the National Strength and Conditioning Association, says that any fitness program should include resistance training, along with aerobic exercise and flexibility training. Aerobic workouts, which strengthen the cardiovascular system, focus primarily on the large muscle groups of the lower body, he says. Strength training offers a way
of balancing that out by challenging all the major muscle groups, including those in the chest, arms, back and abdomen.

1.4.1 Benefits of Resistance training

According to medical research, generally the resistance training is strengthening the muscular system, strengthening the skeletal system, improves bone density (decreases the chance of osteoporosis), increases metabolism, improves posture, limits atrophy of the muscles, increases circulation, aids in prevention adult-onset diabetes, improves mood and self-esteem, improves quality of life, aids in the prevention of heart disease and certain. So a well-planned resistance training program should be a part of everyone’s health and fitness lifestyle regardless of age, gender, or goals.

Resistance training of children has gained acceptance and popularity primarily because strength gains can occur, bone development may be enhanced, and injuries might be prevented in order sports and activities with developmentally appropriate training programs. Aerobically, the additional resistance enhances any routine, from power walking to jogging to square dancing. By resisting the movement, a student’s metabolic rate increases more quickly than if the routine were not resisted. The versatility of the product allows a properly trained instructor to achieve endurance, aerobic and anaerobic gains at the same time.

Structuring a resistance training program with Burke Spencer’s Fitness Partner encourages the lifetime physical activity in students ages 8+ as improve neural motor skills and strength, as improve bone development by
increasing bone density, as improve the strength of bone connective tissue, as strengthen the heart muscle and as improve muscle energy capacity.

1.4.2 Resistance Training during Preadolescence

Preadolescence, or childhood, is defined as the period encompassing pre and early puberty as determined by Tanner (1962), with an upper age of approximately 11 years for females and 13 years for males. During the period of adolescence, studies related to resistance training are very few, though the effectiveness, benefits, and risks of strength training in adults are relatively well documented in the scientific literature. Besides it has traditionally been recommended in the coaching literature that resistance training should be avoided during preadolescence on the basis that significant strength gains could not be made before puberty and that it could be harmful to children.

It is well-established that growth is a key factor responsible for increases in strength during childhood, and that strength tends to improve naturally and in a similar fashion in both boys and girls during this period (Shephard 1982). Based on this, strength gains as a result of training were often not considered a likely possibility until fundamental hormonal changes occur with puberty. In other words, gains in strength were associated with increases in muscle size (hypertrophy), and because the muscles of children show only a limited capacity to hypertrophy, the benefits of resistance training during preadolescence appeared questionable. Early studies conducted in the 1960s and 1970s (Kirsten 1963; Vrijens 1978) as well as a more recent investigation (Docherty et al. 1987) did not report strength gains as a result of training in preadolescents. Despite the fact that only low to moderate loads
were used in these studies, these data suggested that resistance training was ineffective in children.

As for resistance training during preadolescence is concerned, it was generally accepted until recently that resistance training would be ineffective in increasing strength. However, most of the studies conducted since the middle of the 1980s and which have (i) incorporated moderate to high training loads and (ii) controlled for the effects of growth and motor skill acquisition on strength gains, provide convincing evidence that significant and substantial strength gains can be made during preadolescence. Based on the information provided by these studies, it appears that children are equally, if not more, trainable in a relative sense (e.g. percentage improvement) than adolescents and young adults. It seems, however, that preadolescents are less trainable in terms of absolute strength.

Regarding the magnitude of the load, Kraemer and Fleck (1993) report that children should be capable of executing at least six to eight repetitions and that heavier load should be avoided. Basic recommendations regarding resistance in preadolescents have also been proposed by a variety of organizations, including the American College of Sports Medicine, the National Strength and Conditioning Association, the American Orthopedic Society for Sport Medicine, the United States Olympic Committee, and the New Zealand Federation of Sports Medicine. These recommendations can be summarized as follows: as frequency two or three times a week, as duration not to exceed 30 minutes, as repetitions each set should consist of 6-15 repetitions and perform one to three sets of a given exercise. Besides resistance to be increased very progressively i.e 1 to 1.5 kg increments once the child is
capable of executing 15 repetitions of a given exercise while maintaining good technical execution.

The effects of resistance training on cardiorespiratory fitness during childhood appear to be dependent on the nature of the training program. Based on the limited information available, conventional dynamic resistance training appears to have little effect on either absolute (1/min) or relative (ml/kg/min) VO2max in preadolescents (McGovern 1984; Blimkie 1993). Short-term (<20 weeks) resistance training therefore does not seem to have any negative effect on the normal development of cardio respiratory fitness during preadolescence, provided there is an opportunity for participation in a variety of sports or recreational activities. On the contrary, there is some evidence that resistance training programs using hydraulic or isokinetic devices, and featuring alternative concentric contractions between agonistic and antagonistic muscles may provide concurrent improvements in both strength and VO2max in preadolescents (Weltman et al. 1986).

1.4.3 Adaptations to Resistance Training

Resistance training produces both acute responses and chronic adaptations. An acute response refers to immediate changes (in muscle or other cells, tissues or systems) during or immediately after a single bout of exercise. Adaptation refers to how the body adjusts to a repeated (chronic) stimulus. The time course of adaptations vary among individuals and depends on the nature and magnitude of prior adaptations. A resistance-training program must consider the expressions of individual differences in adaptation.
Adaptations to resistance training occur from the cellular to systematic levels. Genetic factors strongly influence the effect of each factor on the ultimate training outcome. Resistance training contributes little to tissue growth without appropriate nutrition. Similarly, training outcome depends on specific hormones and patterns of nervous system activation. Without muscular overload, however, each of the other factors cannot effectively increase muscle mass and muscle strength.

1.4.3.1 Resistance training and Metabolic Adaptations

The metabolic changes with strength training are manifested by reduced mitochondrial density, increased energy-rich-phosphates, increased glycogen stores, increased splitting of energy-rich phosphates, increased citrate splitting of energy-rich phosphates, glycolysis and glycolysis, increased oxidation of carbohydrates, and increased myoglobin. The decrease in mitochondrial volume density is apparently the result of an increase in total contractile protein without a proportional increase in mitochondrial volume. An increase in citrate synthase activity in fast-twitch fibers could possibly be induced by having shorter rest intervals between sets.

Resistance training for children has gained popularity. Resistance training programs using concentric-only muscle actions with high repetitions and low resistance significantly improve children’s muscular strength without advance effect on bone or muscle. Concurrent resistance and aerobic training programs produce less muscular strength and power improvement than training for strength only.
1.4.3.2 Cardiovascular Adaptations to Resistance Training

Training volume and intensity influence the effect of resistance training on cardiovascular system adaptations. The hearts of resistance-trained athletes usually exceed the size of untrained counterparts, but heart size generally falls within the upper range of normal limits related to body size or cardiac function variables. Resistance exercise more acutely increases blood pressure than lower-intensity dynamic movements but does not produce any long-term increase in resting blood pressure.

1.4.3.3 Resistance training and Flexibility

The neuromuscular junction serves as the interface between the nervous system and the muscle. Although changes have been demonstrated in the size and morphology of the synapses after exercise in animals, little is known about morphological adaptations to resistance training in humans. Of resistance training are not result in any flexibility in men; this study even found significant increases in flexibility in women. Hence, strength training does not have to be detrimental to the athlete’s flexibility as long as the athlete stretches appropriately and undergoes a full range of motion with each repetition.

1.5 Concurrent Resistance and Aerobic Training

Concurrent resistance and aerobic training programs produce less muscular strength and power improvement than training for strength only. Concurrent training generally refers to the performance of both aerobic and anaerobic exercise within a fitness or athletic training program. To that end, strength and endurance training are applied in varying sequences within the...
same workout, daily or weekly schedule. Athletes as well as popular and commercial fitness applications capitalize on these basic themes and supply the consumer with unlimited exercise options. Included within this variety are techniques which combine both resistance and aerobic training at the same moment in time not separately. Such techniques are now very popular and are most commonly utilized in group exercise settings in which individuals utilize barbells or dumbbells with the upper body and some kind of aerobic movement with the lower body at the same moment in time. For clarity this type of training will be referred to as simultaneous training.

1.6 Statement of the Problem

The purpose of the study are as follows:

1. To find out the effect of periodized resistance training, periodized aerobic training and periodized concurrent resistance and aerobic training individually on selected physical, physiological and haematological variables of preadolescent girls.

2. To compare the effects of periodized resistance training, periodized aerobic training and periodized concurrent resistance and aerobic training on selected physical, physiological and haematological variables of preadolescent girls.

1.7 Hypotheses

The hypotheses formulated in the present study are as follows:

1. It was hypothesized that the interventions such as periodized resistance training, periodized aerobic training and periodized concurrent
resistance and aerobic training are believed that each one would have the positive and significant changes from the base line to post treatment on selected physical, physiological and haematological variables of preadolescent girls.

2. It was hypothesized that as for as comparative effects are concerned, there is a significant mean difference among the interventions (periodized resistance training, periodized aerobic training and periodized concurrent resistance and aerobic training) on selected physical, physiological and haematological variables of preadolescent girls.

3. Since periodized resistance training and periodized aerobic training are basically different in their nature, it was hypothesized that concurrent aerobic and resistance training would have better results on the selected physical, physiological and haematological variables of pre-adolescent girls as compared to their effect individually.

1.8 Significance of the Study

The significance of the present study are as follows: -

1. The findings of the present study would reveal the training adaptations that are associated with periodized resistance training, periodized aerobic training and periodized concurrent resistance and aerobic training on selected physical, physiological and haematological variables of preadolescent girls.
2. From the results, the coaches, physical education teachers and trainers can have the scientific base and guidance to identify the right method to develop the physical and physiological and haematological variables of pre-adolescent girls.

3. The present study is aimed at testing the effect of periodization using resistance training, aerobic training and concurrent resistance and aerobic training on criterion measures. Since the special feature of the periodization is overcoming the exhaustion of players and athletes, implicating this formula of periodization while they designing the training programme can benefit the coaches and trainers.

4. Having the results of the present study, one can forecast the developmental changes occurred on physical, physiological and haematological at the stage of adolescent stage. It provides an insight into the mechanism of physical and biological aspects. By this way, the physical education teachers, coaches and trainers can place their athletes and players in right directions in the future.

5. As far as periodization based physical training programme concerned, it helps the participants to have adequate recovery for both the fibers of slow twitch and fast twitch, since it is imbibed with the alternating cycle in intensity. Hence it is highly believed as the most appropriate training means for the preadolescent girls to develop both types of fibers in parallel manner.
1.9 Delimitations

The present study was delimited into the following aspects.

1. As subjects, it was delimited to the sixty preadolescent girls studying in Arulmigu Maruthamalai Andavar Higher Secondary School, Coimbatore, Tamilnadu.

2. The age of the subjects was ranged from 10 to 12 years.

3. The period of training was delimited to four days a week for twelve weeks.

4. As criterion variables, physically it was delimited to grip strength for right and left, muscular strength and endurance, flexibility, cardiovascular endurance, body weight and percent body fat, physiologically it was delimited to resting heart rate, maximum oxygen consumption and haematologically, it was delimited to haemoglobin, red blood cells and white blood cells.

5. For collection of data pertaining to criterion variables as for as instruments are concerned it was confined to the instruments that are standardized tests and highly calibrated by reputed firms.

6. Subjects for each training module was delimited to fifteen preadolescent girls.

1.10 Limitations

The limitations of the present study are as follows: -
1. Certain factors like life style, daily routine work, and diet may have impact to certain extent on the effect of the results of the present study. Anyhow since these factors were considered as an uncontrollable one, they turn to be limiting factors for the present study.

2. Likewise the influence of other external factors such as air resistance, temperature and humidity on the results of the present study were also not taken into account.

3. The present study mainly underlines the preadolescent girls. Since they were not homogeneous in their motivational structure, the influence of their internal and external motives on their effort shown were considered as a limiting factor for the present study.

4. Since the subjects of the present study was confirmed to the school belonging to government sector, the influences of their differences in their social and economic structure on results if any also considered as a limiting factor for the present study.

5. The influence of physical maturity of subjects if any during the course of training also not taken into account for the present study.

1.11 Definition of the Terms

Preadolescent

Preadolescent childhood is defined as the period encompassing pre and early puberty as determined by Tanner (1962), with an upper age of approximately 11 years for females and 13 years for males.
Concurrent Training

Generally refers to the performance of both aerobic and resistance training within a fitness or athletic training programme. To that end strength and endurance training are applied in varying sequences within the same workout, in the weekly schedule.

Periodisation

Variation in training volume and intensity over a specified time period; goal to prevent staleness while peaking physiologically for competition.

Strength

Mathews has defined muscular strength as the force that a muscle or groups of muscles can exert against a resistance in one maximum effort.

Endurance Harre (1986) defines endurance as the ability to resist fatigue.

Flexibility

It is the range of movement at a joint or joint complexes.

Resting Heart Rate

The resting heart beat or heart frequency is defined as the frequency of heart beats in one minute, when a person is in resting condition.

Maximal Oxygen Uptake ($V_o_2$ max)

$V_o^2$ max is defined as the highest rate of oxygen consumption attainable during maximal or exhaustive exercise.
Body Weight

The force with which a quantity of matter is attracted toward earth by normal acceleration of gravity (Traditional unit: Kilogram of Weight).

Cardio-vascular Endurance

Clarke defines the cardio-vascular endurance as the moderate contractions of large muscle group for relatively longer periods of time, during which maximum adjustment of the cardio-respiratory systems are necessary.

Body Composition

Body composition is the component part of the body or otherwise it refers to fat and muscle weight.

Percent Body Fat

Fat is the most variable tissue in the body and is distributed throughout the body primarily under the skin and in the abdominal cavity.

Skin fold thickness gives an estimation of total body fat, in as much as fifty percent of total body fat lies immediately under the skin.

Lean Body Weight

The total body weight minus the weight of the body fat is called lean body weight.

\[ \text{LBW} = \text{Total body weight} - \text{weight of fat}. \]

Bio-Chemical
The scales that measures the chemical changes in the human organisms are biochemical variables.

Haemoglobin

Haemoglobin is a protein [Globin] united with a pigment [hematin] and contains iron.

It is the iron containing oxygen carrying pigment in the erythrocyte. It loads up with oxygen in the lungs and unloads its oxygen to the tissues.

Red Blood Cells

Red Blood Cells or erythrocytes are small circular bi-concave discs, so called because they are concave on both sides. They are about 5,00,000 red cells in cubic millimeter of blood. They are pale buff colour which encloses mass of haemoglobin.

White Blood Cells

According to Guytone, “The leucocytes are the mobile units of the body’s protective system. They are formed partially in the bone marrow and partially in the lymph tissue. But after formation, they are transported in the blood to the different parts of the body, where they are to be used. The real value of the white blood cells is that most of them are specially transported to areas of serious inflammation, thereby providing a rapid and potent defense against any infecting agent that might be present.