Chapter I

INTRODUCTION

By nature human beings are competitive and aspire for excellence in every given field. Sports is not an exception. Not only individuals but nations also want to show their supremacy in the field of sports. This friendly rivalry has inspired and motivated all to sweat and strive, to run faster, jump higher, throw longer and exhibit greater strength, endurance and skill in the competition. Sports play a major role in the lives of practically every one the players, the coaches, the officials and the spectators.

Sports is a world wide phenomenon today. The need and importance of performance in sports has increased rapidly in the last few decades. In no period of world history was sports so popular, organised and important as it is today. It has a very prominent role in modern society. It is important to an individual, a group, a nation and indeed the world. There are more nations competing in the Olympic Games than participating in the United Nations. Throughout the world sports has a popular appeal among people of all ages and both sexes.

Much of the attraction of sports comes from the wide variety of experiences and feelings that result from the participation—joy, anguish, success, failure, exhaustion, pain, relief, a feeling of belonging. Sports
can bring money, glory, status, and good will. However sports can also bring tragedy, grief and even death.¹

In fact sports entered a new horizon of sporting culture, leading to the emergence of sports sciences as the backbone of performance sports. This brought into sharp focus the training system as the means of development of sports performance. Scientific knowledge has revolutionised the standard of performance in sports disciplines. Now the coaches are striving to get optimum performance with minimum expenditure of energy and time. The players and athletes are trained on scientific guide lines.²

Now-a-days specific training has been playing a predominant role with emergence of different methods having sustained scientific knowledge for outstanding achievements in various levels of competition. The sportsman is able to achieve a high level of performance by concentrating on major areas like physical power, physiological efficiencies, psychological development, application of biomechanics and environmental adjustments³.

There are a number of racket games which are popular in various countries competing at national and international levels. Those games are organised in a highly developmental form culminating in the

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world championships and Olympics. Among them Tennis is one such game.

According to Tony Mottram⁴ “Tennis is a curious game in which two or four people try to interrupt soft fluffy balls with butterfly catchers. It is fun, whether a player is just starting or has already been playing for a number of years, the game offers a challenge that is always attractive. In its modern form it is hardly more than 100 years old, but it origins are buried in antiquity”.

Tennis is a highly complex and fascinating game, which can provide an enjoyable form of exercise for people of all ages and all levels of ability. An interesting development, which has coincided with the increased popularity of Tennis, has been the greater number of young players reaching the top and winning major tournaments. Mats Wilander won the French open in 1981 at the age of 17, and Ivan Lendal, Boris Becker and Andrea Jaeger are others to be as young champions. Such outstanding achievements by young men and women have boosted the popularity of Tennis and many children are now taking up the game at an early age⁵.

Tennis is played throughout the world. The fact that this marvellous sport is so popular must surely be because it demands so many different qualities of the players that every one can find some enjoyable aspect of the game to suit himself or herself. That is why

Tennis knows no boundaries and why it is equally appreciated in the United States, France, Japan, South Africa, India, Australia, Brazil and Russia.\footnote{Jean Couvercelle, \textit{Your First Book of Tennis} (London: Philippe Lorin Angus and Robertson Publishers, 1980) p.7.}

It is an excellent sport for developing and maintaining physical fitness. It also presents a real challenge to its participants. It provides them with a wonderful opportunity to develop strength, endurance, agility, coordination and other physiological benefits.\footnote{Joyce Hume, \textit{Play Better Tennis} (London: Palhem Books Publishing company, 1986) P.1}

The earliest version of the game appeared in 1873 when Englishmen adopted the French game of real Tennis for outdoor play. This version of the game was played on a court shaped like an egg-timer and divided down the middle by a net 5 feet high. The word Tennis is assumed to have come from the French 'Tenez' a word used in real tennis to warn opponent that you are about to play. The first Wimbledon championship took place in 1877. In 1884 the net height was changed to 3 feet, where it has been ever since and some players started to hit the ball before it had bounced, notably Renshaw, seven times Wimbledon champion. International first ever Davis cup match was held between Britain and United States at Long wood cricket club, Boston.\footnote{Jean Convercelle, \textit{Your First Book of Tennis} P.8.}

It is now becoming increasingly accepted by most Tennis players that the physical demands of the game are such that players will not
produce their best performance without first ensuring that they are in peak physical condition as a result of a regular and specific fitness training programme⁹.

After several decades of modest exposure, Tennis is experiencing an excellent growth in popularity. The increase in number of players, facilities, coaches, and general public interest within the last few years has been phenomenal.

Unfortunately this popularity has not been reflected in the amount of scientific information available on Tennis. There are several reasons for this lack of data. Tennis has not been as popular as some sports in most part of India, and it is frequently associated with the well-to-do classes. Secondly, researchers were finding difficulties to conduct sound studies on the competitive players because of inadequate sample sizes and other technical impediments. This was one of the factors that inspired and motivated the scholar to take up the present project.

During the last few decades, sports training as an object of scientific research has attracted more scholars from various fields of knowledge than ever before. To mention a few the most important contribution of sports medicine to the problem of human performance lies primarily in the area of heart circulation, physiology of performance

and metabolism in its most extended meaning and more in physiology and pathology of apparatus of motion. Theory and practice have soon shown that there are large-scale differences between possibilities of various organic systems, with regard to their development through training and with regard to the physiological limits of sportsmen.

It is notable that achievements at the present day stage of development of sports swiftly increase with a corresponding increase in the volume of training. Even the most gifted athlete will not score outstanding results if he does not undergo training persistently and systematically and prepares himself for the next achievement. As the system of sports training improves, it's effect on the general level of sporting achievements increases. It is indicated that Olympic records of the first modern Olympic games, which in those times seemed to be outstanding, today are within reach of thousands and thousands of rank and file athletes. This is explained in particular, by the evolvement of new, scientifically, substantiated training methods and means of execution of sports exercises (sports techniques and tactics), improvement of sports gear and equipment, as well as other components and conditions of the system of sports training.\(^\text{10}\)

A training programme is the essence of the sports performance. The coaches make effort to improve through systematic manipulation of repetitions of movements, intensity of performance and duration of

exercise. Sports performance is not a single component. It includes strength, speed, endurance, flexibility, co-ordinative abilities, technique and tactics\textsuperscript{11}.

\checkmark Over the past decade, plyometric training has gained tremendous popularity as a means of improving explosive strength. Plyometric is the term now applied to exercises that have their roots in Europe, where they were first known simply as ‘Jump training’. Origin of the term ‘plyometrics’ is derived from word “pleythyein” which means ‘to increase’ or from the Greek words ‘plyo’ and ‘metric’ which mean ‘more’ and ‘measure’. Other terms used in conjunction with plyometrics are depth jump, box jumping and jump training\textsuperscript{12}.

Plyometric training is an excellent method of developing body power and it is proved to be a very effective method for improving explosive strength. It offers rich variation of exercises and load structure. Any activity that activates the stretch reflex mechanism is plyometric exercise. Plyometric exercise is based upon the belief that a rapid lengthening of a muscle just prior to the contraction will result in much stronger contraction.

\textsuperscript{11} Danial A. Arnhem, \textit{Modern Principles of Athletic Training} P.76.
\textsuperscript{12} Henson Phil, "Plyometric Training" \textit{Track and Field Quarterly Review of Jumps} 94 (1994): 53.
Plyometric training may be viewed as an extension of the 'shock' method of strengthening muscle for athletic performance recommended by Verhoshanski\textsuperscript{13} of Russia. The 'shock' method advocated by Verhoshanski consisted of rebound jumps from a height to develop the "reactive neuromuscular apparatus" of the athlete.

The added contractile strength is believed to be due to stretching of muscle spindles, involving a myotatic reflex and resulting in an increased frequency of motor unit discharge stimulation of other receptors and an increased number of activated motor units. Evidences indicate that plyometric exercises were systematically carried out by 1972 gold medal winner Veleri Borzov and Jennis Lusis, gold medal winners (1972).

Plyometric training involves simultaneously voluntary and involuntary muscle contractions. Therefore more motor units are called upon during a single contraction of this type than would be used in either contraction alone. In plyometric exercises eccentric contraction is followed immediately by a concentric contraction\textsuperscript{14}.

Plyometric is exercise designed to enhance the athlete's ability to blend speed and strength training. It is in effect "the" training. When sound training principles are used, plyometric offers the


\textsuperscript{14} Henson Phil, Track and Field Quarterly Review of Jumps P. 54.
mechanism by which an athlete can start quicker, change direction more rapidly, accelerate faster, and improve overall speed. The actual term, plyometric was first coined in 1975 by Fred Wilt. One of America's more forward thinking track and field coaches.\textsuperscript{15}

Plyometric training can take many forms, including jump training for lower extremities and medicine ball exercises for the upper extremities. The user of plyometrics should understand not only how to exercise but also how to implement and modify a programme and use it to its best advantage.\textsuperscript{16}

One of the many benefits of plyometric training is that it can be organised into circuits. By moving from station to station the athlete can do a variety of exercises that stress either the vertical or linear components of various movement patterns or both. By using circuits, athletes can perform activities of even greater duration than with anaerobic, sprint and interval training. This may move the level of cardiovascular stress toward improvement in aerobic conditions, resulting in increased stamina.\textsuperscript{17}

There is no event in track and field where we try to move slowly. Even 10,000 metre runner is attempting to move as fast as possible within the requirements of the event. The more explosive the event, the


\textsuperscript{16} Ibid., P. 5.

\textsuperscript{17} Ibid., P. 16.
more beneficial would be the plyometric training. The greatest benefits of plyometric training naturally would be directed towards the athletes in the jumps, throws, sprints and hurdles. Plyometrics is a training method currently being used which has been rather extensively researched, usually with positive results\textsuperscript{18}.

Circuit training is a very popular and effective organisational form of performing physical exercises. It is based on the premise that the athlete must do the same amount of work in a shorter period of time or must do considerably more work within the limits of an assigned training period. Six to twelve different stations can be set up, each with a specific exercise. The circuit should be so planned that the trainee can complete a circuit without becoming excessively fatigued\textsuperscript{19}.

Circuit training is a method of physical conditioning that employs both weight training and conditioning exercises. In some forms apparatus stunts have been added as a third kind of activity. The method has achieved considerable popularity in England and has found favour in the United States as a means of achieving optimum fitness in a systematised and controlled fashion. The method was originally introduced by Morgan and Adamson in the late 1950s at the University of Leeds, England. It was immediately accepted by physical educators,

\textsuperscript{18} Horrigan Joseph, 'Plyometrics Think before You Leap' Track and Field Quarterly Review of Jumps 89 (1989): 41.
coaches and trainees as an excellent and self motivating means of increasing strength, flexibility and endurance. The system easily lends itself to handling large groups efficiently and productively. It is a practical method, entailing some preliminary planning, but beyond that it needs little coordination. Athletes find it motivating since it makes conditioning fun and challenging through competitions against teammates and against time\(^{20}\).

In circuit training a certain number of exercises are done one after another in the form of a circuit. This circuit is repeated three or more times. It is a training method by which exercises of various kinds for different muscle groups are performed in sequence with or without apparatus after having given a dosage (number of repetitions, intensity of stimulus, duration of pauses etc.) planned before hand and interspersed by intervals. Exercise stations are so arranged that the same muscle groups are not being used at successive stations\(^{21}\).

Circuit training can be used for improvement of technical and tactical elements and enhancement of conditional abilities. But experiences and research have shown that circuit training is particularly more effective for the improvement of strength and endurance abilities. Continuous and interval method of circuit training is more commonly used in training sports men and women. Improvement is accomplished


\(^{21}\) Ibid., P.135.
by decreasing the trial time it takes to complete the circuit and increasing the amount of work accomplished at each station or both. Circuit training offers a number of unique advantages. It combines a number of different components of training. Thus total fitness is emphasised.

Gettman and Pallock (1980-81) have conducted an extensive review of the research that has been conducted in the area of circuit training and derived the advantages viz; (a) It is an activity that attends to the major components of athletic fitness (b) It can be conducted in a very small area (small room with a multi station weight training machine); and (c) the complete workout (3 sets) can be completed in less than 30 minutes. Further the workout can be highly motivating.

Circuit breaker programme is a combination of plyometrics and circuit training. It is one of the recommended methods to develop strength abilities of the body at middle and elementary school level.

This programme consists of seven exercises which are plyometric in nature. The exercises include jump rope, step-ups, shuttle run, push ups, jump-ups, side jumps, and sit-ups. The students have to complete the seven stations in seven minutes in a circuit manner\(^\text{22}\).

Elementary and middle school children can successfully do plyometric training as long as the coach does not call it plyometrics.

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Children of these ages need images, such as animals in the forest jumping over streams and logs to relate to. If movement patterns are placed in the proper context, children can attempt to express them in a 'plyometric' fashion. In fact, hop-scotch is a great early plyometric drill\textsuperscript{23}.

All over the world coaches of various disciplines in sports have conducted research to find out an appropriate way of training for their athletes and players to improve their motor and physiological abilities which are the special factors contributing towards an athlete's performance. Similar studies have been done to evaluate the effect of plyometric training and circuit training, but no study has been conducted, especially to compare the effects of plyometric training, circuit training and circuit breaker programme in Tennis. Therefore, the research scholar choose to make an attempt to compare the effects of plyometric training, circuit training and circuit breaker programme on related physiological variables and motor components of school level Tennis players.

**Statement of the problem**

The purpose of the investigation was to study and compare the effects of plyometrics, circuit training and circuit breaker programmes on related physiological variables and motor components of school level tennis players.

\textsuperscript{23} Donald A. Chu, *Jumping into Plyometrics* P.10.
Delimitations

1. The study was delimited to 80 male Tennis players of 13-18 years of age from various schools in Nilgiris, Ooty.

2. The study was confined to the following motor components and physiological variables.

Motor components

1. Power (Leg, Shoulder and Arm)
2. Muscular endurance
3. Speed
4. Agility
5. Cardio-respiratory endurance
6. Flexibility (Shoulder, Spine, Hip and Back)
7. Balance (Static and Dynamic)

Physiological variables

1. Resting heart rate
2. Exercise heart-rate
3. Respiratory rate
4. Vo$_2$max
5. Cardio pulmonary Index
Limitations

1. As the subjects selected for the study are from different socio-economic groups their dietary habits and life style, routine of study and play were different and were considered as limitation of the study.

2. No special motivational techniques were given to the subjects and any difference in performance due to these aspects are considered as limitation of the study.

3. Non-availability of sophisticated instruments for measuring different variables were considered as limitation of the study.

4. Effect of high altitude which might have affected some of the variable was also considered as limitation of the study.

Hypothesis

It was hypothesised that there would be no significant difference in the effects of plyometrics, circuit training and circuit breaker programme on related physiological variables and motor components of school level Tennis players.

Definition and Explanation of Terms

Plyometric

Plyometric (plyo-more, matric-measured quality) exercise is based upon the belief that a rapid lengthening of muscle just prior to the contraction
will result in a much stronger contraction. Any activity that activates the stretch reflex mechanism is plyometric exercise\textsuperscript{24}.

**Circuit Training**

A training programme that moves an athlete from one exercise station to another through a circuit is called circuit training\textsuperscript{25}.

**Circuit Breaker Programme**

It is one of the recommended methods to develop strength abilities at middle school level. This programme consist of seven exercises which are plyometric in nature. The students have to complete the seven stations in seven minutes in a circuit manner\textsuperscript{26}.

**Power**

Power may be defined as the ability to release maximum force in the shortest possible time power then is the ability to combine strength of muscular contraction with speed of muscular contractions\textsuperscript{27}.

\textsuperscript{24} Phil, Henson, *Track and Field Quarterly Review of Jumps*: 53.
\textsuperscript{26} Tomkins, *Track and Field Quarterly Review of Jumps*: 56.
\textsuperscript{27} L. Johnson and k. Nelson, *Practical Measurements for Evaluation in Physical Education* P.110.
Muscular Endurance

It is the ability of a muscle to repeat identical movements or pressures or to maintain a certain degree of tension over a period of time.\(^{26}\)

**Speed**

Speed may be defined as, "Rapidity with which successive movements of the same kind are performed" According to Barrow and McGee, it is the capacity of the individual to perform successive movements of the same pattern at the fastest rate.\(^{29}\)

**Agility**

Agility is defined as the ability of the body or part of the body to change direction rapidly and accurately.\(^{30}\)

**Cardio-respiratory Endurance**

Cardio respiratory endurance is the ability to continue or persist in strenuous task involving large muscle group for long period of time.\(^{31}\)

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\(^{30}\) Ibid P.113.

Flexibility

Flexibility is the ability of an individual to move the body and its parts through as wide a range of motion as possible without undue strain to the articulations and muscle attachments.\textsuperscript{32}

Balance

Balance is the ability to maintain balance during whole body movements and to regain balance quickly after the balance disturbing movements. Balance ability can be of two types:

1. **Static Balance:**
   
   Ability to maintain balance during stationary position or slow movements.

2. **Dynamic Balance:**
   
   Ability to maintain or regain balance during large range of movements and during rapidly changing position of the body.\textsuperscript{33}

Resting Heart Rate

It is the measurement of heart rate in one minute duration of time, when an organism is under complete physical and mental rest\textsuperscript{34}.

Respiratory Rate

Respiratory rate is the number of respiration taken by an individual in one minute duration of time.

\textsuperscript{32} Johnson and Nelson, *Practical Measurements for Evaluation in Physical Education* P.76.


Exercise Heart Rate

It is the measurement of heart rate of an individual immediately after the exercise.

Maximal Oxygen Consumption
(VO₂Max)

The maximal rate at which oxygen can be consumed per minute, the power or capacity of aerobic or oxygen system.\(^{35}\)

Cardio-Pulmonary Index

Cardio pulmonary index is a measure of efficiency of the cardio pulmonary system based on the formula derived by Hyman\(^{36}\) which is

\[
CPI = \frac{VC + MEP + MBH + Age}{SP + DP + PR}
\]

Where

VC = Vital Capacity
MEP = Maximum Expiratory Pressure
MBH = Maximum Inspiratory Breath Holding Capacity
Age = Completed years
SP = Systolic Pressure
DP = Diastolic Pressure
PR = Pulse Rate

When the variables used in formula measured in resting condition, it is called adynamic cardio pulmonary index, when the variables used in the


formula measured just after exercise condition, it is called dynamic cardio pulmonary index.

Vital Capacity

It is defined as the largest volume of air that can be exhaled after a deepest possible inhalation.\(^ {37}\)

Maximum Expiratory Pressure

Maximum Expiratory Pressure is the force that one can eject in breath out hard which is measured by the Sphygmomanometer under standard conditions of measurement.

Maximum Inspiratory Breath holding

Maximum inspiratory breath holding has been defined as an individual’s ability to hold the breath after a voluntary forced maximal inhalation, without inhaling or exhaling during the period of holding the breath or the maximum duration of holding breath after a full inhalation.

Systolic Blood Pressure

(Pressure exerted by blood during the systole) The maximal level of arterial blood pressure is called the systolic blood pressure.\(^ {38}\)

Diastolic Blood Pressure

(Pressure exerted by blood during the diastole) the lowest level reached by the arterial pressure is called the diastolic pressure.\(^ {39}\)


\(^{39}\) Ibid., P.68.
Significance of the study

Competitive Tennis demands high level of physical and physiological fitness. In competitive sessions the players are taxed both physically and physiologically as well as mentally. A well-planned and scientific training programme can bring athlete to his peak performance level by developing physical and physiological conditions. A well-conditioned athlete will withstand the wear and tear of a competitive season. Therefore, the

Present study will be significant in the following ways:

1. The study will help the profession by way of highlighting the comparative effects of plyometric training, circuit training and circuit breaker programme on related physiological variables and motor components of school level Tennis players.

2. The study will throw some light by virtue of scientifically developed training schedule for Tennis players in order to bring about optimum development of performance.

3. Further this study will provide guidelines for preparing scientific training schedule or modifying the old ones for training Tennis players by physical education teachers and coaches.

4. It will also help to formulate training capsule for the development of various motor components in various age group male Tennis players.