Methodology
In this chapter, the method adopted for the selection of subjects, variables used, experimental design, training programme, procedures for test administration and methods employed for statistical treatment of data have been explained.

**SELECTION OF SUBJECTS**

Since the purpose of the study was to find out the effect of circuit training and parcours training on physical and physiological variables on college men, it was decided to select untrained men students who were not participating in any of the games or sports or in any special training or coaching programme. However, they were allowed to participate in their routine physical education classes in the college. Since, during the period of training the subjects were susceptible for changes due to growth, it was decided to have one control group for the study. For this purpose, thirty men students, free from deformities and ailments, were selected at random by lots from His Highness The Rajah’s College, Pudukottai. The age of the subjects ranged from seventeen to nineteen.

The subjects were randomly assigned equally to one of the three groups in which group I acted as control (n=10), group II underwent circuit training (n=10), and group III underwent parcours training (n=10).

The subjects were free to withdraw their consent, in case they felt any discomfort during the period of training. But there were no dropouts in
SUBJECTS
Thirty college men students

Random group design

Physical variables

1. Explosive power
2. Speed
3. Agility
4. Strength Endurance
5. Flexibility

Pru-test

Physiological variables

1. Resting heart rate
2. Cardiorespiratory endurance
3. VO₂ max

Group I Control group (n=10)
No specific training/conditioning (12 weeks)

Group II Experimental Group 'A' (n=10)
Circuit Training (12 weeks)

Group III Experimental group 'B' (n=10)
Parcours training (12 weeks)

Mid-test (After 6 weeks)

Post-test (After 12 weeks)

Statistical Analysis (ANCOVA)
the study. A qualified physician examined the subjects medically and declared that they were fit for the study. All the subjects had a similar academic work and regular activities in accordance with the requirements of the college curriculum. The subjects in the control group were not engaged in any activity other than the regular curriculum during this training period.

**SELECTION OF VARIABLES**

The main components which influence performance of an athlete are co-ordination, strength, speed, endurance, agility, flexibility, power and resting heart rate. As far as training in various track and field events and games is concerned, strength, speed, endurance, resting heart rate, agility and flexibility are the most important variables. The test of speed (e.g. 100 m run) is an athletic event by itself and at the same time it is important in numerous other sports. Many competitions require explosive strength. Throwing and jumping events are examples of this. Kicking in football, spiking in volleyball and serving in tennis are striking examples of the application of explosive power in various games. Endurance in different forms and strength endurance in particular are important for distance running and other sports and games. Hence, the researcher selected explosive power, speed, agility, strength endurance, flexibility, resting heart rate, cardiorespiratory endurance and maximum oxygen consumption (VO₂ max) as criterion variables for this study.

The general purpose of circuit training is to develop muscular strength, muscular endurance and cardiorespiratory endurance (Antony, 1973).
Circuit training is designed to develop cardiorespiratory endurance as well as flexibility, strength and muscular endurance in essential muscle groups (Miller, 1974).

Parcours is a technique for improving cardiorespiratory endurance that basically combines continuous training and circuit training. Parcours circuits provide an excellent means for gaining some aerobic benefits while incorporating some of the benefits of calisthenics (Prentice, 1994).

The object of parcours training is to develop total body fitness. Parcours training would promote muscular strength and endurance, cardiorespiratory endurance and flexibility.

In this study, the effects of two training programmes, circuit training and parcours training on selected variables have been examined. No such type of study has been done earlier. Millions of youngsters are practicing various games and sports regularly. Often, these young players experience the disadvantage of lack of sufficient fitness and lack of executing powerful movements. Hence, the investigator chalked-out the training schedule which would study the influence on the following variables.

**PHYSICAL VARIABLES**

1) Leg explosive power
2) Speed
3) Agility
4) Strength endurance
5) Flexibility
PHYSIOLOGICAL VARIABLES

1) Resting heart rate
2) Cardiorespiratory endurance
3) Maximum oxygen consumption (VO₂ max)

SELECTION OF TESTS

The present study was undertaken to assess the effects of circuit training and parcours training on leg explosive power, speed, agility, strength endurance, flexibility, resting heart rate, cardiorespiratory endurance and maximum oxygen consumption (VO₂ max) among college men ranging from seventeen to nineteen years of age. As per the available literature, the following standardised tests were used to collect relevant data on the selected dependent variables.

Table – I
VARIABLES AND TESTS

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Variables</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>leg explosive power</td>
<td>standing broad jump</td>
</tr>
<tr>
<td>2.</td>
<td>speed</td>
<td>50 meters run</td>
</tr>
<tr>
<td>3.</td>
<td>agility</td>
<td>shuttle run (4x30 feet)</td>
</tr>
<tr>
<td>4.</td>
<td>strength endurance</td>
<td>sit ups (bent knee)</td>
</tr>
<tr>
<td>5.</td>
<td>flexibility</td>
<td>modified sit and reach test</td>
</tr>
<tr>
<td>6.</td>
<td>resting heart rate</td>
<td>manual method</td>
</tr>
<tr>
<td>7.</td>
<td>cardio-respiratory endurance</td>
<td>12 minutes run/walk</td>
</tr>
<tr>
<td>8.</td>
<td>maximum oxygen consumption</td>
<td>Maud’s formula</td>
</tr>
</tbody>
</table>
RELIABILITY OF THE INSTRUMENTS

Stop watches, measuring tape and flexomeasurecase were used in the study. To find out the reliability of these instruments, test and retest method was applied. The measuring tape used was non-elastic and of a good quality. Further, these instruments had been calibrated in standard units. To determine the reliability of instruments, the test data on each of the variables were recorded three times under similar conditions using the same instruments. The scores obtained were the same. The scores were compared with other scores taken from the instruments from other reputed firms to establish reliability of the instruments.

TESTER’S COMPETENCY AND RELIABILITY OF THE TESTS

Tester’s competency was evolved together with the reliability of tests. Reliability of tests was established by test-retest process whereby consistency of results was obtained by intraclass (univariate correlation) reliability coefficients. The data collected from the pilot study of ten subjects in test-retest were computed for each variable and the obtained correlation have been shown in Table II.
Table – II

INTRACLASS RELIABILITY CO-EFFICIENTS OF SELECTED DEPENDENT VARIABLES

<table>
<thead>
<tr>
<th>Tests</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing broad jump</td>
<td>0.97*</td>
</tr>
<tr>
<td>50 meters run</td>
<td>0.89*</td>
</tr>
<tr>
<td>Shuttle run</td>
<td>0.89*</td>
</tr>
<tr>
<td>Sit up (bent knees)</td>
<td>0.97*</td>
</tr>
<tr>
<td>Sit and reach</td>
<td>0.90*</td>
</tr>
<tr>
<td>Resting heart rate</td>
<td>0.92*</td>
</tr>
<tr>
<td>12 minutes run/walk</td>
<td>0.87*</td>
</tr>
<tr>
<td>VO₂ max</td>
<td>0.87*</td>
</tr>
</tbody>
</table>

* Significant at 0.01 level of confidence.

The table value required for significance at 0.01 level of confidence is 0.77.

ORIENTATION OF SUBJECTS

Prior to the training and administration of tests, the investigator presented a brief introduction of circuit training and parcours training to the subjects. The method of doing each exercise was demonstrated and explained to them by the research scholar. Demonstration was executed by some students to make the subjects understand clearly and give explanation for the purpose of the study with a view to get full co-operation and also to motivate them to exhibit their maximal level of performance in the test.
PILOT STUDY

A pilot study was conducted before finalising the training programmes, to ensure that the intensity and duration of the exercises included in the circuit training and parcours training programme were within the limits of the subjects' capacity to show the satisfactory effect. The subjects were asked to do the exercise continuously to their sub-maximal effort for one circuit. A session of 30 seconds was fixed for each station. The pulse rate was checked during the pilot study after the completion of three circuits with an interval of two minutes in between circuits. For this purpose, ten students who did not act as subjects in the study were chosen. The time for one circuit was four minutes and the programme for a day was fixed to three circuits for circuit training group and run or walk to cover all the eighteen stations for the parcours training group. If the subjects were not able to continue the prescribed exercise, they were asked to continue as long as possible. If and when they were unable to continue, they were permitted a few seconds break, so that they might recover to continue the activity at a sub-maximal speed again. It was assumed that the schedule of circuit training, carried over eighteen minutes and parcours training, carried over twenty four minutes by progressively increasing the number of repetitions in each station would give adequate training effect on physical and physiological variables.

TRAINING PROGRAMME

The control group was not exposed to any specific training/conditioning. The experimental group I and II were subjected to twelve weeks of circuit and parcours training programmes respectively. The training was given for five days per week, with one hour duration each day.
Both circuit and parcours training programmes are presented in Appendices I & II respectively.

**CIRCUIT TRAINING**

In circuit training, a subject moved from one station to another and performed the prescribed exercise with the fixed duration at each station. The time was increased from thirty seconds to forty seconds per station after six weeks training. It was emphasised that the intensity of the exercise was kept at the maximum possible level throughout the total time prescribed. The circuit was repeated thrice daily.

**PARCOURS TRAINING**

Parcours training is a new concept developed in Europe and adopted recently in United States and Canada. It consists of a series of stations set up over a one to two and half mile path, to provide exercise circuit for individuals.

Parcours is a technique for improving cardiorespiratory endurance that basically combines continuous training and circuit training. This technique involves jogging a short distance from station to station and performing a designated exercise at each station according to guidelines and directions provided on an instruction board located at that station. Parcours circuits provide an excellent means for gaining some aerobic benefits while incorporating some of the benefits of calisthenics. Besides promoting muscular and cardiorespiratory endurance, continuous training aids in caloric expenditure, a key to proper weight maintenance (Prentice, 1994).
The time was increased from fifteen seconds to twenty seconds per station after six weeks.

The training programme was scheduled for the evening between 3.30 and 4.30 p.m., five days a week excluding Saturdays and Sundays for twelve weeks.

**COLLECTION OF DATA**

Data on the selected physical and physiological variables were collected as per the method prescribed in test administration before the experimental period (pre-test), after six weeks (mid-test) and at the end of twelve weeks (post-test). Circuit and parcours training were given as per the training programme during the twelve weeks.

**SEQUENCE OF TEST ITEMS – CRITERION MEASURES**

Tests on criterion measures were conducted on two days (Saturday and Sunday) during the early hours of the day before breakfast. Resting heart rate was recorded initially prior to any activity. After warming up, shuttle run, sit and reach, 50 meters run and 12 minutes run/walk, standing broad jump and sit up tests were administered. Adequate rest in between 50 meters run and 12 minutes run and walk tests was provided for each subject.
The criterion tests were conducted as per the following sequence.

A. First day
   1. Resting heart rate
   2. Sit and Reach
   3. Shuttle run

B. Second day
   1. Sit up
   2. 50 meters run
   3. 12 minutes run/walk
   4. Standing broad jump.

ADMINISTRATION OF TESTS

STANDING BROAD JUMP

Purpose

To measure the explosive power of legs.

Facilities and Equipment

Out door jumping pit and a measuring tape.

Procedure

The subject stands with feet several centimeters apart and toes just behind the take off line. Preparatory to jumping, the arms are swung backward and the knees bent. The jump is done by extending the knees and swinging the arms forward simultaneously. Measurement is taken from the take off line to the heel or part of the body that touches the floor nearest the take off line.
Scoring

The score is the best of the three trials in meters and centimeters, to the nearest centimeter (Bosco, 1983).

50 METERS RUN

Purpose
To measure speed

Facilities and equipment
An area on track with a starting line, a 50 meters course and a finish line. Two stop watches.

Procedure
After a short warm up period, the subjects take a position behind the starting line. Best results are obtained when two students run at the same time for competition. The starter used the command “Are you ready?” and “Go”. The latter is accompanied by a downward sweep of the arms as a signal to the timer. The students run across the finish line. Only one trial is permitted.

Scoring
The score is the elapsed time to the nearest tenth of a second between the starting signal and the instant the student crosses the finish line (Clarke, 1976).

SHUTTLE RUN (4x30 feet)

Purpose
To measure agility.
Facilities and equipment

Two lines parallel to each other are placed on the floor 30 feet apart. Two blocks of wood, 2x4 inches and stop watches are needed.

Procedure

The subject starts behind the starting line on the signal "go" and runs to the blocks, picks up one and returns to the starting line. He then returns to the second block, which is carried across the starting line on the way back. Two trials are given with some rest in between.

Scoring

The score for each performer is the length of time required (to the nearest tenth of a second) to complete the course. Only the best trial is recorded (Parry et al., 1988).

SIT UP

Purpose

To assess abdominal endurance.

Facilities and Equipment

A stop watch and a mat.

Procedure

The subject performs the test with bent knees, feet flat about 18 inches from the buttocks, and the hands touching the side of the head. A partner holds the subject's feet as the exercise is performed. The subject touches the elbow to the alternate knee with each sit up. The subject performs as many sit ups in one minute as possible.
Scoring

The number of correct repetitions is recorded as the score (Morrow R. et al., 1995).

SIT AND REACH

Purpose

To assess trunk flexibility.

Facilities and Equipment

Yard stick and a measuring tape.

Procedure

Place a yard stick on the floor and put an 18 inch piece of tape across the 15 inch mark on the yardstick. The tape should secure the yardstick to the floor. The subject sits with zero and the yardstick between the legs. The subject's heels should almost touch the tape at the 15 inch mark and be about 12 inches apart. With the legs held straight, the subject bends forward slowly and reaches with parallel hands as far as possible and touches the yardstick. The subject should hold this reach long enough for the distance to be recorded.

Scoring

The trials should be performed. The best score is recorded to the nearest quarter inch (Morrow, James et al., 1995).

RESTING HEART RATE (MANUAL METHOD)

Purpose

To measure the resting heart rate of the subjects.
Facilities and Equipment

Stop watch and chair.

Procedure and Scoring

The pulse rate of all the subjects was recorded in a sitting position in the early morning. Before taking the pulse rate, the subjects were asked to sit in a chair and relax for 10 to 20 minutes. To record the pulse rate, the finger tips were placed on the left radial artery at the wrist in such a manner that pulsation was clear and the number of pulsations were counted for fifteen seconds and then multiplied by four to record for the full minute (Jenson et al., 1980).

COOPER'S TWELVE MINUTES RUN/WALK

Purpose

To measure cardiorespiratory endurance.

Facilities and Equipment

A stop watch, a starting device (whistle) and an accurately measured and marked track.

Procedure

The mile run was conducted in the standard 400 meter track. All the subjects were given instruction regarding the procedure and asked to run the maximum distance in twelve minutes. One testing assistant was assigned per subject. On the command 'go' all the subjects started running. The tester assigned to each subjects kept track of their progress and instructed them about the time left and verbally motivated them to
continue. At the end of twelve minutes, the distance covered by each individual is noted in miles.

**Scoring**

The score is the distance in miles covered in twelve minutes (Bosco, 1983).

**MAXIMUM OXYGEN CONSUMPTION (VO_{2} MAX)**

**Purpose**

To estimate the VO_{2} max.

**Procedure**

From the 12 minute run/walk test performance, Cooper derived the following regression equation to describe the relationship between distance and VO_{2} max.

\[
\text{run/walk distance (miles)} = 0.3138 + 0.278 \times \text{VO}_{2} \ (\text{ml kg}^{-1} \text{ min}^{-1})
\]

This equation can be reorganized to estimate VO_{2} max from the 12 min run:

\[
\text{VO}_{2} \text{ max (ml.kg}^{-1}.\text{min}^{-1}) = 35.97 \ (\text{miles}) - 11.29.
\]

The mile run was conducted in the standard 400m track. All the subjects were given instructions regarding the procedure and asked to run the maximum distance in 12 minutes. One testing assistant was assigned per subject. On the command ‘go’ all the subjects started running. The tester assigned to each subject kept track of their progress and instructed them about the time left and verbally motivated them to continue. At the end of 12 minutes, the distance covered by each individual was recorded in miles.
Scoring

The score is the distance in miles covered in 12 minutes (Maud et al., 1995).

EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS

The experimental design used for the study was similar to random group design involving thirty subjects, who were divided at random into three groups such as control, circuit training group and parcours training group of ten each.

This study consisted of two independent variables such as circuit training and parcours training. Among the three selected groups, group I acted as a control group; group II was treated with circuit training and group III with parcours training. The subjects in all the three groups were tested prior (pre-test), after six weeks (mid-test) and after twelve weeks (post-test) on leg explosive power, speed, agility, strength endurance, flexibility, resting heart rate, cardiorespiratory endurance and maximum oxygen consumption. This study was aimed at finding out the effects of training on selected dependent variables.

The data collected from the three groups prior to experimental treatment as pre-test data, after six weeks and twelve weeks of training on leg explosive power, speed, agility, strength endurance, flexibility, resting heart rate, cardiorespiratory endurance and maximum oxygen consumption were statistically examined for significant difference, applying the Analysis of Covariance (ANCOVA). No attempt was made to equate the groups in
any manner. Hence to make adjustments for differences in the initial means and test the adjusted post test means for significant differences, the Analysis of Covariance was used.

Whenever 'F' ratio for adjusted test was found to be significant for adjusted post test means, Scheffe's test was followed as a post-hoc test to determine which of the paired mean differences was significant.