Chapter - III

METHODOLOGY

The methodological aspects related to the present investigation have been described. In this chapter, the selection of the subjects, selection of variables, selection of test, orientation of the subjects, tester's competency, and collection of the data, instrument reliability, and reliability of the data, test administrations, experimental design and statistical procedure were presented.

3.1. SELECTION OF THE SUBJECTS

The purpose of the study was to find out the effect of varied packages of strength training on selected motor ability components, body composition and physiological variables of female athletes. To achieve the purpose of the study, seventy five female athletes randomly selected as subjects from St. Joseph Southern Railway Sports Club Stadium Athletes, Trichy, Tamil Nadu. The age of the subjects ranged from 18 to 22 years. The selected subjects were medically examined by a qualified physician and certified that they were medically and physically fit enough to undergo the sprint training programme. The selected subjects were randomly assigned into four equal groups of 15 subjects each. Group-I underwent plyometric training, Group-II underwent barbell training, Group-III underwent uphill training, Group-IV underwent circuit training and group-V acted as control who does not participate in any training programme.

3.2. SELECTION OF VARIABLES

The purpose of the study was to find out the effect of varied packages of strength training on selected motor ability components, body composition and
physiological variables of female athletes. The researcher had gone through the available literature and had discussions with various experts and with his guide before selecting variables. The availability of technique for the purpose of analysis, feasibility, reliability of the procedure and the outcome were extensively taken care before finalizing the variables. The selected independent and dependent variables of this study are as follows.

3.3. INDEPENDENT VARIABLES

In this experimental study three experimental groups were selected, while one group was kept control to assess the difference.

1. Plyometric training
2. Barbell training
3. Uphill training
4. Circuit training

3.4. DEPENDENT VARIABLES

The following motor ability components, body composition and physiological parameters were selected for this study.

3.4.1 Motor Fitness

1. Speed
2. Explosive power
3. Speed endurance

3.4.2 Body Composition Variables

4. Percent body fat
5. Body mass index
6. Lean body mass
3.4.3 Physiological Variables

7. Anaerobic power
8. \( \text{VO}_2 \text{ Max} \)
9. Resting pulse rate

3.5. JUSTIFICATION FOR SELECTION OF EXPERIMENTAL VARIABLES

The experimental variables used in the present study varied packages of strength training. Though many methods prevail to analyze the motor ability components, body composition and physiological parameters the role of strength training is an undisputed one, lot of researches had been carried out on the effects of strength training, but still the bone of contention is about the duration to get the maximum benefit. In this context, the investigator makes and attempt to analyze the varied package of strength training (plyometric training, barbell training, uphill training and circuit training) on four different training groups. Each method of training is designed to achieve specific training goals. Hence, the investigator is motivated to select plyometric training, barbell training, uphill training and circuit training as experimental variables.

3.6. JUSTIFICATION FOR SELECTION OF DEPENDENT VARIABLES

Physical fitness is the key to success in sports and games. Each sports demands specific requirement of some physical fitness for successful performance. Fitness is an important factor in all sports and games and this factor based on the physiological fitness support as well as the lipids profile of the competitors. The investigator interested to know whether the changes on selected motor ability components such as speed, explosive power, speed endurance and body composition such as percent body fat, body mass index, lean body mass and physiological parameters such as anaerobic
power, VO$_2$max, resting pulse rate are due to the varied package of strength training. Therefore, in this study selected variables have been included as dependent variables.

3.7 SELECTION OF TESTS

The investigator analysed various literature, has consulted the experts in physical education and selected the test items to collect data on the selected motor ability components, body composition and physiological parameter which were standardized and most suitable to this study, they are presented in table - I.

**Table – I**

**DEPENDENT VARIABLES AND TESTS**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>Criterion Measures</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed</td>
<td>50 mts run</td>
<td>Seconds</td>
</tr>
<tr>
<td>2</td>
<td>Explosive power</td>
<td>Vertical jump</td>
<td>Centimetres</td>
</tr>
<tr>
<td>3</td>
<td>Speed endurance</td>
<td>150 mts run</td>
<td>Seconds</td>
</tr>
<tr>
<td>4</td>
<td>Percent body fat</td>
<td>Skin fold Calliper</td>
<td>Percentage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$= \left(\frac{4.950}{\text{Density}} - 4.500\right) \times 100$</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Body mass index</td>
<td>$= \frac{\text{wt}}{\text{Ht}^2}$</td>
<td>Kg/m$^2$</td>
</tr>
<tr>
<td>6</td>
<td>Lean body mass</td>
<td>Total body weight – total weight of fat</td>
<td>Percentage</td>
</tr>
<tr>
<td>7</td>
<td>Anaerobic power</td>
<td>Margaria – Kalaman Anaerobic Power Test</td>
<td>Kg m/s</td>
</tr>
<tr>
<td>8</td>
<td>VO$_2$max</td>
<td>Astrand – Astrand Nomogram</td>
<td>l/min</td>
</tr>
<tr>
<td>9</td>
<td>Resting pulse rate</td>
<td>Digital blood pressure monitor</td>
<td>bpm</td>
</tr>
</tbody>
</table>
3.8. ORIENTATION TO THE SUBJECTS

Before the commencement of the varied package of strength training, several sessions were allowed to familiarize the participants with the techniques involved to execute the plyometric training, barbell training, uphill training and circuit training exercises. The investigator explained the purpose of programme to the subjects and their part in the study. For the collection of the data, the investigator explained the procedure of training and testing on selected criterion variables and gave instructions about the procedure to be adopted by them for measuring. The subjects were sufficiently motivated to perform their maximal level during the training and testing period. The control group had no specific training and was advised not to involve in any sort of practice or specific training programme during the experimental period. All the participants who co-operated were well informed of the seriousness and importance of the study.

3.9. COMPETENCE OF THE TESTER

The investigator collected the data with the assistance of research scholars from the Alagappa College of Physical Education, Alagappa University. The purpose of the study and testing procedures were explained and demonstrated to the testers. The investigator had a number of practice sessions in order to familiarize the correct testing procedure. The testers’ reliability was established by test and re-test method. As very high correlation was obtained, the tester competency in taking measurement and test reliability were accepted.

3.10. RELIABILITY OF THE INSTRUMENTS

The required instruments were availed from the College of Physical Education, Alagappa University. They were in good working condition. The instruments were
purchased from the reliable and standardized companies. Their calibrations were tested and found to be accurate enough to serve the purpose of the study.

### 3.11. RELIABILITY OF THE DATA

Before the commencement of experiment, the reliability of the data was established by test and retest method. Ten subjects studying Bachelor’s degree in College of Physical Education, Alagappa University were tested twice on selected dependent variables by the same personals under similar conditions. The intra class co-efficient of correlation was used to find out the reliability of the data with test - retest scores on each criterion variables separately, and the results are presented in table - II.

#### Table – II

**INTRA CLASS CO-EFFICIENT OF CORRELATION ON SELECTED DEPENDENT VARIABLES**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Criterion Variables</th>
<th>‘R’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Percent body fat</td>
<td>0.91*</td>
</tr>
<tr>
<td>2</td>
<td>Body mass index</td>
<td>0.89*</td>
</tr>
<tr>
<td>3</td>
<td>Lean body mass</td>
<td>0.87*</td>
</tr>
<tr>
<td>4</td>
<td>Speed</td>
<td>0.92*</td>
</tr>
<tr>
<td>5</td>
<td>Explosive power</td>
<td>0.88*</td>
</tr>
<tr>
<td>6</td>
<td>Speed endurance</td>
<td>0.93*</td>
</tr>
<tr>
<td>7</td>
<td>Anaerobic power</td>
<td>0.90*</td>
</tr>
<tr>
<td>8</td>
<td>VO₂max</td>
<td>0.91*</td>
</tr>
<tr>
<td>9</td>
<td>Resting heart rate</td>
<td>0.88*</td>
</tr>
</tbody>
</table>

*Significant at 0.05 level of confidence.

(Table value require for significance at 0.05 level of confidence is 0.77)
The table-II states that the intra class co-efficient of correlation on selected variables. Since the obtained ‘R’ values were much higher than the required table value, the data were accepted as reliable in terms subjects.

3.12. PILOT STUDY

A pilot study was conducted to assess the initial speed, strength and power capacity of the subjects in order to fix the training load. Further, it helped to know the subjects, to involve the current study. For that purpose, twenty female athletes were selected at random, and they were divided into four groups which are plyometric training, barbell training, uphill training and circuit training groups. Under the strict supervision of the investigator the subjects performed their respective training. Based on the results of the pilot study the training programme was designed. While constructing the training programmes the basic principles of sports training were followed.

3.13. TRAINING PROGRAMME

In this study, training was done under close supervision with frequent adjustments in training intensity to maintain the desired training stimulus. The training programmes were scheduled for one session a day each session lasted between thirty to forty five minutes approximately excluding warming up and warming down. During the training period, the experimental groups underwent their respective training programme three days per week (alternative days) for twelve weeks. The group–I concentrated on plyometric training, the plyometric training groups performed the following exercises namely single leg hopping, medicine ball overhead throw, tuck jump, box jump, medicine ball side throw, depth jump, hurdle jump, medicine ball overhead back pass, barrier lateral jump, box lateral jump, single arm over hand medicine ball throw, jump and reach, bunny hops, chest pass medicine ball, hop and jump into sand pit, squat
ump, press-ups & hand clap and bounding. The intensity was fixed at low, medium & high, the training volume ranged from 50 to 100 foot contacts per session for twelve weeks. Detailed plyometric training programme given in appendix –II.

Group–II performed barbell training, the intensity starting from 55% of 1RM to 80% 1RM, followed from first week to twelve weeks. Detailed barbell training programme given in appendix –III.

Group–III performed uphill training, the intensity of the training increased progressively across the weeks. Intensity starting from 40 meters @ 45% of HRR to 60 meters @ 95% HRR, followed from first week to twelve weeks. Detailed uphill training programme given in appendix –IV.

Group–IV underwent circuit training sixteen exercises are fixed for the circuit training. Each exercise done for 30 seconds and 15 seconds are kept as recovery for each exercise. The intensity starting from 60% of HRR to 85% of HRR, followed from first week to twelve weeks. Detailed circuit training programme given in appendix –V.

3.14. ADMINISTRATION OF THE TESTS

3.14.1. 50 Meters Dash

Purpose: To measure the speed of the subjects.

Facilities and Equipments: Smooth surface, test course, scorecards, electronic stopwatch and a starting clapper.

Procedure
The subjects were taken the starting positions behind the starting line. The test administrator (at the finish line) raised both arms sideways to indicate the set position. The ‘Go’ signal is given rapidly lowering the arms to the side. The administrator had a stopwatch in his hand and started when the arms reach the side of the body. The subjects ran as fast as possible across the finish line. The watch was stopped when the subjects body (not head or arms) crossed the finish line. One trial was taken.

**Scoring**

The score was the time between the ‘Go’ signal and the moment the participant body crossed the finish line. The time was recorded to the nearest tenth of a second (Safrit, 1990).

### 3.14.2. Vertical Jump

**Purpose**

To measure the explosive power of the leg jump vertically upward.

**Equipments**

A yardstick, several pieces of chalk and a smooth wall surface of at least 12 feet from the floor are required.

**Procedure**

The performer should stand with one side toward the wall heels together and hold a 1 inch piece of chalk in the hand nearest to the wall keeping the heels on the floor he should reach upward as high as possible and make a mark on the wall. The performer then jumps as high as possible and makes another mark at the height of his jump.

**Scoring**
The number of inches between the reach and jump marks measured to the nearest half inch is the score. Three to five trails are allowed and the best trail is recorded as the score.

3.14.3. 150 Meters Run

Purpose

To measure the speed endurance of the subjects.

Facilities and Equipments

150 metres running course with a starting line and a finish line on the track, electronic stopwatch and a pistol.

Procedure

After a short warm-up period, the students took standing start position behind the starting line. To obtain better result, two subjects ran at the same time. The time elapsed from the start to the torso of the runner crossing the finish line was taken as test score. The fractions were rounded to the next longer one tenth of a second. For this purpose digital electronic stopwatches were used.

Scoring

The time taken to run the 150 meters distance was measured in one-tenth of a second (Seagrave, 1996)

3.14.4. Percent Body Fat

Purpose

To measure the percent body fat of the subjects

Equipment

Skinfold calliper and score sheet.

Procedure
The subject was asked to stand erect. The skin fold measurements were taken of three sites namely triceps, subscapular and abdominal. The skin fold was grasped between the thumb and index finger about one centimetre from the site at which calliper was to be applied above the finger holding the skin fold.

**Scoring**

All measurements were made to the nearest millimetre. The percent body fat was found out by applying the formula of Brozek (1971).  
\[ \% \text{ Body fat} = \frac{457}{Bd} - \frac{414.2}{Bd} \]  
is calculated by using Lohman (1981)/ formula Bd= 1.0982-(.000815) (X) + (.00000084) (X^2)/ where X=the sum of triceps, subscapular and abdominal skin fold.

**3.14.5. Body Mass Index**

**Purpose**

To measure the BMI change ratio of the subject.

**Equipments**

Stadio-meter, Weighing machine and score sheet.

**Procedure**

The subjects stand erect on the floor board of the stadio-meter with his back to the vertical backboard of the stadio-meter. The bar is locked in place on the head of the subject, so that the standing height measurement can be read on the tape. The subject to be weighed wearing a minimum f clothing, such as only gym shorts, the subjects was weighted at the same time of the day and to the same degree of accuracy usually the nearest half kilogram. And the weighing scale should be in the kilogram mode.

**Scoring**
The reading of the height measurement was taken in nearest centimetre, and weight measurement was taken in kilograms.

\[
\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (metres)}^2} \quad \text{kg/m}^2
\]

**Calculation of Lean Body Mass**

The percent body fat and total fat were determined and the lean body mass was calculated from the equation given below:

\[
\text{Lean body mass} = \text{Body weight} - \text{Total fat.}
\]


**Purpose**

The purpose of this test was to measure the anaerobic power capacity of the participants.

**Equipment**

A digital timer with switch mats to switch on and off the timer, a firm 15 – steps wooden staircase width 90 centimetres, perpendicular height 250 centimetres, angle 45 degree, perpendicular height between third and ninth step 108 centimetres.

**Procedure**

Two switch mats connected to an electronic timing device are placed on the third and ninth steps of the staircase. The sensitivity of the mat was 15 kg. The subject from six metre in front of the staircase ran up towards the stairs as rapidly as possible without losing momentum leaps to the third, sixth and ninth step in quick succession the clock was started as the subjects stepped on the first switch mat (on the third step) and stopped as he stepped on the second (on the ninth step). Time was recorded to one hundred of the second (*Johnson & Nelson, 1998*)
**Scoring**

Three trials were given to each subjects and the best was recorded for computing anaerobic power by using the following formula.

\[ P = \frac{WD}{t} \]

Where, \( P \) = Power (Kg m/s)

\( W \) = Weight of the subjects in kg

\( D \) = Vertical distance between the third and ninth steps

\( T \) = time taken between third and ninth steps in seconds

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**3.14.7. Maximal Oxygen Consumption (Vo2Max)**

**Purpose**

The purpose of the test was to find out the maximal oxygen consumption (Vo2max) capacity (The test was conducted as describes by Astrand – Astrand Nomogram).

**Facilities and Equipment**

Forty centimetre height bench, stop watch and score sheet.

**Procedure**

The subject was dressed tack – suits without shoes. The subject weight were measured and recorded. The subjects stepped a 40 cms, bench, left foot – up, right foot – up, left foot – down and right foot down. The subjects were asked to breath fully throughout the test and strengthened the knees completely on top of the bench. The stepping frequency was thirty steps per minute.

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**Scoring**
One minute determination of pulse rate after fifth minute of completion of stepping, the pulse rate and weight (L/min) were compared in the Astrand – Astrand nomogram.

3.14.8. Resting Pulse Rate

Purpose

To measure the number of resting pulse per minute.

Equipment

Digital blood pressure monitor was used to observe the radial artery pulse.

Procedure

The pulse was measured at the wrist, by winding up the wristlet cuff of the digital blood pressure monitor – wrist measuring model Ch 607 from citizen systems Japan, around the left wrist, by placing the body of the blood pressure monitor on the inside of the wrist. The measurement must be performed while at sitting position and with the left hand on a table held a level with the heart, keep the body still and relaxed during measurement.

Scoring

The number of pulse per minute was recorded as shown in the digital blood pressure monitor.

3.15. COLLECTION OF THE DATA

The data were collected on the selected motor ability components, body composition and physiological parameters as per the methods described above. The pretest data were collected prior to the training programme and posttest data were collected immediately after the twelve weeks of plyometric training, barbell training, uphill training and circuit training from four experimental groups and a control group.
3.16. EXPERIMENTAL DESIGN AND STATISTICAL TECHNIQUE

The experimental design in this study was random group design involving 75 subjects, who were divided at random into five group of fifteen each. All the four groups selected from the same population. No effort was made to equate the groups prior to the commencement of the experimental treatment. The pre test means of the selected dependent variable was used as a covariate. In order to nullify the initial differences the data collected from the five groups prior to and post experimentation on selected dependent variables were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since four groups were involved, whenever the obtained ‘F’ ratio for adjusted post test means was found to be significant, the Scheffe’s test was applied as post hoc test to determine the paired mean differences. In all the cases level of confidence was fixed at 0.05 for significance.