CHAPTER III
METHODOLOGY

This chapter describes the procedures followed in the selection of subjects, selection of variables, selection of tests, reliability of the data, competency of the tester, orientation to the subjects, pilot study, training programme, administration of tests, and experimental design and statistical procedures.

Selection of Subjects

Only sixty men college volleyball players were selected as subjects at random from Kanyakumari District, Tamilnadu, India. The selected subjects were divided into four groups of fifteen each. Group I underwent plyometric training, Group II underwent weight training, Group III underwent combination of plyometric and weight training were given for three alternate days in a week for a period of twelve weeks. Group IV acted as control group who did not participate in any other training other than their regular routine. The age of the subjects ranged from 17 to 22 years.

Selection of Variables

Dependent Variables

In all sports, speed and strength are important qualities. Generally it requires developing performance in sports and games.
Speed is a magic work in sports. The person who can run faster, throw harder and more quickly is likely to be a better athlete and win more contests. Power is an essential quality in many sports, for it represents the effective combination of strength and speed. Increase in strength or speed will increase power, and when power increases, more work can be done in less time.

Physiological parameters are one of the most important factors that determine the performance level of an individual. Sports performance depends largely on physical fitness factors and the psychological status of the players. Sports activity is a physical activity which is not possible without these abilities. Fitness factors are most important for predicting athletic performance. Natural ability is the promise of potential but fundamentals are the foundations of excellence. Hence, the following variables were selected for this study.

**Physical Variables**

- Speed
- Explosive power
- Muscular Strength
- Agility

**Physiological Variables**

- Resting Heart Rate
- Breath Holding Time
**Independent Variables**

Any physical activity leads to anatomical, physiological, biomechanical and psychological changes. Plyometrics is not a new concept. It has been used for improving performance for years. It is just recently that it has gained wide attention. The word Plyometrics has been in use since the 1960's. Plyometric training is based on using movements that are similar to the type of movement that would be done in a particular sport or activity to improve performance. Several studies have demonstrated that a combination of Plyometrics and weight training is far more effective in improving speed and strength (power).

Hence, the researcher made an attempt to find out the effects of following trainings among volleyball players.

1. Plyometric training
2. Weight training
3. Combination of plyometric and weight training

**Selection of Tests**

As per the available literatures, the following tests were used to collect relevant data on the selected dependent variables and they were presented in the table I.
TABLE I
TESTS SELECTION

<table>
<thead>
<tr>
<th>S.No</th>
<th>Criterion Variable</th>
<th>Name of the Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed</td>
<td>50 m run</td>
</tr>
<tr>
<td>2</td>
<td>Explosive power</td>
<td>Vertical jump test</td>
</tr>
<tr>
<td>3</td>
<td>Muscular Strength</td>
<td>Bent Knee Sit ups</td>
</tr>
<tr>
<td>4</td>
<td>Agility</td>
<td>Shuttle Run</td>
</tr>
<tr>
<td>5</td>
<td>Resting Heart Rate</td>
<td>Radial Pulse Method</td>
</tr>
<tr>
<td>6</td>
<td>Breath Holding Time</td>
<td>Manual Nostril Clip Method</td>
</tr>
</tbody>
</table>

Reliability of the Instruments

Instruments such as stopwatch, Sphygmanometer, nostril clip and measuring tape are availed from the Department of Physical Education, Scott Christian College, Nagercoil, Tamilnadu, India. All the instruments were in good condition, workable and purchased from a reputed company. The calibration was tested and found to be accurate enough to serve the purpose of the study.

Competency of the Tester

The operations of the testing variables were taught by an experienced faculty member and the investigator learnt the procedure and methods to handle and operate the instrument to administer the test. Measurements were taken by the investigator himself by using this equipment.
Reliability of the Data

Reliability was established by test and retest process. Test and retest method was followed in order to establish the reliability of the data by using ten subjects at random. All the variables selected in the present study were tested twice for the subjects by the same personal under the similar conditions. The intra class co-efficient correlation was used to find out the reliability of the data and the results have been presented in table II.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Criterion Variable</th>
<th>‘R’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed</td>
<td>0.86*</td>
</tr>
<tr>
<td>2</td>
<td>Explosive power</td>
<td>0.87*</td>
</tr>
<tr>
<td>3</td>
<td>Muscular Strength</td>
<td>0.89*</td>
</tr>
<tr>
<td>4</td>
<td>Agility</td>
<td>0.86*</td>
</tr>
<tr>
<td>5</td>
<td>Resting Heart Rate</td>
<td>0.94*</td>
</tr>
<tr>
<td>6</td>
<td>Breath Holding Time</td>
<td>0.92*</td>
</tr>
</tbody>
</table>

*Significant at 0.01 level of confidence

Table value required for significance at 0.01 level of confidence is 0.77. Since the obtained ‘R’ value was much higher than the required value, the data were accepted as reliable in terms of instruments, tester and the subjects.
Orientation to the Subjects

The investigator explained the purpose of training programme to the subjects and their part in the study. For the collection of data, the investigator explained the procedure of testing on selected dependent variables and gave instructions about the procedure to be adopted by them for measuring. Three sessions were spent to familiarize the subjects with the technique involved to execute the plyometric and weight training. It helped them to perform the weight and plyometric training perfectly and avoid injuries. Further, the control group was specially oriented, advised and controlled to avoid the special practice of any of the specific training programme till the end of the experimental period. The subjects of all the groups were sufficiently motivated to perform their maximal level during testing and training periods.

Pilot Study

A pilot study was conducted to assess the initial capacity of the subjects to fix the load and also to design the training program. For that purpose, ten subjects were selected at random and they were given different kinds of Weight training and Plyometric training under the watchful eyes of the investigator. During the pilot study, the subjects underwent many Weight training and Plyometric training programme and only limited exercise which are very closely related to develop the dependent variables were located and selected to design
the training programme. The initial load of the subjects was fixed based on the pilot study. While constructing the training programme the principles of sports training (Progression of load, reversibility, overload and specificity) were followed. During construction of the training programme, the individual differences were also being considered.

**Training Programme**

During the training period the experimental groups underwent their respective training programme in addition to their regular programme of the course of study. Group I underwent Plyometric training, Group II underwent weight training and Group III underwent Combination of plyometric training and weight training for alternative days. Group IV acted as control group.

The duration of training session in the twelve weeks was between 45 to 75 minutes approximately, including warming up and cool down. Group IV acted as control. They did not participate in any specific training on par with experimental group. All the subjects involved in this study were carefully monitored throughout the training programme to be away from injuries. They were questioned about their health status throughout the training programme. None of them reported any injuries. However, muscle soreness appeared in the earlier period of the training programme and was reduced in due course.
The training program scheduled with the duration and load was based on the results of the pilot study. The training program was carried out for a period of twelve weeks.

The subjects in the plyometric group performed plyometric drills: the depth jumps, split squat jumps, Rim jumps, squat jumps, lateral barrier jumps, single arm throws, wall throws, squat throws from chest, hurdle jumps. The depth jump height started at 40 centimeters and progressed to 75 centimeters at the 10th week. The subjects in the weight training group performed weight training exercises: the half squat, Bench presses, shoulder presses, Dead lifts and Dumbbell exercises: Hammer Curls, Concentration Curls, over head Triceps extensions, seated shoulder presses, Lateral Raises, front Raises. The subjects in the weight training group started with four sets of ten repetitions at 40 percent of 1RM during the first week and progressed to four sets of six at 90 percent of 1RM during the 10th week. The plyometric weight training group performed a combination of the two training programs (Plyometric and weight training program) but the volume and intensity of the work was reduced by 25 percent. All the training sessions were supervised. The training programs are shown in appendix.

Administration of Tests

1. Speed (50mts Run)

Purpose

The purpose of this test was to measure the ability of speed of the subjects.
Equipments

Stopwatch, score card and whistle.

Procedure

Prior to the test administration, a suitable running area with the distance of 50mts and extension for stopping was marked. The subjects were asked to take a standing start behind the starting point. The commands “Ready” and “Go” were given to start their running. At the same time stopwatch was turned on. The subject ran as fast as possible and when the subject crossing the finishing line, the stopwatch was stopped. No trials were given.

Scoring

The time taken to cover the distance was recorded to the nearest 1/10th of the second.

2. Explosive Power (Vertical Jump)

Purpose

To measure explosive strength in vertical direction.

Equipment used

A plywood board as suggested by Sargent was used to obtain the data.

Procedure

To obtain data for vertical jump, Sargent jump was administered to the subjects. Before the execution of the vertical
jump test, subjects were directed to practice for a few minutes. A plywood board (blackened 1 cm. Thick 1.50 mts. Long and 50 cm. Wide) with lines marked horizontally 1 cm. apart was used. This board was placed vertically, the zero point of the scale being at the reaching height of the shortest subject tested. The subject stood with his side toward the wall and reached as high as possible with heels on the floor and made a mark on the wall with chalked fingers. The subject then swung his arms downward and backward assuming a crouched position with the knees bent at about right angle. The subject then jumped as high as possible, swinging the arms upward, as the highest point of the jump was reached, and another mark was made above the initial one. Three trials were allowed with one-minute rest in between.

Scoring

The score was recorded to the nearest centimetres, between the reach and jump mark. The best of the three trials was recorded as the test score.

3. Muscular Strength

Objective

To evaluate abdominal muscular strength and endurance by performing repeated bent knee sit ups.
Equipment

Stopwatch and mats.

Instructions

Students should lie on their backs with knees flexed, feet on floor and heels between 12 & 18 inches from the buttocks. Arms are crossed over chest with hands on opposite shoulders. Feet one held to the mat by a partner. On “Ready”, “Go” the student curls to a sitting position, maintaining arm contact with chest. When elbows touch the thighs the sit-up is completed. The student then uncurls to a position where the midback contacts the mat. Students are to complete as many sit-ups in this manner as possible in one minute rest between sit-ups is allowed in either the up (or) down position.

Scoring

Only correctly performed sit-ups completed in one minute are counted.

4. Agility (Shuttle Run)

Purpose

To measure speed and agility

Equipments

Two blocks of wood 2 inches by 2 inches by 4 inches, and stop watch.
Procedure

Two parallel lines are marked on the floor 30 feet apart (The width of volleyball court serves as a suitable area) place the blocks of wood behind one of the line. The subject starts from behind the other line. On signal, the subject run to the blocks, picks one up, runs back to the starting line and places the blocks behind the line, runs back and picks the second block, which be carries back across the starting line. Two pupils could run at the same time if two times are available. Two trials are permitted.

Scoring

The score is the best of two trials and measure in the nearest one by tenth of a second.

5. Resting Heart Rate

Purpose

To record the Resting Heart Rate per minutes.

Equipments

Stop watch and chair were used.

Procedure

The pulse rate of all the subject were recorded in a sitting position in the morning session between 6.am before taking the pulse rate, the subjects were asked to sit in a chair and relax for 15min. To record the pulse rate, the three finger tips were placed or the left
radial artery at the wrist in such a manner that pulse was clear and the number of pulse were conducted for 15 seconds and then multiplies by four to record for full minute.

6. Breath holding time

Purpose

The purpose was to measure the ability of the subject hold the breath for longer time.

Equipments

A stop watch, score sheet, were used to administer this test

Procedure

The subject stands at ease and inhaled deeply after which he held his breath for length of time possible to him. The index finger of the respondent serves as an indicator to the investigator to know the start and end of the recording time the thumb and middle finger were used to hold the nose to avoid letting the air through the nostrils. The subjects were requested not to let the air out by opening the mouth while recording the breath holding time.

Scoring

The time of holding the breath till one subject let the air out was clocked by using the stopwatch to the nearest one tenth of a second as breath-holding time.
Experimental Design and Statistical Analysis

The pre test and post test random group design was employed as experimental design for the study. The sixty men selected for the study were assigned at random. This study consists of three independent variables as plyometric training, weight training and combination of weight and plyometric training. Group I was treated with plyometric training, group II was treated with weight training, group III was treated with combination of Weight training and Plyometric training and Group VI acted as control.

The experimental design used in this study was pre and post test random group design involving 60 subjects who were divided at random into four groups of fifteen each. The data collected from the four groups before and after the experimental period were statistically examined for significant improvement by dependent 't' test. Sixty subjects were divided at random and assigned into four groups of fifteen each. No attempt was made to equate the groups in any manner. Hence, to make adjustments for difference in the initial means and to test the adjusted post test means for significant differences among the groups, the analysis of covariance (ANCOVA) was used. Whenever the 'F' ratio for adjusted post test means was found to be significant, the Scheffe’s test was followed as a post hoc test to determine which of the paired means difference was significant.
In all the cases 0.05 level was fixed as significant level to test the hypothesis.

**Justifications for Using One-Way ANCOVA**

One-way univariate analysis of covariance (ANCOVA) was used to determine how each dependent variable was influenced by independent variables while controlling for a covariate (pre-test) (Hari, Anderson, Tatham, and Black., 1998). Analysis of covariance adjusts the mean of each dependent variable to what they would be if all groups started out equally on the covariate. In this study, pretest scores of selected variables have been shown to correlate with the posttest scores, thus they were considered as appropriate covariates.

**Assumptions for ANCOVA**

A preliminary analysis was conducted to determine whether the prerequisite assumptions of ANCOVA were met before preceding the univariate analysis. Thus, the assumption of equality of variance (homogeneity) and the assumption of homogeneity of regression slopes were examined.

Levene’s test of equality of error variances on selected variables was calculated and presented in table III.
### TABLE III
**LEVENE’S TEST OF EQUALITY OF ERROR VARIANCES ON SELECTED VARIABLES AMONG GROUPS**

<table>
<thead>
<tr>
<th>Variables</th>
<th>F- Ratio</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>0.523</td>
<td>0.668</td>
</tr>
<tr>
<td>Explosive power</td>
<td>1.868</td>
<td>0.145</td>
</tr>
<tr>
<td>Muscular Strength</td>
<td>1.505</td>
<td>0.223</td>
</tr>
<tr>
<td>Agility</td>
<td>1.814</td>
<td>0.155</td>
</tr>
<tr>
<td>Resting heart rate</td>
<td>2.564</td>
<td>0.064</td>
</tr>
<tr>
<td>Breath Holding Time</td>
<td>1.767</td>
<td>0.164</td>
</tr>
</tbody>
</table>

(The table value required for 0.05 level of significance with df 3 & 56 is 2.77).

Homogeneity of variances is a term that is used to indicate that groups have the similar variances. Thus, in levene’s test of equality of error variances table, the obtained F-values of the selected dependent variables were lesser than the critical value of 0.05, indicates that the variance of each group was not significantly different from one another.

Therefore, the homogeneity of variance of comparing the three groups regardless of the ability level for each of the dependent variables indicated that homogeneity of variance has been met for all the six dependent variables. Hence it was concluded that the assumption of homogeneity of variance has been met for computing univariate ANCOVA.
The test of significance of the regression of post test (dependent variable) on pre test (covariate) were analyzed and presented in table IV.

**TABLE IV**

**TESTING THE SIGNIFICANCE OF THE REGRESSION OF POSTTEST ON PRETEST OF SELECTED VARIABLES**

<table>
<thead>
<tr>
<th>Variables</th>
<th>F- Ratio</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>34.86</td>
<td>0.000</td>
</tr>
<tr>
<td>Explosive power</td>
<td>19.16</td>
<td>0.000</td>
</tr>
<tr>
<td>Muscular Strength</td>
<td>15.44</td>
<td>0.000</td>
</tr>
<tr>
<td>Agility</td>
<td>14.85</td>
<td>0.000</td>
</tr>
<tr>
<td>Resting heart rate</td>
<td>39.45</td>
<td>0.000</td>
</tr>
<tr>
<td>Breath Holding Time</td>
<td>5.25</td>
<td>0.041</td>
</tr>
</tbody>
</table>

* Significant at .05 level of confidence

(The table value required for 0.05 level of significance with df 1 & 58 is 4.01)

From the table it was observed that regression based method (ANCOVA) predicts the post test scores significantly well from the pretest scores on all the dependent variables. It shows that the pre and post test scores of selected dependent variables were significantly associated. As in regression, it is important that the association between the outcome and the covariate is linear.

After determining the assumptions for computing ANCOVA have been met with the pre data analysis, the univariate ANCOVA
statistical output was examined. Then, providing the ANCOVA result was statistically significant, the univariate results were examined for each dependent variable. For the significant univariate results, the post hoc comparisons were performed to identify where the differences resided. The pairwise comparisons statistic was used for the post hoc results. The results of the descriptive analysis, dependent ‘t’ test, univariate tests, the pairwise comparisons among the six dependent variables are reported in chapter four.