Chapter – III

METHODOLOGY

In this chapter sources and selection of the subjects, selection of experimental variables, experimental design, pilot study, criterion measures, instrument reliability, Tester competency, reliability of tests, subjects reliability, orientation of the subjects, training programme, administration of test, collection of data, statistical analysis and justification of ANCOVA are presented.

Sources and Selection of the subjects

The subjects selected for the study who had participated at Inter Collegiate athletic meet of Periyar University, Salem, Tamilnadu, India was held during the academic year 2011-2012 for a period for four days, in which various affiliated colleges of Periyar University participated. On a purposive sampling forty five (N=45) women athletes were selected from K.S. Rangasamy college of Arts and Science and K.S.R. College of Arts and Science for women, Tiruchengode.

They were further divided into three equal groups. Group I underwent continuous training with mental training (N-15), Group II underwent continuous training without mental training (N-15) and Group III acted as control group. The average age of
the athletes was ranged between 17-21 years as per college records. The selected athletes were found with optimum fitness level.

**Selection of Experimental variables**

The researcher reviewed various scientific literatures, journals, internet sources and research papers which revealed the importance of Bio-motor variables and psychomotor variables for optimum performance of athlete. Taking into consideration of feasibility, criteria availability of instruments and the relevance of this variable of the present study, the following dependent and independent variables were selected for the present study.

**Dependent Variables**

**Bio-motor variables**

- Speed
- Agility
- Flexibility
- Leg Explosive Power

**Psychomotor variables**

- Differentiation ability
- Eye & Hand co-ordination
- Kinesthetic perception
- Reaction ability
Independent Variables

- Continuous training with mental training
- Continuous training without mental training

Experimental Design

Pre test and post test randomized group design was useful to this problem. Forty five (N=45) women athletes who participated in the inter-collegiate athletic meet were from various affiliated college of Periyar University, Salem, Tamilnadu selected as subjects at random between the age 17-21 years. They were divided into three equal groups, each consisted of fifteen (n=15) subjects. Pre test was conducted for all the forty five subjects in the selected creation variables namely Speed, Agility, Flexibility, Leg Explosive Power, Differentiation ability, Eye & Hand co-ordination, Kinesthetic perception and Reaction ability. The initial test scores formed on pre test scores. Experimental group-I was exposed to continuous training with mental training, Experimental group-II was exposed to continuous training without mental training and the control group was not exposed to any experimental training other than their regular activities. The duration of the experimental treatment all 12 weeks. After the experimental treatment all the forty five subjects were measured on the selected Bi-motor and psychomotor variables. The final test
scores formed as post test scores of the subjects. The pre and post test scores were subjected to statistical analysis using Analysis of Covariance (ANCOVA) to find out the significant among the mean differences. Whenever the “F” ratio for adjusted test found to be significant, Scheffe’s post hoc test was used. In all cases 0.05 level of significance was fixed to test the hypotheses.

**Pilot Study**

A pilot study was conducted for the purpose of finalizing and deciding upon the intensity and duration of the package of continuous running with and without mental training. The pilot study was conducted for fifteen subjects to know the suitability of varied packages of continuous running with and without mental and to find out the difficulties and shortcomings of the study. Further it helped to ensure the accurate understanding about the duration of time, which is required for conducting the test.

**Criterion measures**

The criterion measures chosen for this study were:

1. **Speed:**

   Time taken by an individual to run a distance of 30 meters dash was recorded to the nearest 1/10th of a second.

2. **Agility:**

   Time taken in 4 x 10 meters shuttle run was recorded to the nearest 1/10th of a second.
3. **Flexibility:**

   Flexibility was determined by administrating Sit and Reach test and the score was recorded in Centimeters.

4. **Explosive power:**

   Explosive power was measured by using jump and reach test (Sargent Jump Test). The score was recorded in centimeters.

5. **Differentiation ability:**

   Differentiation ability was assessed by using backward medicine ball throw and scored in points.

6. **Eye-hand coordination:**

   The total number of correct trails (points) of the subject was recorded with the help of ball transfer tests.

7. **Kinesthetic perception:**

   Kinesthetic perception was measured by kinesthetic obstacle test and score was recorded in points.

8. **Reaction ability:**

   Reaction ability was measured by using ball reaction exercise test and measured in centimeters.

**Instrument Reliability**

The Stop watches, scales, adhesive tape, markers, measuring tape, medicine balls, and gymnastic mats, etcetera were obtained from standard firms. The reliability of these instruments were ensured and calibrated by their manufactures.
Thus all the instruments used in the study were to measure to
measure the performance considered reliable and precise.

**Tester competency and reliability of tests**

The tester competency was evaluated together with
reliability of tests. To determine the reliability of tests, the
performance of ten subjects selected at random were recorded
twice on the selected bio-Motor and psycho-motor variables under
identical conditions. The Pearson’s product movement correlation
was computed between the selected two measures of each
variable separately and the correlation co-efficient ‘r’ was
presented in Table I

**TABLE –I**

**Correlation Co-efficient of Selected Variables**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the test</th>
<th>Coefficients of Co-efficient ‘r’</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Speed</td>
<td>0.95*</td>
</tr>
<tr>
<td>2.</td>
<td>Agility</td>
<td>0.98*</td>
</tr>
<tr>
<td>3.</td>
<td>Flexibility</td>
<td>0.94*</td>
</tr>
<tr>
<td>4.</td>
<td>Leg Explosive Power</td>
<td>0.91*</td>
</tr>
<tr>
<td>5.</td>
<td>Differentiation ability</td>
<td>0.96*</td>
</tr>
<tr>
<td>6.</td>
<td>Eye &amp; Hand co-ordination</td>
<td>0.98*</td>
</tr>
<tr>
<td>7.</td>
<td>Kinesthetic perception</td>
<td>0.88*</td>
</tr>
<tr>
<td>8.</td>
<td>Reaction ability</td>
<td>0.89*</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)
Subject Reliability

The test-retest method was established to ensure the subject’s reliability which was determined at 0.01 level. For the purpose two subjects were selected at random on the chosen variables, which were recorded twice under identical conditions on different occasion by the investigator.

Orientation of the subjects

Prior to the administration of the tests, the scholar demonstrated the tests with brief explanation. The data was collected both in the morning and evening sessions from a selected woman. The use of equipments were explained and clearly demonstrated by the scholar to the subjects, so as to become familiar with the various test items.

Training Programme

The experimental groups underwent their respective training programmes in addition to their daily routine activities as per the schedule. The experimental group I underwent continuous training with mental training, the experimental group II underwent continuous training without mental training and control group (Group III) was not engaged in any type of training other than athletic training their regular activites.
The duration of training were planned for one and half hour that is from 6.30 to 8.00 am in all the days except Sundays for 12 weeks. The training on each day begun with, warm-up followed by prescribed training packages and ended with warm-down process.

The mental training programme was given for 20 minutes before the continuous training on each day except on the rest day for 12 weeks. Continuous training programmes were presented in the table-II and Mental training programme consisted of psych-up strategies namely attention focus, self talk, relaxation, imagery and preparatory arousal and it was also presented in the Table-III.

The subjects were to withdraw their consent in case they felt any discomfort during the period of training. But there were no drop outs in the study.

The subjects underwent their respective training programmes under the strict supervision of the investigator. Prior to every training session, the experimental groups had a ten minutes warm-up exercise, which included jogging, stretching etcetera.

All the subjects involved in the training programmes were questioned about their stature throughout the training period.
None of them reported any injury. However, muscle soreness was reported in the early weeks, but it subsided later. Attendance was calculated for the experimental group by dividing the total number of training sessions by the number of sessions present. It was 95.40% for the experimental group.

**Table II**

**CONTINUOUS RUNNING PROGRAM**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Week</th>
<th>Duration of Work out</th>
<th>MHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>1000 Meters Run</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1100 Meters Run</td>
<td>60%</td>
</tr>
<tr>
<td>II</td>
<td>3</td>
<td>1200 Meters Run</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1300 Meters Run</td>
<td>60%</td>
</tr>
<tr>
<td>III</td>
<td>5</td>
<td>1400 Meters Run</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1500 Meters Run</td>
<td>70%</td>
</tr>
<tr>
<td>IV</td>
<td>7</td>
<td>1600 Meters Run</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>1700 Meters Run</td>
<td>70%</td>
</tr>
<tr>
<td>V</td>
<td>9</td>
<td>1800 Meters Run</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>1900 Meters Run</td>
<td>80%</td>
</tr>
<tr>
<td>VI</td>
<td>11</td>
<td>2000 Meters Run</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>2100 Meters Run</td>
<td>80%</td>
</tr>
</tbody>
</table>

- A Phase consists of two weeks
- MHR= Maximum Heart Rate
### Table III

**MENTAL TRAINING STRATEGIES PACKAGE**

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon.</td>
<td>P.R. (1)</td>
<td>P.A (1)</td>
<td>I.M (1&amp;2)</td>
<td>S.T (2)</td>
<td>P.R (1&amp;2)</td>
<td>P.A (2&amp;3)</td>
<td>I.M (2&amp;3)</td>
<td>S.T (1&amp;2&amp;3)</td>
<td>I.M (4)</td>
<td>P.R (2,3&amp;4)</td>
<td>P.A (4)</td>
<td>P.A (1,2&amp;4)</td>
<td></td>
</tr>
<tr>
<td>Tue.</td>
<td>A.F (1)</td>
<td>I.M (1)</td>
<td>P.A (1&amp;2)</td>
<td>P.R (2)</td>
<td>P.A (2)</td>
<td>A.F (3)</td>
<td>P.A (3&amp;4)</td>
<td>I.M (1&amp;2&amp;3)</td>
<td>S.T (2,3&amp;4)</td>
<td>P.A (2,3&amp;4)</td>
<td>A.F (2,3&amp;4)</td>
<td>P.A (3&amp;4)</td>
<td></td>
</tr>
<tr>
<td>Wed.</td>
<td>P.A (1)</td>
<td>P.R (1)</td>
<td>S.T (1&amp;2)</td>
<td>A.F (2)</td>
<td>S.T (2&amp;3)</td>
<td>S.T (3)</td>
<td>S.T (3&amp;4)</td>
<td>A.F (1,2&amp;3)</td>
<td>P.R (2,3&amp;4)</td>
<td>S.T (3&amp;4)</td>
<td>S.T (2,3&amp;4)</td>
<td>P.R (4)</td>
<td></td>
</tr>
<tr>
<td>Thu.</td>
<td>I.M (1)</td>
<td>S.T (1)</td>
<td>P.R (2)</td>
<td>I.M (2&amp;3)</td>
<td>P.A (3)</td>
<td>A.F (3&amp;4)</td>
<td>P.R (1,2&amp;3)</td>
<td>P.A (4)</td>
<td>I.M (2,3&amp;4)</td>
<td>I.M (1,3&amp;4)</td>
<td>A.F (2,3&amp;4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fri.</td>
<td>S.T (1)</td>
<td>A.F (1)</td>
<td>A.F (1&amp;2)</td>
<td>P.A (2)</td>
<td>A.F (2&amp;3)</td>
<td>P.R (2&amp;3)</td>
<td>I.M (3)</td>
<td>P.R (2,3&amp;4)</td>
<td>A.F (2,3&amp;4)</td>
<td>A.F (2,3&amp;4)</td>
<td>P.R (4)</td>
<td>I.M (1,3&amp;4)</td>
<td></td>
</tr>
<tr>
<td>Sat.</td>
<td>A.F (1)</td>
<td>P.A (1)</td>
<td>I.M (1&amp;2)</td>
<td>S.T (2&amp;3)</td>
<td>P.A (1&amp;2)</td>
<td>P.R (2&amp;3)</td>
<td>A.F (4)</td>
<td>P.R (1,3&amp;4)</td>
<td>I.M (2,3&amp;4)</td>
<td>S.T (2,3&amp;4)</td>
<td>P.A (1&amp;3)</td>
<td>P.R (4)</td>
<td></td>
</tr>
</tbody>
</table>

- A.F - Attention Focus
- S.T - Self Talk
- P.R - Progressive Relaxation
- I.M - Imagery
- P.A - Preparatory Arousal

1,2,3,4 - Indicates Schedule number
Administration of Tests

Figure: I

Thirty Meters Run Test
1. **Speed:** 30 Meters dash

**Purpose:** To assess the speed of the subject.

**Equipments:** Stop watches, 30 meters straight smooth space and free of obstacle.

**Procedure:** The subject stood on the starting line. On the command of starter, the subject ran towards the finishing line. At the same time the time keeper started the stop watch and stopped after touching the finishing line by the subject. No trials were given.

**Scoring:** The score was recorded to the nearest one tenth of a second. *(Barrow and McGee, 1979).*
Figure: II

4 x 10 Meters Shuttle Run Test
2. **Agility**: 4 x 10 meters shuttle run.

**Purpose:**

To measure agility

**Equipments:**

Stop Watch, Measuring tape, lime powder, flag post, thread, paper and pen.

**Description:**

A distance of ten yards is marked by two parallel lines. The subject stands behind the starting line. On getting starting signal “Go” he runs fast, towards the other line and touches it with one hand and runs back to the starting line. After touching it, he repeats the shuttle run.

**Scoring:**

The time taken by the performer to complete the course of 4x10 yards to the nearest 1/10\textsuperscript{th} of the seconds is recorded as score in the test.
Figure: III

Sit & Reach Test
3. **FLEXIBILITY**: Sit & Reach Test

**Purpose**

The purpose of this test is to measure the athlete's lower back and hamstring flexibility.

**Equipment Used**

- A 'sit & reach' bench with a ruler
- An assistant

**Procedure**

- The subject sat on the floor with bare foot flat against the table, and legs straight. She then reached forward and pushed the fingers along the table as far as possible.
- The distance from the finger tips to the edge of the table represented the score.
- As the 'sit and reach' bench had an overhang of 15 cm, the subject who reached 10 cm past their toes scored 25 cm.
- Several warm-up attempts were given before recording the best score.

**Scoring**

Maximum reading taken by the subject was recorded in centimeters.
Figure: IV

Sargent Vertical Jump Test
4. **Leg Explosive Power**: Sargent vertical jump

**Purpose**: To measure the explosive power of legs.

**Equipments**: Measuring tape, chalk powder and a smooth wall surface.

**Procedure**: The subject stood with her one side towards the wall with heels together and with a piece of chalk in hand. In this position the subjects stretched her arms as high as possible with heels in contact with the floor and made a mark on the wall. The subject the swung her arms forward and backward, high-up, flexed her knees and gave a maximum vertical thrust to her body and Jumped as high as possible and made another mark at the maximum height of her jump reach. Each subject was given two successive trials *(Johnson and Nelson, 1988)*.

**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 scores.
Backward Medicine Ball Throw Test
5. **Differentiation Ability**: (Backward Medicine Ball throw test)

**Purpose:** To determine the differentiation ability of the subjects.

**Equipments and Materials:**

1. A gymnastic mat (3’x6’)
2. One medicine ball weighing 2 kg.
3. 5-medicine balls (1 kg each)
4. Pencil, paper and pad.

**Procedure:**

The floor pattern with mat was drawn as represented in the Fig.V.

A circle with 40 cms radius was drawn in the middle and a medicine ball of 2 kg weight was kept in the centre of the circle. The subject was asked to stand behind the starting line with back towards the mat at a distance of 2 meters. The subject using both hands was made to throw five medicine balls (1 kg each) by overhead throw trying to hit 2 kg medicine ball kept in the centre circle. Three trials were allowed. Only the overhead throw was insisted and at the same time the subjects were not permitted to look back.
Scoring:

Medicine ball touching the mat - 1 point
Medicine ball touching the circle - 2 point
Medicine ball falling inside the circle - 3 point
Medicine ball hitting 2 kg ball placed in the centre - 4 point

Score:

Points were awarded according to the first pitch of the ball. The score of the individuals was the total points scored in all five throws. Three trials were given and the best one was recorded.
Figure: VI

Ball Transfer Test
6. **Eye & Hand Coordination:** (Ball Transfer Test)

**Purpose:** To measure the Eye & Hand Coordination of the subjects.

**Equipments:**

1. Two Boxes of large enough to hold at least 10 inch playground balls.
2. 10 Basket Ball

**Procedure:**

At a signal the subjects quickly take a basketball from left box and place it to right box. (One at a time). The manner in which they deposited the ball in the box depended on the nature and level of skill desired. The scholar asked the subject to a) Simply place the balls in the basket, b) toss it from a specified distance, c) toss it over a basket, d) bounce it in, e) bank it in. The size and number of balls were altered accordingly as seen in the fig. VI.

**Scoring:**

The elapsed time for a certain number of trials was recorded.
Figure: VII

Kinesthetic Obstacle Test
7. Kinesthetic perception

**Purpose:**

To measure the kinesthetic ability of the individual to predict position during movement without the use of the visual stimuli.

**Equipments:**

12 chairs, material for blind fold, tape marker, measuring tape.

**Procedure:**

12 Chairs were arranged as shown in Figure (Fig.VII). Each performer was allowed 3 practice trials, walk through the course with blind fold for a score.

**Scoring:**

The performer scored 10 points for each station successfully cleared without touching. There were 10 stations for a maximum score of 100 points.

**Penalty:**

(a) There was a 10 point penalty for touching any part of the body against any part of a chair. When such a penalty occurred, the subject was directed to the centre line and one step ahead of the station where the penalty occurred.
(b) There was a 5 point penalty for each occurrence of the line on pattern of the chairs. Upon such occurrences, the subject was directed back into the center of the pattern at the nearest point from which she went astray.
Figure: VIII

Ball Reaction Exercise Test
7. Reaction Ability: (Ball reaction exercise test)

**Purpose:** To measure the reaction ability of the subjects.

**Equipments:**

Two wooden planks of 4 meter length each, two to three inflated basket ball, whistle, supporting stand, measuring tape, pencil, paper and writing pad.

**Procedure:**

The plank was kept inclined by a supporting stand having a height 1.20 meters, so that it would enable the ball to roll free from a height of 1.20 meters as shown in fig. VIII. The lower end of the wooden plank was at a distance of 1.50 meters from the starting line. Outside edge of the wooden planks were inscribed in cms. A ball was held by the tester at the top of the planks. The subjects were asked to stand behind the starting line with back towards plank and the tester “on signal” rolled the ball. The subject turned and ran towards to the planks and stopped the ball with both hands which was left rolling by the tester at the time of the signal.

**Scoring:**

The score was measured from the top of the planks to the point where the subject stopped the ball. Best of five trials was recorded in centimeters *(Uppal, 2001).*
Collection of Data

The data on Speed was assessed by 30 meters run, agility was assessed by 4x10 shuttle run, flexibility was assessed through sit & reach test, leg explosive power was assessed by Sargent vertical jump, Differentiation ability was assessed by Medicine ball throw, Eye & Hand co-ordination was assessed by Ball transfer test, Kinesthetic perception was assessed by Kinesthetic obstacle test and Reaction ability was assessed by Ball reaction exercise test. Pre test data were collected before the training programme and post test data were collected immediately after twelve weeks of training session. On the first day Bio-Motor variables tests were conducted, whereas the psychomotor variables were conducted on the second day morning session.

Statistical Analysis:

The collected data from the three groups prior to and after the training programme on selected criterion variables were statistically analyzed by analysis of covariance (ANCOVA). Whenever the ‘F’ ratio for adjusted post test means was found to be significant, 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 of confidence was fixed as a level of confidence to test the hypothesis.


Justification of ANCOVA

Analysis of covariance is used to determine how each dependent variable is influenced by two independent variables while controlling for a covariate. ANCOVA is to reduce the size of the error term in the analyses thereby increasing power. Analysis of covariance adjusts the mean of each dependent variable to what they would be if all groups started out equally on the covariate. Analysis of covariance gives results preferable to those of a direct comparison of gain scores i.e., post-test minus pre-test for the two groups, because gains are limited in size by the difference between the test’s ceiling and the magnitude of the pre-test score. In this study, pre-MP and pre-MR have been shown to correlate with the dependent variables, thus they were considered as appropriate covariates.

One-way ANCOVA is used to examine the effects of two or more independent variables on a set of dependent variables. A two-way ANCOVA enables us to examine the joint effect of the independent variables on the dependent variables, and get more powerful tests by reducing error (within-cell) variance.
A moderate to strong correlation among the dependent variables is an additional justification for using one-way ANCOVA. If there is no correlation, or if the correlation is weak among the dependent variables, ANCOVA is not considered since a single outcome measure may be diluted in a joint test involving many variables that display no effect. In such a situation, individual invariable tests are directly conducted.