CHAPTER - III

METHODOLOGY
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In this chapter, procedures and methods applied in selection of subjects, selection of variables, selection of tests, competence of the tester, reliability of the instruments, reliability of the data, orientation to the subjects, pilot study, training programme, collection of the data, administration of the tests, experimental design and statistical technique are presented.

SELECTION OF SUBJECTS

The purpose of the study was to compare the effects of power training programmes of varying intensities on selected power and speed related parameters. For this purpose, forty men students from the total strength of one hundred and two studying bachelor’s degree in Physical Education in H.H. The Rajah's College, Pudukkottai were selected as subjects at random. The age, height and weight of the subjects ranged from 18 to 21 years, 160 to 172 cms and 50 to 60 kg respectively, and the means were 19.4 years, 167 centimeters and 56 kilograms respectively.
The subjects successfully completed the minimum strength requirement test recommended by Voight and Draovitch\(^94\), which consist of static stability and dynamic movement testing for thirty seconds. The selected subjects were randomly assigned to four groups of ten each. Group-I underwent Maximal Resistance Training with 60% Intensity, Group-II underwent Maximal Resistance Training with 80% Intensity, Group-III underwent Plyometric Training with 60% Intensity and Group-IV underwent Plyometric Training with 80% Intensity. They underwent the respective training programme for a duration of twelve weeks with three days per week in addition to the regular physical education programme of the college curriculum. A written consent was obtained from the subjects. However, they were free to withdraw their consent in case they felt any discomfort during the period of their participation. There were no such dropouts in this study.

SELECTION OF VARIABLES

Dependent Variables

Sports Training is a long continuous and systematic process. It requires physical and mental hard work, to attain high level performance in competitions at various levels. It is right to say that sports training are a scientific endeavour to reach high level performance. Sports achievements are based on optimum level of training to develop conditional and co-ordinative abilities which are the pre requisites to achieve excellent results in competitive sports. A large portion of sports training is devoted to the study of performance capacity which further comprises of physical condition, (physical fitness), technique and co-ordinative abilities, tactics, physique and psychic factors.

In all sports, speed and strength are integral components of fitness. Speed is a magic word 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. Simply put, the combination of speed and strength is power. Increase in strength or speed will increase power, and when power increases, more can be done in less time.
Speed, power and strength are critical to many sports. Speed running is an athletic event itself and at the same time it is an important training for numerous other sports. Speed is mostly considered in the form of acceleration. Speed is an important factor in almost all games, and it can make the difference determining whether a performer can gain an advantage over his opponent. The speed of an athlete is the product of stride length and stride frequency. It is apparent that to increase speed, a runner must achieve an increased stride length and stride frequency.

Since power and speed play an important role in almost all games and sports, the following dependent variables were selected for this study.

1. Anaerobic Power
2. Explosive Power
3. Elastic Power
4. Speed
5. Stride Length
6. Speed Endurance
Independent Variables

All athletic programs should incorporate the fundamental factors of training, namely physical, technical, tactical, psychological and theoretical training. They are an essential part of any training program regardless of the athlete's age, individual potential, training level, or training phase. The relative emphasis placed on each factor varies, however, according to these features and the characteristics of the sport or event.

Many competitions are held to test power. Throwing and jumping events kicking in Soccer, spiking in Volleyball, serving in Tennis, striking in Cricket are examples for the application of power in various games. Since power plays an important part in almost all sports and games. Power has been to increase either by increasing the amount of work or force that is produced by the muscles or by decreasing the amount of time required to produce force.

Athletes for thousands of years have used various forms of resistance training to enhance their sporting performance, but it was only during the past 20 years that it has been transformed from the pursuit of a relatively small number of state athletes into an integral part of the training routine of most athletes. While
resistance training has historically been seen as a means to enhance muscular strength and size, it is currently used by a variety of individuals to increase power, speed and endurance, enhance muscle tone, and assist in rehabilitation and injury prevention and to aid in the maintenance of muscular function in old age. The current study uses resistance training in the development of the muscular functions of strength, explosive power and speed, from a performance enhancement perspective.

Resistance training is an anaerobic form of exercise. Many training programmes can be used to enhance the ability of the body to perform at very high force and/or power and to improve the body's ability to perform repeated bouts of maximal activity.

Most jumping and power activities involve a counter movement (eg. Wind-up, back swing), during which the muscles involved are first stretched rapidly and then shortened to accelerate the body or limb. This type of muscle action is known as a "plyometric contraction". As the muscles are activated, force is increased in the tendon – muscle complex, increasing its stiffness or resistance to stretching. The results are a storage of elastic energy in the muscles and tendon that is recovered in the
subsequent desirable “release” movement. A suddenly imposed stretch also increases neural stimulation to the muscles.

Plyometric training is the key to develop maximal explosive power and speed of movement which in turn are the elements involved in all sports. By doing various exercises one can greatly increase the performance level.

Intensity is the pace at which physical activity is done or the effort involved in performing a given task is undertaken. An activity can be carried out with different intensities, which have different effects on the organism. Thus, the exercise load must have some minimum intensity in order to have some effect on the organism. With the improvement in training state, the effective zone of intensity shifts to higher levels.

Based on the above mentioned concepts of Maximal Resistance Training and Plyometric Training the following independent variables have been designed.

1. Maximal Resistance Training with 60% Intensity,
2. Maximal Resistance Training with 80% Intensity,
3. Plyometric Training with 60% Intensity
4. Plyometric Training with 80% Intensity
SELECTION OF TESTS

The present study was undertaken to compare the effects of Power Training programmes of varying intensities on Anaerobic power, Explosive power, Elastic power, Speed, Stride length and Speed Endurance. As per the available literature, the following standardized tests were used to collect relevant data on the selected dependent variables and they are presented in Table I.

**TABLE I**

**TESTS SELECTION**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Criterion Variables</th>
<th>Test Items</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anaerobic Power</td>
<td>Margaria-Kalamen Anaerobic power test</td>
<td>1/10th of a second</td>
</tr>
<tr>
<td>2</td>
<td>Explosive Power</td>
<td>Vertical Jump Test</td>
<td>In Centimeters</td>
</tr>
<tr>
<td>3</td>
<td>Elastic Power</td>
<td>Bunny Hop test</td>
<td>In Meters</td>
</tr>
<tr>
<td>4</td>
<td>Speed</td>
<td>50 Meters Run</td>
<td>1/10th of a second</td>
</tr>
<tr>
<td>5</td>
<td>Stride Length</td>
<td>50 Meters Run</td>
<td>In Meters</td>
</tr>
<tr>
<td>6</td>
<td>Speed Endurance</td>
<td>150 Meters Run</td>
<td>In Meters per seconds</td>
</tr>
</tbody>
</table>
COMPETENCY OF THE TESTER

All the measurement in this study were taken by the investigator with the assistance of students of Physical Education, Health Education and Sports, H.H. The Rajah's College, Pudukkottai. To ensure that the assistants of the investigator were well versed with the technique of conducting tests, they had a number of practice sessions in the correct testing procedure. The tester's reliability was established by test and re-test methods.

RELIABILITY OF THE INSTRUMENTS

The digital timer with switch mats, stopwatches, measuring tape, and Sargent, jump board used in this study were borrowed from Department of Physical Education, Health Education and Sports, H. H. The Rajah's College, Pudukkottai, Tamilnadu in India. The video camera used in the study was hailed from well-established studio in Pudukkottai. These instruments had been purchased from reliable and standard companies and were considered accurate enough for the purpose of the study.
RELIABILITY OF THE DATA

Test and retest method was followed in order to establish the reliability of data by using ten subjects at random. All the dependent variables selected in the present study were tested twice for the subjects by the same personnel under similar conditions. The intra class co-efficient of correlation was used to find out the reliability of the data as suggested by Johnson and Nelson 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>Anaerobic Power</td>
<td>0.94*</td>
</tr>
<tr>
<td>2.</td>
<td>Explosive Power</td>
<td>0.96*</td>
</tr>
<tr>
<td>3.</td>
<td>Elastic Power</td>
<td>0.94*</td>
</tr>
<tr>
<td>4.</td>
<td>Speed</td>
<td>0.94*</td>
</tr>
<tr>
<td>5.</td>
<td>Stride Length</td>
<td>0.96*</td>
</tr>
<tr>
<td>6.</td>
<td>Speed Endurance</td>
<td>0.97*</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’ values were much higher than the required value, the data were accepted as reliable in terms of instrument, tester and the subjects.

**ORIENTATION TO THE SUBJECTS**

The investigator explained the purpose of the training programme and their part in the study to the subjects. For the collection of data, the investigator explained the procedure of testing on selected dependent variables and gave instruction about the procedure to be adopted by them for measuring. Five sessions were spent to familiarize the subjects with the techniques involved in undergoing Maximal Resistance Training and Plyometric Training. It helped them to perform the Maximal Resistance Training and Plyometric Training exercises perfectly without injuries. The subjects of all the groups were sufficiently motivated to perform their assigned tasks during the testing 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 programme. For that purpose, ten men subjects were selected at random and they were given different kinds of Power Training in the form of Maximal Resistance Training and Plyometric Training under the watchful eyes of the investigator. During the pilot study, the subjects underwent Maximal Resistance Training and Plyometric Training Exercises. Finally, limited exercises, which were closely related to develop the dependent variables and design the training programme. The initial loads of the subjects were fixed based on the results of the pilot study and the directions given by Dan Wathen and William B. Allerheibigen96. The training respective intensities and programme were fixed for Maximal Resistance Training and Plyometric Training separately. While constructing the training programmes the basic principles of sports training (progression of 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 programmes in addition to their regular course of study as per their curriculum. Group-I underwent Maximal Resistance Training with 60% Intensity, Group-II underwent Maximal Resistance Training with 80% Intensity with, Group-III underwent Plyometric Training with 60% Intensity and Group-IV underwent Plyometric Training with 80% Intensity for all three days per week for twelve weeks.

The duration of training session in all the days were between one hour to one and half hours approximately which included warming up and limbering down. 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. Before the commencement of the experimentation, the investigator recorded the 1 RM for each subject separately for the four experimental groups.
Assessment of One Repetition Maximum (1 RM)

After selecting the resistance training, 1 RM was found for each subject of Maximal Resistance Training group for each exercise separately by increasing and decreasing the weight. 1 RM is the maximum amount of weight a person can successfully lift one repetition only through the full range of motion.

In ploymetrics, the type of exercise performed controls intensity, plyometric ranges from simple task to high complex and stressful exercises. Intensity of plyometric exercise can be increased by adding light weights in certain cases, by raising the platform height for depth Jumps or simply by aiming at covering a greater distance in longitudinal Jumps. Volume is often measured by counting foot contacts. In this study maximum number of foot contact were assessed separately for each exercise.

The percentage of intensities for Maximal Resistance Training and Plyometric Training are presented in Table III.
### TABLE - III

**PERCENTAGE OF INTENSITY FOR MAXIMAL RESISTANCE TRAINING AND PLYOMETRIC TRAINING GROUPS**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Groups</th>
<th>Components</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
<th>Phase IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Maximal Resistance Training with 60% Intensity</td>
<td>Sets</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Repetition</td>
<td>16 to 20</td>
<td>14 to 18</td>
<td>12 to 16</td>
<td>10 to 14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensity</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>2.</td>
<td>Maximal Resistance Training with 80% Intensity</td>
<td>Sets</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Repetition</td>
<td>16 to 20</td>
<td>14 to 18</td>
<td>12 to 16</td>
<td>10 to 14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensity</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>3.</td>
<td>Plyometric Training with 60% Intensity</td>
<td>Sets</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Repetition</td>
<td>16 to 20</td>
<td>14 to 18</td>
<td>12 to 16</td>
<td>10 to 14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensity</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>4.</td>
<td>Plyometric Training with 80% Intensity</td>
<td>Sets</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Repetition</td>
<td>16 to 20</td>
<td>14 to 18</td>
<td>12 to 16</td>
<td>10 to 14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensity</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
</tbody>
</table>

* A Phase consists of Three weeks duration.
COLLECTION OF THE DATA

The data on Anaerobic Power, were collected by administrating Margaria-kalamen Anaerobic Power test, Explosive Power were collected by administering Vertical Jump Test. The Data on Elastic Power were collected by administrating Bunny Hop test. Speed and Stride Length were collected by administrating 50 meters Run and that on Speed Endurance were collected by administrating 150 meters Run. Pre test data were collected two days before the training programme and posttest data were collected two days immediately after the last training session. In both the cases, the data were collected two consecutive days. On the first day Anaerobic Power test, Explosive power test and Elastic power test were conducted, whereas 50 meters run (Speed, Stride Length) and 150 meters Run (Speed Endurance) were conducted on the second day.
ADMINISTRATION OF THE TESTS

1. Margaria Kalamen Anaerobic Power Test (Anaerobic Power)

Purpose

To measure the anaerobic power of the subject.

Equipment Used

1. A firm fifteen step staircase

2. Digital timer with switch mats to switch 'ON' and switch 'OFF' the time.

Procedure

The subjects stood 6 meters in front of the staircase. They ran up the stairs as rapidly as possible, taking three steps at a time. The clock was started as the person stepped on the first switch mat (on the 3rd step) and stopped as he stepped on the ninth step. The time it took to traverse the distance between stair 3 and stair 9 was recorded in 0.01 sec.

Scoring

The power generated is a product of the subject's weight (W) and vertical distance (D) divided by time (t).
\[
P = \frac{W \times D}{t}
\]

Where,

\begin{align*}
P & = \text{Power} \\
W & = \text{Weight of the subject in kilograms} \\
D & = \text{Vertical height between third and ninth steps in stairs} \\
t & = \text{Time from third to ninth step in seconds}
\end{align*}

2) **Sargent Jump (Explosive Power)**

**Purpose**

To measure explosive power 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 test, all the subjects were instructed given by the tester regarding the test performance. They were taught how to perform the test perfectly by the investigator. 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 trails were allowed with one-minute rest in between.

**Scoring**

The score was recorded to the nearest centimeters, between the reach and jump mark. The best of the three trials was recorded as the test score\(^97\).

\(^97\) Dudley A. Sargent., “Physical Test of a Man”, *American Physical Education Review*, 26, (April 1921), 188.
3) Bunny Hops Test (Elastic power)

Purpose

To measure the elastic power.

Equipments Used

Measuring tape

Procedure

The procedure prescribed by Loern Seagrave\(^\text{98}\) was employed to measure the elastic power. The subject took the position on the take off line. When he completed five strides in bounding (Bunny hops) the performance was measured from the nearest break to the take off line. Three trials were given. The five strideBounding test (Bunny hops) for distance will provide the best assessment of an individual’s power capacity.

Scoring

The best performance was recorded to the nearest 0.01 metres.

4) 50 meters run (Speed and Stride length)

**Purpose**

To assess Speed and Stride length.

**Equipments Used**

Measuring tape, starting clapper, stopwatch, and video camera.

**Procedure**

The standing start method was adopted for this purpose. The time from the 'clap' to the runner crossing the finish line was taken as the test score. The fractions were rounded to the next largest one tenth of a second. For this purpose digital electronic watch was used. Two trials were conducted with sufficient rest in between and the better of the two trials were recorded. Further, each subject's run was video-recorded to assess the number of contacts (strides) he made between the starting and finishing lines. The recorded cassette was played in slow motion and the number of contacts was counted for the best trials.

**Scoring**

1) Speed was recorded in 1/10 second.

2) Stride length was computed by using the following formula.

\[
\text{Stride length} = \frac{50\text{mts}}{N}.
\]

\(N= \text{Number of contacts (Strides during the run)}\).
5) 150 meters run (Speed Endurance)

Purpose

To assess speed endurance.

Equipments Used

Measuring tape, Starting clapper and Stopwatch.

Procedure

The standing or crouch start method of maximum effort sprint over 150mts was adopted for this purpose. The time from the ‘clap’ to the runner crossing the finish line was taken as the test score. The fractions were rounded to the next largest one tenth of a second. For this purpose digital electronic watch was used.

Scoring

The average velocity is calculated by using the following formula

\[
\text{Speed Endurance} = \frac{\text{Distance}}{\text{Time taken}} \text{ Mts / Seconds}^{99}
\]

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99 Loren Seagrave, p.100
EXPERIMENTAL DESIGN AND STATISTICAL TECHNIQUE

The pre test and post test random group design was used as experimental design in which forty men subjects were divided into four groups of ten each at random. No attempt was made to equate the groups in any manner. Group-I underwent Maximal Resistance Training with 60% Intensity, Group-II underwent Maximal Resistance Training Plyometric with 80% Intensity, Group-III underwent Plyometric Training with 60% Intensity, Group-IV underwent Plyometric Training with 80% Intensity. The subjects tested on selected criterion variables like Anaerobic Power, Explosive Power, Elastic Power, Speed, Stride Length and Speed Endurance prior to and immediately after the training programme.

The data collected data from the four groups prior to and immediately after the training programme on the selected criterion variables were statistically analyzed with dependent ‘t’ test and Analysis of Covariance (ANCOVA). Whenever the ‘F’ ratio for adjusted posttest means was found to be significant, Scheffe’s test was followed, as a post hoc test to determine which of the paired mean differences was significant. In all the cases .05 level of confidence was fixed as a level of confidence to test the hypotheses.