Chapter III

METHODOLOGY

This chapter deals with the procedure followed in the selection of the subjects, selection of variables, selection of test, instrument reliability, reliability of the data, pilot study, orientation to the subjects, training programme, collection of data, test administration, experimental design and statistical procedures applied for analyzing the data.

SELECTED OF SUBJECTS

To achieve the purpose of the study, the data were analyzed into two parts. The first part of the study is achieved by finding out the effect of training and to find out the most effective training methodology, second part of the study is to select minimum number of factors which could bring together the variable of similar characteristic of the combined, high force and high power weight training.

For the present study, 60 male subjects were selected at random from Dr. Sivanthi Aditanar College of Physical Education, Tiruchendur, TamilNadu, India. The age of the subjects ranged between 18-25 years. The selected subjects were divided into three experimental groups and a control group with fifteen subjects (n=15) each. Experimental group I (CTG=15) underwent combined weight
training, Group II (HFTG=15) underwent high force weight training, Group III (HPTG=15) underwent high power weight training and Group IV served as control (CG=15).

All subjects were informed about the nature of the study and their consent was obtained to co-operate till the end of the experiment. The age of the subjects was ranged from 18 to 25 years.

Pilot study groups and experimental groups (namely CTG, HFTG and HPTG) were trained-up in which three modes of weight training were given independently with separate subjects in each group.

The subjects were free to withdraw their consent in case they felt any discomfort during the period of their participation, but there were no dropouts. A qualified physician examined the subjects medically and declared them fit for the study.

**SELECTION OF VARIABLES**

The goals of weight training may be directed towards the increase in strength and speed or a combination of these variables. The investigator had gone through the relevant literature in the area of weight training and its various aspects in association with the guide and other experts in this area. The variables were selected after considering the feasibility and availability of proper techniques and instruments. In this experimental study, three experimental (CGT,
HFTG, and HPTG) groups with different loads were given weight training while one group was kept as control group to assess the difference.

**Dependent Variables**

Speed, strength and power are the three key elements common to all the athletic events. Any departure from these key elements will adversely affect the performance. The athlete’s body can be trained to improve an individual in each of them: speed, muscular strength and power. Keep in mind, however, that the body can use the parameters by training a single component, two components, or all of them. Strength is also the source of power. Power is the product of muscle force and movement speed. Various sports differ markedly in their requirements of fitness parameters for successful performance. The importance of fitness variables for determining the success of an athlete or team is well acknowledged among coaches of anaerobic sports such as football, basketball, or hockey. Important in speed, strength and power may be the most important elements for enhancing athletic performance. However, the importance of these variables to the athlete is not only related to how fast or how quick he is, but whether the athlete can maintain the performance at maximum levels throughout the duration of a competitive contest. Hence, the following dependent variables were selected for this study.
1. Speed
2. Vertical power
3. Horizontal power
4. Leg strength
5. Anaerobic power
6. Elastic power and
7. Agility

**Independent Variables**

Athletes train to the specificity of their events, and they may not be so concerned with muscular size or symmetry. An athlete should begin by analyzing the sport and determining the required body positions and movements to be performed. From this awareness the athlete can determine what areas of the body to focus on in training and how to go about the training. The individual first determines whether muscular endurance, strength, or power is needed in the particular sport. Keep in mind the points made about fitness enthusiasts, body builders and athletes.

Weight training is useful to develop strength. It focuses on selecting particular exercises, performing specified repetitions for each exercise and using specific amounts of weight for each lift.
Resistance training over time causes a general increase in the number, diameter, density of collagen fibers and muscle strength. Progressive weight training exercise can therefore enhance athletic power by improving movement speed as well as muscle force. Heavy–resistance weight training ultimately produces a greater maximum force; the greater force production comes at a cost in time of application. A movement with high power output using relatively light loads has been shown to be more effective for improving power parameters.

Each stage in an athlete’s training requires modification of the various modes and methods of training according to the goals set by the athlete, skill coach and conditioning specialist. The successful athlete has an optimal blend of training modes and methods. Weight training is only a means of achieving success. It in itself is not an end product. Hence, the following weight training methods was selected as independent variables.

1. Combined weight training
2. High force weight training and
3. High power weight training.
SELECTION OF TESTS

As per the available literatures, the following standardized 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>Variables</th>
<th>Test</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>30 meters run</td>
<td>In Seconds</td>
</tr>
<tr>
<td>Vertical Power</td>
<td>Vertical Jump</td>
<td>In Kg.mt/Sec</td>
</tr>
<tr>
<td>Horizontal Power</td>
<td>Standing Broad Jump</td>
<td>In Kg.mt/Sec</td>
</tr>
<tr>
<td>Leg Strength</td>
<td>Leg dynamometer</td>
<td>In Kilograms</td>
</tr>
<tr>
<td>Anaerobic Power</td>
<td>Margaria-Kalamen Anaerobic Power Test</td>
<td>In Kg.mt/Sec</td>
</tr>
<tr>
<td>Elastic Power</td>
<td>Bunny Hops</td>
<td>In Meters</td>
</tr>
<tr>
<td>Agility</td>
<td>Shuttle Run</td>
<td>In Seconds</td>
</tr>
</tbody>
</table>
INSTRUMENT RELIABILITY

Instruments like leg dynamometer, measuring tape and stopwatches available in the human performance laboratory of Dr. Sivanthi Aditanar College of Physical Education, Tiruchendur, were all reliable and manufactured by standard companies. Instrument reliability was also established by test-retest method.

RELIABILITY OF THE DATA

Before the commencement of the experiment, the reliability of the data was established by suing 10 subjects at random. To ensure reliability, test and re-test method was executed. The same testing personnel by using the same equipments under identical conditions tested all the variables selected in the present investigation twice on the same subjects. The intra class co-efficient of correlation was used to find out the reliability of the data and the results are given in the table II.
TABLE II
INTRA CLASS CO-EFFICIENT OF CORRELATION ON SELECTED VARIABLES

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Variables</th>
<th>‘R’ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed</td>
<td>0.81</td>
</tr>
<tr>
<td>2</td>
<td>Vertical Power</td>
<td>0.83</td>
</tr>
<tr>
<td>3</td>
<td>Horizontal Power</td>
<td>0.82</td>
</tr>
<tr>
<td>4</td>
<td>Leg Strength</td>
<td>0.87</td>
</tr>
<tr>
<td>5</td>
<td>Anaerobic Power</td>
<td>0.80</td>
</tr>
<tr>
<td>6</td>
<td>Elastic Power</td>
<td>0.82</td>
</tr>
<tr>
<td>7</td>
<td>Agility</td>
<td>0.81</td>
</tr>
</tbody>
</table>

*Significant at 0.01 level.

(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 explained the involvement of the subjects. Before the commencement of the training programme, the weight training techniques were taught to group I, II and III. Four one-hour sessions were spent on alternate days to practice the techniques. This helped
them to perform the weight training exercises perfectly by avoiding injuries.

**PILOT STUDY**

A pilot study was conducted to assess the initial strength and capacity of all the subjects in order to fix the load. For this, 18 boys were selected at random and divided into three groups of six each, in which group I underwent combined weight training, group II performed high force training and group III underwent high power training exercises under the supervision of experts and the scholars. Based on the response of the subjects in the pilot study, the training schedule were constructed and presented in appendix I, II and III. However, the individual differences were considered. While constructing the training programmes, the basic principles of sports training namely progression, over load and specificity were followed.

**TRAINING PROGRAMME**

During the training period, the experimental groups underwent their respective training programmes three days per week on alternate days for nine weeks in addition to their regular physical education activities. Experimental group I (CTG) underwent combined weight training which includes both high force and high power weight training (first five weeks high force weight training and the remaining four weeks heavy (60% of their 1Rm Values) and light
(40% of their 1Rm Values)] weight training combined), Group II (HFTG) underwent high force weight training by using 80% of their 1RM values and Group III (HPTG) underwent high power weight training by using 50% of their 1RM values. Before the commencement of the experimentation and middle of the training period (after fifth week), the investigator recorded the 1RM for each subject separately for three experimental groups. The experimental group I, II and III performed the weight training at different velocity. Training volume and load was increased progressively on different phase (A phase consist of three weeks). The training schedule for the three experimental groups were presented in appendix I, II and III. Every day the workout lasted for 30 to 40 minutes approximately. Group IV (CG) served as control group. However, they were involved in regular physical education activities as per the college routine.

The subjects underwent their respective training programme under strict supervision. Prior to every training session, subjects underwent 10-20 minutes warm-up exercises, which included jogging, stretching, striding, and assisting exercises such as push-ups, parallel squats, bench press and crunches. All the subjects involved in the training programmes were questioned about their stature throughout the training period. None of them reported any injuries. However, muscle soreness was reported in the early weeks, but it subsided later.
**COLLECTION OF DATA**

The data on selected dependent variables for pre and post tests were collected two days before and after the training programme respectively. On the first day vertical power, anaerobic power, agility and elastic power were tested. Whereas leg strength, speed, and horizontal power were tested on the second day.

**TEST ADMINISTRATION**

1. **30 Metres Run test**

**Objective**

To assess the speed

**Equipment**

Measuring tape, starting clapper and stopwatches

**Marking**

Two lines (starting and finish) were drawn 30 metres apart in 400 metres track straight.

**Direction**

Students were advised to use standing start method. The subject stood behind the starting line with the command ‘ready’ and on ‘clap’ they ran through the 30 meters distance. A stopwatch measured the elapsed time from starting signal to the runner
crossing the finish line. Since the timing was operated by hand, the time was rounded off to one tenth of a second.

**Scoring**

Each subject was given two trials with sufficient rest in between and the best out of the two trials was recorded (Jackson, Baumgartner, 1991).

### 2. Vertical Jump Test

**Objective**

To measure the vertical power.

**Equipment and Materials**

A jump board marked in inches, chalk dust and weight scales were used for the test.

**Directions**

Record the performer’s weight and then have him assume a standing position facing sideways to the jump board, the preferred arm behind the back (hand grasping top of shorts at the back), and the other arm raised vertically with the hand turned outward and fingers extended. Holding the described position, the performer should stand as tall as possible on the toes so that the height of the extended middle finger of the raised arm touching the board can be recorded. Chalk dust is then placed on the middle finger, and the
performer adopts a full squat position with head and back erect and body in balance. The performer is then asked to jump as high as possible, using only the legs and to touch the board at the top of the jump. The tester should record the height of the ‘chalk mark’ on the jump board. Each performer is allowed three trials.

**Scoring**

The subject’s score was recorded in meters using the measure of the best jump, difference between the reaching height and jumping height. Vertical power was calculated by using the following formula *(Johnson and Nelson, 1988)*.

\[ \text{Vertical power} = \frac{\text{Distance} \times \text{Body weight}}{\text{Gravity}} \]

**3. Standing Broad Jump Test**

**Objective**

To measure the horizontal power

**Equipment and Materials**

A 15 meter measuring tape to measure the distance, jumping pit and a take-off board.

**Directions**

The subjects were asked to stand without crossing the take-off board with the feet parallel to each other. They have to swings their arms, bends the knees and jump as far forward as possible.
Scoring

The jumping distance is measured from the outer edge of the take-off board to the nearest landing mark made by the jumper. Three trials were permitted, and the best was recorded as the score. Horizontal power was calculated by using the following formula (Johnson and Nelson, 1988).

\[
\text{Horizontal power} = \frac{\text{Distance} \times \text{Body weight}}{\text{Gravity}}
\]

4. Leg Strength Test

Objective

To measure the leg strength.

Equipment

Leg dynamometer.

Directions

The subject stands on the dynamometer base with feet parallel and about six inches apart. The malleoli of the ankle joint should be as nearly opposite to the attachment of chain of the dynamometer to its base as possible. The subject stands with head erect, back straight and fingers extending down the thighs. The examiner holds the bar at the top of the subject’s fingers to obtain proper adjustment. The bar is then connected to the chain.
The subject held the centre of the bar palms, down at the level of the pubic bone with head up and back straight with a bend at the knees. The handle was hooked on to the chain so that the subject’s knees were fixed between 115 and 125 degrees. The subject was asked to lift the bar straight up. After the completion of the lift, the subject’s knee joints were almost completely extended to ensure maximum effort (Johnson and Nelson, 1988).

**Scoring**

Three trials were permitted, and the best was recorded as the score.

5. **Margaria-Kalamen Anaerobic Power Test**

**Objective**

To assess the maximum anaerobic power.

**Equipment**

1. A firm fifteen-step staircase

2. Stop watch

**Directions**

The subjects from six meters in front of the staircase ran up the stairs as rapidly as possible, taking three steps at a time. The stopwatch was started as the person stepped on the third step and
the watch was stopped as he stepped on the ninth step. Time was recorded to one hundredth of a second.

**Scoring**

Six trials were given to each subject and the best of the three trials was considered for computing anaerobic power. Power was calculated by using the following formula (Fox and Mathews, 1989).

\[
P = \frac{W \times D}{t}
\]

Where P = Power

W = Weight of the subject in Kilo grams

D = Vertical distance between the third and ninth steps

T = Time taken between the third and the ninth steps in seconds.

**6. Bunny Hops Test**

**Purpose**

To measure elastic power

**Equipment**

Measuring tape.
Procedure

The procedure prescribed by (Seagrave, 1996) was employed to measure elastic power. The subject took position on the take off line. When the subjects completed the five stride bounding (Bunny Hops), the performance was measured from the nearest break to the takeoff line. Three trials were given.

Scoring

The best of the three trials was recorded in meters.

7. Shuttle Run Test

Objective

To measure the agility

Equipment and Materials

Measuring tape, stop-watch and two blocks of wood (2"×2"×4")

Directions

From the starting line two wooden blocks were placed 30 feet away. The subject is asked to stand behind the starting line and on the signal "go" the subjects ran to the blocks, picked up one, returned to the starting line, and placed the block behind the starting
line and then repeated the process with the second block. Adequate rest was allowed between the two trials.

**Scoring**

The score for each subject was the elapsed time which was recorded to the nearest tenth of a second. The best trial score is recorded. *(Johnson and Nelson, 1988).*

**EXPERIMENTAL DESIGN**

The experimental design used for this study was similar to a random group design involving sixty subjects, who were divided at random into four groups of fifteen each. This study consisted of three experimental groups: combined, high force and high power weight training. Among the four selected groups, group I underwent combined weight training, Group II underwent high force weight training, Group III underwent high power weight training and Group IV acted as control group. All the subjects were tested prior to and after the experimentation on speed, vertical power, horizontal power, leg strength, anaerobic power, elastic power and agility.

**STATISTICAL TECHNIQUE**

**Part I**

The data collected from the four groups before and after the experimental period were statistically examined for significant improvement by dependent 't' test. No attempt was made to equate
the groups in any manner. Hence, to make adjustments for difference in the initial means and test the adjusted posttest means for significant differences, the analysis of covariance (ANCOVA) was used. Whenever the 'F' ratio was found to be significant, Scheffe’s test was used as post hoc test to determine which of the paired means differed significantly.

**Part II**

Principle component analysis was applied to select minimum number of factors, which could bring together the variables of similar characteristics of the combined, high force and high power weight training.

In all cases the criterion for statistical significance was set at 0.05 level of confidence (P<0.05).