CHAPTER - III

METHODOLOGY
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Methodology

Research methodology involves the systematic procedure by which the researcher starts from the initial identification of the problem to its final conclusion. The role of the methodology is to carry out the research work in a scientific and valid manner.

The purpose of this study was to investigate the relative effects of jump rope training, running ABC and stick drill training followed by speed training on speed parameters. This chapter discusses the methodology that was used in the study. It describes in detail about the selection of participants, selection of variables, selection of tests, orientation to the participants, competence of the tester, reliability of the instruments, reliability of the data, pilot study, training programme, collection of the data, administration of the tests, experimental design and statistical techniques were presented.

Selection of Participants

The participants of this study comprised of sixty male (n=60) students from Dr. Sivanthi Aditanar College of Physical Education, Tiruchendur, India, during the academic year 2006/2007.
The selected participants were randomly (Simple Random Sample) assigned to one of four groups of fifteen (n=15) each, such as three experimental groups and a control group. The Group A (n=15) underwent jump rope training followed by speed training, Group B (n=15) underwent running ABC followed by speed training, and Group C (n=15) underwent stick drill training followed by speed training for a duration of 12 weeks and the number of sessions per week was confined to three alternative days, in addition to the regular schedule of the college and Group D (n=15) acted as control, who was asked to refrain from any special training except their leisure time pursuit as college students. Members of these groups will consist of healthy males who have no previous background or structured training in jump rope, running ABC and stick drill. Prior to enrollment in the study, Participants were informed of all possible risks involved in this study, and signed an informed consent form previously. Informed consent form were presented in Appendix A. Characteristics of participants in the four groups for age, height and weight were presented in Table 3.1. Individual data are presented in Appendix B.

Table 3.1
Participant’s Characteristics by Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Age (yr)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jump Rope</td>
<td>15</td>
<td>22.3 ± 1.6</td>
<td>176.5 ± 5.2</td>
<td>67.6 ± 4.1</td>
</tr>
<tr>
<td>Running ABC</td>
<td>15</td>
<td>22.1 ± 1.8</td>
<td>172.9 ± 2.9</td>
<td>65.5 ± 4.2</td>
</tr>
<tr>
<td>Stick Drill</td>
<td>15</td>
<td>22.7 ± 1.8</td>
<td>176.7 ± 4.8</td>
<td>66.6 ± 4.3</td>
</tr>
<tr>
<td>Control</td>
<td>15</td>
<td>22.8 ± 0.9</td>
<td>173.8 ± 2.8</td>
<td>67.1 ± 2.1</td>
</tr>
</tbody>
</table>

Values are given as mean ± SD.
Selection of Variables

Dependent variables

Acceleration is the phase of sprint races where the kinematics parameters of the stride are changing most dynamically. The acceleration phase is one of the most complex elements of the development of running velocity (Coh and Tomazin, 2006). Initial rate of acceleration is determined by the body’s maximum anaerobic power, which is expressed by the speed of energy generation per unit of time, in the anaerobic-alactacid process (Verkhoshansky, 1996).

In running, stride frequency times stride length determines the speed of movement. An athlete who wants to improve their personal record at any distance has no choice: they must do something to improve the product of the two elements (Incalza, 2007). The importance of stride length and stride frequency to the velocity curve of the 100 meters is well documented in the sports science literature (Mackala, 2007).

The greater the angle through which the limbs move (that is, the range of motion), the greater the stride length. Thus, the limiting factor of maximal running velocity in humans may be their range of motion at the hip joint, which will be influenced by both hip extension and hip flexion (Karp, 2006).

The sprinter has to react quickly (reflex speed), accelerate as fast and for as long as possible (power), reach the highest possible running speed (maximum velocity), maintain this for as long as possible (maximum speed
endurance) and minimize the lose of velocity caused by fatigue (sub-maximal speed endurance) (Letzelter, 2006).

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

1. Acceleration
2. Speed
3. Stride length
4. Stride frequency
5. Mobility
6. Explosive power (vertical)
7. Explosive power (horizontal)
8. Speed endurance

**Independent variables**

Training principles are generally called a guideline and are only meant as an orientation basis for training (Zawieja-Koch, 2005). Of all human skills, speed is the hardest and most difficult to improve when compared to other factors such as strength and endurance. For this reason many attempts have been made by coaches during the last 50 years to invent new training methods, in order to improve the speed of their athletes. These attempts have led coaches to include running in either more difficult or much easier conditions than those faced by the sprinter in track competitions (Saraslanidis, 2000).

The specific speed depends on a variety of factors, but the best way to improve speed is to increase the percentage use of the aerobic energy supply.
This can be achieved, not only through an increase of the maximum oxygen uptake (the traditional method), but also through the use of specific training methods to develop the oxidative capacity of the muscles (Verkhoshansky, 1996).

Rope jumping is considered a total body movement that can apply to almost any sport. Rope jumping as a training activity draws on nearly every muscle in the body. The reinforcement of the universal athletic position through rope jumping also increases the athlete’s ability to react and accurate changes in direction. Ongoing adjustments also increase an athlete’s capacity for streamlined and efficient movements (Lee, 2003).

Speed is developed through running drills, acceleration, down-hill runs and crouch starts (Shuravetzky, 1995). Running is an activity that is governed by certain dynamics, which are amenable to mathematical description. Furthermore the output, namely the performance, can be quantified, in terms of time, distance, speed and acceleration (Prendergast, 2001).

Practice specific running drills throughout the years that correspond with the recorded EMG muscles activity during sprinting. Running drills training are an effective way to condition and train the stretch shortening cycle of the specific muscle groups involved in sprinting. Running drills also provide the coach with a method of iso-lating and correcting technical faults in the athletes sprinting action (Heynen, 2001).
The athlete starts from a three-point stance and runs the intervals at full speed. The objective is to experience the lengthening of the stride length as the momentum builds and the speed increases. Running speed is the product of stride length and stride frequency. Athletes achieve their maximum speed only by adopting a specific ratio between length and frequency of stride and any significant alteration in the length or frequency will cause a reduction in speed (Donati, 1995).

The primary training emphasis the change from day to day, some attention will be given regularly to each of these components. However, one specific training target will require emphasis on a daily basis (Seagrave, 1996). The following independent variables were selected for this study along with speed training.

1. Jump rope training
2. Running ABC
3. Stick drill training

Selection of Tests

As per the available literature the following standardized test were used to collect the relevant data on the selected dependent variables and they were presented in Table 3.2.
Table 3.2
Tests Selection

<table>
<thead>
<tr>
<th>Criterion Variables</th>
<th>Test Items</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration</td>
<td>30 meters run</td>
<td>In 1/10 seconds</td>
</tr>
<tr>
<td>Speed</td>
<td>50 meters run</td>
<td>In 1/10 seconds</td>
</tr>
<tr>
<td>Stride Length</td>
<td>50 meters run</td>
<td>In centimeters</td>
</tr>
<tr>
<td>Stride Frequency</td>
<td>50 meters run</td>
<td>In numbers</td>
</tr>
<tr>
<td>Mobility</td>
<td>Sit and reach test</td>
<td>In centimeters</td>
</tr>
<tr>
<td>Explosive Power (Vertical)</td>
<td>Vertical jump test</td>
<td>In centimeters</td>
</tr>
<tr>
<td>Explosive Power (Horizontal)</td>
<td>Standing broad jump</td>
<td>In centimeters</td>
</tr>
<tr>
<td>Speed Endurance</td>
<td>150 meters run</td>
<td>In 1/10 seconds</td>
</tr>
</tbody>
</table>

Orientation to the Participants

The investigator explained the purpose of the study to the participants and their part in the study. For the collection of the data, the investigator explained the procedure of testing on selected dependent variables and gave instructions about the procedure to be adopted by them. Five sessions were spent to familiarize the participants with the technique involved to execute the jump rope training, running ABC training and stick drill training. It helped them to perform the jump rope training, running ABC training and stick drill 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 participants of all the groups were sufficiently motivated to perform their maximal level during training and testing periods.
Competency of the Tester

All the measurement in this study was taken by the investigator with the assistance of students from Dr. Sivanthi Aditanar College of Physical Education, Tiruchendur. To ensure that the investigator and his assistants were well versed with the techniques 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 method.

Reliability of the Instruments

Instruments used for this study were stopwatches, measuring tapes, sit and reach box and vertical jump board and were availed from Dr. Sivanthi Aditanar College of Physical Education, Tiruchendur, Tamilnadu, India. The instruments were purchased from reliable and standardized companies and were considered accurate enough to serve for the purpose of the study.

Reliability of the Data

Test and retest method was followed in order to establish the reliability of the data by using ten participants at random. All the dependent variables selected in the present study were tested twice by the same personnel under similar conditions. The intra class co-efficient of correlation was used to find out the reliability of the data and the results are presented in Table 3.3.
Table 3.3
Intra Class Co-Efficient of Correlation on Selected Dependent Variables

<table>
<thead>
<tr>
<th>Test (Variables)</th>
<th>‘R’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 meters run (Acceleration)</td>
<td>0.89*</td>
</tr>
<tr>
<td>50 meters run (Speed)</td>
<td>0.86*</td>
</tr>
<tr>
<td>50 meters run (Stride Length)</td>
<td>0.86*</td>
</tr>
<tr>
<td>50 meters run (Stride Frequency)</td>
<td>0.87*</td>
</tr>
<tr>
<td>Sit and reach test (Mobility)</td>
<td>0.87*</td>
</tr>
<tr>
<td>Vertical jump test (Vertical Power)</td>
<td>0.91*</td>
</tr>
<tr>
<td>Standing broad jump (Horizontal Power)</td>
<td>0.90*</td>
</tr>
<tr>
<td>150 meters run (Speed Endurance)</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 with df 9 is 0.77)

Since, the obtained ‘R’ values on selected criterion variables were much higher than the required value, the data were accepted as reliable in terms of instruments, testers and the participants.

**Pilot Study**

Prior to the formal study sessions, a pilot study was conducted to validate research procedure and the initial capacity of the participants to fix the load and also to design the training programme. For the purpose, fifteen participants (n=15) were selected as random, and they were divided into three groups of five participants each. Group A (n=5) underwent jump rope training followed by speed training, Group B (n=5) underwent running ABC followed by speed training, and Group C (n=5) underwent stick drill training followed by speed training for five sessions under the watchful eyes of the investigator. The initial loads of the participants were fixed and the training programme for
jump rope training, running ABC and stick drill training were designed separately based on the performance in the pilot study. 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 considered.

Training Programme

During the training period, the experimental groups underwent their respective training programmes in addition to their regular programme. Group A (n=15) underwent jump rope training followed by speed training, Group B (n=15) underwent running ABC followed by speed training and Group C (n=15) underwent stick drill training followed by speed training for three alternative days per week for 12 weeks.

The duration of training session in all days was between one hour to one and half hour approximately which included warming up and limbering down. Group D (n=15) acted as control they did not participated in any specific training on par with experimental groups. All the participants 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 with any injuries. However, muscle soreness appeared in the earlier period of the training programme and was reduced in due course.
The training programme was scheduled for the morning between 6.00 am and 7.30 am, three alternative days a week for 12 weeks. The detailed training programme for the twelve weeks was presented in the Appendix E.

**Collection of the Data**

The data on acceleration was collected by administrating 30 meters run. Speed, Stride length, and stride frequency were collected by administering 50 meters run. Mobility, was collected by administrating by sit and reach test. Explosive power (vertical and horizontal) were collected by administrating by vertical jump test and standing broad jump. Speed endurance was collected by administrating by 150 meters run respectively. The pre and post tests data were collected on selected criterion variables prior to and immediately after the training programme. In both the cases the tests were administered in two consecutive days in the evening sessions. On first day, acceleration, speed, stride length, and stride frequency was tested. On second day, mobility, explosive power (vertical and horizontal), and speed endurance was tested.

**Administration of the Tests**

1. **Acceleration (30 meters run)**

**Purpose**

To measure the acceleration efficiency of the participants.

**Facilities and Equipments**

Test course, electronic stopwatch, scorecards, and a starting clapper.
Procedure

The participants were allowed to run fast about 50 meters to measure speed, the measurement of the flying 30 meters time was assessed, i.e., the time taken to cover the distance of 30 meters between the 20th meters and the 50th meters line mark from the starting line of the test course.

Scoring

The acceleration efficiency was calculated by subtracting the flying 30 meters time from the 50 meters standing start time. The calculated time was rounded-off to one-tenth of a second (Seagrave, 1996).

2. Speed (50 meters run)

Purpose

To measure the speed of the participants.

Facilities and Equipments

Smooth surface, test course, scorecards, electronic stopwatch, and a starting clapper.
**Procedure**

The participants 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 participant ran as fast as possible across the finish line. The watch was stopped when the participant 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. Stride Length (50 meters run)**

**Purpose**

The purpose of this test was to measure the stride length of the participants.
Facilities and Equipment

Test course on the track, sawdust, scorecards, and a standard measuring tape was used.

**TEST COURSE**

Start 50 Meters Finish

20 Meters Δ 30 Meters

ACCELERATION ZONE TEST ZONE

Procedure

The participant were allowed to run fast about 50 meters to measure speed, the measurement of the length of stride was taken in the test course, which consists of an acceleration zone of 20 meters and the test zone of 30 meters (between 20th to 50th meters). The participant used the acceleration zone to gain maximum speed through the 30 meters test course. A light coating of sawdust was spread over the test zone that highlighted the footprints. Stride length was the distance from the tip of the rear toe to the tip of the front toe was recorded to the nearest centimeters. To avoid the bilateral discrepancies two successive strides were measured to the nearest centimeter (Seagrave, 1996).

Scoring

The average of two successive strides of the participant was recorded in centimeter as the individual score.
4. Stride Frequency (50 meters run)

Purpose

The purpose of this test was to measure the stride frequency of the participants.

Facilities and Equipment

Test course on the track, sawdust, standard measuring tape, scorecards, and electronic stopwatch was used.

**TEST COURSE**

![Test Course Diagram]

Start 50 Meters Finish

20 Meters \( \Delta \) 30 Meters ACCELERATION ZONE TEST ZONE

Procedure

The participant were allowed to run fast about 50 meters to measure speed, the measurement of the stride frequency was taken in the test zone of 30 meters (between 20\(^{th}\) to 50\(^{th}\) meters). The time elapsed for five right/left foot contacts of the participant after the initial supporting phase in the test zone. Thus, recording the time taken for ten strides (Seagrave, 1996).
Scoring

Dividing the number of strides (10) taken by the time recorded given the number of strides ran in one-second.

5. Mobility (Sit and reach test)

Purpose

The purpose of this test was used to measure the low back- hamstring area.

Facilities and Equipment

Adequate floor space, a specially constructed box with a measuring scale in which 23 cm was set at the level of the feet and scorecards.

Procedure

The participant must remove their shoes to be tested. To begin the test, the participant sat in front of the test apparatus with feet flat against the end board. The knees should be fully extended and the feet shoulder width apart. To perform the test, the participant extended the arms forward with one hand placed on top of the other.

In the actual test the participant reached forward, palms down, along the measuring scale of the testing apparatus. The reach is repeated three consecutive times, and on the fourth trial, the maximum reach was held for one second. The distance of the maximum reach was recorded as the test score.
Scoring

The score measured to the nearest centimeters, the most distant point reached on the fourth trail. The fingertips of both hands should reach this point. If the reach of the two hands was uneven, the test should be re-administered (Safrit, 1990).

6. Explosive Power (Vertical jump test)

Purpose

To measure the vertical jump ability of the participants.

Facilities and Equipments

Measuring board marked in centimeters attached to wall, chalk powder, damp cloth or duster, yardstick, and scorecards.

Procedure

For vertical jump, the participant stands with the dominate arm extended, holding a piece of chalk to mark the wall. The feet are flat on the floor. The participant should reach as high as possible, making a mark on the measuring board. Then a preparatory position should be taken for the jump, which was a squat position with the feet still flat on the floor. The participant should jump as high as possible, touching the board again with the chalk at the height of the jump. Three trials were taken.
Scoring

For each trial, the score was the distance between the two chalk marks, measured to the nearest centimeters. The test score was the best trial score (Safrit, 1990).

7. Explosive Power (Standing broad jump)

Purpose

To measures the horizontal distance of the participants.

Facilities and Equipments

Out door jumping pit, restraining line, scorecards, and a measuring tape.

Procedure

In starting position, the participant stands behind the restraining line. The toes must not touch the line, and the feet were several inches apart. Although any preliminary motions may be made as long as the feet are not moved, usually the participant dips the body several times, swinging the arms backward with one dip and forward with the next. On the actual jump, the arms swing forward at the same time and land at the same time. The object of the test was to jump as far as possible.

Scoring

Record the best of three trails to the nearest centimeters. Measure the perpendicular distance from the restraining line to the heel or other body parts that touches the floor nearest the takeoff line (Safrit, 1990).
8. Speed Endurance (150 meters run)

Purpose

To measures the speed endurance of the participants.

Facilities and Equipments

An area on 400 meters track with 200 meters starting point and 50 meters behind the finish line as a finishing point, with the distance of 150 meters running course, electronic stopwatch, scorecards, and clapper.

Procedure

After a short warm-up period, the participants took standing start position behind the starting line. To obtain better result, two participants ran at the same time. The time elapsed from the ‘clap’ to the runner crossing the finishing line was taken as test score. The fractions were rounded to the next largest one tenth of a second. For this purpose digital electronic stopwatches were used. Two trials were conducted with sufficient rest in between and the better of the two trials were recorded.

Scoring

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

Experimental Design

This study was conducted to determine possible cause and effect relationship of 12 weeks jump rope training, running ABC and stick drill
training followed by speed training program on the effects of speed parameters in healthy collegiate males. A pre and post test randomized design was employed for this investigation. This study consisted of three experimental groups, Group A (n=15) underwent jump rope training followed by speed training, Group B (n=15) underwent running ABC training followed by speed training, Group C (n=15) underwent stick drill training followed by speed training, and Group D (n=15) acted as control group. All the participants were tested prior to and after the experimentation on acceleration, speed, stride length, stride frequency, mobility, explosive power (vertical and horizontal), and speed endurance.

**Statistical Technique**

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 (Broota, 1989). The scheffe's test was used as post-hoc test to determine which of the paired means differed significantly where the differences in adjusted posttest means resided in univariate ANCOVA among four groups. All of the statistical analysis tests were computed at 0.05 level of significance (P<0.05).

**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), the linear relationship between the covariates and the dependent variables and the homogeneity of regression slopes were examined.

Levene’s test of equality of error variances on selected variables was calculated and presented in table 3.4.
Table 3.4
Levene's Test of Equality of Error Variances on Selected Variables among Groups

<table>
<thead>
<tr>
<th>Variables</th>
<th>F- Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration</td>
<td>0.19</td>
</tr>
<tr>
<td>Speed</td>
<td>1.83</td>
</tr>
<tr>
<td>Stride Length</td>
<td>1.56</td>
</tr>
<tr>
<td>Stride Frequency</td>
<td>1.77</td>
</tr>
<tr>
<td>Mobility</td>
<td>2.50</td>
</tr>
<tr>
<td>Explosive Power (Vertical)</td>
<td>1.71</td>
</tr>
<tr>
<td>Explosive Power (Horizontal)</td>
<td>0.70</td>
</tr>
<tr>
<td>Speed Endurance</td>
<td>2.29</td>
</tr>
</tbody>
</table>

(The table value required for 0.05 level of significance with df 3 & 56 is 2.78).

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 four groups regardless of the ability level for each of the dependent variables indicated that homogeneity of variance has been met for all the eight 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 analysed and presented in table 3.5.
Table 3.5
Testing the Significance of the Regression of Posttest on Pretest of Selected Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration</td>
<td>Due to Regression</td>
<td>0.08</td>
<td>1</td>
<td>0.08</td>
<td>4.37*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1.06</td>
<td>58</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>Due to Regression</td>
<td>0.56</td>
<td>1</td>
<td>0.56</td>
<td>18.09*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1.80</td>
<td>58</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Stride Length</td>
<td>Due to Regression</td>
<td>159.87</td>
<td>1</td>
<td>159.87</td>
<td>4.42*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>2100.31</td>
<td>58</td>
<td>36.21</td>
<td></td>
</tr>
<tr>
<td>Stride Frequency</td>
<td>Due to Regression</td>
<td>0.16</td>
<td>1</td>
<td>0.16</td>
<td>5.72*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1.66</td>
<td>58</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Mobility</td>
<td>Due to Regression</td>
<td>15.41</td>
<td>1</td>
<td>15.41</td>
<td>6.30*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>141.92</td>
<td>58</td>
<td>2.45</td>
<td></td>
</tr>
<tr>
<td>Explosive Power (Vertical Jump)</td>
<td>Due to Regression</td>
<td>639.48</td>
<td>1</td>
<td>639.48</td>
<td>155.89*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>237.92</td>
<td>58</td>
<td>4.10</td>
<td></td>
</tr>
<tr>
<td>Explosive Power (Horizontal Jump)</td>
<td>Due to Regression</td>
<td>509.60</td>
<td>1</td>
<td>509.60</td>
<td>23.27*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1270.05</td>
<td>58</td>
<td>21.90</td>
<td></td>
</tr>
<tr>
<td>Speed Endurance</td>
<td>Due to Regression</td>
<td>0.61</td>
<td>1</td>
<td>0.61</td>
<td>4.93*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>7.14</td>
<td>58</td>
<td>0.12</td>
<td></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 4.0)

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.
The interaction terms was calculated to test the assumption of homogeneity of regression slopes and presented in table 3.6.

**Table 3.6**

*Interaction Term on Selected Variables of Groups and Pre Test*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration</td>
<td>Group * Pre Test</td>
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<td>0.01</td>
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<td>52</td>
<td>0.01</td>
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<tr>
<td>Speed</td>
<td>Group * Pre Test</td>
<td>0.05</td>
<td>3</td>
<td>0.02</td>
<td>0.62</td>
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<tr>
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<td>Error</td>
<td>1.27</td>
<td>52</td>
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<td>Stride Length</td>
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<td>590.34</td>
<td>52</td>
<td>11.35</td>
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<td>Stride Frequency</td>
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<td>0.02</td>
<td>1.82</td>
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<tr>
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<td>52</td>
<td>0.01</td>
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<td>Mobility</td>
<td>Group * Pre Test</td>
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<td>0.31</td>
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<td>41.91</td>
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<td>Explosive Power (Vertical)</td>
<td>Group * Pre Test</td>
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<td>1.65</td>
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</tr>
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</table>

(The table value required for 0.05 level of significance with df 3 & 52 is 2.79)

The table 3.6 shows that the interaction F-ratio of the covariate by dependent variables interaction (Group x Pre test), effect was not significant.
then the assumption of homogeneity of regression slopes has not been broken, therefore the assumption was met.

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 eight dependent variables are reported in chapter four.