Chapter III

METHODOLOGY

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

In this chapter, procedures and methods were applied in selection of participants, selection of variables, selection of test, competency of the tester, reliability of instruments, reliability of the data, orientation to the participants, pilot study, training programme, collection of data, administration of the tests, experimental design, and statistical techniques.

Selection of Subjects

To achieve the purpose of the study, twenty four \((n=24)\) male Kho-Kho players were selected from the affiliated colleges of Manonmaniam Sundaranar University, Tirunelveli randomly as participants. The age of the participants was ranged from 21 to 25 years. The selected participants were divided into two groups
such as Group A underwent ladder training and Group B acted as control group.

**Selection of Variables**

Speed, agility, explosive power, flexibility, balance and coordination can play an important role in almost all games and sports. So, the speed, agility, flexibility, explosive power, balance and coordination were selected as dependent variables for this study.

Ladder training also helps in improving balance, muscle endurance, reaction time and coordination between the various parts of the body. Other than these physical benefits, agility ladder exercises also help in improving the nervous system and related muscle groups. Hence, Ladder training was selected as independent variables.

**Selection of Tests**

Discussing with the experts in the field, reviewing the literature and considering the feasibility especially from the point of view of availability of equipment and time factor the following measures were selected for the study and presented in Table I.
TABLE I
TESTS SELECTION

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Criterion Variables</th>
<th>Test Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Speed</td>
<td>50 M run</td>
<td>In seconds</td>
</tr>
<tr>
<td>2.</td>
<td>Agility</td>
<td>Illinois Agility Test</td>
<td>In seconds</td>
</tr>
<tr>
<td>3.</td>
<td>Flexibility</td>
<td>Sit and Reach</td>
<td>In centimetres</td>
</tr>
<tr>
<td>4.</td>
<td>Explosive Power</td>
<td>Vertical Jump</td>
<td>In centimeters</td>
</tr>
<tr>
<td>5.</td>
<td>Balance</td>
<td>Single leg Stroke Stand</td>
<td>In seconds</td>
</tr>
<tr>
<td>6.</td>
<td>Coordination</td>
<td>Coordination Test</td>
<td>In numbers</td>
</tr>
</tbody>
</table>

**Competency of the Tester**

All the measurements in this study were taken by the investigator. To ensure that the investigator is well versed with the technique of conducting tests he had a number of practice sessions in the correct testing procedure. The tester's reliability was established by test and re-test method.

**Instruments Reliability**

The measuring tape was used in this study were availed from the Department of Physical Education, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu. The instruments were purchased from reliable and standardized 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 the data by using ten participants at random. All the dependent variables selected in the present study were tested twice for the participants 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 were presented in Table II.

**TABLE II**

**INTRA CLASS CO-EFFICIENT OF CORRELATION ON SELECTED DEPENDENT 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>0.87*</td>
</tr>
<tr>
<td>2.</td>
<td>Agility</td>
<td>0.86*</td>
</tr>
<tr>
<td>3.</td>
<td>Flexibility</td>
<td>0.92*</td>
</tr>
<tr>
<td>4.</td>
<td>Explosive Power</td>
<td>0.90*</td>
</tr>
<tr>
<td>5.</td>
<td>Balance</td>
<td>0.91*</td>
</tr>
<tr>
<td>6.</td>
<td>Coordination</td>
<td>0.89*</td>
</tr>
</tbody>
</table>

*Significant at .01 level of confidence. (Table value required for significance at 0.01 level of confidence is 0.77).

Since the obtained ‘R’ values were higher than the required value, the data were accepted as reliable in terms of instruments, tester and the participants.
Orientation to the Participants

Before the collection of data, the participants were oriented about the purpose of the study and their part in this study. The investigator explained the procedure of testing the selected dependent variables. Five sessions were spent to familiarize the participants with the techniques involved in ladder training and testing procedures. The participants of the two groups were sufficiently motivated to perform their maximal level during training and testing periods.

Pilot Study

A pilot study was conducted to assess the initial capacity of the participants to fix the load, to select the exercises and to design the training programme. Ten men participants were selected at random for this purpose, and they were given ladder training under the watchful eyes of the investigator. 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 routine at the Department of Physical Education and Sports of Manonmaniam Sundaranar University, Tirunelveli. Group A underwent ladder training for three days per week for eight weeks. The duration of training session in all the days were between one hour to one and half hour approximately, which included warm-up and warm-down. Group B acted as control that did not participate in any specific training on par with experimental groups.

All the men 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.

Collection of Data

The data on selected dependent variables namely speed, agility, flexibility, explosive power, balance and coordination were collected by using standardized test items. Pre-test data were
collected two days before the training programme and post-test data were collected two days after the training programme. In both cases, the data were collected in two consecutive days. On the first day speed, flexibility and explosive power was conducted whereas balance, agility and coordination were conducted on the second day.

**Administration of the Tests**

1. **Speed (50 Meters Run)**

   **Purpose**

   To measure the speed of the subjects.

   **Facilities and Equipment**

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

   **TEST COURSE**
**Procedure**

The subject was taken to the starting position 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 subject ran as fast as possible across the finish line. The watch was stopped when the subject’s torso crossed the finish line. Best of two trials 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. Two trials were given and the best trial was taken for the final score.

**2. Agility (Illinois Agility Test)**

**Purpose**

To assess the agility of the participants.

**Equipments Used**

Stopwatch, measuring tape, cone, and score card.
Description

The length of the course is 10 meters and the width (distance between the start and finish points) is 5 meters. Four cones were used to mark the start, finish and the two turning points. Another four cones were placed down the center an equal distance apart. Each cone in the center is spaced 3.3 meters apart.

Procedure

Participants should lie on their front (head to the start line) and hands by their shoulders. On the 'Go' command the stopwatch is started, and the participants gets up as quickly as possible and runs around the course in the direction indicated.
Scoring

One trail was recorded without knocking the cones over, to the finish line, at which the timing is stopped.

3. **Flexibility (Sit and reach test)**

**Purpose**

To ensure the flexibility of the low back and posterior thigh.

**Equipment**

Sit and reach box, Scorecard and pencil

**Procedure**

The subject was asked to be bare foot and to begin the test, the subject sat in front of the test apparatus with feet flat against the end board. The knees were fully extended and the feet must be should width apart. To perform the test, the subject extended the arms forward with one hand placed on top of the other.

**Scoring**

Three trials were given and the distance of the maximum reach was recorded as the test score.
4. **Explosive power (Vertical jump test)**

**Purpose**

To measure the ability to exert maximum energy in one explosive act projecting the body through space

**Equipments**

The Sargent Jump Board, Chalk, Tape and Rope.

**Procedure**

The subject was asked to stand next to the concrete pillar with heels together on the floor on his dominant hand side holding a piece of chalk. The sargent board was fixed on the concrete pillar with 2 mts height. From this position the subject reached upward as high as possible and made a mark on the board. Once in the starting position, the subject was not allowed to move his feet, that is, to walk in or step in to the jump.

**Scoring**

The height of the jump was measured from the distance between the standing and the jumping heights. Measurement was taken to the nearest centimeter. Three trials were given and the best trial was taken as the final score.
5. Balance (Stork Stand)

Purpose

To measure the static balance of the performer while supported on the ball of the foot of the dominant leg.

Equipment and Materials

Stop watch with a second hand.

Procedure

From a stand on the foot of the dominant leg, place the other foot on the inside of supporting knee and place the hands on the hips. Upon a given signal, raise the heel from the floor and maintain the balance as possible without moving the ball of the foot from its initial position or letting the heel touch the floor.

Scoring

The score is the greatest number of seconds counted between the time the heel is raised and the balance is lost on three trails with the preferred foot. Only the highest score is recorded.

6. Coordination (Alternate Hand Wall Toss Test)

Purpose

To measure hand-eye coordination
**Equipment required**

Tennis ball or baseball, smooth and solid wall, marking tape, stopwatch (optional).

**Procedure**

A mark was placed a certain distance from the wall (3 feet). The subject was stood behind the line and facing the wall. The ball was thrown from one hand in an underarm action against the wall, and attempted to be caught with the opposite hand. The ball is then thrown back against the wall and caught with the initial hand. The test can continue for a nominated for a set time period (30 seconds).

**Scoring**

The score is measured from the number of successful catches in a 30 second period.

**Experimental Design and Statistical Procedure**

The pre test and post-test random group design was used as experimental design in which twenty four men participants were divided into two groups of twelve each at random. Group A underwent ladder training and Group B acted as control. The participants were tested on this selected criterion variables such as speed, agility, flexibility, explosive power, balance and
coordination prior to and immediately after the training programme.

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). 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 III.

**TABLE III**

**LEVENE’S TEST OF EQUALITY OF ERROR VARIANCES ON SELECTED VARIABLES AMONG GROUPS**

<table>
<thead>
<tr>
<th>Variables</th>
<th>F- Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>0.136</td>
</tr>
<tr>
<td>Agility</td>
<td>0.683</td>
</tr>
<tr>
<td>Flexibility</td>
<td>0.216</td>
</tr>
<tr>
<td>Explosive Power</td>
<td>0.097</td>
</tr>
<tr>
<td>Balance</td>
<td>0.629</td>
</tr>
<tr>
<td>Coordination</td>
<td>0.294</td>
</tr>
</tbody>
</table>

(The table value required for 0.05 level of significance with df 1 & 22 is 4.30).

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 two groups regardless of the ability level for each of the dependent variables indicated that homogeneity of variance has been met for all the six dependent variables. Hence it was concluded that the assumption of homogeneity of variance has been met for computing univariate ANCOVA.

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

**TABLE IV**

**INTERACTION TERM ON SELECTED VARIABLES OF GROUPS AND PRE TEST**

<table>
<thead>
<tr>
<th>Variables</th>
<th>F- Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>0.023</td>
</tr>
<tr>
<td>Agility</td>
<td>2.193</td>
</tr>
<tr>
<td>Flexibility</td>
<td>0.616</td>
</tr>
<tr>
<td>Explosive Power</td>
<td>1.488</td>
</tr>
<tr>
<td>Balance</td>
<td>0.241</td>
</tr>
<tr>
<td>Coordination</td>
<td>0.136</td>
</tr>
</tbody>
</table>

(The table value required for 0.05 level of significance with df 1 & 20 is 4.35)
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 six dependent variables are reported in chapter four.