Chapter III

PROCEDURE

In this chapter the procedure adapted for the selection of subjects, selection of variables, criterion measures, reliability of data, administration of test and collection of data, design of the study and the statistical techniques used for analyzing the data have been described.

Selection of Subjects

One hundred twenty male Kho-kho players from various colleges affiliated to Delhi University, Delhi and Choudhary Charan Singh University, Meerut, who had participated in the Intercollegiate Kho-kho Tournament in 2001-2002 were selected as subjects for this study. The average age of subjects was 21 years ranging from 19 to 24 years.

To ensure maximum co-operation from the subjects, the research scholar had a meeting with the subjects and lecturers of physical education working in different colleges. The purpose of the study was clearly explained to them in order to ensure that there was no ambiguity among the subjects regarding the requirements and effort they had to put
in the successful completion of the project. All the subjects voluntarily agreed to take part in the study and assured fullest cooperation.

**Selection of Variables**

The selection of variables was done by using the following criteria:

The research scholar gleaned through the scientific literature pertaining to the cross sectional analysis of physical and physiological variables from different library sources available at the library of the Lakshmibai National Institute of Physical Education, Gwalior and also consulted experts in these areas to select the physical and physiological variables with regard to the purpose of the study. Along with the said literature and expert opinion, the administrative feasibility in terms of availability of instruments and expertise for measuring and recording of data was also given due consideration while selecting physical and physiological variables.

Based on the above mentioned criteria the following variables were selected.
Physical Variables

1. Speed (50 mts. Dash)
2. Agility (Shuttle Run)
3. Agility (Squat Thrust)
4. Endurance (12 Minutes Run)
5. Shoulder Flexibility (Arm Rotation)
6. Trunk Flexibility (Sit and Reach)
7. Dynamic Balance (Modified Bass Dynamic Test)
8. Power (Standing Broad Jump)
9. Power (Vertical Jump)
10. Reaction Time (Nelson Hand Reaction Test)

Physiological Variables

1. Resting Heart Rate
2. Systolic Blood Pressure
3. Diastolic Blood Pressure
4. Vital Capacity
5. Total Fat Percentage
6. Respiratory Rate

7. Hemoglobin

**Criterion Measures**

Kho-kho performance was subjectively evaluated by three Kho-kho experts. These expert possessed 'A' grade certificate from Kho-kho Federation of India.

1. Speed was recorded to the nearest 1/10th of a second using 50 mts. Dash.

2. Agility was recorded using 4x10 meters shuttle run and squat thrust test. The scores were in 1/10 of a record in case of shuttle run and number of correctly executed squat thrusts in one minute.

3. Endurance was measured as the distance covered in meter in a period of twelve minutes recorded to the nearest 50 meters.

4. Distance between the hands recorded in centimeters after executing backward arms rotation measured the shoulder flexibility.

5. Forward bent of trunk from long sitting position was chosen to measure the flexion of trunk to the nearest quarter inch (Sit and Reach).
6. Power was measured by the distance jumped in centimeters in Sargent jump and standing broad jump.

7. Points scored out of hundred in performing Modified Bass Test of Dynamic Balance test was the measure of balance.

8. Number of heart beats per minute during resting condition was taken as resting heart rate.

9. Blood pressure (mm. of hg) was recorded in terms of the pressure exerted on the walls of the arteries during systolic and diastolic phase (systolic and diastolic pressure).

10. Vital capacity was recorded with help of wet spirometer nearest to one tenth of a liter.

11. The thickness of four sites (biceps, triceps subscapular, superailiac) was added and the sum was converted into fat percentage.

12. The number of breaths in one minute during resting condition was recorded as respiratory rate.

13. Hemoglobin was measured by the assessment of the blood sample by a qualified professional biochemist.
Reliability of Data

The reliability of data was ensured by establishing instruments reliability and tester competency.

Instrument Reliability

The stop watches used for recording time were properly calibrated and synchronized from the manufacture, that is Krishna Watch Company, Bombay. The sphygmomanometer (mercury column type) and stethoscope was used for measuring blood pressure and was supplied by Electro-Medical Company, Delhi. The reliability the instruments was ensured by the manufacture. The Skin-Fold Calipers used for measuring skinfolds of the subjects was insured from the reliability of the instrument. Therefore, all the instruments used for measuring performance of the subjects on different variables were reliable and precise enough for the collection of data needed for the study.

Tester Competency and Reliability of the Test

The tester competency was evaluated together with the reliability of tests. To determine the reliability of tests, the data on all the selected physical variables except reaction time were recorded twice under identical conditions by the scholar.
A Pearson's Product Moment Correlation was computed between the two measures of each variables and reliability co-efficient thus obtained here been shown in table 1.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Test Variable</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Speed (50 meters)</td>
<td>0.92</td>
</tr>
<tr>
<td>2.</td>
<td>Agility (Shuttle Run)</td>
<td>0.91</td>
</tr>
<tr>
<td>3.</td>
<td>Agility (Squat Thrust)</td>
<td>0.94</td>
</tr>
<tr>
<td>4.</td>
<td>Endurance (Twelve Minutes Run/Walk Test)</td>
<td>0.88</td>
</tr>
<tr>
<td>5.</td>
<td>Shoulder Flexibility (Arm Rotation)</td>
<td>0.93</td>
</tr>
<tr>
<td>6.</td>
<td>Trunk Flexibility (Sit &amp; Reach Test)</td>
<td>0.91</td>
</tr>
<tr>
<td>7.</td>
<td>Dynamic Balance (Modified Bass Dynamic Test)</td>
<td>0.87</td>
</tr>
<tr>
<td>8.</td>
<td>Power (Standing Broad Jump)</td>
<td>0.94</td>
</tr>
<tr>
<td>9.</td>
<td>Power (Vertical Jump)</td>
<td>0.92</td>
</tr>
<tr>
<td>10.</td>
<td>Reaction Time (Speed of Movement Test)</td>
<td>0.94</td>
</tr>
<tr>
<td>11.</td>
<td>Resting Heart Rate</td>
<td>0.98</td>
</tr>
<tr>
<td>12.</td>
<td>Systolic Blood Pressure</td>
<td>0.93</td>
</tr>
<tr>
<td>13.</td>
<td>Diastolic Blood Pressure</td>
<td>0.91</td>
</tr>
<tr>
<td>14.</td>
<td>Vital Capacity</td>
<td>0.90</td>
</tr>
<tr>
<td>15.</td>
<td>Total Fat Percentage</td>
<td>0.87</td>
</tr>
<tr>
<td>16.</td>
<td>Respiratory Rate</td>
<td>0.96</td>
</tr>
<tr>
<td>17.</td>
<td>Heamoglobin</td>
<td>0.95</td>
</tr>
</tbody>
</table>
Administration of Tests and Collection of Data

Speed

Objective

To measure the speed of the subjects.

Equipment and Marking

Stop watches, clappers and the distance was marked two parallel line of 5 meters each, 50 meters apart.

Scoring

The elapsed time from the starting signal "Until the runners tarso crossed the finish line was measured to the nearest one tenth of a second as a score.¹

Agility (Shuttle Run)

Objective

To measure agility of the subject.

Equipment and Marking

Stop watches, wooden blocks (2" x 2" x 4") and distance was marked with two parallel lines 10 yards apart.

¹Johnson and Nelson, Practical Measurement for Evaluation in Physical Education.p.20.
Procedure

The performers (two at a time) stood behind one of those lines which was starting and finish line. On signal "go" they ran fast, picked up one block returned to the starting line, turned run forward picked up the second block turned and ran through. Three trials were given after adequate rest.²

Scoring

The score of each performance was the best length of time required to complete the course.

Agility (Squat Thrust)

Objective

To measure agility of the subjects.

Equipment

Stopwatch.

Procedure

From standing position the subject flexed the knee and wrist and placed the hands on the floor in front of the feet. Then thrused the leg

²Ibid., p.215.
backward to front leaned position. From front leaning position he returned to the squat position and finally returned to standing position. On signal "go" the subject repeated all those movements in sequence as rapidly as possible in one minute. Two trials were given after sufficient rest.

**Scoring**

Number of correctly executed squat thrusts in one minute best out of two trials was considered as the score of the test.

**Endurance (Cooper's Twelve Minute Run/Walk Test)**

**Objective**

To measure the cardiorespiratory endurance.

**Equipment and Marking**

Whistle, a stopwatch and marks for dividing the total 200 meters course into four zones.

**Procedure**

The performers stood behind the starting line with an assigned spotter behind them. Upon getting the starting signal ran or walked as many laps as possible around the course within 12 minutes. The spotters
maintained a count of each lap, and when the signal to stop was given, they immediately ran to the spots at which their runners were at the instant the whistle was blown.

**Scoring**

The score in meters was determined by multiplying the number of completed laps with the distance of each lap plus the number of segments of an incomplete lap to the nearest 50 meters.³

**Shoulder Flexibility**

**Objective**

To measure the shoulder flexibility.

**Equipment**

Yard stick and ruler.

**Procedure**

The subject assumed prone position with arms straight and grasped the rulers about shoulder width apart. Then the subject raised the stick ruler upward as high as possible while keeping his chin on the floor and the elbows straight. The tester, then placed the yard stick vertically,

³ Ibid., p. 143.
touching the stick ruler, and the reading was recorded. Three trials were given.

**Scoring**

Best lift of the three trials was subtracted from arm length (the length between middle finger tips and acromion process).\(^4\)

**Trunk Flexibility (Sit and Reach Test)**

**Purpose**

To measure the trunk flexibility.

**Equipment**

Yards stick.

**Procedure**

The subject sat on the mat with feet placed in the foot prints and pressed firmly against the cross board. The arm were extending forward with the hands placed palms down on the upper surface of the scale. In this position, the subject bend forward four times and held the position of maximum reach on the fourth count. The knee remained straight. If the

\(^4\)Ibid., p. 186.
hands reached unevenly the hand reaching the shorter distance determined the score.\textsuperscript{5}

**Scoring**

The maximum distance reached, taken to the nearest half inch, was recorded as the score in the measure of trunk and hip flexibility.

**Dynamic Balance (Modified Bass Dynamic Test)**

**Objective**

To measure the dynamic balance.

**Equipment and Marking**

Stop watches, 3/4 inches marking tape and yard stick. The marking of the floor was done.

**Procedure**

The subject stood with right foot on the starting mark. The performer then leaped to the first tape mark with the left foot and tried to hold a steady position on the ball of his left foot for as many records as possible up to 5 seconds. He, then leaped to the second tape with right foot and so on, alternating the feet from tape to tape and tried to remain on

the ball at each tape for as many seconds as possible up to 5 second, with
the tape mark completely covered with the ball so that it could not be
seen.

**Scoring**

The score for each mark successfully landed was five points. In
addition, one point was awarded for each seconds the balance was held
upto five seconds per marks, thus performance could score 10 points per
mark or a total of 100 points for the test.\(^6\)

**Power (Vertical Jump)**

**Objective**

To measure vertical explosive power of the muscles of the legs
against the gravity.

**Equipment**

Metallic tape and chalk.

**Procedure**

The researcher marked the vertical distance on a smooth wall
available in the respective college complex. The metallic tape and chalk
was used to mark the distance in centimeters on the wall.

The subject was made to stand with his side towards the wall and reach as high as possible with heels on the floor. The subject was asked to swing his arms downward and backward assuming a crunched position with the knees bent at about a right angle. They tried to jump as high as possible, swinging the arms upward. As the highest point of the jump was reached another mark was made above the initial one with finger tips already dipped in chalk powder. The score was noted in nearest centimeter between the reach and jump marks.

**Scoring**

The best of three trials was scored.\(^7\)

**Power (Standing Broad Jump)**

**Objective**

To measure the explosive leg strength of the subject.

**Equipment and Marking**

A gymnastic single mat, a 10 meter measuring tape and a take off line was marked in front of the mat 50 centimeter away.

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Procedure

The subject stood behind the take off line with feet parallel to each other. The performer flexed his knees and took his arms backward, then with a vigorous forward swing of arms and extension of flexed knees he took off in one chance and jumped on the mat as for forward as possible. There trials were given after adequate rest.

Scoring

Best of the three trials in centimeters was considered as the performance of the subject in the test. ⁸

Reaction Time (Nelson Hand Reaction Test)

Objective

To measure the reaction time of subject.

Equipment and Marking

A 50 centimeter scale, with a concentration zone was marked at 20 cm. of the scale, chair and a table.

Procedure

The subject was asked to sit on a chair with his fore arm and hand resting on the table. The tips of thumb and index finger were held in a

ready to pinch position about 10 centimeters beyond the edge of the table. The upper edge of thumb and index finger was kept in a horizontal position. The scale was held near the top, keeping it between the subjects thumb and index finger with the base line ('O' cm. mark) even with the upper surface of the thumb. The subject was directed to look at the concentration zone (which was a black shaded zone about 20 cm. above the base line) and was told catch to the scale (by pinching the thumb and index finger) when it was released.

**Scoring**

When the subjects caught the scale, the score was read just above the upper edge of the thumb. The score of the test was the average of the five trials.

**Resting Heart Rate**

This test was chosen with purpose to measure pulse rate per minute in sitting position in a comfortable chair and a stopwatch was used to conduct this test.

The subject was asked to sit in a comfortable chair. The pulse rate was measured by lightly pressing the finger tips against the carotid artery in the neck and the pulse rate was counted for a duration of one minute.
Blood Pressure

(Systolic and Diastolic Blood Pressure)

This test was selected to measure the systolic and diastolic blood pressure of the subjects in reclining position with the help of conventional sphygmomanometer and a stethoscope.

This test was taken immediately after the pulse count test to ensure that the circulatory system had reached steady state. The cuff of the sphygmomanometer was wrapped around the base of the upper arm (above the elbow) and edge approximately one inch above the auricular space. The tester then fixed the earphones of the stethoscope in the ears and its drum was placed on the brachial artery just above the hollow part of the elbow. Then the air pressure was inflated into the cuff till the pulse sound disappeared. Than the pressure was gradually released till he heard the sound. The reading was recorded on the mercury column of the sphygmomanometer as the systolic blood pressure (mm. hg.) the air pressure was further released until a feeble and dull beat was noticed, at this point again the mercury column was red and recorded as the diastolic blood pressure (mm./hg.) of the subject.
Score

The systolic and diastolic blood pressure were recorded in millimeter of mercury (mm./hg.).

Vital Capacity

This test was selected with an aim of measuring the ability of the subject to inhale the maximum wind into the lungs. A wet spirometer was used to measure the vital capacity.

The subject stood near the table where wet spirometer was kept and drum of the same was filled with water. The subject was asked to take a deep breath and then he look the mouth piece into the mouth and released the breath into the rubber pipe which was attached with drum dipped in the water as a result of which the inner drum started rising and a chain was connected with it over pulley which had marking in cubic centimeters. The scholar took the reading from the pulley when it showed the maximum value. Each subject was given three consecutive trails.

Score

The best out of three trials was recorded as the score of the subject in cubic centimeters.
Fat Percentage (Skinfold Measurement)

**Purpose**

The purpose of the test was to measure the percentage of the body fat of the subjects.

**Equipment**

Skinfold caliper.

The right side of the body was used to determine the percentage of fat. The thickness of the skin and subcutaneous fat was grasped between the thumb and index finger and measurement was taken to the nearest millimeter and recorded.

**Biceps Skinfold**

With the subject standing erect with arm hanging loosely, a fold was picked up on the anterior of the mid part of biceps and the skinfold was vertical reading to the nearest half millimeter was recorded.

**Triceps Skinfold**

The skinfold of the triceps muscles of the subject was taken at the back of the upper arm at about one centimeter above the marked level as done in the case of measurement of the biceps region. The measurement
was taken directly in lines with the point of the olecranan process. The measurement was recorded in millimeter.

**Suprailiac Skinfold**

The skinfold of the subject was picked up approximately one centimeter above and one centimeters medial to the anterior superior iliac spine. The measurement was recorded in millimeters.

**Subscapular Skinfold**

The subject was asked to stand in relaxed position and skinfold was picked up just above top of inferior angle of scapula and measurement was taken with the help of skinfold caliper and recorded in millimeters.

The thickness of the four sites (Biceps Skinfold, Triceps Skinfold, Suprailiac Skinfold, Subscapular Skinfold) was added and sum was converted into fat using table given by Rehman.

**Respiratory Rate**

Respiratory rate was taken in resting state of the subjects, who were asked to lie in supine position on the mat. The respiratory rate was felt by placing the hand just below the thoracic cavity. The total number of exhalations per minute was recorded for each subject.
Hemoglobin

This test was chosen with a view to measure the hemoglobin contents present in the blood of the subjects. A hoemometer was used to measure the hemoglobin contents present in the blood.

The index finger of the subject was cleaned with the absolute alcohol. After that the finger was pricked by disposable needle and as the drop of the blood came out by pressing the fingers of the subject, the tester used a dry hemoglobin pipe, which was attached with a rubber pipe and its other end was kept in his mouth and through this pipe and its other end he kept in his mouth and through this pipe he sucked the blood upto 20 mark. The blood was then transferred into a test tube containing N/10 HLL about 6 ml. The blood was properly mixed in the solution after shaking the tube. The tube was kept in a stand for five minutes. The distilled water was then added drop by drop until the colour of the blood sample matched exactly with the colour of the stand. The volume of the sample after matching the colour indicated the result of the hemoglobin content present in the blood of the subjects.

Score

The hemoglobin contents found in the blood was recorded as gm/100 of blood as score of the subjects.
Dependent Variables

Kho-kho Playing Ability

To assess Kho-kho performance the technique of subjective evaluation was employed by three experts. The expert kept the following criteria to evaluation.

1. Ability to chase
2. Ability to run
3. Employment of fundamentals

The experts graded each subject out of 100 points. Average of three experts scores was taken as final scores for each subject.

Collection of Data

The data was collected from hundred and twenty subjects during September to December 2001. These were the four months during which intercollege tournaments and the coaching camps were held.

Data of 120 subjects collected during intercollege tournaments and coaching camps is presented in Appendix A.
Analysis of Data

The relationship between dependent variables (performance) and independent variables (physical and physiological) were established by computing Pearson Product Moment Correlation (zero order) and the combined effect or contribution of physical and physiological variables to Kho-kho performance was obtained through Multiple Correlation. Kho-kho performance was predicted from physical and physiological variables by utilizing regression equation. For testing the hypothesis the level of confidence was set at .05.