Chapter - III

PROCEDURE

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

SELECTION OF SUBJECTS

Forty five fast / medium pace bowlers, Forty five Spin bowlers & Forty five batsmen belonging to Chandigarh, Himachal Pardesh, Uttar Pardesh, Delhi, Punjab and Jammu & Kashmir were selected as subjects for this study. These cricketers have represented their state in under 16, under 19 and Ranji Trophy matches. The subjects had more on less close homogeneity in their training and living habits. They were undergoing regular training and coaching at their respective centers. The age of the subjects ranged from 16 to 24 years. Prior to the administration of tests, a meeting of all the subjects selected was called in each centre in which
their coaches were also present, along with the data collection team. In
the meeting the procedure of the test was well explained to the subjects.
All the subjects voluntarily agreed to co-operate with the scholar. The
subjects were found very enthusiastic and co-operative through out the
investigation. The detailed description of the subjects related to the study
is given in Table 1.

Table - 1

DESCRIPTION OF THE SUBJECTS

<table>
<thead>
<tr>
<th>Name of the State</th>
<th>Specialization</th>
<th>Number in each category</th>
<th>Number of Subjects</th>
<th>Batsmen (age range)</th>
<th>Fast Bowler (age range)</th>
<th>Spinner (age range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punjab</td>
<td>Batting</td>
<td>20</td>
<td>40</td>
<td>17-24</td>
<td>17-24</td>
<td>17-24</td>
</tr>
<tr>
<td></td>
<td>Fast Medium</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bowler Spinner</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.P</td>
<td>Batting</td>
<td>10</td>
<td>20</td>
<td>17-24</td>
<td>17-24</td>
<td>17-24</td>
</tr>
<tr>
<td></td>
<td>Fast Medium</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bowler Spinner</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delhi</td>
<td>Batting Fast</td>
<td>10</td>
<td>20</td>
<td>17-24</td>
<td>17-24</td>
<td>17-24</td>
</tr>
<tr>
<td></td>
<td>Medium Bowler</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spinner</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chandigarh</td>
<td>Batting</td>
<td>20</td>
<td>40</td>
<td>17-24</td>
<td>17-24</td>
<td>17-24</td>
</tr>
<tr>
<td></td>
<td>Fast Medium</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bowler Spinner</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.P</td>
<td>Batting</td>
<td>5</td>
<td>10</td>
<td>17-24</td>
<td>17-24</td>
<td>17-24</td>
</tr>
<tr>
<td></td>
<td>Fast Medium</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bowler Spinner</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J&amp;K</td>
<td>Batting</td>
<td>2</td>
<td>5</td>
<td>17-24</td>
<td>17-24</td>
<td>17-24</td>
</tr>
<tr>
<td></td>
<td>Fast Medium</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bowler Spinner</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SELECTION OF VARIABLES

The scholar carried out an intensive study of available literature and later after having a meeting with the experts and the guide; he selected the following anthrometric, physiological and physical variables which were considered to be the major factors contributing to the excellence in the game of cricket.

ANTHROPOMETRIC VARIABLES

1. Standing Height in centimeters
2. Weight in Kilograms
3. Percentage of body fat
4. Leg length in centimeters
5. Chest girth in centimeters
6. Thigh girth in centimeters
7. Calf girth in centimeters
8. Biceps girth in centimeters
9. Lean body weight
10. Ponderal Index
PHYSIOLOGICAL VARIABLES

1. Resting pulse-rate
2. Resting BP (Systolic)
3. Resting BP (Diastolic)
4. Hemoglobin
5. Vital Capacity
6. Anaerobic Power

PHYSICAL VARIABLES

1. 12 Min Run/Walk
2. Power of Leg-Extensors
3. Shoulder & Arms Strength (Explosive Strength)
4. Abdominal & Oblique (Strength Endurance)
5. Agility
6. Trunk Flexibility
7. Side Splits Test
8. Shoulder Flexibility
9. Shoulder & Arm (Strength Endurance)
10. 50 Mts. Dash
These tests were selected keeping in mind the administrative feasibility, availability and suitability with regard to the subject employed for the study.

**RELIABILITY OF DATA**

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

**INSTRUMENTS RELIABILITY**

The instruments used for the purpose of this study were supplied by recognized firms and were available in the research laboratory of Sports Authority of India, Netaji Subas, National Institute of Sports, Patiala and Sports Authority of India, Jawhar Lal Nehru, Stadium, New Delhi. In addition to the above, the instruments were being constantly used for collection of data on sports person and thus were being constantly maintained. Hence, all instruments used were considered as accurate for the purposeful of the study.
TESTER COMPETENCY

The research scholar had sufficient practice to collect the data on all the variables selected, under the supervision of the guide and experts available at Sports Authority of India, Netaji Subas, National Institute of Sports, Patiala and Sports Authority of India, Jawhar Lal Nehru, Stadium, New Delhi, Cricket Stadium, Chandigarh, Punjab Cricket Association, Mohali.

To determine tester competency as well as reliability of data, ten subjects from each group were selected at random. They were tested and re-tested after a gap of one day by the scholar. Pearson's Product Moment Correlation was computed between two measures of each variable separately and the co-efficient of correlation have been shown in Table 2.
TABLE-2

RELIABILITY OF ANTHROPOMETRIC, PHYSIOLOGICAL

AND PHYSICAL VARIABLES

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Test</th>
<th>Co-efficient of correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Standing Height in centimeters</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>Weight in Kilograms</td>
<td>1.00</td>
</tr>
<tr>
<td>3</td>
<td>Percentage of body fat</td>
<td>0.90</td>
</tr>
<tr>
<td>4</td>
<td>Leg length in centimeters</td>
<td>0.98</td>
</tr>
<tr>
<td>5</td>
<td>Chest girth in centimeters</td>
<td>0.98</td>
</tr>
<tr>
<td>6</td>
<td>Thigh girth in centimeters</td>
<td>0.99</td>
</tr>
<tr>
<td>7</td>
<td>Calf girth in centimeters</td>
<td>0.99</td>
</tr>
<tr>
<td>8</td>
<td>Biceps girth in centimeters</td>
<td>0.98</td>
</tr>
<tr>
<td>9</td>
<td>Lean body weight</td>
<td>0.90</td>
</tr>
<tr>
<td>10</td>
<td>Ponderal Index</td>
<td>1.00</td>
</tr>
<tr>
<td>11</td>
<td>Resting pulse-rate</td>
<td>0.94</td>
</tr>
<tr>
<td>12</td>
<td>Resting BP(Systolic)</td>
<td>0.94</td>
</tr>
<tr>
<td>13</td>
<td>Resting BP(Diastolic)</td>
<td>0.92</td>
</tr>
<tr>
<td>14</td>
<td>Haemoglobin Content</td>
<td>0.90</td>
</tr>
<tr>
<td>15</td>
<td>Margaria Anaerobic Power</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>Test Description</td>
<td>Correlation</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>16</td>
<td>Vital Capacity</td>
<td>0.93</td>
</tr>
<tr>
<td>17</td>
<td>12 Min Run/Walk</td>
<td>0.92</td>
</tr>
<tr>
<td>18</td>
<td>Power of Leg-Extensors</td>
<td>0.89</td>
</tr>
<tr>
<td>19</td>
<td>Shoulder Rotation Test</td>
<td>0.87</td>
</tr>
<tr>
<td>20</td>
<td>Abdominal &amp; Oblique Strength Endurance</td>
<td>0.90</td>
</tr>
<tr>
<td>21</td>
<td>Agility</td>
<td>0.87</td>
</tr>
<tr>
<td>22</td>
<td>Trunk Flexibility</td>
<td>0.90</td>
</tr>
<tr>
<td>23</td>
<td>Side Splits Test</td>
<td>0.86</td>
</tr>
<tr>
<td>24</td>
<td>Shoulder Flexibility</td>
<td>0.92</td>
</tr>
<tr>
<td>25</td>
<td>Shoulder &amp; Arm (Explosive Strength)</td>
<td>0.82</td>
</tr>
<tr>
<td>26</td>
<td>50 Mts. Dash</td>
<td>0.87</td>
</tr>
</tbody>
</table>

The values of co-relation in the above Tables establishes the tester’s competency and reliability of data.

**COLLECTION OF DATA**

The necessary data on the selected anthropometric, physiological and physical fitness variables were collected during their regular teaching training and coaching sessions in cricket at Chandigarh,
Himachal Pradesh, Uttar Pradesh, Delhi, Punjab and Jammu & Kashmir. Prior to the actual collection of the data the scholar, personally met the concerned coaches to request for their full cooperation.

Two practice sessions were devoted for the administration of the tests on selected anthropometric, physiological and physical variables of different groups. The resting pulse rate, resting blood, pressure, hemoglobin content, vital capacity and anthropometric measurements were taken in the morning session and speed, leg power, agility, anaerobic capacity and shoulder strength were obtained in the evening session. Special care was exercised to administer the different tests under similar conditions.

The data on variables of speed, leg power, agility, pull ups, anaerobic capacity, resting pulse rate, vital capacity and hemoglobin content were collected by employing the standard testing protocols. The anthropometric, physiological and physical variables along with their unit of measurement and equipments are presented in table-3
### Table-3

**VARIABLES, EQUIPMENT AND UNIT OF MEASUREMENT**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unit</th>
<th>Test/Equipment/Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Standing height</td>
<td>Centimeter</td>
<td>Wall scale</td>
</tr>
<tr>
<td>2. Weight</td>
<td>Kilogram</td>
<td>Weighing Machine</td>
</tr>
<tr>
<td>3. Body fat</td>
<td>Percentage</td>
<td>Skin fold caliper</td>
</tr>
<tr>
<td>4. Leg Length</td>
<td>Centimeter</td>
<td>Measuring Tape (Gullick)</td>
</tr>
<tr>
<td>5. Chest Length</td>
<td>Centimeter</td>
<td>Measuring Tape (Gullick)</td>
</tr>
<tr>
<td>6. Thigh Girth</td>
<td>Centimeter</td>
<td>Measuring Tape (Gullick)</td>
</tr>
<tr>
<td>7. Calf girth</td>
<td>Centimeter</td>
<td>Measuring Tape (Gullick)</td>
</tr>
<tr>
<td>8. Biceps girth</td>
<td>Centimeter</td>
<td>Measuring Tape (Gullick)</td>
</tr>
<tr>
<td>9. Lean body weight</td>
<td>Percentage</td>
<td>Skinfold caliper</td>
</tr>
<tr>
<td>10. Ponderal index</td>
<td>--</td>
<td>Standing height 3 weight</td>
</tr>
<tr>
<td>11. Resting pulse rate</td>
<td>Count 10 sec.</td>
<td>Stop Watch</td>
</tr>
<tr>
<td>12. Resting blood pressure</td>
<td>Systole/Diastolic</td>
<td>Syphygmomano meter</td>
</tr>
<tr>
<td>13. Hemoglobin content</td>
<td>gm. %</td>
<td>Sahli's Acid Haemation method</td>
</tr>
<tr>
<td>14. Vital Capacity</td>
<td>litres</td>
<td>Spiro meter</td>
</tr>
<tr>
<td>15. Anaerobic Power</td>
<td>Second</td>
<td>Margaria test</td>
</tr>
<tr>
<td>16. Speed</td>
<td>Second</td>
<td>50 Mts. dash</td>
</tr>
<tr>
<td>17. Endurance</td>
<td>Second / Minute</td>
<td>Cooper test Run/walk (12 minutes)</td>
</tr>
<tr>
<td>19. Agility</td>
<td>Second</td>
<td>Shuttle run 4x10mts.</td>
</tr>
<tr>
<td>20. Flexibility</td>
<td>Centimeter</td>
<td>Hip flexibility, shoulder flexibility and trunk flexibility tests.</td>
</tr>
</tbody>
</table>
ADMINISTRATION OF TESTS

ANTHROPOMETRIC VARIABLES

STANDING HEIGHT

Equipment – Wall Scale:

Description – Height scale was marked on the wall in centimeters. Subjects were asked to stand erect without shoes, keeping the legs and head together, touching the wall. Buttocks upper back & rear of the head were kept erect without tilt. Subjects were asked to take and hold a full breath and stand tall while measurement was taken. A still hard board was held vertically on his head, slightly pressing the head and touching the scale marked on the wall at right angle. The subject was asked to step out by lowering the head and reading indicated by the hard board's lower end was read on the scale.

Scoring: The height was recorded to the nearest to 0.1 centimeter¹.

¹ Mathews, Measurement in Physical Education, pp 310-316.
BODY WEIGHT

Equipment: Weighing Machine

Description: The subjects were weighed wearing as little clothing as practicable. Shoes were not permitted.

Scoring: Weight was recorded to the nearest half kilogram.²

![Figure 2](image)

MEASUREMENT OF WEIGHT

CALF GIRTH

Equipment: Measuring Tape (Gullick)

Description: The tape was wrapped horizontally around the naked lower leg of the subject at the maximal bulge of the calf muscle. With slight up and down movements of the tape keeping it in a horizontal direction, the maximal circumferential measurement was taken.

Scoring: The maximal circumferential measurement was recorded nearest to 0.1 cm.3

THIGH GIRTH

Equipment: Measuring Tape (Gullick)

Description: The subject wearing only underwear was asked to stand at ease with equal weight on both the feet. The middle of the thigh was marked by a horizontal line dividing the distance between the trochanterion and the lateral and lower most point on the lateral condyle of femur, in equal two parts. The tape was wrapped around the thigh

at the level of the horizontal line. The circumference was measured by keeping the tape in a horizontal direction and touching gently thigh surface all around.

Scoring: The maximal circumferential measurement was recorded nearest to 0.1 cm.$^{4}$

**CHEST GIRTH**

Equipment: Measuring Tape (Gullick)

Description: For measuring the chest girth, the tape was placed around the chest at the level of nipples so that it was in light contact with skin all around. The measurement was taken in standing position at the end of a normal expiration.

Scoring: The measurement was recorded nearest to 0.1 cm.$^{5}$

---

**LEG LENGTH**

Equipment: Measuring Tape (Gullick).

Description: For measuring the leg length, the scholar placed his hand approximately six inches below the subject's waist and asked the subject to swing the leg back and forth slowly and lift it outwards. By palpation, the examiner could locate the head of the femur from the floor while standing erect was recorded with help of the tape to the nearest centimeter as score.

Scoring: The measurement was taken to the nearest half centimeter.\(^6\)

**BICEPS GIRTH**

Equipment: Measuring Tape (Gullick)

Description: The subject was asked to stand at ease with equal weight on both the feet and with hands hanging freely. The upper-arm circumference is usually measured on the right naked upper arm. Locating the points acromiale

---

\(^6\) Mathews, *Measurement in Physical Education*, p. 316
and radiale, the mid point of these two points was marked with a skin marking pencil by a horizontal line. The tape was wrapped around the upper-arm at the marked level keeping the tape horizontal and touching lightly to the skin all around.

Scoring: The circumferential distance was recorded in 0.1 cm.²

**BODY FAT**

**Equipment:** Lange's Skinfold Calliper.

**Description:** The skinfold of the following sites was measured.

1. Biceps
2. Triceps Skinfold
3. Sub-scapular Skinfold
4. Supra-iliac Skinfold

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?

To eliminate error, the reading was made in three to four seconds, when essential compression had taken place. If this precaution was not taken, the skin fold would gradually have decreased.

1. **Biceps skin fold**: With the subject standing erect with arm hanging loosely, a fold was picked up on the anterior of the mid part of biceps keeping the skinfold vertical.

2. **Triceps skinfold**: The subject with a naked arm was asked is asked to stand at ease with hanging arms. Usually, the midpoint of the upper arm marked previously for measuring upper-arm circumference helps to provide a landmark for measuring triceps skinfolds. This skinfold was also taken at exactly the same level where the upper-arm circumference was measured. In this case the skinfold was picked up on the posterior side of upper arm over the triceps muscle. The skin and subcutaneous
fat fold was picked at about 1cm above the marked level on the anterior side of the tri-ceps muscle. The Jaws of the caliper are applied on the fold so that the marked horizontal line was approximately at a level of the mid point of the Jaws and that the Jaws hold a double layer of skin plus subcutaneous fat. The lighter arm of the caliper was slowly released so as to put full pressure of the Jaws on the vertical skinfold. The reading was noted from the dial of the caliper about two seconds after leaving the smaller arm of the caliper when the reading in quite stable. The measurement was recorded correct upto 0.2mm.⁸

3. **Sub-scapular Skinfold**: The skinfold was picked diagonally below the interior angle of the scaula almost parallel to the medial border of scapula, in such a way that the skinfold forms an angle of roughly 45 degrees to the horizontal with its lower end pointing outwards. The Jaws of Calliper were applied about half centimeters below the fold picking tip of the thumb.

The measurement was as usual recorded after two seconds of releasing full pressure on the fold.

4. **Supra-iliac skinfold**: A skinfold was lifted about 1 cm. above and 2 cm. medial to the anterior superior iliac spine on the left side. The Jaws of the skinfold caliper were applied parallel which was usually horizontal or slightly oblique pointing upwards latterly and downwards medially. The reading was recorded correct upto 0.2mm as in all other skinfold measurements.9

**Scoring**: The measurement was recorded to the nearest millimeter. The sum of the skin fold thickness at four sites of the body was converted into percentage of body fat with the help of the standard table suggested by Durnin and Rahaman10. Each subject's lean body weight and the weight of the fat was calculated by the following formula.

---

Fat Weight = \frac{\text{Body weight} \times \% \text{ of Fat}}{100}

Lean body weight = \text{total body weight} - \text{fat weight}

\textit{Figure - 3}

\textbf{MEASUREMENT OF BODY FAT}
PONDERAL INDEX

Ponderal Index was computed by the following formula:

\[
Ponderal\ Index = \frac{Standing\ Height^{11}}{3 \sqrt{weight}}
\]

PHYSIOLOGICAL VARIABLES

RESTING PULSE RATE

Equipment: Stop watch

Description: The resting pulse rate was taken at the radial artery early in the morning when the subject was in a resting condition.

Scoring: The number of beats in one minute was recovered as the final store.

BLOOD PRESSURE

Equipment: Stethoscope and Sphygmomanometer (Mercury Type).

Description: Each subject was asked to relax on a chair. Care was taken in seating subject so as to achieve a comfortable position and also some time was allotted for stabilizing

---

the circulatory function. The standard procedure as followed by medical practitioners was employed for taking the blood pressure.

Scoring : The recording of blood pressure was done in mmHg.

HAEMOLGLOBIN CONTENT

Equipment : Haemometre pippette, haemometre tube and stirrer.

Description : Sahli's Acid Haematin Method was used for haemoglobin content in the blood. In the hemometre tube N/10 hydrochloric acid was taken on the twentieth division of the percentage scale.

The tip of the left middle finger was cleaned with spirit and punctured with a needle and then exactly 20 cubic mm of blood was drawn into pipette and the blood was mixed with hydrochloric acid. The tube was then allowed to stand in the comparator for about 10 minutes for the maximum development of colour. Distilled water was added drop by drop to the mixture. On every drop of distilled water to this solution, it was stirred to ensure thorough mixing. The colour of the mixture was
matched against the colour standard of the removing the stirrer. After the colour of the mixture matched against that of the colour standard, the tube was taken out of the comparator.

Scoring: The reading on the haemometry scale on the tube was read at the level of the lower meniscus of the solution and the score was recorded in grams of hemoglobin per 100 Mtr. of blood.

**VITAL CAPACITY**

Equipment: Spiro meter

Description: The subject was asked to exhale fully through the mouth piece of the wet spirometre after a deep inhalation.

Scoring: The measurement was recorded from the spirometer scale to the nearest 1/10 of a litter.

**ANAEROBIC POWER**

Equipment: Stop watch and 16 stairs of normal inclination, steps measuring six inches.
Description: The subject was instructed to run up the stairs as fast as possible taking 2 steps at a time. The subject was asked to continue past 12th step and not to stop on the step. Three trails were given. The time keeper started the watch when the subject's foot stepped on the 4th step and stopped the stop watch when the subject's foot struck on the 12th step.

Scoring: The vertical height of each step was determined in centimeters and multiplied eight times. The average of the three trails to the nearest 1/100th of a second was recorded.\(^{12}\)

**PHYSICAL FITNESS VARIABLES**

**SPEED (50 MTS. DASH)**

Equipment: Stop watch, clapper.

Description: The subjects were made to run a distance of 50 metres. On the command "on your marks", the subject stood on the starting line and started, when the clapper sounded.

---

\(^{12}\) Ibid., pp. 459-461
Only two subjects ran at a time. They ran up to the finish line, which was marked 50 metres away and three time keepers for each runner recorded the time.

Scoring: The time was recorded of the nearest 100 of the second.\textsuperscript{13}

**ENDURANCE (COOPER TEST)**

**Equipment:** Stop-watches, marker flags, tape.

**Description:** The subjects were made to walk / run for 12 minute continuously. A standard track was used for conducting this test. The track was divided into segments of 10 mts. and marker flags were kept at the inner edge of the track. The subjects were given a briefing. On the signal 'Go' they started running or walking in batches of 15. On completion of 12 minutes signal was given to the subjects to stop running.

**Scoring:** The distance covered by each subject was recorded to the nearest 10 meters.

\textsuperscript{13} Clarke, *Application of Measurement to Health and Physical Education*, p. 179.
**Figure - 4**

12 MINUTE RUN / WALK TEST

**TENNIS BALL THROW**

Equipment: Measuring Tape, marker flags.

Description: The subject was made to throw the tennis ball from standing position from behind a line drawn on the field.

The ball was thrown using over head throw movement.
and it was not hurled or thrown using under hand throw movements.

**Scoring:** The point of contact of the ball on the field was marked by pegging marker flags. If the second or third throw was further the flag marker was moved. The distance was recovered to the nearest centimeter.

**PULL-UPS**

**Equipment:** Horizontal bar

**Description:** Pull ups were employed to assess the endurance and arms girdle mussels. For pulls ups, the subject was made to hang on a horizontal bar with palms facing forward. The subject was asked to pull his body upward by bending the elbows until the chin reached the bar and then back to the initial stage. This continued for a maximum number of times without swing in the body.

**Scoring:** The number of correctly done pull ups was recorded as the score.\(^{14}\)

---

SIT-UPS

Equipment: Stop-watch

Description: The subject was instructed to lie on his back bending his knees and keeping feet on the floor, so that the heels were not more than twelve inches away from the buttocks and the angle of the knee was 90 degrees. Then, he was asked to put his hands at the back of his neck or side ways along the floor. A partner was asked to hold his feet, to keep them in contact with the floor. Then by flexing abdominal muscle he brought his head towards the knees.

Scoring: Maximum number of sit ups within 1 minute were recorded.

AGILITY (4 x 10 metre shuttle run)

Equipment: Stop watches, wooden blocks.

Description: Two lines, ten metres apart were marked parallel to each other. The subject stood behind one of the lines and two wooden blocks were kept on the line opposite the
starting line. On the signal start the subject ran to the block, took one block and returned to the starting line and placed the block behind the line. He again ran to the second block which was carried across the starting line on way back. Two subjects were allowed to run together.

Scoring: Two trials were given and time taken to complete the course was recorded to the nearest 100 of the second as the final score.\textsuperscript{15}

\textit{Figure - 5}

4 X 10 METERS SHUTTLE RUN

\textsuperscript{15} Ibid, p. 218.
SHOULDER ROTATION TEST

Equipment: 66 inches of rope.

Description: The subject was made to grasp one end of the rope with his left hand & other end grasp with his right hand in a like manner a few inches away. He was asked to extend both arms to full length in front of his chest and rotate the rope over his head. As he met resistance in rotating his shoulders, he was permitted to slide the grip of his right hand so that the arms can spread and allow him to lower the rope until it is resting across his back. Keeping his arms locked, rotate to the starting position and measure the number of inches of rope between the thumbs of his hands. The least amount of distance indicates a better level of performance. Secure the maximum shoulder width across the back from deltold to deltold with the rope.
Scoring: His shoulder width is subtracted from the total inches of his best score of three trials. Thus, the lower score is recorded.\(^{16}\)

**SIDE SPLITS TEST**

Equipment: Wall-bar and centimeters marking on the floor.

Description: The subject was asked to stand and extend the legs apart from the front to rear and lower the crotch as near to the floor as possible. Make it a slow steady motion without bouncing. As he lower, an assistant was position behind him with the zero end of the yardstick on the floor. When he reached to his lowest point, the case is raised upward until the ruler guide rests under his crotch. The reading to the nearest of a centimeter taken in the case window at the lower line.

Scoring: The best score of three trials is recorded.\(^{17}\)

\(^{16}\) Johnson, Barry L. and Nelson, Jack K. *Introduction to Physical Education Measurement and Evaluation* pp. 82

\(^{17}\) Johnson, Barry L. and Nelson, Jack K. *Introduction to Physical Education Measurement and Evaluation* pp. 80
TRUNK FLEXIBILITY

Equipment: Bench, scale in centimeters.

Description: The subject assumed a sitting position on floor with knees fully extended and soles of feet against bench. The subject flexed trunk four times with arms fully extended and hands on top of each other. Last attempt was held for two seconds so that measurement could be taken. The better of the two trials was used.

Scoring: Scholar placed tape in centimeters mark near to the edge of bench. Measurement reached by the subjects was recorded.

Standing Broad Jump

Equipment: Tape, Marker

Description: The subject was made to stand behind the line for take off. Before take off the subject was asked to bend his legs, swing arms, backward and then take off in the forward direction. Take off was from both the feet simultaneously, jumped as forward as possible and landed on the feet in the pit.
Scoring: Measurement was taken from the mark closest to the take off line. Three trails were permitted and best of the two were taken in to account.

**STATISTICAL PROCEDURE**

On Way Analysis of Variance (F-ratio) for all the variables was computed for comparison of different type of cricketers separately. To assess the significance of difference between the ordered paired means, in case of significant F-ratio, LSD Post Hoc Test for significance was applied. The level of significance was set at 0.5.

Further the line graphs were prepared taking into consideration the means of the three groups of cricketers separately for all variables.