CHAPTER – 3
METHODS AND PROCEDURE

"A research design is the arrangement of conditions for collection and analysis of data in manner that aim to combine relevance to the research purpose with economy in procedure.

- Jahoda and others

In any research one of the most important prerequisite is the collection of appropriate data without which no worthwhile study" can be possible. In this regard, Mouley (1964) remarks, "Scientific problem can be resolved only on the basis of data and a major responsibility of the scientist is to set up a research design capable of providing data necessary to the solution of the problem, while the unity of the research makes it impossible to say that one aspect, is more crucial than other, the collection of data is of paramount importance in the conduct of scientific research. Obviously, no solution can be more adequate than the data on which it is based.

In the present study an attempt has been made to compare the anthropometrical and physiological variables between Kabaddi and Kho-Kho players who have participated in Haryana Olympic Games and Senior State Championship of Kho-Kho and Kabaddi. The concept frame work within which the study conducted has been undertaken through the following steps.

3.1 SAMPLE

In the present study, 120 male Kabaddi and 120 male Kho-Kho players of Haryana who participated in Haryana Olympic Games and Haryana State Kho-Kho and Kabaddi Championships. The players who remained in last ten teams were selected during the State Championship. The data collected by the investigator from the various places as given under:
2. Haryana Olympic Games held at Faridabad in 2010.
4. Different training centres in Haryana state.

3.2 TOOLS USED:

1. Linear measurements were taken with the help of anthropometer.
2. A flexible tape was used to measure the circumferences.
3. The skin-fold caliper was used to measure the skin-folds.
4. Diameter was taken with the help of vernier caliper and anthropometer compass.
5. The weight of the subject was measured with the help of portable actuated weighting machine.
6. Vital capacity of the subjects was measured by Digital peak flow meter.
7. Basal Pulse Rate and Blood pressures were measured by Digital Apparatus.
8. Haemoglobin of the subjects was tested by the lab. Technician in Pathological Laboratory.

3.3 SELECTION OF VARIABLES:

- Age
- Weight
- Height
- Leg Length
- Thigh length
- Lower leg length
- Foot length
- Foot width
- Sitting height
- Trunk length
- Total arm length
- Upper arm length
- Fore-arm length
- Hand length

**BODY CIRCUMFERENCES**
- Shoulder
- Chest
- Abdomen
- Hip
- Thigh
- Calf

**BONE DIAMETERS**
- Bioacromial diameter
- Bitrochanteric diameter
- Femur Bicondylar diameter
- Ankle diameter

**SKIN FOLDS**
- Biceps skin-folds
- Triceps skin folds
- Sub-scapular skin-folds
- Suprailiac skin-folds
- Thigh skin-folds
- Calf skin-folds
BODY COMPOSITIONS
- Body Density
- Fat %
- Fat Weight
- Lean Body Mass

PHYSIOLOGICAL PARAMETERS
- Diastolic Blood Pressure
- Systolic Blood Pressure
- Basal Pulse Rate
- Haemoglobin

VITAL CAPACITY
- FEV1
- PEF

3.4 PROCEDURE FOR COLLECTION OF DATA
The investigator met the subjects, whom were to be tested, in their respective training centres camps and during the senior state championships and Haryana Olympic Games and explained and guided to them the purpose of the present investigation. He demonstrated them the various tests items, which the subjects had to took, so that the subjects form a mental prepare of various tests they was going to attempt. The subjects were asked to clarify their doubts by asking questions and quires. The research scholar also took the help of other research scholars, classmates, coaches and other professional friends to record the data of different test items in a require manner.

3.5 COLLECTION OF DATA
The data were collected during the (Haryana Olympic Games) held at Faridabad, Senior Kho-Kho State Championship held at Bhambhewa (Jind) and Kabaddi State Championship held at Rajakheri (Panipat). For the collection of data, keeping in view the difficulty of administering the test and collection of
data individually, the test and collection of data individually, the investigator sought the help of few experts for this purpose. These experts were made conversant with the purpose of the study, detailed regarding the test to be used, and the procedural to be followed for the recording of the score. The data were collected with the help of standardized equipments.

**Reliability of Data:**

The reliability of data was ensured by establishing the instrument reliability.

**Instrumental Reliability**

Measuring steel tape, skin fold caliper, vernier caliper, anthrop meter rod, weighing machine, peak flow meter, digital blood pressure apparatus, and stop watches used in the study were obtained from Jagson Lab., Ambala and most of the instrument were available in the above said research laboratory. Their calibrations were accepted as accurate enough for the purpose of the study. Digital Peak Flow meter, Digital Blood Pressure apparatus were obtained from Pt. BDS PGIMS, Rohtak.

**Reliability of Measurements:**

To ensure that the investigator was well versed in the techniques of conducting the tests he had a number of practice sessions in the testing procedure under the guidance of the supervisor Dr. Ramesh Kumar, Department of Physical Education, M.D. University, Rohtak. The measurements for different sites i.e. linear measurement, circumferences, diameters, skin folds, blood pressure, pulse rate and vital capacity were taken and recorded. After two days, the same measurements were taken on the same subjects and under the similar conditions. Then the coefficient of correlation by Pearson’s Product Moment method was calculated which provided the reliability.
## Table 3.1

**RELIABILITY COEFFICIENT OF CORRELATION**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Test (measurements)</th>
<th>Coefficient of Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Linear Measurements</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Height</td>
<td>95*</td>
</tr>
<tr>
<td>2.</td>
<td>Leg Length</td>
<td>96*</td>
</tr>
<tr>
<td>3.</td>
<td>Lover leg length</td>
<td>95*</td>
</tr>
<tr>
<td>4.</td>
<td>Thigh Length</td>
<td>95*</td>
</tr>
<tr>
<td>5.</td>
<td>Trunk Length</td>
<td>96*</td>
</tr>
<tr>
<td>6.</td>
<td>Total Arm length</td>
<td>96*</td>
</tr>
<tr>
<td>7.</td>
<td>Upper Arm Length</td>
<td>94*</td>
</tr>
<tr>
<td>8.</td>
<td>Fore Arm Length</td>
<td>96*</td>
</tr>
<tr>
<td>9.</td>
<td>Hand Length</td>
<td>94*</td>
</tr>
<tr>
<td>10.</td>
<td>Foot Length</td>
<td>95*</td>
</tr>
<tr>
<td>11.</td>
<td>Trunk Height at Vertax</td>
<td>95*</td>
</tr>
<tr>
<td>12.</td>
<td>Foot Breadth</td>
<td>95*</td>
</tr>
<tr>
<td>(B)</td>
<td><strong>CIRCUMFERENCE (GRITH) MEASUREMENTS:</strong></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Shoulder circumference</td>
<td>94*</td>
</tr>
<tr>
<td>14.</td>
<td>Chest Circumference</td>
<td>96*</td>
</tr>
<tr>
<td>15.</td>
<td>Abdominal circumference</td>
<td>95*</td>
</tr>
<tr>
<td>16.</td>
<td>Hip circumference</td>
<td>95*</td>
</tr>
<tr>
<td>17.</td>
<td>Thigh circumference</td>
<td>97*</td>
</tr>
<tr>
<td>18.</td>
<td>Calf Circumference</td>
<td>96*</td>
</tr>
<tr>
<td>(C)</td>
<td><strong>RELIABILITY OF SKELETAL DIAMETERS</strong></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Femur Diameter</td>
<td>96*</td>
</tr>
<tr>
<td>20.</td>
<td>Ankle Diameter</td>
<td>97*</td>
</tr>
<tr>
<td>21.</td>
<td>Biaxomial Diameter</td>
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<tr>
<td>22.</td>
<td>Bitrochentric Diameter</td>
<td>95*</td>
</tr>
<tr>
<td>(D)</td>
<td><strong>RELIABILITY OF SKINFOLD MEASUREMENTS</strong></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Biceps skinfold</td>
<td>95*</td>
</tr>
<tr>
<td>24.</td>
<td>Triceps skinfold</td>
<td>95*</td>
</tr>
<tr>
<td>25.</td>
<td>Subcapular skinfold</td>
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<tr>
<td>26.</td>
<td>Suprailiae skinfold</td>
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</tr>
<tr>
<td>27.</td>
<td>Thigh skinfold</td>
<td>95*</td>
</tr>
<tr>
<td>28.</td>
<td>Calf skinfold</td>
<td>96*</td>
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<tr>
<td>(E)</td>
<td><strong>Physiological Variables Measurements</strong></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>Diastolic Blood Pressure</td>
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</tr>
<tr>
<td>30.</td>
<td>Systolic Blood Pressure</td>
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<tr>
<td>31.</td>
<td>Basal Pulse Rate</td>
<td>96*</td>
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<tr>
<td>(F)</td>
<td><strong>Vital Capacity</strong></td>
<td></td>
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<tr>
<td>32.</td>
<td>FEV1</td>
<td>95*</td>
</tr>
<tr>
<td>33.</td>
<td>PEF</td>
<td>95*</td>
</tr>
</tbody>
</table>
Subject Reliability:

The above test retest coefficient of correlation method also established the subject reliability was significant at 0.01 level of confidence, as the same subject were under similar conditions by the same tester and no maturational techniques were used and not any training was given.

Techniques and Landmarks for Taking Anthropometric Measurements

All the anthropometric measurements where side was involved where taken on the right side of the individual standard technique described by Weiner and Lourie (1969) was followed for measurements. The necessary anatomical landmark, and the sites for skin folds were marked with a sketch pen. The body weight recorded to the nearest of half a kilogram and all other measurements were recorded upto 1/10th of centimeter.

The Tests and their Administration:

Anthropometric Variables

Age: The age of each subject was known by subtracting date of birth of the individual from the date of observation. The reading thus obtained was converted into years

Weight:

Objective: To measure the weight of the subjects.

Equipment: Portable Weighing machine.
Illustration 3.1: Measurement of body weight

**Description:** The weight of the subject was taken with a weighing machine. The pointer of the machine was set to zero. The subjects were allowed wearing minimum clothes. They wearing T-shirts and vest but without shoes and asked to stand on the machine one by one.

**Scoring:** The weight was recorded to the nearest half of a kilogram. For every measurement the needle of the scale was set to zero. The calibration of machine was checked intermittently by measuring standard weight kg on it.
Stature of height:

Objective: To measure the standing height of the subjects.

Equipment: Anthropometer

Illustration 3.2: Measurement of stature of height
**Description:** It is the vertical distance from the horizontal ground to top of the head. The stature of height was measured with an anthropometric rod. The measurement was taken with the subject standing straight against an upright wall touching it with needs buttock and back. The head was oriented in the Frankfort plane (the upper border e.g. the tragus of the ear or the tragion and the lower border of the eye socked where on a horizontal line) and the needs were together, and the hands were hanging downward. The subject was stretched upward by a gentle traction on the mastoid region, taking. Care that the heel were kept on the ground. The anthropometer was held vertically in front of the subject in mid-segittal plane and the horizontal movable bear was brought down touch the point the stature was recorded upto1/10\textsuperscript{th} of centimeter.

**Scoring:** Height was recorded upto1/10\textsuperscript{th} of centimeter.

**Total Leg Length:**

**Objective:** To measure the leg length.

**Equipment:** anthropometer

**Description:** Leg length was taken from the end of the spinal column to the floor. Also taken from greater trochanter to floor.

**Scoring:** Leg length was recorded upto1/10\textsuperscript{th} of centimeter.

**Thigh Length:**

**Objective:** To measure the thigh length.

**Equipment:** Anthropometer

**Descriptions:** The subject was asked to stand in an erect position. One end of the anthrop meter was fixed at the patella line and the other end of the anthrop meter was adjusted to such position that touches the point of tangency to a vertical line contacting the buttocks.

**Scoring:** thigh length was recorded upto1/10\textsuperscript{th} of centimeter.
Lower Leg Length:
Objective: To measure the lower leg length.
Equipment: Anthropometer
Description: It is the straight distance between the superior surface of the medial condyle of the tibia and the floor. The subject was asked to stand in an erect position. The distance between the tibia and the standing surface was measured with the anthropometer rod.
Scoring: lower leg length was recorded upto 1/10th of centimeter.

Foot Length:
Objective: to measure the foot length
Equipment: Anthrometer
Description: It is the distance between the tip of the most tarsal phalange and the most posterior part of the calceneus. The measurement was taken with the help of anthropometer rod. The subject was asked to stand in a comfortable position with feet slightly apart and reading was recorded upto 1/10th of centimeter.
Scoring: Foot length was recorded upto 1/10th of centimeter.

Foot Breadth:
Objective: To measure the foot length
Equipment: Vernier caliper
Description: It is the distance between the metatarsal medial and metatarsal lateral. The subject was asked to stand in an erect position with equal weight on both the feet. The fixed arm of vernier caliper was made to touch the metatarsal medial and the other movable arm with metatarsal lateral and reading was recorded.
Scoring: Foot breadth was recorded upto 1/10th of centimeter.
Sitting Height at vertex:

**Objective:** To measure the sitting height of the subjects.

**Equipment:** anthropometer

**Description:** It is the vertical distance from the point vertex to the sitting plane. The subject was asked to sit erect on a table with his feet unsupported, the hands rested on the thighs, the head was oriented in the Frankfurt plane, gentle upward traction was erected in the mastoid region and distance between the vertex and the table top was measured with an anthropometer rod, touching the back of the subject at the sacral and inter scapular regions in the mid sagittal plane. The reading was recorded up to 1/10 of a centimeter.

**Scoring:** The sitting height was recorded up to 1/10th of centimeter.

Trunk Length:

**Objective:** to measure the trunk length

**Equipment:** Anthropometer

Illustration 3.3: Measurement of trunk length
**Description:** It is the straight distance between anterior and superior boarder of the manubraim sternum to the sitting plane. The subject was asked to sit erect on a table with his feet unsupported, the hands resting on the thighs. The head was oriented in the Frankfort plane, gentle upward traction was erected on the mastoid region and the distance between the anterior and superior boarder of manubrium sternum and the sitting plane was recorded with the anthropometer rod up to 1/10 of a centimetre.

**Scoring:** Trunk length was recorded up to 1/10th of centimeter.

**Total arm length:**

**Objective:** To measure the length of arm.

**Equipment:** anthropometer

*Illustration 3.4: Measurement of total arm length*
**Description:** The arm length was measured with a anthropometer road from acromial process to the tip of the third Finger.

**Scoring:** The arm length was recorded upto1/10th of centimeter.

**Upper Arm Length :**

**Objective:** to measure the upper arm length

**Equipment:** Anthropometer

![Illustration 3.5: Measurement of upper arm height](image)

**Description:** It is the straight distance between acromiol point to the mid olecrann point on the back of the elbow. The subject was asked to stand in an erect position with hands hanging sideways. One of the anthrop meter was fixed at the olecrann point and the other was adjusted on the acromiol point and
the reading was recorded up to one tenth of a centimetre.

**Scoring:** Upper arm length was recorded upto $1/10$th of centimeter.

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**Fore Arm Length:**

**Objective:** to measure the fore arm length

**Equipment:** Anthropometer

![Illustration 3.6: Measurement of forearm height](image)

**Description:** It is the straight distance between the points radiate and stallion, measured with the anthropometric upper segment while the individual stood erect with her arm hanging down freely.

**Scoring:** Fore arm length was recorded upto $1/10$th of centimeter.

**Hand Length:**

**Objective:** To measure the hand length
**Equipment:** Anthropometer

**Description:** It is straight distance between the point pisiform and the third met corps, measured with the anthropometer upper segment while the individual stood erect with his arms hanging down freely.

**Scoring:** Hand length was recorded up to 1/10th of centimeter.

**Body Circumference:**

**Shoulder Circumference:**

**Objective:** to measure the shoulder circumference

**Equipment:** Flexible measuring tape

**Illustration 3.7: Measurement of shoulder circumferences**

**Description:** It was measured along laterally at the maximal protrusion of the
deltoid muscles and anteriority of the articular prominence of the sternum and second rib. The subject was asked to stand in comfortable position. Measurement was taken with the half of a flexible steel tape. The tape was applied in such manner that it touched the maximal protrusion of the deltid muscles and the articular prominence of the sternum and second rib. The reading was recorded up to 1/10 of a centimeter.

**Scoring:** Shoulder circumference was recorded up to 1/10th of centimeter.

**Chest Circumference:**

**Objective:** To measure the chest circumference of the subject.

**Equipment:** Flexible measuring Tape

![Illustration 3.8: Measurement of chest circumferences](image-url)

**Description:** Chest girth was taken with the help of flexible steel tape at the level of Nipple. The tape was placed around the chest at the Nipples so that it may be in light contact with the skin all around. The measurement was taken in standing position at the end of normal expiration.
**Scoring:** Measurement was recorded upto 1/10th of centimeter.

**Abdomen Circumference:**

**Objective:** to measure the abdomen circumference  
**Equipment:** flexible measuring tape.  
**Description:** This circumference was measured at the level of umbilicus with the help of steep tape.  
**Scoring:** Abdomen circumference was recorded upto 1/10th of centimeter.

**Hip Circumference**

**Objective:** To measure the circumference of the hip.  
**Equipment:** Flexible Measuring tape.

*Illustration 3.9: Measurement of hip circumferences*

**Description:** Hip girth was measured with the help of a flexible steel tape at a level from the maximal protrusion of the buttocks to the symphysis pubis.
Scoring: The measurement was recorded up to 1/10\textsuperscript{th} of centimeter.

**Thigh Circumference**

**Objective:** To measure the circumference of the thigh.

**Equipment:** Flexible Measuring tape

**Description:** Thigh circumference was measured with the help of the flexible steel tape placed around the point of maximal thigh circumference with its top edge placed just under the fold of the buttocks. The subject was stand with body weight equally distributed on both feet.

**Scoring:** The measurement was recorded to the nearest centimeter.

**Calf Circumference**

**Objective:** To measure the circumference of the calf.

**Equipment:** Flexible Measuring tape.

Illustration 3.10: Measurement of calf circumferences
**Description:** Calf circumference was taken with the help of the steep tape at
the maximum circumference on the calf in a place at right angle to its long axis.
The leg will be held hanging over a table top so that the tape measure may be
in a horizontal plane. In this position the calf muscle is fully relaxed.

**Scoring:** The measurement was recorded upto 1/10th of centimeter.

**SKELETAL DIAMETERS**

**Biacromial Diameter:**

**Objective:** to measure the biacromial diameter

**Equipment:** Anthropometer compass

**Illustration 3.11: Measurement of biacromial diameters**

**Description:** With the individual standing in a relaxed position and arms
hangings down freely, the distance between the most lateral points of acromial
processes on either side was measured with the help of anthropometer upper
segment by standing behind the subject.

**Scoring:** Biacromial diameter was recorded upto $1/10^{th}$ of centimeter.

**Bitrochanteric Diameter**

**Objective:** to measure the bitrochantric diameter

**Equipment:** Anthropometer compass

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**Illustration 3.12: Measurement of bitrochanteric diameters**

**Description:** The individual was asked to stand in an erect position with feet together. The measurement was taken with the help of anthropometer compass. The anthropometer upper segment was adjusted on the hip at the level of greater trochanter of the two sides and the measurement was recorded up to $1/10^{th}$ of a centimeter.
**Scoring:** Bitrochanteric diameter was recorded upto1/10th of centimeter.

**Femur Bicondylar Diameter:**

**Objective:** to measure the femur bicondylar diameter

**Equipment:** Vernier caliper

**Illustration 3.13: Measurement of femur bicondylar**

**Description:** With the individual seated on a table and the knee bent at a right angle, greatest distance between the lateral and medial epecondyles of the femur was measured with the help of vernier callipers with slight pressure on one crass bar.

**Scoring:** Femur bicondylar diameter was recorded upto1/10th of centimeter.
Ankle Diameter:

**Objective:** to measure the ankle diameter

**Equipment:** Vernier caliper

**Description:** It is the straight distance between the medical tibia and lateral malleolus of the fibula. The vernier caliper was used to measure the ankle diameter.

**Scoring:** Ankle diameter was recorded up to 1/10th of centimeter.

Skin fold Measurement:

**Biceps Skin fold**

**Objective:** To measure the body fat percentage.

**Equipment:** Skinfold Caliper, Sketch Pen.

**Illustration 3.14: Measurement of biceps skin-fold**

**Description:** A fold mid way between the acromiol and olecrann processes on the anterior aspect of the arm was the anatomical landmarks for the side for skin fold measurement of the biceps. The fold ran parallel to the length of the
The measurement of biceps was taken by holding the skin fold at the side. Special care was taken not to grasp the underlying muscular tissue. The reading on the calibrated caliper was noted in millimeter.

Each side was measured twice. Whenever there was a discrepancy of more than one person between the two values, a third measurement was taken. To eliminate the possibility of experimental bias, the first series of measurement was completed prior to starting the second series of measurements so that the experimenter did not have a recollection of the previous measurements for any one site. The mean of the measurements stores was taken at the individual runner.

**Scoring:** The measurement was recorded in millimeters.

**Triceps Skin folds:**

**Objective:** to measure the triceps skin folds

**Equipment:** Skin fold caliper and sketch pen

*Illustration 3.15: Measurement of triceps skin-fold*
**Description:** A fold midway between the acromial and olecrann processes on the posterior aspect of the arm was taken as the anatomical site for the skinfolds measurement of the triceps. The fold ran parallel to the length of the arm.

The arm of the subject was held vertically while measuring the triceps. The skinfolds was held firmly between the thumb and finger and the measurement was taken with the help of caliper.

**Scoring:** The measurement was recorded in millimeters.

**Sub Scapular Skinfolds:**

**Objective:** To measure the body fat percentage.

**Equipment:** Skinfolds Caliper, Sketch Pen

**Description:** The skin fold was be picked diagonally below the inferior angle of the scapula almost parallel to the medial border of scapula, in such a way that the skin fold forms an angle of roughly 45° to the horizontal, with its lower end pointing outwards. The jaw of caliper was be applied about half a centimeter below the fold picking tip of the thumb. The measurement, as usual, recorded after two seconds of releasing full pressure on the fold.

**Suprailliac Skinfolds:**

**Objective:** To measure the body fat percentage.

**Equipment:** Skinfolds Caliper, Sketch Pen
Illustration 3.16: Measurement of suprailiac skin-fold

**Description:** The skin fold of the subject was picked up approximately one centimeter and about two centimeter medial to the anterior superior iliac spine.

**Scoring:** The measurement was recorded with skin folds caliper in millimeters.

**Thigh Skin-fold:**

**Objective:** To measure the body fat percentage.

**Equipment:** Skinfolds Caliper, Sketch Pen

**Description:** The subject was asked to sit on a table with naked thigh and legs hanging freely. The skin fold was picked about 1 cm at previously marked thigh on the anterior side.

**Scoring:** The measurement was taken in millimeters.

**Calf Skinfolds:**

**Objective:** To measure the body fat percentage.
**Equipment:** Skinfolds Caliper, Sketch Pen

**Illustration 3.17: Measurement of calf skin-fold**

**Description:** The subject was asked to sit on the corner of a table top in such a way that his one leg was in front of the longer side of table and other leg was in front of the breadth side of the table. The tester was sit on his heal in between the two legs of the subject and pick up the skin fold on the medial side of the left leg of the subject and apply the jaws of the caliper exactly in line with the marked level where the calf circumference was measured.

**Scoring:** The reading was recorded in millimeters.

**Estimation of Body Composition:**

The four skinfolds measurement were used to estimate the density, percent fact, lean body mass and fate weight as the main constituents of body composition. The description of these variables and the methods of these
variables and the methods of their estimation are given below.

**Body Density:**

This indicates the weight in grams per cubic centimeter of body tissues. Body density is estimated from the sum of four skinfolds measurements (Biceps, Triceps, Sub-scapular and Suprailiac). In the present study body density was estimated using Durning and Reliman’s equation (1967). The formula is as follows:

\[
\text{Body Density (Y)} = 1.1533 - 0.0643 \times X
\]

(Where \( X \) = Sum of four skinfolds in millimeters converted in logarithms).

**Fat Percentage:**

Percent fat is the amount of fat in 100 kg. of body weight. It was calculated from Body density using Siri’s (1956) formula which is given as under:

\[
\text{Percent fat} = \left(\frac{4.95}{\text{Body Density}} - 4.5\right) \times 100
\]

**Fat Weight:**

This is the weight of the overall body fat, which is deposited in the subcutaneous area of the body. About fifty percent of the depot fat is stored in specialized cells under the skin, the thickness of which depends upon the amount of fat in the body. This is calculated from the weight of the body and percent fat. The formula of Durnin and Rehman was used to estimate fat weight which is given below:

\[
\text{Fat Weight} = \left(\frac{\text{Percent Fat}}{100}\right) \times \text{Body Weight}
\]
Lean body mass:

This is the amount of muscle in the body. Lean body mass is considered to be divisible into biological constant proportions. These would include water (70-72%), minerals (7%) and organic substances including an undermined but probably constant percentage (2-3%) of essential liquids in bone-marrow, the central nervous system and other organs. In other words, the lean body mass includes the weight of the essential fat (Bakhnke and Wilmores, 1974). This is calculated by subtracting the fact weight from the total body weight. Again Durnin and Rahinan’s formula was used to estimate the amount of lean body mass,

\[
\text{Lean body mass} = \text{Body weight} - \text{Fat Weight}
\]

Physiological Parameters

Blood Pressure and basal pulse rate:

Objective: To measure the blood pressure and basal pulse rate

Description: Electronic blood pressure measuring devices are becoming the norm now mercury is being phased out because of its hazardous nature. Most of these are now accurate enough for routine clinical use and are relatively inexpensive. To check the blood pressure and pulse rate of players. The investigator used digital blood pressure apparatus machine.

Equipment: Digital apparatus

Scoring: The systolic and diastolic blood pressure was recorded in millimeter of mercury pressure (mm hg) as the score of the each subject. The basal pulse rate per minute was recorded as the score of each subject.

Haemoglobin

To check the haemoglobin level of players, the investigator has called a laboratory technician at the spot.
Illustration 3.18: Teasing of haemoglobin

Vital Capacity (PEF and FEV1)

To measure the peak expiratory rates of the subject, the subjects were asked to put the Peak flow meter in their mouth and exhale with full force. Peak expiratory flow rate (PEFR) of the subject was recorded in the litres with peak flow meter. The best of the three reading was used to as the recorded value of the peak expiratory flow rate in liters.

Peak expiratory flow rate:

Objective: To measure the peak expiratory flow rates of the subject.

Equipment: Peak flow meter.
Illustration 3.19: Measurement of vital capacity (FEV1 and PEF)

**Description:** The subject was asked to put the Peak flow meter in their mouth and exhale with full force. Peak expiratory flow rate (PEFR) of the subject was recorded in the litres with peak flow meter.

**Scoring:** The best of the three reading was used to as the recorded value of the peak expiratory flow rate in liters.

**FEV1** (Forced Expiratory Volume in 1 Second):

**Objective:** to measure the FEV1

**Equipment:** peak flow meter
**Description:** The subjects were asked to put the Peak flow meter in their mouth and exhale with full force. Peak expiratory flow rate (FEV1) of the subject was recorded in litres with FEV1.

**Scoring:** The best of the three readings was used as the recorded value of the FEV1.

### 3.6 STATISTICAL DESIGN:

The data has to be presented, analyzed, and interpreted by a suitable statistical technique for a comprehensive understanding of the inherent lack. In the present study, the investigator wanted to compare the selected anthropometric variables between Kho-Kho and Kabaddi players. A ‘t’ test was used by using Statistical Package for Social Sciences (SPSS).