CHAPTER-III

PROCEDURE
PROCEDURE

Review of related literature had given us appropriate guidance in adopting an objective method of assessing the difference in physical and physiological characteristics of middle and long distance runners. In this chapter the selection of subjects, criterion measures, tools and techniques used in collecting data and statistical method applied for its interpretation are described.

SELECTION OF SUBJECTS:

For the purpose of the study 50 Indian elite male middle and long distance runners were selected from

- India camp held at Patiala - Data of 7 athletes of 800 m runners, 9 athletes of 1500 – 5000 m runners and 10 athletes of 5000 – 10000 m runners were collected from 14th May to 24th May 2005.
- All India Inter-varsity, held at Ranchi - Data of 3 placeholder athletes of 800 m runners, 4 placeholder (1 athlete of previous year) athletes of 1500 – 5000 m runners and 4 placeholder (1 athlete of previous year) athletes of 5000 – 10000 m runners were collected from 25th Jan to 1st Feb 2004.
- Lucknow and Allahabad sports hostel - Data of 4 athletes of 800 m runners, 4 athletes of 1500 – 5000 m runners and 5 athletes of 5000 – 10000 m runners were collected from 24th June to 30th June 2005.

SAMPLE:

For the purpose of this study three sample groups were formed. 1st group comprises of 14 elite 800 m runners, 2nd group comprises of 17 elite 1500 – 5000 m runners and 3rd group comprises of 19 elite 5000 – 10000 m runners.
CRITERION MEASURES AND COLLECTION OF DATA:

Recording the variables as given below shall consist data in the form of various criterion measures selected for the study.

(A) PHYSICAL VARIABLES:

(1) **Weight in Kg.**

The subjects were examined in clothing of known weight in order to record nude weight with the help of weighing machine.

(2) **Height in cm.**

(a) **Standing height:**

Stature was taken as the maximum distance from the point vertex on the head to the ground. Subject was made to stand erect with heels together and arms hanging naturally by the side and head in the Frankfort plane, along a wall on which was fixed a measuring tape.

(b) **Sitting height:**

The subject was made to sit on the stool with his legs hanging down freely. The subject was asked to stretch his back as far as possible and to hold his head upright so that Frankfort plane becomes horizontal. Gentle upward pressure was applied to the mastoid processes. The muscle of the thigh and buttock were contracted in order to stretch him full. The horizontal bar of the anthropometer rod was brought down so that it touched the highest point on the head. The distance between anthropometric rod and the highest point of the stool was measured.

3. **Length in cm.**

(a) **Upper arm length:**

The subject was made to stand erect with arms hanging down normally with the palm of right hand directed towards thigh. Inferior border of the acromion process and the external superior
border of the head of radius were marked. The distance between these two points was measured with the help of measuring tape and the value was taken.

(b) Fore arm length:

The subject was made to stand with arms hanging down normally. Radial and dactyliion were marked on the right hand. The distance between these two points was measured with the help of measuring tape.

(c) Thigh length:

The subject was made to stand erect with weight equally distributed on both legs. Trochanterion and tibial lateral of the right leg were marked. The distance between these two points was measured with the help of measuring tape.

(d) Lower leg length:

The subject was made to stand erect with weight equally distributed on both legs. Tibial of the right leg was marked. The distance between tibial and floor was measured with the help of measuring tape.

4. **Breadth in cm.**

(a) Shoulder breadth:

The measurement was taken of the distance between the most lateral points on the acromion process, when the subject was standing erect with the arms hanging loosely at the side. Sliding caliper was applied from behind the subject, so that branch of caliper was at an angle of 45 from the horizontal plane.

(b) Hip breadth:

The subject was made to stand erect with sliding caliper applied from behind the subject, so that the branches of sliding caliper were at the most lateral points on the superior border of the iliac crests.
5. **Diameters in cm.**

(a) **Humerus biepic condyle diameter:**
The subject’s right arm was raised forward to the horizontal and the forearm flexed to right angle at elbow. The distance between medial and lateral epicondyle of the humerus was measured with the help of Vernier caliper and the value was recorded.

(b) **Femur biepic condyle diameter:**
The subject was made to sit on a stool and the right leg was flexed at the knee to form a right angle with thigh. The distance between medial and lateral epicondyle of the femur was measured with the help of Vernier caliper and the value was recorded.

6. **Muscles girth in cm.**

(a) **Biceps muscle girth:**
The subject was made to raise his right arm to the horizontal position in the sagittal plane with the fully supinated forearm flexed at the elbow to an angle of 45. The subject was encouraged to ‘Make a muscle’ by fully tensing his biceps. The measurement was taken with the help of measuring tape wrapped at right angles to the long axis of the upper arm where the maximum girth was affected.

(b) **Calf muscle girth:**
The subject was made to stand erect with body weight equally supported on both legs. The measuring tape was wrapped around the right lower leg and measurement was taken at right angles to the axis of lower leg where it was maximal.

7. **Skin folds measurements in mm.**

(a) **Triceps skin fold:**
The mid acromiale-radiale line on the posterior surface of the right arm was marked and the skin fold about one centimeter above marked level was picked up and jaws of the calipers were
applied to the fold and after waiting for 2 to 3 seconds the reading was taken. One more reading was taken in the same way and average of the two was the final score.

(b) Sub scapular skin fold:

A point below the right scapula was marked. The skin fold about one centimeter below marked level was picked up and jaws of the caliper were applied to the fold and after waiting for 2 to 3 seconds the reading was taken. One more reading was taken by the same procedure and average of the two was the final score.

(c) Suprailium skin fold:

A point was marked on a slightly diagonal fold on the crest of the ilium at the midaxillary level, the skin fold about 2 to 5 centimeter above marked level was picked up and jaws of the caliper were applied to the fold after waiting for 2 to 3 seconds the reading was taken. One more reading was taken by the same procedure and average of the two was considered as the final score.

(d) Calf skin fold:

The subject was made to sit on chair with knees bend at right angles. Medial side of the right calf, slightly above the level of the maximum girth was marked. The skin fold above the marked level was picked up and jaws of the caliper were applied to the fold. After waiting for 2 to 3 seconds the reading was taken. One more reading was taken by the same procedure and average of the two was considered as the final score.

(e) Thigh skin fold:

The subject was made to stand erect. Medial side of the right thigh, slightly above the level of the maximum girth was marked. The skin fold above the marked level was picked up and jaws of the caliper were applied to the fold. After waiting for 2 to 3 seconds the reading was taken. One more reading was taken by
the same procedure and average of the two was considered as the final score.

8. **Somatotype in gradings.**

Heath Carter (1984) method was applied to determine somatotype of subjects.

(a) **Endomorphy:**

\[-0.7182 + 0.1451* \Sigma SF - 0.00068* \Sigma SF^2 +0.0000014* \Sigma SF^3\]

(where SF = sum of triceps, sub scapular and suprailim skin folds multiplied by (170.18/height in centimeter))

(b) **Mesomorphy:**

0.858 * humerus breadth + 0.601 * femur breadth + 0.188 * corrected arm girth + 0.161 * corrected calf girth – height * 0.131 + 4.5

(Subtract the triceps skin fold and calf skin fold from the arm girth and calf girth, respectively).

(c) **Ectomorphy:**

Ectomorphy was determined by comparing the HWR ratio with following underlined values.

\[\text{HWR} = \frac{\text{Height in cm}}{\sqrt[3]{\text{Weight in Kg}}}\]

- If HWR is greater than or equal to 40.75 than ectomorphy = 0.732 * HWR – 28.58
- If HWR is less than 40.75 and greater than 38.25 then ectomorphy = 0.463 * HWR – 17.68
- If HWR is equal to or less than 38.25 than ectomorphy = 0.1

9. **Proportionality in ratings.**

The following indices were used to determine various body proportions.
(i) Sitting height-Stature index = \( \frac{\text{Sitting height}}{\text{Stature}} \times 100 \)

(ii) Ponderal index = \( \frac{\text{Stature}}{3 \cdot \sqrt[3]{\text{Weight}}} \)

(iii) Thigh length-Lower leg length index = \( \frac{\text{Thigh length}}{\text{Lower leg length}} \times 100 \)

(iv) Upper arm length-Lower arm length index = \( \frac{\text{Upper arm length}}{\text{Lower arm length}} \times 100 \)

(v) Hip breadth-Stature index = \( \frac{\text{Hip breadth}}{\text{Stature}} \times 100 \)

(vi) Shoulder breadth-Stature index = \( \frac{\text{Shoulder breadth}}{\text{Stature}} \times 100 \)

(B) PHYSIOLOGICAL VARIABLES:

(1) Heart rate in beats/ min.

The morning resting heart rate of the subject was taken. The subject was made to sit in the resting position and asked to semi-pronate his forearm and slightly flex the wrist. Three fingertips were placed on the radial artery at the lateral border of the wrist and the pulse was counted for one minute with the help of stopwatch two reading were taken and there average was held to be final score.

(2) Vital capacity in cm\(^3\).

Subject was made to sit in resting position. He was asked to take a force full inhalation. Than the mouth piece of Spirometer was put in between his lips. After this he was asked to do a force full exhalation in to the mouth piece of Spirometer. The reading was noted of two efforts and there average was held to be final score.
TOOLS:

The following instruments were used to collect the relevant data.

(1) Weighing machine
(2) Stadiometer
(3) Sitting height table
(4) Steel measuring tape
(5) Sliding caliper
(6) Skin fold caliper
(7) Stop watch
(8) Spirometer etc.

The instruments were of standard quality; their accuracy was ensured by the manufacturer. International society for the advancement of Kinanthropometry’s (ISAK) approved techniques were used for recording the various body measurements. The reliability was checked by test- retest methods and average co-efficient was found to be 0.96.

STATISTICAL PROCEDURE:

Reiterating the objective of the study we have to point out that we intend to investigate the differences in physical and physiological parameters of elite 800, 1500 – 5000 and 5000 –10000 m runners of India for that the one way analysis of variance was used. Where significant differences were observed Scheffe’s test was used to find out the ascending or descending order of means.

LEVEL OF SIGNIFICANCE:

The significance of differences in physical and physiological parameters of elite middle and long distance runners was tested at 0.05 level.