Chapter III

PROCEDURE

This chapter describes the methodology and procedure adopted. Precisely this includes selection of subjects, selection of variables, procedure of recording anthropometric and skinfold measurements, reliability of data, collection of data and the statistical techniques employed for analysis of the data.

Subjects

For the present investigation, 180 athletes (90 males and 90 females) from different states and Union Territories of India who participated in the South Zone Inter-Varsity and in the All India Inter-University Athletic Meet at Thiruchendur, (Tamil Nadu) and Chandigarh (Punjab) respectively and who were selected at random served as subjects. The subjects referred were grouped into three, with sprinters (n=30) who took part in the 100 mts sprint, Jumpers (n=30) who took part in the High Jump Event and Throwers (n=30) who took part in the Shot Put Event. The average age of the subjects ranged from 18 to 24.
Prior to testing, the investigator was well acquainted with the subjects with due help from the coaches of the teams to explain the procedure in collecting the data. They were requested to co-operate and participate actively for the same.

Selection of Variables

The anthropometric measurements and body types that influence the performance in Track and Field events were recorded by reviewing and studying related literature in detail. A feasible analysis as to which of the important variables could be taken up for the investigation was made in consultation with the experts, keeping in mind the availability of the equipments, acceptability to the subjects and the legitimate time that would be devoted for tests as well as to keep the entire study integrated.

With the above criteria in mind, the following Anthropometric measurements (Carter, 1980) and Body types (Heath-Carter, 1982) to be taken on each subject were selected because they are very closely related to the performance of Track and Field athletes.
The chosen variables were on:

a) Anthropometric Measurements

(i) Height
(ii) Weight
(iii) Shoulder Width or Bis acromial diameter
(iv) Hip Width or Bisiliospinal diameter
(v) Elbow width or Bi-condylar Humerus diameter
(vi) Knee width or Bi-condylar femur diameter
(vii) Arm circumference
   (a) Upper Arm (b) Forearm
(viii) Calf Circumference
(ix) Thigh circumference
(x) Leg Length
(xi) Arm Length.

b) Body Types.

(i) Balanced Endomorphy
(ii) Mesomorphic Endomorphy
(iii) Mesomorph Endomorphy
(iv) Endomorphic Mesomorph
(v) Balanced Mesomorph
(vi) Ectomorphic Mesomorph
(vii) Mesomorph Ectomorph
(viii) Mesomorphic Ectomorph
(ix) Balanced Ectomorph
(x) Endomorphic Ectomorph
(xi) Endomorph Ectomorph
(xii) Ectomorphic Endomorph
(xiii) Central.

Procedure of Recording Anthropometric Measurements.

Body Stature (Height)

Purpose: To measure the erect body length from the sole of the foot to the top of the head.

Equipment: A standardized stadiometer.

Description:

The subject is asked to stand barefoot on the platform with heels, buttocks, back and head touching the upright of the stadiometer. The feet is placed parallel to each other and head held in the frankfurt horizontal plane, ie, tragion and right orbital lying in the same plane. The shoulders held comfortably and arms hung to maximum with palms touching the thighs. The sliding caliper of the stadiometer is lowered slowly so that it touched the vertex of the head in the mid sagittal plane. The measurement is recorded to 1/10th of a centimeter.

Body Weight

Purpose: To measure the total body mass.

Equipment: A standard weighing machine.
Description: The subject is asked to stand barefoot in the centre of a platform, exerting equal pressure on both the feet without any movement thereafter. The subject is allowed minimum possible clothing at the time of measurement. The weight is recorded to 1/10 th of a kilogram.

**Bisacromial Diameter**

(Shoulder Width)

Purpose: To measure the distance between the lateral margin of the acromial process with shoulders relaxed and elbows close to the body.

**Equipment:** Anthropometric compass.

Description: The subject stands with his shoulders relaxed to the point of slumbering forward. This gives the maximum shoulder width. The measurer feels the outside edge of the acromial process of the shoulder blade, which on a lean subject can be felt as a ridge just above the shoulder joints. The investigator rests the edge of one anthropometer arm upon one process and brings the other inwards until the edge of the other arm rests on the opposite process. The counter again reads to the nearest centimeter.

Caution: Squaring the shoulders backward invariably decreases his acromial diameter.
Bisiliac Diameter
(Hip Width)

**Purpose:** The width of the pelvic girdle is obtained at the level of the greatest distance between the lateral margins of the iliac crests.

**Equipment:** Anthropometric rod.

**Description:** The subject is made to stand with heels together and the anthropometer arms are brought into contact with the top of the hip bone (iliac crest) at the place which gives the greatest hip diameter. The object is to measure the body width only and strong pressure is put on the anthropometer blades to push aside any fat covering the bone.

Bicondylar Diameter
(Elbow Width)

**Purpose:** To measure the maximum distance between lateral and medial epicondyles of the humerus at right angles to the long axis of the upper arm.

**Equipment:** Sliding Caliper.

**Description:** The subject is asked to sit on a chair. The elbow is bent to a right angle and the width across
the outermost part of the lower end of the humerus is measured. Pressure is put on the blades of the anthropometer to compress any fat present.

Caution: The elbow width usually lies not at right angles to the long axis of the arm, but skewed, since the inner condyle of the humerus is lower than the outer one.

**Bicondylar Diameter**

*(Knee width)*

**Purpose:** To measure the widest margins between the lateral and medial epicondyles of the femur.

**Equipment:** Sliding Caliper.

**Description:** The individual is asked to sit on a chair with the knee bent at $90^\circ$ and the width across the outermost part of the lower end of the femur is measured.

**Upper Arm Circumference**

**Purpose:** To measure the maximum circumference of the upper arm taken horizontally.

**Equipment:** A standard flexible tape (Gullick Tape)

**Description:** The subject is asked to stand with arms hanging down freely. A circumferential point, half a
distance between the tip of the acromion and radial is located and marked. The tape is placed around this point in the horizontal plane i.e. at right angles to the axis of the hanging arm. The measurement is taken without pressing the skin surface, with no air space underneath and it is recorded to the nearest 1/10th of a centimeter.

Forearm Circumference

**Purpose:** To measure the maximum girth of the forearm when the hand is held palm up and relaxed.

**Equipment:** Gullick tape.

**Description:** The subject is asked to sit on a chair. The arm is extended slightly forward with palm facing upward and relaxed. The maximum girth of the forearm is taken to the nearest 1/10th of a centimeter.

Calf circumference

**Purpose:** To measure the maximum circumference of the calf.

**Equipment:** Gullick Tape.

**Description:** The calf circumference is taken with a steel tape at the maximum circumference of the calf in a plane at right angles to its long axis. Pressure is put on both the feet, the most bulging surface of the calf muscle is marked. The tape is placed around this point
horizontally in a plane at right angles to the long axis, with no extra pressure exerted on the skin contour. Reading is recorded to the nearest 1/10th of a centimeter.

**Thigh Circumference**

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

**Equipment:** Gullick Tape

**Description:** Thigh circumference is measured with a steel tape placed around the thigh horizontally with its top edge just under the fold of the buttocks. The subjects is to stand with body weight equally distributed on both the feet. The measurement is taken to the nearest 1/10th of a centimeter.

**Leg Length**

**Purpose:** To measure the length between the height of iliospinal (correction value) and the sole of the foot.

**Equipment:** Anthropometric rod.

**Description:** It is a projective measurement and is determined by subtracting correction value 40 mm. from the height of anterior iliospinal. The subject is asked to stand in an erect position with equal weight on both the feet. The difference in length between the height
of iliospinal (correction value) and the sole of the foot is recorded to the nearest 1/10th of a centimeter. The correction value varies with age and stature. In case of an adult an average value of 40 mm is recommended to be subtracted from the obtained leg length.

**Arm Length**

**Purpose:** To measure the straight distance between the acromion to the tip of the middle finger.

**Equipment:** Anthropometric Rod.

**Description:** The subject is asked to stand in attention position with arms hanging downward beside the body. The palms are kept stretched and parallel to the thighs. The subject is asked not to sink or elevate the shoulder once the position is set. The distance between the acromion and decyilion (tip of the middle finger) is measured to the nearest 1/10th of a centimeter.

**Body Types**

The Heath-Carter somatotype rating form is used. This method seems suitable for description of individual variation in the human species.

**Skinfold Measurements**

**Purpose:** The objective is to measure the thickness of a complete double layer of skin and subcutaneous
tissue without including any underlying muscle tissue.

**Equipment:** Skinfold Caliper

**Description:** The right side of the body is used to determine the percentage of fat. The thickness of the skin and subcutaneous fat is grasped between the thumb and index finger and measurement is taken to the nearest 1/10th of a millimeter and recorded.

To eliminate error, the reading is made in three to four seconds, when essentially all compression has taken place. If this precaution is not taken the skinfold would gradually have decreased because the tissue is squeezed out from the saws of the caliper. The skinfold measurements include.

**Triceps skinfold**

This skinfold thickness is taken over the triceps muscle at a point half way between the tip of the shoulder acromion process and process of the elbow. The spot is located with the forearm flexed to 90°. However, while recording the measurements the arm is allowed to hang freely. The fold is lifted parallel to the long axis of the arm.
Subscapular region

This skinfold is taken at the tip of the scapular (interior angle) with the subject in a relaxed standing position. The fold is lifted in the diagonal plane about 45° from the vertical and horizontal plane.

Supra-iliac

The subject is asked to stand relaxed. The skin is lifted one centimeter above the superior margin of the iliac crest, the point where it is cut by an imaginary vertical line drawn about 2-3 centimeters from the axillary fossa. The measurement is taken vertically.

Calf

The skinfold is located at the rear of the calf and at the point of greatest circumference. The skinfold is lifted parallel to the long axis of the leg. The Knee is flexed at 90°, and supported on the knee of the anthropometrist or on a chair.

Reliability of Data

The reliability of data was ensured by establishing instrument accuracy and Tester competency.
Instrument Reliability

The stadiometer, used for the measurement of height in centimeters, was a standard equipment (supplied by Anand Agencies, India) and was accurate enough for the purpose of the study.

The weighing machine used for measuring weight was tested for its accuracy by weighing and comparing different persons already weighed on a standard balance. Its reliability was examined and confirmed.

The steel tape used for anthropometric measurement was non-elastic and flexible (supplied by Freemans, India).

The anthropometric rod used for the measurement of shoulder and hip width, the compass used for the measurement of elbow and knee width, were standard equipment (supplied by Anand Agencies, India) and all the above mentioned measurements were recorded in centimeters.

Lange skinfold caliper was used to measure the skinfold thickness in millimeters. It was a standard equipment supplied by T.E.C New York and it was accurate enough for the purpose of this study.

All the instruments used were taken from the Research Laboratory of Lakshmibai National College of
Physical Education, Gwalior and Trivandrum, which were supplied by well known manufactures catering to various research laboratories and hence considered accurate and reliable.

**Tester Competency**

All the measurements were taken by the research scholar herself with the assistance from some other Lecturers and Research Assistants of Lakshmibai National College of Physical Education, Trivandrum.

Before going for the original data collection the scholar had a number of practice sessions under the supervision and guidance of Dr. Jayant Mukerji (Lecturer, L.N.C.P.E., Gwalior) and other experts.

To establish tester competency, five subjects were chosen at random and the measurements on all the anthropometric and skinfold variables were taken on them both by the research scholar and by the experts under identical conditions. The reliability coefficients of measurement between the two are presented in Tables 1 and 2.
<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Variables</th>
<th>Coefficient of correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Height</td>
<td>0.95</td>
</tr>
<tr>
<td>2.</td>
<td>Weight</td>
<td>0.97</td>
</tr>
<tr>
<td>3.</td>
<td>Shoulder width or bisacromial diameter</td>
<td>0.89</td>
</tr>
<tr>
<td>4.</td>
<td>Hip width or bisiliac diameter</td>
<td>0.85</td>
</tr>
<tr>
<td>5.</td>
<td>Elbow width or bicondylar humerus diameter</td>
<td>0.91</td>
</tr>
<tr>
<td>6.</td>
<td>Knee width or bicondylar femur diameter</td>
<td>0.90</td>
</tr>
<tr>
<td>7.</td>
<td>Upper arm circumference</td>
<td>0.89</td>
</tr>
<tr>
<td>8.</td>
<td>Forearm circumference</td>
<td>0.85</td>
</tr>
<tr>
<td>9.</td>
<td>Calf circumference</td>
<td>0.87</td>
</tr>
<tr>
<td>10.</td>
<td>Thigh circumference</td>
<td>0.86</td>
</tr>
<tr>
<td>11.</td>
<td>Leg length</td>
<td>0.84</td>
</tr>
<tr>
<td>12.</td>
<td>Arm length</td>
<td>0.88</td>
</tr>
</tbody>
</table>
TABLE A_2

COEFFICIENT OF CORRELATION FOR TESTER RELIABILITY
ON SKINFOLD MEASUREMENTS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Variables</th>
<th>Coefficient of correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Triceps</td>
<td>0.85</td>
</tr>
<tr>
<td>2.</td>
<td>Subscapular region</td>
<td>0.90</td>
</tr>
<tr>
<td>3.</td>
<td>Suprailliac</td>
<td>0.92</td>
</tr>
<tr>
<td>4.</td>
<td>Calf</td>
<td>0.87</td>
</tr>
</tbody>
</table>

It is evident from the above two tables that the reliability coefficients achieved were high and thus data collected was accepted to be reliable.

Collection of Data

The chosen variables were collected by the research scholar along with the assistance of trained personnel who visited Thiruchendur (Tamil Nadu) and Chandigarh (Punjab) during the South Zone Inter University and the All India Inter University Track and field Meet in the years 1989 and 1990 respectively.
The data was collected from the athletes with their consent and convenience either on the Track and Field arena or at their place of accommodation by the investigator who was assisted by team coaches, managers and a few faculty members from L.N.C.P.E, Trivandrum.

Statistical Techniques Employed

For the purpose of comparing the influence of selected anthropometric measurements and body types on selected track and field events i.e. sprinters, Jumpers and Throwers, One-way Analysis of Variance was utilised as an overall test of significance of difference between means. Whenever the analysis of variance resulted in a significant 'F'-ratio, post-hoc comparison test was computed to find out the significance of the differences of paired means.