Chapter III

Procedure
PROCEDURE

This chapter contains the methods employed for selecting the subjects, tools and techniques used for collecting the relevant data and statistical procedures applied for its analysis.

**SELECTION OF SUBJECTS:** For the purpose of this study 25 elite male throwers for each Javelin, Shot put, Discus and Hammer throws were selected from various National and Inter-National tournaments, State and SAI hostels and India camp.

**Anthropometrical measurement from 25 Elite male shot putters were collected from:**
- Eight- Shot putters from All India Police Athletic championship, Kolkata date. 20-11-2004
- Five Shot putters from Delhi SAI Hostel, dated 11-03-2005.
- Three Shot putters from India camp, dated- 05-02-2005.
- One Shot putter from Indo-Pak Punjab competition, dated -18-02-2005.
- Two Shot putters from State Hostel Lucknow, dated- 30-12-2004.

**Anthropometrical measurement from 25 Elite male Discus thrower were Collected from:**
- Seven Discus throwers from All India Police Athletic championship, Kolkata, dated- 20-11-2004
- Five Discus throwers from Delhi SAI Hostel, dated 11-03-2005.
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- Four Discus throwers from India camp, dated- 05-02-2005.
- One Discus thrower from State Hostel Lucknow, dated- 30-12-2004.
- One Discus thrower from Indo-Pak Punjab competition, dated-18-02-2005.

**Anthropometrical measurement from 25 Elite male Javelin thrower were collected from:**

- Eight Javelin throwers from All India Police Athletic championship, Kolkata, dated- 20-11-2004
- Three Javelin throwers from Delhi SAI Hostel, dated 11-03-2005
- Four Javelin throwers from SAI Hostel Patiala, dated 27-01-2005.
- Three Javelin throwers from India camp, dated- 05-02-2005.
- Two Javelin throwers from State Hostel Lucknow, dated- 30-12-2004.

**Anthropometrical measurement from 25 Elite male Hammer thrower were collected from:**

- Seven Hammer throwers from All India Police Athletic championship, Kolkata, dated- 20-11-2004
- Three Hammer throwers from India camp, dated- 05-02-2005.
- One Hammer thrower from State Hostel Lucknow, dated- 30-12-2004.
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The selected subjects belonged to the 15 states of India. Namely -U.P, Punjab, Haryana, Delhi, Bihar, Chhattisgarh, Jharkhand, Karnataka, Kerala, M.P, Maharashtra Uttaranchal, J&K, West Bengal, Andhra Pradesh, Tamilnadu.

CRITERIAN MEASURE

The criterion measures for this study were-

- Weight - Kilogram
- Anthropometrical parameters - Centimeter and mm.
- Proportionality (indices) - Ratios
- Somatotype - Grading
- Body Composition - % (percents)

RELIABILITY OF DATA

Reliability of data was ensured by establishing the reliability of anthropometrical Instruments and tester’s competency.

INSTRUMENTS RELIABILITY

Anthropometric kit was used for obtaining anthropometric measurements. The instruments were of standard quality. The manufacturer had ensured their accuracy. International society for the advancements of kinanthropometry (ISAK) approved techniques were used for obtaining Anthropometrical data. The reliability was checked by test-retest method and average co-efficient was found to be 0.96.

The following instruments were used for collecting the data

1- Weighing machine
2- Steel measuring tape
3-Stadiometer
4-Vernier caliper
5-Skinfold caliper
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6-Sliding caliper
7-Chest caliper
8-Sitting height table

TESTER COMPETENCY

The researcher was well versed in anthropometrical measuring technique he had number of practice sessions under the supervision of Dr. B. B. Singh, Reader department of Physical health & sports education A.M.U. Aligarh.

COLLECTION OF DATA

The data in the form of criterion measure of study described above were collected through the following methods-

1. BODY MASS: - The subjects were examined in clothing of known weight in Kg in order to record nude weight with the help of weighing machine. The position of the subject was anatomical position, the palm face outward eye looking ahead neck and back was straight.

2. STATURE: - Stature in cm. 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 frank fort horizontal plane along a wall on which a measuring tape was fixed. The subject is instructed to “look straight ahead” and “take a deep breath.” And the recorder had noted the height up to nearest mm. with the help of measuring tape.

3. SITTING STATURE: - 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 planes becomes horizontal. Gentle upward pressure was applied to the mastoid processes. The muscles of the thigh and buttock were contracted in order to stretch him full.
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The horizontal bar of the anthropometric rod was brought down so that it touched the highest point on the head. The distance between anthropometer rod and the highest point of the stool was measured.

4. CHEST BREADTH: - The subject stood erect and abducted the arms so as the tape can be placed around the chest. Arms of the subjects were lowered after placing the tape. The measurement was taken through the nipple line at the mid-tidal volume.

5. UPPER ARM LENGTH: - The subject was made to sit erect with arms hanging down normally with the palm of right hand direction towards thigh. Inferior border of the Acromion process to radiale were marked. The distance between these two points was measured with the help of measuring tape and the value was recorded.

6. LOWER ARM LENGTH: - The subject was made to stand with arms hanging down normally. Radiale and dactylic were marked on the right hand. The distance between two points was recorded with the help of measuring tape.

7. TOTAL ARM LENGTH: - The subject was made to stand with arms hanging down normally. Acromion and Dactylion were marked on the right hand. The distance between two points was measured with the help of measuring tape.

8. UPPER LEG LENGTH-The subject was made to stand erect with weight equally distributed on both legs. Trochanterion and Tibiale lateral of the right leg was marked. The distances between these two points was measured with the help of measuring tape.

9. LOWER LEG LENGTH -: The subject was made to stand erect with body weight equally distributed on the legs. The distance was measured between Tibiale medial to Sphyrion Tibiale with the help of measuring tape.
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10. TOTAL LEG LENGTH: The subject was made to stand erect with body weight equally distributed on the legs. The distance between trochanterion to pternion or grand was measured with the help of measuring tape.

11. FOOT LENGTH: The subject was standing at plane surface the straight distance between acropodion and pternion, was recorded with the help of measuring tape.

12. SHOULDER BREADTH: The subject stood with arms by the sides and weight evenly distributed on both legs. The measuring distance between left acromion to right acromion process was recorded from behind the neck.

13. BICEPS MUSCLE GIRTH: The subject was made to raise his right arm to horizontal position in the sagittal plan with the fully supinated forearms flexed at the elbow to an angle of 45°. The subject was asked to tense his biceps, the measurement was taken with the help of measuring tape wrapped at right angle to the long axis of the upper arm where the maximum girth was possible.

14. 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 angle to the axis of lower leg, where it was maximum.

15. THIGH MUSCLE Girth: The Subject stood erect with arms by sides. The tape was positioned horizontally just below the gluteal furrow about 2/3 of the distance from the mid-knee to the crotch. The measurement was taken with help of measuring tape.

16. HIPS BREADTH: The subject was made to stand erect with sliding caliper applied from behind the subject so that branches of sliding caliper were at the most lateral points on the superior border of the iliac crests.
Figure: 2 - Anatomic Locations of the Sites for Girth Measurements

(According to McArdle et.al. 1991)

A - Shoulders
B - Chest
C - Biceps
D - Forearm
E - Wrist
H - Hips
I - Thigh
K - Calf
L - Ankle
Figure: 3- Landmarks for Skinfold Measurement According to Anthropometric Standardization Manual (Lehman et al. 1988)

Suprailiac Skin Fold at 45° angle

Fig: A superailiac skin fold

Fig: B Midaxillary

Fig: C Thigh Skinfold

Fig: D Medial calf skin fold
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Figure: 4 - Anatomic Locations for the Measurement of Skeletal Diameters and Skin Fold Thickness

- Biacromi
- Chest
- Bi- iliacc
- Wrist
- Bitrochanteric
- Knee
- Ankle
- Elbow
- Triceps
- Subscapular
- Chest, biceps, Abdominal & thigh skin folds
- Thigh
- Triceps and Sub scapular skin folds
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17. HUMERUS BIEPICONDYLER 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 epicondylar of the humerus was measured with the help of Vernier caliper and the value was recorded.

18. FEMUR BIEPICONDYLER DIAMETER: - The subject was made to sit and the right leg was flexed at the knee to from a right angle with thigh. The distance between medial and lateral epicondylar of the femur was measured with the help of vernier caliper and the value was recorded.

19. FOREARM GIRTH: - Subject stood erect with the arms extended in front of the body and parallel to the floor with the palm supinated. Reading was recorded at the level of maximum circumference with the help of measuring tape.

20. CHEST DEPTH: The subject sit erect on a stool or table and the measurement taken from his anteriorl to posteriorl level of mesosternal point (at the level of 5th to 6th ribs) with the help of chest depth caliper/chest caliper.

21. WRIST BREADTH: The subject sit on stool extends hand towards the anthropometrist with palm facing downwards. He measures the breadth between the most medial and lateral points of the distal epiphyses of radius and ulna, with the help of sliding caliper.

22. ANKLE BREADTH: The subject was seated with foot gently touching the ground. Distance was measured between the sphyrion tibiale to sphyrion fibular with help of the sliding caliper.

23. 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 2-3 seconds the reading was taken. One more reading was taken in the same way and average of the two was the final score.

24. 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 - 3 seconds the reading was taken. One more reading was taken by the same procedure and average of the two was the final score.

25. SUPRAILIAC SKIN FOLD: A point above the anterior superior iliac spine on the line to the anterior auxiliary’s boarder of right side was marked. The skin fold about 2 to 5 centimeter above marked level was picked up, the caliper was applied to the fold and after waiting for 2 - 3 seconds the reading was taken. One more reading was taken by the same procedure and average of the two was considered.

26. THIGH SKIN FOLD: The skin fold measure was taken on the anterior surface mid-way between the mid-inguinal point and the superior border of patella. The knee should be flexed at 90°.

27. CALF SKIN FOLD: The subject was made to sit on a chair with knees bent 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.

28. PERFORMANCE: The subject best performance or distance throwing during the competitions or sports trials.

30. TRAINING AGE: It was total time spent on training till 31 Dec-2005.

31. TOTAL AGE: The subject’s total age was calculated from birth to 31 December 2005.
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SOMATOTYPE

The following heath and Carter (1984) method was applied to determine Somatotype of subjects;

**Endomorphy:**

\[-0.7182 + 0.1451 \times \sum SF - 0.00068 \times \sum SF^2 + 0.0000014 \times \sum SF^3\]

[Where \(SF = \text{sum of triceps, sub scapular and supraillic skin fold multiplied by 170.18/height in centimeter}\).]

**Mesomorphy**

\[0.858 \times \text{humerus breadth} + 0.601 \times \text{Femur breadth} + 0.188 \times \text{Corrected arm girth} + 0.161 \times \text{Corrected calf girth} - \text{height} \times 0.131 + 4.5\]

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

**Ectomorphy:**

The ectomorphy was determined by comparing the calculated height, weight ratio (HWR) of the subject with the underline values given below.

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

- If HWR is greater than or equal to 40.75 than ectomorphy = \(0.732 \times \text{HWR} - 28.58\)
- If HWR is less than 40.75 and greater than 38.25 then ectomorphy = \(0.463 \times \text{HWR} - 17.68\)
- If HWR is equal to or less than 38.25 than ectomorphy = 0.1

**Proportionality**

The following indices were used to determine various body segmental Proportionality.
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- Sitting height – stature index = \( \frac{\text{Sitting height}}{\sqrt{\text{Stature}}} \times 100 \)
- Ponderal Index = \( \frac{\text{Weight}^{\frac{3}{4}}}{\text{Height}} \)
- Thigh Length–lower leg length index = \( \frac{\text{Thigh Length}}{\text{Lower leg length}} \times 100 \)
- Upper arm length – lower arm length index = \( \frac{\text{Upper arm length}}{\text{Lower arm length}} \times 100 \)
- Hip Breadth – Stature Index = \( \frac{\text{Hip breadth}}{\text{Stature}} \times 100 \)
- Shoulder Breadth – Stature Index = \( \frac{\text{Shoulder breadth}}{\text{Stature}} \times 100 \)

BODY COMPOSITION:

**Body Fat Percentage:** It is body fat mass in terms of percentage and was estimated from the equation of Katch and Mc Ardle:

\[ \text{Body fat (\%) = 0.43(A) + 0.58(B) + 1.47} \]

\( A = \) Triceps fat fold (mm)
\( B = \) Subscapula fat fold (mm)
STATISTICAL PROCEDURE

Reiterating the objective of the study, we have to point out that we intend to investigate the anthropometrical differences among four types of throwers. Further we also intended to find out the relationship between anthropometrical measurement and the performance of the throwers. Thus we had used analysis of variance to found out the significant difference among the four types of throwers. Where the difference was significant, we had used L.S.D. test to analyse, which group mean was greater than other. Product moment correlation technique was used to find out, the relationship existing between the anthropometrical measurement and performance of the thrower groups.

LEVEL OF SIGNIFICANCE

The significance of differences among thrower’s anthropometrical measurements was tested at 0.05 level of significance.