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CHAPTER – III
METHODOLOGY

In this chapter details about the subjects, criterion measure, instruments and tools used, reliability of data, experimental design and analytical procedure of data have been presented.

3.1 THE SUBJECTS

A total of five hundred male students of classes XI and XII were selected as subjects for the present study. Out of them three hundred were from rural area and the rest of two hundred were from urban area. The subjects were selected from six higher secondary schools of West Bengal.

3.2 CRITERION MEASURE

For the present study the anthropometric parameters, physical parameters and personality factors were selected as the measuring criteria.

Among physical parameters the selected ones were height, weight, BMI and %BF. In addition to this, chronological age was also considered for investigation in this study.

The selected anthropometric measurements were skinfolds of biceps, triceps, subscapular, suprailliarc, supra spinal & calf, girths of biceps & calf and breadth of femur and humerus.

In performance related fitness the selected parameters were locomotor speed, leg explosive strength and agility.

In personality characteristics, sixteen personality factors as proposed by Cattell were the selected criteria for measurement.

3.3 INSTRUMENTS AND TOOLS USED

For collecting data the following instruments and tools were used.

Instruments:

i) Anthropometer : Anthropometer was used for measuring body height.

ii) Weighing machine : Weighing machine was used for measuring body weight.
iii) Skinfold caliper: Skinfold caliper was used for measuring skinfold of biceps, triceps, subscapular, suprailliac, supraspinale and calf.

iv) Steel tape: Steel tape was used for measuring girths of biceps and calf.

v) Sliding caliper: Sliding caliper was used for measuring breadths of femur and humerus.

vi) Stop watch: Manually operated digital stopwatch was used to measure time.

Tools:

i) Standing Broad Jump Test: Standing Broad Jump test was used to measure Leg Explosive Strength.

ii) Shuttle Run Test: 4 × 10 yards. Shuttle run test was used for measuring agility.

iii) Cattell 16 PF Questionnaire: Personality characteristics were assessed by using Cattell 16 PF Questionnaire.

iv) School Final Pass Certificate: Date of birth as evident from MP Certificate was used to calculate chronological age.

3.4 RELIABILITY OF DATA

Reliability of data was ascertained by confirming reliability of instruments and tools as well as testers reliability. Reliability of the instruments were guaranteed from their manufacturers. The practical tests used were standardised tests. Tester’s reliability was confirmed by test-retest method.

3.5 PROCEDURE FOR COLLECTING DATA

Anthropometric Measurements:

The following measurements were taken to calculate anthropometric somatotype, %BF and BMI.

Base:

- Height (cm.)
- Weight (kg)

Skinfold thickness:

- Biceps (mm)
- Triceps (mm)
• Subscapular (mm)
• Suprailliac (mm)
• Supraspinale (mm)
• Calf (mm)

**Breadth:**
• Humerus (cm)
• Femur (cm)

**Girth:**
• Biceps (cm)
• Calf (cm)

3.5.1 Measurement of Base:

3.5.1.1 Height

**Purpose:** To measure the body height from head to foot of the subject.

**Facilities and Required Equipments:** A steel tape, horizontal surface and anthropometer manufactured by Hindusthan Minerals & Natural History Specimens Supply Co., Kolkata, India.

**Procedure:** Each subject was asked to stand erect on a horizontal surface and to stretch as much as possible taking care that heels were touching each other on the horizontal surface vertically and the horizontal arm was brought down so that it touched the highest point on the head in the mid sagittal plane and the height was recorded in cm.

3.5.1.2 Weight

**Purpose:** To measure the body weight of the subject.

**Required Facilities and Equipment:** A weighing machine, manufactured by CROWN Co. Ltd., for measuring body weight of the subject.

**Procedure:** A standard weighing machine was used for measuring weight. The subject stood on the weighing machine maintaining erect posture and the body weight was recorded in kg.
3.5.2 Measurement of Skinfold Thickness

Skinfold measurements were taken in millimeter from erect standing position of the subject by skinfold caliper manufactured by Hindusthan Minerals & Natural History Specimens Supply Co., Kolkata, India.

3.5.2.1 Biceps

The skinfold measurement taken parallel to the long axis of the arm at the biceps skinfold side was considered as the biceps skinfold.

Subject position: The subject was found in a relaxed standing position. The right arm was relaxed with the shoulder externally rotated and the elbow extended by the side of the body.

Method: The skinfold was measured by raising a vertical fold at the mid acromiale-radiale line on the anterior surface of the arm. Photograph 1 shows the technique used.

Photograph 1: Skinfold measurement of Biceps
3.5.2.2 Triceps

The skinfold measurement taken parallel to the long axis of the arm at the triceps skinfold side was considered as the triceps skinfold.

Subjects position: The subject was found in a standing position. The right arm was relaxed with the shoulder joint externally rotated to the mids-prone position and elbow extended by the side of the body.

Method: The measurement was taken on the posterior surface of the arm. Photograph 2 shows the technique used.

Photograph 2: Skinfold measurement of Triceps

3.5.2.3 Subscapular

The skinfold measurement taken with the fold running obliquely downwards at the subscapular skinfold side was considered as the subscapular skinfold.

Subject position: The subject was found in relaxed standing position with the arm hanging by the sides.
Method: The line of the skinfold was determined by the natural fold lines of the skin. Photograph 3 shows the technique used.

Photograph 3: Skinfold measurement of Subscapular

3.5.2.4 Suprailliac
The skinfold measurement taken near horizontally at the Illiac Crest skinfold site was considered as the suprailliac skinfold.

Subject position: The subject was found in a relaxed standing position when the right arm was abducted.

Method: The line of the skinfold generally runs slightly downward posterior anterior by the natural folds of the skin. Photograph 4 shows the technique used.
3.5.2.5 Supraspinale

The skinfold measurement taken with the fold running obliquely downwards at the supraspinale skinfold side was considered as the supraspinale skinfold.

Subject position: The subject was found in relaxed standing position with the arms hanging by the sides.

Method: The fold runs medially downward and anteriorly at about a 45° angle as determined by the natural folds of the skin. Photograph 5 shows the technique used.
The skinfold measurement taken vertically at the medial calf skinfold side was considered as the calf skinfold.

**Subject position**: The subject was found in relaxed standing position with the right foot placed on the box or chair. The right knee was bent at about 90°.

**Method**: The subject's right foot was placed on a box or chair with the calf-relaxed. The fold was parallel to the long axis of the leg. Photograph 6 shows the technique used.
3.5.3 Measurement of Breadth:

The breadths of Humerus and Femur were measured by sliding caliper manufactured by Galaxy International, New Delhi, India, graduated in cms.

3.5.3.1 Humerus

The linear distance between the most lateral aspect of the lateral humeral epicondyle and the most medial aspect of the medial humeral epicondyle was considered as the humerus breadth.

Subject position: The subject was found in a relaxed standing position or seated position. The right arm was raised anteriorly to the horizontal and the forearm was flexed at right angles to the arm.

Method: With the small sliding caliper gripped correctly, the middle fingers were used to palpate the epicondyles of the humerus, starting proximal to the sides. The bony points first left were the epicondyles. The caliper faces were placed on the epicondyles and maintain strong pressure with the index fingers until the value was
Because the medial epicondyle is normally lower than the lateral epicondyle the measured distance may be somewhat oblique. Photograph 7 shows the technique used.

3.5.3.2 Femur

The linear distance between the most lateral aspect of the lateral femoral epicondyle and the most medial aspect of the medial femoral epicondyle was considered as the femur breadth.

Subject position: The subject was found in a relaxed seated position with the hand clear of the knee region. The right leg was flexed at the knee to form a right angle with the thigh.

Method: The distance was measured between the medial and lateral epicondyles of the femur. With the subject seated and the caliper was placed, the middle fingers were used to palpate the epicondyles of the femur beginning proximal to the sides. The bony points first felt were the epicondyles. The caliper faces were placed on the epicondyles and strong pressure was maintained with the index fingers until the value was read. Photograph 8 shows the technique used.
3.5.4 Measurement of Girths:

The girths were measured by steel tape, manufactured by Tajima Asa Bhanu Tools Ltd., Hyderabad, India, graduated in cms. The measurement was taken in such a way that the tape was kept as right angle to the long axis of the body segments. During measurement compression on the skin by tape was as minimum as possible.

3.5.4.1 Biceps

Biceps girth was considered as the circumference of the arm perpendicular to the long axis of the arm at the level of the peak of the contracted biceps brachii, when the arm was raised anteriorly to the horizontal.

Subject position: The subject was found in a relaxed standing position with the left arm hanging by the side. The subject's right arm was raised anteriorly to the horizontal with the forearm supinated and flexed at about 45° – 90° to the arm.
Method: The measurer stood by the side of the subject and with the tape loosely in position. The subject was asked to partially tense the elbow flexors to identify the probable peak of the contracted muscles. The subject was encouraged to contract the arm muscles as strongly as possible and hold it while the measurement was made at the peak of the biceps brachii. Photograph 9 shows the technique used.

Photograph 9: Girth measurement of Biceps

3.5.4.2 Calf

The circumference of the leg at the level of the medial calf skinfold side, perpendicular to its long axis was considered as the calf girth.

Subject position: The subject was found in a relaxed standing position with the arms hanging by the sides. The subject’s feet was separated with the weight evenly distributed.

Method: The subject usually stood in an elevated position. This elevated position made it easier for the measurer to align the eyes with the tape. The tape was passed around the calf and then slid the tape to the correct plane. The stub of the tape and the housing were both held in the right hand while the left hand was used to adjust the
level of the tape. The stub was controlled with the left hand and using the cross-hand technique positions the tape so that it was held in a plane perpendicular to the axis of the leg. The tape was then readjusted as necessary to ensure it had not slipped and did not indent the skin. Photograph 10 indicates the procedure followed.

Photograph 10: Girth measurement of Calf

3.5.5 Calculation of Somatotyping:

After measuring these sites the somatotype components were calculated with the help of Heath-Carter (1992) equation for Anthropometric somatotype as follows:

- Endomorphy = $-0.7182 + 0.1451 \times \Sigma SF - 0.00068 \times \Sigma SF^2 + 0.0000014 \times \Sigma SF^3$
  where $\Sigma SF = (\text{Sum of triceps, subscapular and supraspinale}) \times (170.18 / \text{ht in cm})$

- Mesomorphy = $(0.858 \times \text{humerus breadth}) + (0.601 \times \text{femur breadth}) +$
  $(0.188 \times \text{corrected arm girth}) + (0.161 \times \text{corrected calf girth}) -$
  $(\text{ht in cm} \times 0.131) + 4.5$
  where, corrected calf girth = calf girth (cm) – calf skinfold / 10
  corrected arm girth = arm girth (cm) – biceps skinfold (mm) / 10
• Ectomorphy = \((HWR \times 0.732) - 28.58\)

If HWR (Height / cube root of weight ratio) is less than 40.75 but more than 38.35, then

\[\text{Ectomorphy} = (HWR \times 0.463) - 17.63\]

The somatotyping was calculated by using M E R Goulding Software developed by Tim Olds (School of Physical Education, Exercise and Sports Science, University of South Australia) and Lindsay Carter (Professor Emeritus, Department of Exercise and Nutritional Sciences, San Diego State University)

3.5.6 Percent Body Fat:

There are a number of procedure for estimation of body fat. For the estimation of body fat the body density was calculated first with the help of Durnin and Womersley (1974) formula as given below:

\[\text{Body density} = 1.1620 - 0.0630 \log (\text{Biceps + triceps + subscapular + suprailliac skinfolds})\]

The calculated body density were converted to percent body fat by the formula devised by Brozek et al. (1963). The formula for calculating percent body fat were:

\[\text{Percent body fat} = \left(\frac{4.57}{\text{Body density}} - 4.142\right) \times 100\]

3.5.7 Body Mass Index (BMI):

For calculating Body Mass Index (BMI) two physical parameters such as height (in meter) and weight (in kg) of the subjects were measured. After measuring the height and weight of the subjects, the BMI was calculated with the help of following formula:

\[\text{BMI} = \frac{\text{Weight in kg}}{(\text{Height in meter})^2}\]

3.5.8 Performance related fitness parameters:

Performance related fitness was assessed by using following practical tests:

3.5.8.1 50 Yard Dash

50 Yard Dash test was used to measure locomotion speed.
**Purpose**: To measure the locomotion speed of the subject.

**Required Facilities and Equipments**: For measuring locomotion speed from the time of 50 yard dash of the subject, a starting clapper, a plane running ground, a stop watch manufactured by CASIO Computer Co Ltd, Tokyo, Japan, a whistle, marking powder and a trained time keeper were used.

**Procedure**: Two runners at a time took their starting position behind starting line. On hearing the sound of the starting clapper the runners started running down in their lanes at top speed to cross the finishing line. The ground was marked with two lanes, each four feet wide. The score was the time taken to cover the distance of 50 yard dash by the subject and was measured in second. A trained time keeper operated the stop watch at the finishing line. Another one recorded the result.

**3.5.8.2 Shuttle Run**

Shuttle Run test was used to measure agility

**Purpose**: To measure speed and agility, the reliability of the test item as indicated by Barrow (1979) was 0.89 and he also observed a face validity of the test item which was 0.83

**Required Facilities and Equipments**: Two parallel lines were drawn on the field 10 yard apart, two $2 \times 2 \times 4$ inches wooden blocks, stop watch and a measuring tape

**Procedure**: The subject was asked to stand behind the starting line. The two wooden blocks were placed on the other line away from the starting line. On hearing the sound of the starting clapper the subject ran fast towards the other line, took one of the blocks and returned to the starting line and placed it behind the starting line. The subject continued running shuttle back to pick up the second block and carried it to the starting line. This whole procedure completed the shuttle run

**Scoring**: The time taken by each subject from the sound of clapper to finish was recorded in second. Two time-keepers were present there for collecting the actual time of the two subjects.
3.5.8.3 Standing Broad Jump

Standing Broad Jump test was used to measure leg explosive strength.

**Purpose**: To measure the leg explosive strength and power.

**Required Facilities and Equipments**: The floor was used with a take off mark and measuring tape.

**Procedure**: The subject should stood with feet several inches apart and with the toes just back of the take off mark. The subject swing the arms and bend the knees in making the jump forward. Both feet left the floor at the same time.

**Instruction**: The subject took a crouch before the take off and preliminary movement. As the jump was made, the subject threw his arms up and out. He jumped on both feet and tried not to fall backward on landing.

**Scoring**: The measurement was made from the take-off line to the nearest point where any part of the body touched the floor. Three trials were permitted and the best was recorded to the nearest inches.

3.5.9 Personality :

**Procedure**: At the beginning, the subjects sat in a classroom. A copy of questionnaire along with the answer sheet had been provided to each of the subjects. The questionnaires provided to the subjects was the Bengali translation of Cattell’s 16 PF Questionnaire (Form C), standardized by Prof. Sukumar Ghosh and Dr. A. K. Chatterjee (Dept. of Applied Psychology, University of Calcutta). In the questionnaire there were one hundred five questions and each question had three alternatives. Before giving answers the subjects were given the following instructions :

i) Write your name and other particulars at the top of the answer sheet.

ii) Answer the questions as frankly and truely as possible.

iii) Although this is an untimed test, we would like you to answer the questions as quickly as you can. Give the first, natural answer as it comes to you.

iv) Use the middle answer only when it is absolutely impossible to lean toward ‘yes’ or ‘no’ answer.

v) Don’t skip any question. Occasionally, a statement may not seem to apply to you
or your interests, but answer each one somehow.

After the completion of instructions, the subjects started to answer the questions. The answer sheets were collected from the subjects when they finished their input of information.

**Scoring** : After checking the answers marks were given according to the chosen options and adding points for marked choices factor by factor using norm given in Annexure – E. Raw scores were transformed to standard scores (STENS) by a look up table given in Annexure -- E.

### 3.6 EXPERIMENTAL DESIGN

In the present study parallel group design was used. There were two group of subjects – rural and urban were compared in somatotyping, physical characteristics, performance related fitness and personality factors.

### 3.7 ANALYTICAL PROCEDURE

The obtained data in form of digital scores were treated statistically to get results and to draw conclusions. The mean and standard deviation were calculated as descriptive statistics. Coefficient of correlation was calculated as the measure of relationship. Statistical significance of two group mean difference was tested by t-test. The statistical calculations were completed using SPSS version 10.