

CHAPTER III

MATERIALS

AND METHODS

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In this chapter the selection of subjects, selection of variables, orientation of subjects, reliability of instruments, competency of testers, criterion measures, administration of tests, subject reliability, collection of data and statistical techniques used for analysing the data are explained.

3.1. SELECTION OF SUBJECTS

Thirty three Basketball, twenty Volleyball and thirty seven Football players who participated in All India Inter-University Tournaments in the year 1996-97 were selected as subjects at random and their age was between eighteen and twenty five years.

The purpose of the study and the procedure of the tests to be administered were explained to the subjects, and a written consent was obtained from the individual subjects to undergo the tests.

3.2. SELECTION OF VARIABLES

The research scholar had gone through both critical as well as allied literature related to the problem and listed the variables which constituted the components of body composition, anthropometric and physiological variables. Keeping in mind the feasibility criteria, facilities and equipments available, the following variables were selected to analyse the body composition, anthropometric and physiological variables to determine the significant difference among the university men Football, Volleyball and Basketball players.

3.2.1. ANTHROPOMETRIC VARIABLES

1. Age

2. Weight

3. Height

Sitting Height

4. Length

Lower Limb length

Upper Limb length

5. Width

Humerus

Femur

6. Circumference

Chest

Abdomen

Relaxed arm

Flexed arm

Calf

7. Skinfold

Biceps

Triceps

Subscapular

Anterior thigh

Suprailiac

Medial Calf

Sum of Six skin folds

8. Indexes

Ponderal index

Skelic index

9. Somato type

Endomorphy

Mesomorphy

Ectomorphy

3.2.2. BODY COMPOSITION

- 1. Body fat percentage**
- 2. Absolute body fat**
- 3. Lean Body weight**

3.2.3. PHYSIOLOGICAL VARIABLES

- 1. Anaerobic power**
- 2. Resting pulse rate**
- 3. Cardiorespiratory endurance**

3.3. CRITERION MEASURES

The following criterion measures were chosen for testing the hypothesis.

3.3.1. ANTHROPOMETRIC VARIABLES

- 1. Age recorded in years**
- 2. Weight measured in Kilograms**
- 3. Height measured in centimetres.**
- 4. Humerus, femur and limb lengths and circumference measured in centimetres.**
- 5. Sum of six skinfolds measured in millimetres.**
- 6. Ponderal index, skeletal index, endomorphy, mesomorphy and ectomorphy recorded in points.**

3.3.2. BODY COMPOSITION

1. Body fat percent recorded in percentage.
2. Absolute body fat recorded in milligrams.
3. Lean body mass recorded in kilogram.

3.3.3. PHYSIOLOGICAL VARIABLES

1. Anaerobic power recorded in kg.m/sec.
2. Resting pulse-rate counted per minutes.
3. Cardiorespiratory endurance recorded in metres.

3.4. RELIABILITY OF DATA

The reliability data was ensured by establishing the instrument reliability, testers' competency and reliability of the tests. The reliability was established by test, re-test process. For this purpose thirty three Basket ball, twenty Volley ball and thirty seven Football men players who represented in the All India Inter-University Tournaments were tested and re-tested on selected variables.

3.4.1. Instruments Reliability

Stop watch was used for measuring anaerobic power and recorded in kilogram metres per second, pulse rate in seconds, cardiorespiratory endurance in minutes. Skinfold caliper and vernier caliper was used for measuring body composition and anthropometric measures; and recorded in millimetre and centimetre respectively. Steel tape was also used to measure anthropometric variables. They were procured from standard reliable companies and their calibrations were

tested with other standard instruments and they were considered and accepted as reliable and precise for the purpose of this study.

3.4.2. Subject Reliability

The test, re-test intra-class co-efficient of correlation also indicated subject reliability as the same subjects were used under similar conditions by the same tester.¹

3.4.3. Tester's Reliability

All measurements were taken by the investigator himself with the assistance of experienced research scholars. For all measurements the investigator conducted pilot study and was well acquainted with measurements. The investigator took a number of measurements to ensure the accuracy of the measurements. Finally, measurements in all the variables were taken by the investigator. The scores thus obtained for each variable by test, re-test methods were correlated, using intra-class correlation. The co-efficient of correlations are presented in Table I.

¹Jerry R. Thomas and Jack K. Nelson, *Introduction to Research in the Health Physical Education, Recreation* (Champaign, Illinois : Human Kinetics Publishers, 1985), P.258.

TABLE I
INTRA - CLASS CO-EFFICIENT OF CORRELATION TEST RE-TEST
SCORES

Test items	Correlation value
Age	0.91*
Body weight	0.93*
Height	0.99*
Sitting Height	0.95*
Lower Limb length	0.91*
Upper Limb length	0.90*
Humerus Width	0.96*
Femur Width	0.94*
Chest circumference	0.99*
Abdominal circumference	0.92*
Relaxed arm circumference	0.91*
Flexed arm circumference	0.97*
Calf circumference	0.98*
Sum of six skinfolds	0.92*
Ponderal index	0.95*
Skelic index	0.91*
Endomorphy	0.92*
Mesomorphy	0.95*
Ectomorphy	0.99*
Percent fat	0.98*
Absolute fat	0.97*
Lean body weight	0.93*
Anaerobic power	0.91*
Resting pulse rate	0.96*
Cardio-respiratory endurance	0.94*

*Significant at 0.01 level of confidence

3.4.4. Orientation of the subjects

A thorough orientation of the requirements of the experimental procedures and testing were explained to the subjects, so that there was no confusion about efforts required on their part. In order to get full co-operation from the subjects, they were oriented about the method of performing the test items and were demonstrated to the subjects before starting the tests.

3.4.5. Pilot Study

A pilot study was conducted with five subjects before conducting the tests to find out the suitability and adaptability.

3.5. TEST ADMINISTRATION

3.5.1. ANTHROPOMETRIC VARIABLES

3.5.1.1. Age

The chronological age was recorded as given by the students at the time of admission.

3.5.1.2. Body Weight

The subject stood in centre of the scale platform of the clinical weighing balance with minimum clothing and the weight was recorded in kilograms.

3.5.1.3. Height

Standing height was taken as the individual stood against the upright wall with a marked scale, touching it with heels, buttocks and back. The head was oriented in such a way that the upper border of

the ear opening and the lower border of the eye socket was on a horizontal line and the heels were together. The subject was instructed to take and hold a full breath and stand tall while the square was brought on to the subjects vertex. The height was recorded to the nearest centimetre.

3.5.1.3.1. Sitting Height

The subject was seated on a table with his feet unsupported. The right angle formed almost at the knee but did not completely touch the edge of the table. The hands rested on the thighs. The head was oriented front horizontal plane and the distance between the vertex and table was measured. Gentle upward traction was exerted on the mastoid region while the subject was holding a full inspiration.

3.5.1.4. Length

3.5.1.4.1. Upper limb length

Arm length was measured from acromion process above the shoulder joint to the tip of the middle finger inside view.²

3.5.1.4.2. Lower limb length

Leg length was measured from the end of the spinal column to the floor and it was also taken from greater trochanter to the floor.³

²J.M. Jenner, *The Physique of Olympic Athletes* (London: George Allen and Urwin Ltd., 1964), P.145.

³L.Barry Johnson and Jack K. Nelson, *Practical Measurement for Evaluation in Physical Education* (New Delhi : Surjeet Publications, 1988), P.182.

3.5.1.5. Width

3.5.1.5.1. Humerus Width

Vernier Caliper was used to measure the bone diameter. The points on either epicondyle of the distal extremity of the humerus or femur most lateral to the medial were the landmarks used.

The breadth of the humerus was taken when the arm of the subject was raised forward approximately to the level of the shoulder and the forearm was flexed at right angle to the arm applying the discs of the caliper to the epicondyles, bisecting the angle of the elbow and lying in the same plane as the arm and forearm.

3.5.1.5.2. Femur Width

The femur breadth was measured in centimetres. When the subject was sitting on a chair with his foot on the floor and the leg vertical, the researcher knelt down in front of the subject, and applied the discs to the epicondyles, bisecting the knee angle and keeping the caliper branches in a plane parallel to the thigh and leg and the measurement was taken.

3.5.1.6. Circumference

3.5.1.6.1. Chest Circumference

Subject stands erect. His arms are raised and the tape is placed across the back at the level of nipples, but is brought across the front above the fullness of the breast. Record the measurement at the maximum dimension during the normal breathing.⁴

⁴Surinder Nath, "*Anthropometry*", (Delhi : Friends Publications, 1993), P.81.

3.5.1.6.2. Abdomen Circumference

Subject stands erect with his heels together. Using the flexible tape, measure the relaxed abdomen at the level of the umbilicus just above the "fat roll".⁵

3.5.1.6.3. Relaxed arm Circumference

The relaxed arm was measured when it was maximally flexed and muscles full contracted.

3.5.1.6.4. Flexed arm Circumference

The flexed arm was measured when it was fully extended and the muscles contracted.

3.5.1.6.5. Calf Circumference

It is the point of maximal calf circumference at the top of the calf muscles and lowered until the greatest girth is located, at right angles to the long axis of the leg.

3.5.1.7. Skinfolts

3.5.1.7.1. Biceps skinfold

The skinfold measurement was taken in millimetres with the subject's hand hanging loosely. The skinfold was raised with the thumb and forefinger of the left hand over the biceps muscle on the front of the subject's right upper arm, half way between the shoulders and the elbow where the skinfold runs parallel to the long axis of the arm.

⁵*Ibid.*, P.74.

3.5.1.7.2. Triceps skinfold

It was measured with the subject standing with the arms by the side and the elbow extended but relaxed, the skinfold was raised with the thumb and forefinger of the left hand over the triceps muscle on the back of the right arm, half way between the acromion and elbow, and was measured in millimetres.

3.5.1.7.3. Subscapular skinfold

With the subject standing with shoulders erect but relaxed and arms by the side, the skinfold was raised with the thumb and forefinger of the left hand lateral to the interior angle of the right scapula and running downward and outward in the direction of the ribs, was taken in millimetres.

3.5.1.7.4. Anterior thigh skinfold

The right foot was placed on a twenty centimeter step with the knee slightly flexed and thigh muscle relaxed. The skinfold was raised as mentioned earlier, midway on the anterior of the thigh between the trochanteric and the proximal border of the pettala. The fold was lifted parallel to the long axis of the thigh and the measurements were taken in millimetres.

3.5.1.7.5. Suprailiac skinfold

The skinfold measurement was taken in millimetres while the subject was drawing a medium breath and holding it, the skinfold was raised with the thumb and forefinger of the left hand in a position one to two inches above the right anterior suprailiac spine so that the fold runs forward and slightly downward.

3.5.1.7.6. Medial calf skinfold

The skinfold was measured while the subject was sitting on a chair with his foot on the floor and the leg vertical and the skinfold was raised with the thumb and forefinger of the left hand on the medial side of the right calf just above the level of the maximum calf girth so that the fold runs vertically.

3.5.1.7.7. Sum of six skinfolds

Sum of six skinfolds, subscapular skinfold, triceps skinfold, biceps skinfold, suprailiac skinfold, anterior thigh skinfold and medial calf skinfold added together in millimetres.

3.5.1.8. Index

3.5.1.8.1. Ponderal index

Ponderal index was calculated by dividing the height by cube root of weight.

3.5.1.8.2. Skelic index

Skelic index was calculated by dividing the lower limb length by sitting height and finally multiplying by hundred.

3.5.1.9. Somato type

3.5.1.9.1. Endomorphy

Endomorphy, the first component of somatotype was calculated from the sum of subscapular skinfold, triceps skinfold and calf skinfold using the Health Carter Anthropometric rating scale.

3.5.1.9.2. Mesomorphy

Mesomorphy, the second component was calculated using the same scale from humerus breadth, femur breadth, biceps circumference, calf circumference in relation to height.

3.5.1.9.3. Ectomorphy

Ectomorphy, the third component was obtained from the same rating scale using the ponderal index.

3.5.2. BODY COMPOSITION

3.5.2.1. Lean body weight

Lean body weight was calculated from skinfold measurements from three sites ; subscapular, triceps and thigh skinfold and from weight using Wilmore and Behnke's formula.

3.5.2.2. Absolute body fat

Absolute body fat was obtained by subtracting lean body weight from total weight.

3.5.2.3. Body fat percentage

Body fat percentage was estimated by subtracting lean body weight from total body weight, then dividing it by the total body weight and finally multiplying by hundred.

3.5.3. PHYSIOLOGICAL VARIABLES

3.5.3.1. Margaria staircase test

Purpose

To measure the anaerobic power of the subjects.

Facilities and Equipments

The margaria staircase test requires a staircase (Stair: 175mm high) and two switch mats connected to a time recorder.

Procedure

The subject stood two metres away from the first stairs and was asked to run at top speed, two steps at a time, up a staircase. A switch mat was placed on the 8th and the 12th stairs(4th and 6th steps taken). A clock starts as the person steps on the first switch mat and stops as he steps on the second.⁶

Scoring

Time was recorded to one hundredth of a second. The test was administered three times, recording the best score.

Result

$$P = \frac{W \times 9.8 \times D}{T} \quad (\text{unit} \longrightarrow \text{kg.m}^2.\text{s}^{-3} \text{ or watts})$$

⁶J. Duncan Mac Dougall, Howard A. Wenger and Howard J. Green, *Physiological Testing of the High Performance Athlete* (2nd ed) (Champaign, Illinois: Human Kinetics Publishers, 1991), P.193.

Where

P - Anaerobic power (W)

9.8 - Normal acceleration of gravity (ms^{-2})

W - Weight of the subject (Kg)

D - Vertical height between first and second switch mats (m)

T - Time taken from first to second switch mat(s)

3.5.3.2. Resting pulse rate

Purpose

To determine resting heart rate of the subjects.

Facilities and Equipments

Stop watch

Procedure

There were two pulse points to choose from the radial artery in the wrist or the carotid artery in the throat. The radial artery was the preferred place because the reading was usually more accurate. Resorted to carotid artery only if we absolutely could not locate the radial artery in the wrist.⁷

The pulse rate of all the subjects were recorded in a sitting position immediately after getting out of bed in the morning. To record the pulse rate, index finger and middle finger was placed at the base of outer third of the wrist, the side on which the thumb was located. To determine the resting pulse rate, the pulse beats were counted for sixty seconds.

⁷Neil F. Grodon, *Breathing Disorders - Your Complete Exercise Guide* (Champaign, Illinois : Human Kinetics Publishers, 1993), PP.107-109.

Scoring

The number of pulse beats counted for one minute was taken as the score of the subject.

3.5.3.3. Cooper's 12-minutes running/walking test

Purpose

To measure the cardio-respiratory endurance of the subjects.

Facilities and Equipments

An outdoor 400 meter track, cones, stopwatches and a whistle.

Procedure

Cones were placed around the track to indicate portions of completed laps. All the subjects started together on a signal. They were instructed to try to cover as much distance as possible in twelve minutes. They were allowed to walk, but should be encouraged to run at an even pace that can be maintained. Runners were given a signal when eleven minutes have passed. At the end of twelve minutes, the test administrator blowed whistle, and the runners noted the last cones they have passed.⁸

Scoring

Distance ran in twelve minutes was recorded in metres.

⁸Harison Clarke and David H. Clarke, *Advanced Statistics* (Englewood Cliffs, New Jersey : Printice Hall, Inc., 1972), PP.4-7.

3.6. Statistical Analysis

The data collected from the university men Basketball, Volleyball and Football players on the body composition, anthropometric and physiological variables were statistically analysed with one way analysis of variance to find out the significant difference among the players. The level of significance was fixed at 0.05.⁹

3.6.1. Post-hoc Test of Significance

Scheffe's Post-hoc Test was used to find out the paired means significant difference.¹⁰

⁹*Ibid.*, PP.132-133.

¹⁰*Ibid.*, PP.18-20.