

## **CHAPTER - III**

### **METHODOLOGY**

This Chapter describes in detail of the procedures adopted for selection of subjects, selection of experimental variables, pilot study, experiment design, procedure, training programme, criterion measures, reliability of the data, test administration, collection of data and statistical treatment of data involved in the study.

#### **3.1 SELECTION OF SUBJECTS**

The study was designed to find out the effects of different strength training on selected body composition, motor ability, physiological and hematological variables of male athletes. For this purpose, Seventy five athletes from Sports Authority of India, Netaji Subash Eastern Center, Kolkata were randomly selected as subjects for the study and their age was between eighteen and twenty two years.

#### **3.2 SELECTION OF EXPERIMENTAL VARIABLES**

Based on the relevant literature reviewed and in accordance with views of professional experts in Physical Education, the following body composition, motor ability, physiological and hematological variables were selected.

**(A) DEPENDENT VARIABLES****a. Body Composition**

- ❖ Percent Body Fat
- ❖ Body Mass Index
- ❖ Lean Body Mass

**b. Motor Ability Variables:**

- ❖ Speed
- ❖ Explosive Power
- ❖ Speed Endurance

**c. Physiological Variables:**

- ❖ Anaerobic Power
- ❖ VO<sub>2</sub> Max
- ❖ Resting Pulse Rate

**d. Hematological Variables:**

- ❖ Hemoglobin
- ❖ Red Blood Corpuscles

**(B) INDEPENDENT VARIABLES**

Experimental Group A	:	Plyometric Training
Experimental Group B	:	Barbell Training
Experimental Group C	:	Uphill Training
Experimental Group D	:	Circuit Training
Group E	:	Control Group

### **3.3 PILOT STUDY**

A Pilot Study was conducted for the purpose of finalizing and deciding upon the intensity and duration of the different strength training programme. The Pilot study was conducted with twenty subjects to know the suitability of different strength training and to find out the difficulties and shortcomings of the study. Furtherer, it helped to ensure the accurate measurement of selected body composition, motor ability, physiological and hematological variables among male athletes.

### **3.4 SELECTION OF TESTS**

The present study was undertaken primarily to assess the effects of different strength trainings, (Plyometric training, Barbell training, Uphill training and Circuit training) on selected body composition, motor ability, physiological and hematological variables such as percent body fat, body mass index, lean body mass, speed, explosive power, speed endurance, anaerobic power,  $VO_2$  Max, resting pulse rate, hemoglobin, red blood corpuscles among male athletes. As per the available literatures, the following test were used to collect relevant data on the selected dependent variables and they were presented in the table – I.

**TABLE-I**  
**SELECTION OF THE TESTS**

<b>S.No</b>	<b>Variables</b>	<b>Tests</b>
1	Percent Body Fat	Skinfold Caliper
2	Body Mass Index	By applying formula
3	Lean Body Mass	Skin fold caliper
4	Speed	50 yards run
5	Explosive Power	Standing Broad Jump
6	Speed Endurance	300 mts run
7	Anaerobic Power	Margaria Kalamen Anaerobic power test
8	VO2 Max	Multi Stage Shuttle Run Test
9	Resting Pulse Rate	By taking radial pulse
10	Hemoglobin	Blood Sampling Analysis
11	Red Blood Corpuscles	Blood Sampling Analysis

### **3.5 INSTRUMENTS RELIABILITY**

Instruments such as stop watches, pulse monitor, skin fold caliber and measuring flexible tape were used for this study. All instruments were in good and working condition. Their calibrations were tested and found to be accurate enough to serve the purpose of the study. Qualified assistance was made use of collecting hematological variables.

### **3.6 SUBJECTS' RELIABILITY**

The subjects' reliability was established by test-retest method. Ten subjects were selected in the Sports Authority of India, Netaji Subash Eastern Center, Kolkata, and they were tested twice by the same tester under the similar conditions on each criterion variable. The intra class correlation was used to find out the subjects' reliability with test-retest scores on each criterion variable separately.

### **3.7 RELIABILITY OF THE DATA**

Reliability was established by test and retest process. Test and retest method was followed in order to establish the reliability of the data by using three groups each group 15/20 subjects. All the variables selected in the present study were tested twice for the subjects by the same personals under the similar conditions. The intra class co-efficient correlation was used to find out the reliability of the data and the result have been presented in Table II.

**TABLE II**  
**INTRACLASS CO EFFICIENT OF CORRELATION VALUES ON**  
**SELECTED CRITERION VARIABLES**

<b>S.No</b>	<b>Variables</b>	<b>'R' Value</b>
1.	Percent Body Fat	0.88*
2.	Body Mass Index	0.89*
3.	Lean Body Mass	0.87*
4.	Speed	0.91*
5.	Explosive Power	0.92*
6.	Speed Endurance	0.89*
7.	Anaerobic Power	0.92*
8.	VO2 Max	0.91*
9.	Resting Pulse Rate	0.89*
10.	Hemoglobin	0.88*
11.	Red Blood Corpuscles	0.87*

\* Significant at .05 level of confidence.

(The table value required for significance at .05 level of confidence was 0.767).

### **3.8 COMPETENCY OF THE TESTER**

The investigator learned the procedures and methods to handle and operate the instruments to administer the tests. Measurements were taken by the investigator himself using standard equipments. Services of qualified assistants were used for taking other physiological and hematological measurements.

### **3.9 COLLECTION OF THE DATA**

Plyometric training, barbell training, uphill training and circuit training groups were given as per the training schedule of three days per week for twelve weeks. The pre and post test data on the selected criterion variables were collected by administering the test as per the standardized procedures at prior and after twelve weeks of the training programme.

### **3.10 EXPERIMENTAL DESIGN AND PROCEDURES**

The study involved a single dimensional design with five groups assigned with different strength trainings. To facilitate the study, seventy five male athletes of Sports Authority of India, Netaji Subash Eastern Center, Kolkata were selected as subjects at random and their age was between eighteen and twenty two years. They were divided into five equal groups namely experimental Group A (plyometric training), experimental Group B (barbell training), experimental Group C (uphill training), experimental Group D (circuit training) and experimental Group E (Control Group) who did not involve in any special training. The pre-test was taken from the subjects at prior to the administration of the different strength trainings. The subjects were involved with their respective training programme for three days per week for a period of twelve weeks under the personal supervision of the research scholar. At the end of twelfth week, the post – test was taken on selected criterion variables.

### **3.11 CRITERION MEASURES**

From the literatures and with the consultation of professional experts, the selected dependent variables were measured with the following as the criterion measures for this study for testing the hypothesis. The criterion measures adopted for the studies measuring the body composition, motor ability, physiological and hematological variables are given below.

#### **PERCENT BODY FAT**

Percent Body Fat was measured by using skin fold caliper. The measurement was recorded in centimeters.

#### **BODY MASS INDEX**

For measuring body mass index, skin fold measurement was taken and the unit of measurement was in kilograms.

#### **LEAN BODY MASS**

For measuring lean body mass, skin fold measurement was taken and the unit of measurement was in centimeters.

#### **SPEED**

For measuring speed, 50 mts run was used and the unit of measurement was in seconds.



### **EXPLOSIVE POWER**

For measuring explosive power, standing broad jump was used and the unit of measurement was recorded in meters'.

### **SPEED ENDURANCE**

Speed endurance was measured by using 300 mts run and the unit of measurement was recorded in seconds.

### **RESTING PULSE RATE**

For measuring resting pulse rate, radial pulse was taken and the unit of measurement was in counts/minute.

### **VO<sub>2</sub>MAX**

Maximum Oxygen uptake (VO<sub>2</sub> max) was measured by using Multistage Shuttle run test. The measurement was recorded in ml/kg/min.

### **ANAEROBIC POWER**

It was measured by using Queen's College step tests. The results data were recorded in kg-meters/ seconds

### **HEMOGLOBIN CONTENT**

The subjects hemoglobin content in blood was measured using Shalis Method or Acid Haematin Method. The hemoglobin content recorded in gram percentage.

## RED BLOOD CORPUSCLES COUNT

Red Blood cells was measured in millions per cubic milli litre.

### 3.12 ADMINISTRATION OF TESTS

#### 3.12.1 BODY COMPOSITION

##### PERCENT OF BODY FAT

###### Objective

To estimate the fat mass percentage of the subjects.

###### Equipments

Skinfold Caliber, Stadiometer, weighing machine and measuring steel tape.

###### Procedure

Fat mass percentage was measured by the subjects with the help of four fold measurements, body mass and body weight. Before going to assess the fat mass percentage absolute fat mass value should be found out with the help of Durin and Rahaman formula (1921) Before estimating the fat mass percentage body density should be measured by the following formula.

###### Formula

Body Density =  $1.1620 - 0.0630 \text{ kg} \times \text{leg of the sum of the four skin folds}$   
(Biceps + triceps + suprailliac + subscapular)

After estimating body density (d) from Durin and Rahaman formula body fat percentage was derived using Gini formula as suggested by Durin and Rahaman in (1921).

$$\text{Body Fat Percentage} = \frac{4.950}{d} - (4.500 \times 100)$$

### **Scoring**

Fat mass value was measured in percentage.

## **BODY MASS INDEX**

### **Objective**

To estimate the body mass index of the subjects.

### **Equipments**

Stadio meter, weighting machine and measuring steel tape.

### **Procedure**

The body mass index is defined as the ratio of body weight (measured in kilograms) and the square of the height (measured in meters). Body weight is measured with the individual clad in lightweight shorts and shirt. Reading or recorded to nearest 0.5 kilogram. Standing height is measured with the individual in stocking feet, felly erect, and stretched to full height while keeping the heels flat on the floor.

### **Scoring**

The body mass index is determined as follows:

$$\text{BMI} = \text{Body weight (Kg)} / \text{Height (m)}^2$$

## LEAN BODY MASS

### Objective

To estimate the body mass percent of the subjects.

### Equipment

Skinfold Caliber, Stadiometer, weighing machine and measuring steel tape.

### Procedure

Body mass percentage was measured by the subjects with the help of skin fold measurement, body height and body weight. Before going to assess the body mass percentage, absolute skeletal mass value should be found out with the help of Matiega's formula. After the estimate of skeletal mass we can conclude the skeletal mass in percentage of the body weight in the following manner. This value should be substituted in the muscle mass percentage formula with the weight of an individual in percentage scale, the skeletal mass value should be obtained.

### Formula

$$\text{Skeletal Mass (O)} = \frac{L \times r^2 \times K}{1000}$$

Where,

- O = Absolute mass in Kg
- L = Body height in centimeters
- r = Four anthropometric measurements
- K = 1.2

**Formula :**

$$\text{Skeletal mass Percentage} = \frac{\text{Absolute Skeletal mass}}{\text{Body weight}} \times 100$$

Above said formula Matiege (1921) has estimated three components basis on body measurements.

1. The weight of the skeletal
2. Skin plus subcutaneous fat
3. Skeletal muscle

**Scoring**

Skeletal mass values was measured in percentage.

**3.12.2 MOTOR ABILITY VARIABLES****1. SPEED****50 yards Run****Purpose**

To assess speed.

**Equipments used**

Measuring tape, starting clapper and stopwatch.

**Procedure**

The standing start method was adopted for this purpose. The time elapsed from the 'clap' to the runner crossing the finish line was taken as the test score. The fractions were rounded to the next largest one tenth of a second. For this

purpose digital electronic watch was used. Two trials were conducted with sufficient rest in between.

### **Scoring**

The best of two trials was recorded as test score.

## **2. EXPLOSIVE POWER**

### **Standing Broad Jump**

#### **Purpose**

To measure explosive power in horizontal direction.

#### **Equipment used**

Steel measuring tape.

#### **Procedure**

The subjects were taught, the method to perform standing broad jump perfectly by the investigator. Before the execution of standing broad jump test, subjects were directed to practice for a few minutes. A horizontal line was marked in the long jump pit. The subject stood behind the line facing the pit, feet parallel and then swung his arm forward and backward assuming a crouched position with knees bent at about right angles. He then jumped forward as far as possible. Three trials were allowed with one-minute rest in between.

## **Scoring**

Distance between the nearest break point to the horizontal line was recorded as the subject's performance in the nearest centimetre. The best of the three trials was recorded as the test score.

### **3. SPEED ENDURANCE**

#### **300 meters run**

##### **Purpose**

The purpose of the test was to measure the speed endurance of an individual for a given distance.

##### **Equipments**

Stop watch, whistle, finishing stand, paper, pencils.

##### **Procedure**

The subject was asked to take a positions behind the starting line after a short warm up. The starter gives the single "Go" the administrator switch on the stop watches. The subject run as test as possible and crossing the finishing line which will be draw so meters from the starting line. The watch for a designated runner is stopped when the subjects cross the finish line one trial was taken.

##### **Scoring**

The score is the elapsed time to the nearest tenth of a second between the starting and the instant the student crossed the finish line.

### **3.12.3 PHYSIOLOGICAL VARIABLES**

#### **1. Resting Pulse Rate**

##### **Purpose**

The objective was to record the resting heart beats of each subject per minute.

##### **Equipment**

Heart rate monitor (or) biomonitor was used to measure the resting heart rate.

##### **Procedure**

The resting heart rate of the subjects was monitored through the heart rate using the method of finger plythermography with the help of an opto-electronic transducer on finger.

Resting heart rate of each subject was recorded in the morning time between 6.00 A.M to 6.30 A.M. fifteen minutes before taking the heart rate, the subject was asked to sit and rest himself comfortably on chair. The investigator fixed on opto sensor unit to the thumb of the subjects using velcrostraps. It was fixed in such a way that the light on the opto sensor unit was the distal end of the fingertip and the L.D.R was near to the fingertip. The velcrostap on the L.D.R side was fastened firmly while, the strap on the lamp side was loosely fastened.

The PCG/pulse ON-OFF switch of the biomonitor was kept in the pulse position. Then the heart rate monitor was switched on by pressing the pulse push



button switch. After about 30 seconds, the put L.E.D indicator flashed and beeps occurred rhythmically with respect to the subjects pulse. The heart rate per minute was indicated by the three digital meter.

### Scoring

After a minute, the digital meter showed the subjects heart rate.

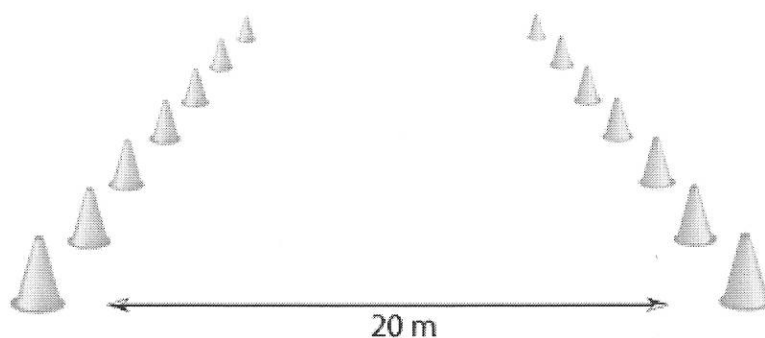
## 2. VO2 MAX

### 20M SHUTTLE RUN TEST (BEEP TEST)

#### Multistage Fitness Test, MSFT

#### Purpose:

The multistage fitness test is a commonly used maximal running aerobic fitness test. It is also known as the 20 meter shuttle run test OR beep or bleep test among others for assessing VO2 max (Lerger,L.A and Lambart ,J ,1982).



**Equipment required:**

Flat, non-slip surface, marking cones, 20m measuring tape, CD and DVD, recording sheets.

**Description:**

This test involves continuous running between two lines 20m apart in time to recorded beeps. For this reason the test is also often called the 'beep' or 'bleep' test. The test subjects stand behind one of the lines facing the second line, and begin running when instructed by the CD. The speed at the start is quite slow. The subject continues running between the two lines, turning when signaled by the recorded beeps. After about one minute, a sound indicates an increase in speed, and the beeps will be closer together. This continues each minute (level). If the line is not reached in time for each beep, the subject must run to the line turn and try to catch up with the pace within 2 more 'beeps'. Also, if the line is reached before the beep sounds, the subject must wait until the beep sounds. The test is stopped if the subject fails to reach the line (within 2 meters) for two consecutive ends. There are several versions of the test, but one commonly used version has an initial running velocity of 8.5 km/hr, which increases by 0.5 km/hr each minute (more on test variations, and see video examples).

**Scoring:**

The athletes' score is the level and number of shuttles (20m) reached before they were unable to keep up with the recording. This score can be converted to a  $VO_2$  max equivalent score using this calculation.

**3. ANAEROBIC POWER****Purpose**

To measure the anaerobic power of subjects.

**Equipment**

Margaria stair sprinting tester with switch mats and time counter.

**Procedure**

The equipment consisted of two switch mats, and a clock of counter. The first switch mat was placed on the third step of the stairs and the second switch mat on the ninth step. The 'Counter' connected by the both the switch that was placed at an appropriate place outside the stairs between the two switch mats for convenient viewing by researcher and his associates. The subject was to start at a point 6mts from the first step of the stairs. He was given start using 'on your marks', sets and whistle (for 90).

The subject stand towards the stairs look his first step on his strong foot no the first switch mat placed on the third step by skipping first two steps of the stairs. His first step achieved the clock in the counter and his next step was on the

sixth step, skipping steps four and five. Subjects strong foot again landed on the switch mat placed on the nine step. Skipping steps seven and eight, which halted the clock in the counter. The subjects continued his sprint beyond ninth step and stopped. The counter should the time taken for the 'anaerobic sprint' of the subject from step III to step IX of the stair to the nearest hundredth (100) of a second. The researcher noted down the timings clocked by the subjects and the anaerobic power was computed using the Mathews (1991) formula.

### **3.12.4 HEMATOLOGICAL VARIABLES**

#### **1. HEMOGLOBIN CONTENT**

**(Shalis Method or Acid Haematin method)**

##### **Purpose**

To find out the level of hemoglobin in blood

##### **Equipment**

Hemoglobin tube, Diluted hydrochloric acid, pipette, Distilled water, a table.

##### **Procedure**

Place n/10 Hcl acid into the hemoglobin tube in the lowest mark (0.10,20). Add one drop of blood to the 20 cubic m.m.marks into the hemoglobin pipette and transfer in to the acid tube. Capillary blood to venous blood may be used. Rinse the pipette 2 or 3 times. Mix well and allow standing for 5 minutes the solution is

diluted drop by drop by distilled water. Each time mix the solution with stirring rod until it matches stained tube by observing is not made within 2 minute. After mixing in the blood with the n/10 HCl acid 2% should be debuted from the result obtained.

### **Normal Results**

Normal values vary with age and sex. Women generally have lower hemoglobin values than men.

1. Men - 14.0 - 18.0 g/dl
2. Women - 12.0 - 16.0 g/dl

## **2. RED BLOOD CORPUSCLES COUNT**

### **Purpose**

To find out the number of red blood cells in the blood.

### **Apparatus**

Haemocytometer and coverslip, RBC pipette, Hayem's fluid.

### **Procedure for Red Blood Corpuscles Counting**

1. The Haemocytometer was cleaned and focused under high power of a microscope and the rulings were observed. A clean coverslip was placed over the chambers.
2. A clean dry RBC pipette was taken and blood was drawn to 0.5 mark. The tip of the pipette was wiped.

3. Hayem's fluid was drawn into the pipette up to 101 mark carefully avoiding air bubbles.
4. The contents of the pipette were gently mixed taking care to avoid haemolysis.
5. First few drops that come out of the pipette were discarded to avoid pure Hayem's fluid. Then a small drop of the mixture from pipette tip was under the cover slip by applying the same at the edge of the cover slip. Now the mixture was held in the NEUBEUR counting chamber.
6. Five minutes was allowed for the cells to settle on the Haemocytometer and then the number of cells in 1 square millimeter area were counted.
7. During routine tests only cells in the first five squares out of 25 squares were counted.

### **Normal Results**

The red blood corpuscle is a count of red blood cells per cubic millimeter of blood. Normal red blood cells values at various ages are

- |    |        |   |                   |
|----|--------|---|-------------------|
| 1. | Male   | - | 4.6 - 6.0 million |
| 2. | Female | - | 4.2 - 5.0 million |

### **3.13 TRAINING PROGRAMME**

The experimental groups I, II, III and IV were subjected to twelve week of plyometric training (Group I), barbell training (Group II), uphill training (Group III) and circuit training (Group IV) respectively. Then training was given for three days per week (alternative days) for twelve weeks. Every training session lasted for 60 to 90 minutes. The training program was scheduled for the morning between 6.00 am and 8.00 am. The control group was not exposed to any specific Training. However, they were participating in their regular Physical activities.

The subjects underwent their respective programme under strict supervision prior to and during every session. Subjects underwent a 10 minutes warm up and cool-down exercises which included jogging, stretching, striding and push-ups. All the subjects involved in the training were questioned about their stature throughout the training period. None of them reported any injuries. However, muscle soreness was reported in the early weeks, but it subsided later. (Appendix I-IV).

### **3.14 STATISTICAL TECHNIQUES**

The experimental design used in this study was similar to random group design involving seventy five subjects who were divided at random into five groups of fifteen each. This study consisted of four independent variables such as plyometric training, barbell training, uphill training and circuit training. Among the five selected groups, group I underwent plyometric training, group II underwent barbell training, group III underwent uphill training, and group IV

underwent circuit training and group V as control. All the subjects were tested prior and after the training on selected body composition, motor ability, physiological and hematological variables namely percent body fat, body mass index, lean body mass, speed, explosive power, speed endurance, anaerobic power, VO<sub>2</sub> Max, resting pulse rate, hemoglobin, red blood corpuscles.

The study was mainly aimed at in finding out the effects of different strength trainings on selected criterion variables. The data collected from the five groups at prior and after experimentation on selected body composition, motor ability, physiological and hematological variables namely percent body fat, body mass index, lean body mass, speed, explosive power, speed endurance, anaerobic power, VO<sub>2</sub> Max, resting pulse rate, hemoglobin, red blood corpuscles were statistically examined for significant difference, if any, applying the analysis of covariance (ANCOVA). Since five different groups were involved whenever, the "F" ratio for adjusted post mean was found to be significant, the Scheffe's test followed as a post hoc test to determine the paired means difference.