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CHAPTER - III

METHODOLOGY

3.1 Introduction:

In view of the relevant studies of the preceding chapter and to comply with the objectivity of the study, the modalities of objective measurements were planned, oriented and executed in this chapter.

In this chapter the procedure adopted for the selection of subjects, selection of variables, criterion measures, procedure for administering the test, collection of the data, reliability of the data and statistical technique for analyzing the data have been described.

3.2 Sample:

Twenty four male subjects between 13 - 15 years of age were randomly selected from amongst the trainees and students respectively for the present study. The subjects were the students of school and one of the groups did not belong to Athletic coaching centre. They were randomly divided into two equal experimental groups - AP and OP. AP group was the active participation group that had undergone regular training programme. On the other hand, the subjects of OP group were mere Occasional Participants in different physical activities.

3.2.1 Sampling Design

Table –1: Sampling design of the present study.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Groups</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Active Participants (undergone regular training programme)</td>
<td>12</td>
</tr>
<tr>
<td>2.</td>
<td>Occasional Participants (merely participate occasionally in physical activities)</td>
<td>12</td>
</tr>
</tbody>
</table>
3.3 Personal Data:

Age, Height and Body Weight were considered as the personal data of subjects. Age, height, and body weight of the subjects were recorded at the beginning of the study. Age was recorded as per school record of the subjects. Procedure of measuring weight and height are described later at 3.5.1.1 Body Mass and 3.5.1.2 Stature respectively.

3.4 Criterion Measured:

Table – 2: Variables and their Component

<table>
<thead>
<tr>
<th>Variables</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.Anthropometric</td>
<td>Body Mass, Stature, Biiliocristal Breadth, Length of Arm, Length of Forearm, Length of Thigh, Length of Leg, Body Mass Index (BMI), Pryor’s Width Length Index, Rrelative Arm Index, Crural Index.</td>
</tr>
<tr>
<td>2.Physiological</td>
<td>Resting Heart Rate (RHR), Exercise Heart Rate (EHR), Recovery Heart Rate (Re HR), Predicted VO2max</td>
</tr>
<tr>
<td>3. Biochemical</td>
<td>T3, T4, and TSH</td>
</tr>
<tr>
<td>4.Psychological</td>
<td>Self – Concept</td>
</tr>
</tbody>
</table>

3.5 Experimental Design of the Study:

After selection of subjects (AP and OP), the initial data on the relevant variables on four different parameters, were collected by the researcher himself at all points along with the assistance of some qualified professional in the relevant field. The data on hormonal estimation were derived from the collected blood samples of the subjects which was operated by qualified technicians on every event. The bio – assay was done by the renowned s.SERUM ANALYSIS CENTRE, KOLKATA (AN ISO 9001:2000 CERTIFIED LAB), through CHEMILUMINESCENCE ASSAY (CLIA). All tests were conducted by the same group of professional assistance for consecutive three days according to feasibility.
Table – 3: Phases of Test of the present study.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Number of tests</th>
<th>Intervals in Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase I</td>
<td>Initial</td>
<td>‘0’ (June,’10)</td>
</tr>
<tr>
<td>Phase II</td>
<td>1st</td>
<td>‘3rd’(Sept.’10)</td>
</tr>
<tr>
<td>Phase III</td>
<td>2nd</td>
<td>‘6th’(Dec.’10)</td>
</tr>
<tr>
<td>Phase IV</td>
<td>3rd</td>
<td>‘9th’ (Mar.’11)</td>
</tr>
<tr>
<td>Phase V</td>
<td>4th</td>
<td>‘12th’ (June,’11)</td>
</tr>
</tbody>
</table>

The AP group had undergone a well–organized micro–cycle for the athletes whereas the OP group used to take part in any physical activity, sports and games without any regular frequency. The subjects were selected according to random choice.

The treatment was executed by the concerned qualified coach on the selected sample (AP) for one year comprising double periodization.

The data were collected at an interval of three months following a longitudinal mode in five successive phases for analysis of findings.

3.6 Procedure for Collecting Data:

The tests were conducted by the researcher with the help of qualified assistants in the gymnasium and pathological laboratory.

3.6.1 Physical (Anthropometric) Variables

3.6.1.1 Body Mass

- **Definition:** Mass is the quantity of

![Fig. – 8: Measurement of Body Mass](image-url)
matter in the body. Mass is calculated through the measurement of weight, i.e., the force the matter exerts in a standard gravitational field.

- **Equipments Required:** Weighing Machine.
- **Methods:** The subject stood on the machine without support and with the weight distributed evenly on both feet. The mass in minimal clothing was recorded in kilograms. *(Source: ISAK)*

3. 6.1.2 Stature

- **Definition:** The perpendicular distance between the transverse plane of the Vertex and the inferior aspects of the feet.
- **Equipments Required:** Anthropometer.
- **Methods:** The subject stood erect with the feet running parallel to one another, the heels touching one another, the arms hanging maximum on the sides, and the head resting on the eye – ear or the Frankfort plane. The Frankfort plane is achieved when the Orbitale (lower edge of the eye socket) is in the same horizontal plane as the tragion (the notch superior to the tragus of the ear).
  - The investigator standing on the right side of the subject hold the anthropometer vertically in the mid – sagittal plane of the subject. Then the cross bar fitted to the movable socket is lowered with right hand to touch the Vertex gently. The subject is instructed to take and hold a deep breath. Measurement is recorded before the subject exhale. *(Source: ISAK)*

Fig. – 9: Measurement of Stature
3. 6.1.3 Bi – illiocristal Breadth

- **Definition:** Bi – illiocristal Breadth is the linear distance between the most lateral points of the iliac crests. It is the straight distance between the two illiocristal points.

- **Equipments Required:** Rod compass.

- **Subject’s Position:** The subject assumes a relaxed standing position, with the arms across the chest.

- **Methods:** The measurer stands infront of the subject. The body of the compass lies on the backs of the hands while the thumbs rest against the inside edge of the compass branches, and the extended index fingers lie along the outside edges of the branches. The branches of the compass are kept at about 45° pointing upward.

  In this position, the middle fingers are free to palpate the bony landmarks on which the compass faces are to be placed and the index fingers are then be able to exert presser to reduce the thickness of any underlying soft tissues.

  The measurement is taken when the compass is in place with firm pressure maintained by index fingers.

3. 6.1.4 Length of Arm

- **Definition:** It is the linear distance between the Acromiale and Radiale sites.
Equipments Required: Segmometer / Rod compass.

Subject’s Position: The subject assumes a relaxed standing position, with the arms hanging by the sides. The right forearm should be pronated.

Methods: One branch of the compass is held on the Acromiale while the other branch is placed on the Radiale of the right arm of the subject. The measurement is recorded when the scale is parallel to the long axis of the arm.

3. 6.1.5 Length of Forearm

- Definition: It is the linear distance between the Radiale and Stylion.

- Equipments Required: Segmometer / Rod compass.

- Subject’s Position: The subject assumes a relaxed standing position, with the arms hanging by the sides. The right forearm should be pronated.

- Methods: One branch of the compass is held on the Radiale while the other branch is placed on the Stylion of the right arm of the subject. The measurement is recorded when the scale is parallel to the long axis of the arm.

3. 6.1.6 Length of Thigh

- Definition: It is the linear distance between the Trochanterion and Tibiale lateral sites.

- Equipment(s) Required: Rod compass.

- Subject’s Position: The subject assumes a
standing position with the feet together and the arms folded across the thorax.

- **Methods:** From the right side of the subject, one branch of the rod compass is placed on the *Trochanterion* and the other branch is placed on the *Stylion Tibiale* lateral site. The linear distance between the two landmarks is recorded.

3. **6.1.7 Length of Leg**

- **Definition:** It is the vertical distance from the *Tibiale* lateral site to the standing surface.

- **Equipments Required:** Rod compass.

- **Methods:** The base of the anthropometer (Rod compass) is placed on the top of the subject’s standing surface and the moving branch is placed on the *Tibiale* lateral site. Then the height is measured from the right side of the subject when the scale is in vertical plane.

3. **6.1.8 Body Mass Index (BMI)**

- Body Mass Index is a measure of body composition. The higher the figure the more overweight is. Like any of these types of measures it is only an indication. BMI is calculated by taking a person's weight and dividing by their height squared.

- **Equipment required:** Weighing Machine and Stadiometre as for weight and height.

- **Procedure:** BMI is calculated from body mass (M) and height (H).
  
  - BMI = M / (H x H), where M = body mass in kilograms and H = height in meters.
  
  - The higher the score usually indicating higher levels of body fat.
• **Scoring**: The table shows the World Health Organization BMI classification system.

### Table – 4: Classification of BMI.

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI (kg/m²)</th>
<th>Sub-classification</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.50</td>
<td>Severe thinness</td>
<td>&lt; 16.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate thinness</td>
<td>16.00 - 16.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mild thinness</td>
<td>17.00 - 18.49</td>
</tr>
<tr>
<td>normal range</td>
<td>18.5 - 24.99</td>
<td>Normal</td>
<td>18.5 - 24.99</td>
</tr>
<tr>
<td>Overweight</td>
<td>≥ 25.00</td>
<td>pre-obese</td>
<td>25.00 - 29.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Obese (≥30.00)</td>
<td>30.00 - 34.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>obese class I</td>
<td>35.00 - 39.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>obese class II</td>
<td>≥ 40.00</td>
</tr>
</tbody>
</table>

(Source: World Health Organization)

3. 6.1.9 Pryor’s Width Length Index \[((\text{Bi} – \text{iliac diameter} / \text{Standing Height}) \times 1000)\] (Ref. Clarke, 1976)

Formula = \(\frac{\text{Bi} – \text{iliac diameter}}{\text{Standing Height}}\) \times 1000

• This ratio for each subject was calculated by substituting in the formula, the scores of bi – iliac diameter of a subject in centimeters and the score of standing height also in centimeters. The obtained value of this index was recorded correct to three decimal places. This ratio is named as Pryor’s Width – Length Index (Clarke, 1976).

• **Lucas and Pryor** stated that the width – length index is an expression of the relationship of the width to the length of the body. It is obtained by measuring the diameter of the crest of the ilium and the standing height. The crest measurement is divided by the height to give the relative breadth of the body, or width – length index. Weight does not enter into the calculation. The size of the index increases with the relative breadth of the body.
3. 6.1.10 Relative Arm Index (*Clarke, 1976*)

\[
\text{Formula} = \frac{\text{Length of fore arm}}{\text{Length of arm}} \times 100
\]

- **Definition**: Relative Arm Index is the ratio between Length of fore arm and Length of arm.
- **Equipments Required**: Mentioned earlier.
- **Methods**: Relative Arm Index is derived as mentioned in the formula.

3. 6.1.11 Crural Index (length of lower leg / length of Thigh) (*Clarke, 1976*)

\[
\text{Formula} = \frac{\text{Length of lower leg}}{\text{Length of Thigh}}
\]

- **Definition**: Crural Index is the ratio between Length of lower leg and Length of Thigh.
- **Equipments Required**: Mentioned earlier.
- **Methods**: Crural Index is derived as mentioned in the formula.

3.6.2 Physiological Variables

3.6.2.1 Resting Heart Rate (HRrest)

- **Definition**: The total rate counted in one minute during resting condition is called Resting Heart Rate.
- **Equipments Required**: Stop Watch.
- **Methods**: The subject is given at least thirty minutes rest before this

![Fig. – 15: Measurement of Resting Heart Rate.](image)
measurement. Then the heart beats are counted by palpation of radial artery for 3 times. A thirty seconds pulse count taken in each time with the help of a watch.

- **Scoring:** The score is multiplied by 2 to count into a minute method. The mean reading is recorded as the resting heart rate of the subject.

### 3.6.2.2 Exercise Heart Rate (HRmax)

- **Definition:** Heart rate at the end of stipulated time.

- **Equipments Required:** Bench (16 inches or 40 cm) [wooden box], stopwatch, and metronome.

- **Methods:** The subject steps up and down on the platform at a rate of 30 steps per minute for 5 minutes. Pulse rate of a subject is measured at the carotid artery for 10 seconds just after five seconds of completion of exercise.

- **Scoring:** Multiplying the 10-seconds pulse count by 6, the exercise heart rate is obtained.

### 3.6.2.3 Aerobic Power (VO₂ max)

- **Definition:** The maximal rate at which oxygen can be consumed per minute; the power or capacity of the aerobic or oxygen system.

- **Equipments Required:** Åstrand – Åstrand Nomogram

- **Methods:** From the adjusted Nomogram by Åstrand, it is estimated by reading horizontally from the “body weight” scale (step test) to the “oxygen uptake” scale. The point on the “oxygen uptake” scale (VO₂, l) is then connected with the corresponding point on the “pulse rate scale” and the predicted maximal oxygen uptake is read on the middle scale.
3.6.2.4 Physical Efficiency Index (PEI)

- **Objective:** The objective of this test is to monitor the development of the athlete's cardiovascular system.

- **Equipment required:** Bench (45cm high), stopwatch, and metronome.

- **Methods:** The subject steps up and down on the platform at a rate of 30 steps per minute for 5 minutes. The athlete immediately sits down on completion of the test, and the heartbeats are counted for 1 to 1.5 (1st pulse count), 2 to 2.5 (2nd pulse count), and 3 to 3.5 (3rd pulse count) minutes {(bpm)}.

- **Scoring:** The score is equal to \((100 \times \text{test duration in seconds}) \div 2 \times (\text{total heartbeats in the recovery periods})\). Result = \(30000 \div (\text{pulse1 + pulse2 + pulse3})\)

3.6.3 Biochemical Variables

3.6.3.1 Triiodothyronine (T₃)

- **Investigation:** Total Triiodothyronine, Serum by CLIA

- **Instruments Used:**

  1. ARCHITECH 1 – 200 SR. ABBOTT, U.S.A.
  2. AXSYM ABOTT, U.S.A.
  3. AUTOMATED PC – RIA MAS STRATEC, GERMANY
  4. BECKMAN COULTER ACCESS®2, U.S.A.
  5. BECKMAN COULTER UNICCEL™ DXI 600, U.S.A.

*Fig.– 17: Drawing Blood Sample.*
Methods: Subjects are instructed to be present in empty stomach at the laboratory (Happy Life Diagnostic Centre, Mathurapur, South 24 Parganas, West Bengal) on the scheduled dates. Then blood is collected with the help of an expert technician and sent to the SERUM Analysis centre, Kolkata.

Report: The thyroid function test report was made by CHEMILUMINESCENCE ASSAY (CLIA)

3.6.3.2 Thyroxine (T₄)

Investigation: Total Thyroxine, Serum by CLIA

Instruments Used:
1. ARCHITECH 1 – 200 SR. ABBOTT, U.S.A.
2. AXSYM ABOTT, U.S.A.
3. AUTOMATED PC – RIA MAS STRATEC, GERMANY
4. BECKMAN COULTER ACCESS®2, U.S.A.
5. BECKMAN COULTER UNICCEL™ DXI 600, U.S.A.

Methods: Subjects are instructed to be present in empty stomach at the laboratory (Happy Life Diagnostic Centre, Mathurapur, South 24 Parganas, West Bengal) on the scheduled dates. Then blood is collected with the help of an expert technician and sent to the SERUM Analysis centre, Kolkata.

Report: The thyroid function test report is made by CHEMILUMINESCENCE ASSAY (CLIA)

3.6.3.3 Thyroid Stimulating Hormone (TSH)

Investigation: Thyroid Stimulating Hormone: ULTRA – Sensitive TSH Assay, Serum by CLIA

Instruments Used:
1. ARCHITECH 1 – 200 SR. ABBOTT, U.S.A.
2. AXSYM ABOTT, U.S.A.

3. AUTOMATED PC – RIA MAS STRATEC, GERMANY

4. BECKMAN COULTER ACCESS®2, U.S.A.

5. BECKMAN COULTER UNICCEL™ DXI 600, U.S.A.

- **Methods:** Subjects are instructed to be present in empty stomach at the laboratory (Happy Life Diagnostic Centre, Mathurapur, South 24 Parganas, West Bengal) on the scheduled dates. Then blood is collected with the help of an expert technician and sent to the sSERUM Analysis centre, Kolkata.

- **Report:** The thyroid function test report is made by CHEMILUMINESCENCE ASSAY (CLIA)

### 3.6.4 Psychological Variables

#### 3.6.4.1 Self – Concept

- **Definition:** Self – concept is the student’s perception on self. They are ascertained indirectly, sometimes by the way a student thinks about himself or herself with the way he or she would like to be.

- **Used Tools:** Standardized Bengali Version of Questionnaire of Children’s Self – Concept Test by Dr. S. P. Ahluwalia. It is the questionnaire of 80 statements. One copy of the test items is given in the Appendix.

**Six areas of Self – Concept:**

1. *Behaviour*

2. *Intellectual and School Status*

3. *Physical Appearance and Attributes*

4. *Anxiety*

5. *Popularity*

6. *Happiness and Satisfaction*
**Procedure:** The subjects are asked to take a seat and questionnaires and response sheets are served. Before starting the test, the purpose and direction of the test was clearly explained to them. They are directed to encircle ‘yes’ or ‘no’ which they find appropriate against each of the 80 question in the response sheets.

**Scoring:** The test items are scored in the direction of high (adequate) self – concept according to the scoring stencil. One score is awarded to each Statement either ‘yes’ or ‘no’ as described in the key. The sum of the scores for each sub – scale of the self – concept scale by adding the scores. The total self – concept score is obtained by adding scores of all the six areas, which is used as a total self – concept score.

3.7 The outline of Macro – Cycle for Active Participation (AP) Group:

Table – 5: The outline of Macro – Cycle for Active Participation (AP) Group

<table>
<thead>
<tr>
<th>Period</th>
<th>Duration</th>
<th>Phase</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transitional</td>
<td>Mid May’10- Mid June’10</td>
<td>Nil</td>
<td>Participation in other conventional games and Recreational Games &amp; General fitness Program</td>
</tr>
<tr>
<td>Preparatory</td>
<td>Mid June’10- Nov’10</td>
<td>I</td>
<td>Continuous methods, General Endurance and Strength Training Programs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>Strength and Endurance combination and Perfection of Techniques</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>Practice of Technique and Time Trials, tactical tit bits</td>
</tr>
<tr>
<td>Competition</td>
<td>Dec’10-Mid Feb’11</td>
<td>Pre Competition</td>
<td>Maintenance of Strength and Endurance; Local Participation and tactical perfection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Competition</td>
<td>Participation and Scouting</td>
</tr>
<tr>
<td>Transitional</td>
<td>Mid Feb’11- March’11</td>
<td>Nil</td>
<td>Participation in other conventional games and Recreational Games &amp; General fitness Program</td>
</tr>
<tr>
<td>Preparatory</td>
<td>Mid Feb’11- March’11</td>
<td>Nil</td>
<td>General Fitness , Maintenance of Strength and Endurance Time Trials</td>
</tr>
<tr>
<td>Competition</td>
<td>April’11- May’11</td>
<td>Main Competition</td>
<td>Participation and Scouting</td>
</tr>
</tbody>
</table>
Programme of Occasional Participation (OP) group

Since the OP group did not undergo any organized training programme and at the same time they had been participating in different types of physical activity at oad intervals, they were not the regular participants. They used to take part in various activities with a frequency of two or three days per week.

3.8 Statistical Computation for Analysis of Data:

The standard Statistical procedures have been adopted to analyze and interpret the data collected through various standard tests and measurements. For this study, mean, standard deviation, ANOVA are calculated by comprised statistical software SPSS 20.0.