Procedure
&
Methodology
CHAPTER-III

PROCEDURE AND METHODOLOGY

In the present investigation an attempt has been made to evaluate the methodology and procedures adopted by the researcher to collect anthropometric data in context to determine medalist and non-medalist football players of different levels. This chapter describes the sampling procedures, tools and statistical techniques to be used in the present investigation for analysis, interpretation and results.

2.1 SAMPLING

The study was confined to the male medalist and non-medalist football players, who participated at different levels viz. district level, state level, inter-college level and inter University level football championships. A total of 425 subjects were taken in the present investigation. The distribution of the subjects is as follows;

2.2 GROUPWISE DISTRIBUTIONS OF SUBJECTS

<table>
<thead>
<tr>
<th>DISTRICT-LEVEL</th>
<th>STATE-LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNDER – 14 YEARS</td>
<td>UNDER – 19 YEARS</td>
</tr>
<tr>
<td>30</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTER-COLLEGE LEVEL</th>
<th>INTER-UNIVERSITY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medalist Players</td>
<td>Non-Medalist Players</td>
</tr>
<tr>
<td>27</td>
<td>58</td>
</tr>
</tbody>
</table>
In district level competitions held on 20-09-2008 at G.S.S.S. Majra, the total number of teams participated in the under-14 years football tournament was three, viz. Nahan, Paonta Sahib and Majra. The medalists represented Nahan and Paonta Sahib and non-medalist represented Majra. In under 19 years held on 24-09-2008 to 27-09-2008 at G.S.S.S. Paonta Sahib, the total number of teams participated were four, viz. Paonta Sahib, Nahan, Bhangani and Bankala. The medalists represented Nahan and Paonta Sahib and non-medalist represented Bhangani and Bankala.

In state level competitions held on 24-09-2008 to 27-09-2008 at Sarkaghat, District Mandi, the total number of teams participated in the under-14 years football tournament was 06, namely Una, Bilaspur, Mandi, Solan, Sirmour and Kullu. The medalists represented District Mandi and District Solan and non-medalists District Bilaspur, District Kullu and District Sirmour (players of Chamba district were not available). In under 19 years held on 05-10-2008 to 08-10-2008 at Sunder Nagar, District Mandi, the total number of teams participated was 12, namely Una, Chamba, Bilaspur, Mandi, Solan, Sirmour, Kullu, Kangra, Shimla, I & S, Hamirpur and Sports Hostel Rohru. The medalists represented District Una and District Shimla and non-medalists District Hamirpur, District Solan, District Sirmour and Sports Hostle Rohru (the non-medalists from rest of the districts were not available).

In inter college level competitions held on 20-12-2008 to 23-12-2008 at Govt. College Daulatpur Chowk, the total number of teams participated were 14 namely Daulatpur Chowk, Una, Sarkaghat, Mandi, Palampur, Haripurgular, Jogindernagar, Kullu, Hamirpur, Paonta Sahib, Kangra, Seema, Dhaliara and Dharamshala. The medalists represented Daulatpur Chowk and Paonta Sahib and non-medalists Sarkaghat, Dharamshala, Una and Dhaliara (the non-medalists from rest of the districts were not available).

In North Zone Inter University competitions held at Punjabi University Patiala on 18-10-2008 to 25-10-2008, the total number of teams participated were 34. The medalists represented Panjab University Chandigarh and Punjabi University Patiala and non-medalist
2.3 TOOLS TO BE USED

- **Anthropometric Rod** for measuring height, sitting height, upper extremity length, lower extremity length, bi-acromial breadth and bi-cristal breadth.
- **Weighing Machine** for measuring body weight.
- **Sliding Caliper** for measuring humerus bi-epicondylar diameter and femurous bi-epicondylar diameter.
- **Skinfold Caliper** for measuring biceps skinfold, triceps skinfold, subscapular skinfold, supra iliac skinfold and calf skinfold.
- **Measuring Tape** for measuring chest circumference, abdomen circumference, hip circumference, upper arm circumference, thigh circumference and calf circumference.

Anthropometric measurements were taken on each subject. The investigator had sufficient training to take anthropometric measurement before starting the fieldwork. All the measurements were taken from the left side of the subject. During the course of measurement the subjects were in minimum clothing without shoes. The skinfolds were measured by using Harpenden skinfold caliper. The methodology was used as per the techniques given by Heath and Carter (1967).

2.4 PROCEDURE

In this section the procedure adopted for the selection of the subjects viz. reliability of data, instrument validity, tester competency, selection of variables and statistical techniques for analyzing the data, have been described.

2.5 SELECTION OF SUBJECTS

The subjects selected for the present study were those who have participated at district, State, Inter College and inter-university level competitions in football.
championship. For the present investigation the number of total 425 football players was
taken from different levels of football championship viz. 177 players of Medalists and 248
players of Non-medalists have been taken from different levels of football championships.
Purposive random sampling procedure was adopted by investigator to collect the data.

2.6 RELIABILITY OF DATA
Reliability of data was ensured by considering the instrumental reliability and
tester's competency.

2.7 INSTRUMENTAL VALIDITY
Measuring anthropometric rod, weighing machine, skinfold caliper, sliding caliper
and steel tape used in the present investigation were obtained from standard firms and most
of the instruments are available in the Department of Physical Education, Himachal Pradesh
University, Shimla-5. There calibrations were accepted as accurate enough for the purpose
of the study.

2.8 TESTER COMPETENCY
The competency of tester was ensured by proper training of the scholar and his
assistants/colleagues viz. the experienced experts in the fields of test, measurement and
evaluation.

2.9 VARIABLES USED

The following measurements were taken for the present investigation:

1) Height (cm)
2) Body weight (kg)
3) Sitting Height (cm)
4) Body Mass Index (BMI) (kg/m^2)
5) Upper extremity length (cm)
6) Lower extremity length (cm)
7) Bi-acromial breadth (cm)
8) Bi-cristal breadth (cm)
9) Chest circumference (cm)
10) Abdomin circumference (cm)
11) Hip circumference (cm)
12) Upper arm circumference (cm)
13) Thigh circumference (cm)
14) Calf circumference (cm)
15) Biceps skinfold (mm)
16) Triceps skinfold (mm)
17) Sub-scapular skinfold (mm)
18) Suprailiac skinfold (mm)
19) Calf skinfold (mm)
20) Humerious biepicondylar diameter (cm)
21) Femurous biepicondylar diameter (cm)

2.10 TECHNIQUES OF TAKING ANTHROPOMETRIC MEASUREMENTS

Height

It measures the vertical distance from vertex to floor.

Instrument used: Anthropometric Rod

Procedure: -

The subject is asked to stand erect on a horizontal surface stretching the body as much as possible. Heels of the subject must be touching each other and the head must be on Frankfort horizontal (eye-ear) plane. Anthropometric rod is placed on the mid sagittal plane of the subject. The moving cross – bar of the Anthropometric rod is allowed to touch the vertex of the subject lightly. Results are recorded from the reading scale of the vertically placed anthropometric rod (cm).
Sitting Height

It measures the vertical distance from vertex to the sitting surface of the subject when the body is stretched as much as possible.

**Instrument used:** Anthropometric Rod

**Procedure:**

The subject is asked to sit on a horizontal surface preferably on a stool. Vertebral column is stretched to its maximum. The shoulders should run parallel, the thighs should be almost horizontal and the knees should be allowed to bend. Place the movable cross-bar of the anthropometric rod on the vertex of the subject. Results are recorded from the reading scale of the Anthropometric Rod in centimeters (cm).

Body Weight

It measures the total body weight of the subject.

**Instrument used:** Weighing machine.

**Procedure:**

Body weight is the weight of the body when the bowel is empty. The subject is asked to stand erect on the weighing machine bare foot and in minimum clothes. Results are recorded from the reading scale of the weighing machine in kilograms. Results will be accurate if the weight of the clothes is also measured separately and is subtracted from the recorded weight of the subject, or the researcher provides a standard garment (Previously Measured) to the subject.

**Body Mass Index (BMI)**

Although BMI cannot be technically classified as a body-composition measurement method, it has received widespread use with adults for clinical and epidemiologic assessments. The BMI requires measurement only of height and weight. It is defined as $BW / H^2$ and expressed as kg / $m^2$. The development of BMI norms from large data base permits the classification of individuals into categories of underweight, normal weight, overweight and obese.
It is derived from body mass and stature:

\[
\text{BMI} = \frac{\text{Body mass (kgs.)}}{\text{Stature (m)}^2}
\]

**Upper Extremity Length**

It measures the vertical distance from the acromion to the dactylium.

**Instrument used:** Anthropometric Rod

**Procedure:**

The subject is asked to stand erect on a horizontal surface stretching the body as much as possible. Arms will be hanging by the sides with finger stretched. The fixed cross bar is allowed to touch the acromiam and the moving cross bar to the dactylium position lightly. Results are recorded on the reading scale of the Anthropometric Rod in centimeter (cm).

**Lower Extremity Length**

It is measured the vertical distance from the iliocristale to the floor.

**Instrument used:** Anthropometric Rod

**Procedure:**

The subject is asked to stand erect on a horizontal surface stretching the body as much as possible. The moving cross-bar of the Anthropometric Rod is allowed to touch the iliocristale i.e. the highest point on the margin of the iliac crest as it is likely to be influenced by fat. Note that the subject should not bend side wards. Results are recorded on the reading scale of the Anthropometric Rod from floor to iliocristale in centimeters (cm).

**Bi-acromial Breadth**

It measures the straight distance between the two acromia.

**Instrument used:** Anthropometric Rod
**Procedure:**

The subject is asked to stand erect so that the two acromia lie on the horizontal plane. The subject should keep his shoulders straight. The landmarks i.e. two acromia are located by palpating with the first finger while the other fingers hold the cross bar. The two cross bars are touched gently over the two acromia. Results are recorded from the reading scale of the Anthropometric Rod in centimeters (cm).

**Biiliocristal Breadth**

It measures the straight distance between the two iliac cristalia.

**Instrument used:** Anthropometric Rod

**Procedure:**

The subject is asked to stand erect so that the two iliac cristalia lie on the horizontal plane. To locate the landmarks, place your fingers on the lateral border of the upper margin of the iliac crest, slide your fingers from down upwards where the lateral margin of the iliac crest crosses over the upper margin. Place two cross bars of the anthropometric rod on the two iliac cristalia of the subject. Results are recorded from the reading scale of the anthropometric rod in centimeter (cm).

**Chest Circumference**

It measures the circumference of the chest of the subject when he is breathing normally.

**Instrument used:** Steel tape.

**Procedure:**

The subject is asked to stand erect. The tape should be held horizontally at the level of nipples passing over the lower scapular angle. The arms of the subject may be raised before fixing the tape around the chest, but in no case they should be allowed to remain horizontal. The arms should rest normally while taking the measurements.
Upper Arm Circumference

It measures the maximum Circumference of the upper arm horizontally.

**Instrument used:** Steel tape.

**Procedure:**

The subject is asked to stand erect on the horizontal plane. The measurement should be taken at right angle to the axis of the hanging arm, where the biceps muscle is most developed. Results are recorded in centimeters (cm).

Hip Circumference

It measures the Circumference of the hips at their widest position.

**Instrument used:** Steel tape.

**Procedure:**

The subject is asked to stand erect on the horizontal plane keeping his feet close to each other. The steel tape is applied around the hip of the subject. Results are recorded from the reading scale of the steel tape in centimeters (cm).

Thigh Circumference

It measures the Circumference of the thigh at the lowest point in the gluteal furrow and horizontal to the thigh.

**Instrument used:** Steel tape.

**Procedure:**

The subject is asked to stand erect with the legs slightly (6-12 cm) apart. The steel tape is placed round the thigh just below the gluteal fold. Results are recorded from the reading scale of the steel tape in centimeters (cm).

Abdominal Circumference

**Instrument used:** Steel tape.
**Procedure:**

The subject was asked to stand erect. The measurement was taken 1 inch above the umbilicus with the help of measuring tape. The results are recorded in centimeters (cm).

**Calf Circumference**

It measures the Circumference of the calf where muscle is most developed.

**Instrument used:** Steel tape.

**Procedure:**

The subject is asked to sit on a horizontal plane, preferably on a flat stool, bending the knee at right angle and hanging the lower leg freely. The steel tape is applied around the calf muscle, where it is most developed. Results are recorded from the reading scale of the steel tape in centimeters (cm).

**Biceps Skinfold**

The biceps skinfold is measured on the mid upper arm over the biceps muscle.

**Instruments used:** Skinfold Caliper

**Procedure:**

The subject was asked to stand erect hanging the arm freely by the side. On the left arm of the subject, pick the skin and subcutaneous tissue fold over the biceps muscle. The jaws of the caliper were applied on the fold. Results were recorded from the circular reading scale of the skinfold caliper in millimeters (mm).

**Triceps Skinfold**

The triceps skinfold measured on the back of the left upper arm over the triceps muscle.

**Instruments used:** Skinfold Caliper
Procedure:

The subject was asked to stand erect hanging the arms freely by the side. Picking up the mid-point of the back of the upper arm of the subject over the triceps muscle. The Skinfold caliper was applied. The results were recorded after two seconds of applying pressure from the circular reading scale of the Skinfold caliper in millimeters (mm).

Sub-scapular Skinfold

The sub-scapular skinfold is measured below the inferior angle of the scapula.

Instruments used: Skinfold Caliper

Procedure:

The subject was asked to stand erect with arms hanging freely by the side. Pick up the Skinfold below the inferior angle of the scapula and mark it. The jaws of the Skinfold Caliper were applied on the marked point. It is difficult to locate the sub-scapular site. For that, subject was asked to raise the left arm above the head and gradually down the arm.

Suprailiac Skinfold

The suprailiac skinfold measures about one cm above the two medial to the anterior superiliac spine.

Instruments used: Skinfold Caliper

Procedure:

The subject was asked to stand erect, pick up the skinfold of the above mentioned site on the anterior superior iliac spine, and the jaws of the Skinfold caliper were applied to it. Results were recorded from the circular reading scale of the Skinfold caliper in millimeters (mm).
Calf Skinfold

The calf skinfold is measured on the medial side of the calf muscle where it is developed at its maximum.

**Instruments used:** Skinfold Caliper

**Procedure:-**

The subject was asked to sit on the horizontal surface bending the knees at right angle with the lower legs hanging freely and to pick up the Skinfold on the medial calf muscle with the long axis of the leg. The jaws of the Skinfold caliper were applied to the site and the results were recorded from the circular reading scale of the Skinfold caliper in millimeters (mm).

Humorous Bi-epicondylar diameter

**Instruments used:** Sliding Caliper

**Procedure: -**

With the subject erect, left shoulder & elbow flexed at $90^\circ$, measurements were taken at the distal condyles of the humorous (at the elbow joint) by keeping the caliper at the horizontal plane.

Femur Bi-epicondylar diameter

**Instruments used:** Sliding Caliper

**Procedure: -**

With the subject sitting on the bench with left knee refluxed at $90^\circ$, measurements were taken at the distal condyles of femur. The caliper was first released, fixed at the correct position & then compressed till the readings were taken.
2.11 STATISTICAL ANALYSIS

The various statistical formulae, which have been used for the analysis of present data, are presented. Following statistical consideration have been done for each group.

1) **Arithmetic Mean (ξ)**

Adding up all the observation and dividing the sum by the number of subject included in the group gives this value.

\[ \xi = \frac{X}{N} \]

Where \( \xi \) = Arithmetic mean

\( X \) = Sum of all observations

\( N \) = Number of observations

2) **Standard deviation:**

It gives the dispersion of observed values around the mean. It is observed by following calculations:

\[ S.D = \sqrt{\left(\sum \xi^2 - \left(\frac{\xi^2}{N}\right) / (N-1) \right)} \]

Where \( \xi^2 \) = sum of the square of the individual value.

\( \xi^2 \) = square of the sum of the individual value.

\( N \) = total number of subjects

3) **Standard Error of Mean (S.E.M)**

Standard error of mean is calculated to estimate the average dispersion of the arithmetic mean around the true mean.

\[ S.E.M = \frac{S.D}{\sqrt{N}} \]

Where \( S.D \) = Standard deviation of the individual value

\( N \) = total number of subjects.

4) **Test of Significance ('t' value)**

This is applied to know whether the observed differences between two sample mean (\( X_1 \) and \( X_2 \)) of character are indicative of real differences due to the random sampling error.
Formula used for this calculation is given below:

\[ t = \frac{X_1 - X_2}{\sqrt{\frac{(S.E.M_1)^2}{n_1} + \frac{(S.E.M_2)^2}{n_2}}} \]

Where \( X_1 \) = mean of first sample
\( X_2 \) = mean of second sample

S.E.M_1 and S.E.M_2 are the error of first and second sample mean.
The level of significance is noted from 't' table against the degree of freedom

5) **Analysis of variance (ANOVA)**

It is used to test the significance of the difference among the sample means when the numbers of samples are more than two. The process of computing ANOVA is as follows.

I) Sum of the observation of variable sample.

\[ \sum X_1 + \sum X_2 + \sum X_3 + \ldots \ldots + \sum X_n = G.T \]

Where \( \sum X_1, \sum X_2, \sum X_3 + \ldots \ldots + \sum X_n \) are the summations of the different samples?

II) Correction factor (C.F) = (G.T/N)

Where \( G.T = \sum X_1 + \sum X_2 + \sum X_3 + \ldots \ldots + \sum X_n \),

\( N= \) Total number of observations in all the groups.

III) The total sum of squares (TSS)

\[ = \sum X_1^2 + \sum X_2^2 + \sum X_3^2 + \ldots \ldots + \sum X_n^2 - \frac{(G.T)^2}{N} \]

IV) Sum of squares between the samples (SSB)

\[ = \left( \frac{\sum X_1}{n_1} \right)^2 + \left( \frac{\sum X_2}{n_2} \right)^2 + \left( \frac{\sum X_3}{n_3} \right)^2 + \ldots \ldots + \frac{(G.T)^2}{N} \]

Where \( n_1, n_2, n_3 \) are the number of observations of respective groups.

V) Sum of squares with in the sample (SSW)

\[ SSW = TSS - SSB \]
### ANOVA TABLE

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of square</th>
<th>Degree of freedom</th>
<th>Mean sum of squares</th>
<th>Variance ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between sample</td>
<td>SSB</td>
<td>$r - 1$</td>
<td>MSSB = $SSB / (r - 1)$</td>
<td>MSSB / MSSW = $F(r - 1) (n - r)$</td>
</tr>
<tr>
<td>Within sample</td>
<td>SSW</td>
<td>$n - r$</td>
<td>MSSW = $SSW / (n - r)$</td>
<td></td>
</tr>
</tbody>
</table>

6) **Post-hoc 't' test:**

Whenever ANOVA shows the significant difference among the sample means, post hoc 't' test (multiple stages) was applied to see the difference in different groups.

The post hoc 't' test for this was

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{MSSW}{\frac{(n_1 + n_2)}{n_1 \times n_2}}}}$$

Where $\bar{X}_1$ & $\bar{X}_2$ are the mean of first & second sample,

$MSSW = \text{Mean sum of squares}$