CHAPTER III

METHODOLOGY

In the introduction chapter, the researcher introduced the research area with its perspectives, nature of the game and the demand of the game. After reviewing all the available scientific literature, the researcher identified the research problem of this study and prepared to start for making a bridge between the information gaps. Then the researcher formulated objectives of the study and the hypothesis for the direction of this thesis. Methodology is an area from where the total research being guided and control.

The methodological description should be enough for a future researcher to reproduce the study. In this chapter study location, description of population and subjects, inclusion and exclusion criteria, ethical consideration, variables studied and administrations of test, design of the study, data collection, and statistical procedure for data analysis are described.

3.1 STUDY LOCATION

The present study was conducted in Bolpur and Santiniketan, Birbhum district of West Bengal, India, because the convenience of laboratory facilities and the advantage of home district of present researcher. Birbhum is the northern most district of Burdwan division of West Bengal state. It lies between 23°32′30″ and 24°35′00″ north latitude and 88°1′40″ and 87°5′25″ east longitude. In shape it looks like an iso-cellular triangle. The apex is situated at the northern extremity not far south of point where the Ganges and the hills of the Santhal Paraganas begin to diverge hile the river Ajay forms the base of this triangle. Birbhum is bounded on the north and west by Santhal Paraganas, on the east by the districts of Murshidabad
and Burdwan and on the south by Burdwan, from which it is separated by the Ajay River. The district extends over an area of 4545 sq. km. The climate of the district is generally dry, mild and healthy. The hot weather usually last from the middle of March to middle of the June, the rainy season from the middle of June to the middle of October and the cold weather from middle of October to the middle of March. They do not always correspond to these limits. As a rule, the wind is from south-east is summer and rom the north-west in Winter (Bengal district gazetteers Birbhum, Govt. of West Bengal, 1996).

The data was collected in the Exercise and Sports Physiology Laboratory and in the playground of the Department of Physical Education, Visva–Bharati University, Santiniketan, West Bengal, India.

3.2 DESCRIPTION OF POPULATION

In the present study Indian soccer player were the population, but the study was confined to the West Bengal state of India, mainly because of financial problem, man power and laboratory facilities. In West Bengal there are 20 districts. Birbhum
is one of the under developed and low economic zone. So the researcher interested to collect data from a poor district population those who are regularly playing football (soccer). In Birbhum district there are three sub-divisions namely Suri, Rampurhat and Bolpur. Soccer is very popular in Bolpur sub-division than other two sub-divisions. So finally the population of football player was chosen from the Bolpur sub-division of Birbhum district, West Bengal.

3.3 SUBJECTS

3.3.1 PILOT STUDY - 1 (LABORATORY METHOD)

The pilot study was done in the Exercise and Sport Physiology Laboratory, Department of Physical Education, Visva-Bharati University, West Bengal, India. In this study total 10 (5+5) subjects were participated. In this pilot study only laboratory test were applied to the subjects. The mean age of the subjects was 21±1 years and all the subjects were collected from the Visva-Bharati University football team. Subjects those who are willing to participate in this laboratory test were allowed for this study.

3.3.2 PILOT STUDY - 2 (FIELD METHOD)

In the pilot study – 2 the researcher collected subjects from the Department of Physical Education, Visva-Bharati University. All the subjects were from M. P. Ed Part I students. The mean age was 22±2 years. The total 30 student’s data were collected. But in this study the two female student’s data was eliminated. So the total number of subject was 28. In this pilot study the researcher measured resting heart rate, exercise heart rate (after 3 minutes), relative VO₂ max and absolute VO₂ max was calculated from the exercise heart rate by Queen’s College method. All the
subjects were participated at least Inter class football competition and most of them participated Inter departmental football competition.

3.3.3 FINAL STUDY

In the final study total 18 district level football players were participated. All of them were represented Birbhum district West Bengal at least one time in their carrier. Some of the subjects also participated zonal level and state level. The mean age of this group was 20±2 years, the mean body weight was 58±3 kg and the mean height was 164.89±7.27 cm. All the subjects were regularly participating in the local league, district league and various tournaments. Also they were engaging themselves with football practice in the preseason and offseason. The final study subjects were chosen those who are typically football (soccer) player for the proper reflection in the results. When the present researcher collecting the data of this group, they were in the district level football camp under a qualified coach for preparation of their coming state level tournament. So the group was control and maximum motivation for giving their proper data.

Plate 3: Subjects of Final Study
3.4 INCLUSION AND EXCLUSION CRITERIA

As per the requirement of this study the researcher was fixed some inclusion and exclusion criteria for the selection of subjects to be included for this study.

**Inclusion:** The subjects who had the following attribute were included in this study.

i. Male and age ranges between 20-25 years.

ii. Generally healthy and regular football player.

iii. Similar socio-economic background.

iv. Voluntarily willing to participate.

v. Not engaged in other games and sports.

vi. Living nearby vicinity of the study area.

vii. At least four year of training age in football.

viii. Minimum one time district representation.

**Exclusion:** Subjects with following condition were excluded from the experiments.

i. Chronic ailments and medication.

ii. Major injury and disabilities.

iii. Fear about the laboratory test.

3.5 SAMPLING PROCEDURE

3.5.1 PILOT STUDY – 1 (LABORATORY METHOD)

For this study total 10 willing subjects were selected from the Visva-Bharati University football team. Then they have been divided into two groups: Group A (N = 5) and Group B (N = 5). When group A was giving their data, group B subjects observing all the procedures and when group B subjects was giving their data group
A observing all the procedure. One by one alternatively group A and group B subjects were giving their data in the Exercise and Sports Physiology Laboratory, Department of Physical Education, Visva-Bharati, under the total control of a qualified laboratory technician.

3.5.2 PILOT STUDY – 2 (FIELD METHOD)

In the Department of Physical Education, Visva-Bharati, there were three years under graduate course, one year teacher training programme and two years master’s programme. The total student strength was 250. Out of that the present researcher selected master degree part I students. Because they were just complete their teen age. So the gross hormonal changes in their body were subsided. Also their cardio-respiratory condition was mature enough and they have already participated Inter class tournament in football. For the above reason M. P. Ed Part I student was selected and out of 30 students 28 subjects data (2 female excludes) was extracted in this study and presented in the result chapter.

3.5.3 FINAL STUDY

In the final study, 20 regular football players were selected from the Birbhum district football team, with the permission from district football association and the coaches. Out of these 20 subjects 10 subjects has been selected conveniently. After collecting the data of these 10 subjects, other 10 subject’s data were collected. In the final study all the subjects were tested for 3 times. In the beginning they have been giving chance for a trial then the data was taken.
3.6 ETHICAL CONSIDERATION

The Departmental Committee and Board of Studies, Department of Physical Education, Visva–Bharati University was go through the methodological procedure of this research and gave necessary suggestions. After incorporating the suggestions and then forwarded this project to the University Research Board for necessary comments and approval of this project. Finally the University Research Board approved this experiment.

3.7 VARIABLE STUDIED

The researcher reviewed aerobic, anaerobic power of soccer player and then come to the conclusion that though there were many studies on aerobic qualities of soccer player but, less study was detected anaerobic qualities. In the cellular body composition and its relations with aerobic and anaerobic power was still now untouched and kept open for future research. In this study the variables which were chosen with broad heading; aerobic, anaerobic power and cellular body composition variables.
3. 7. 1 AEROBIC VARIABLES

3. 7. 1. a QUEEN'S COLLEGE STEP TEST

The Queens College Step test is one of many variations of step test procedures, used to determine aerobic fitness. Compared to the Harvard Step Test, this version has a lower step height, slower cadence, shorter test and more simple analysis (Johnson, B. L., & Nelson, J. K. (1982)).

**Purpose:** This sub-maximal test provides a measure of cardiorespiratory or endurance fitness.

**Equipment Required:** 16.25 inches / 41.3 cm Bench (step), stopwatch, metronome or cadence tape, heart rate monitor (optional).

**Procedure:** The test giver steps up and down on the platform 24 steps per minute. The subjects are to step using a four-step cadence, ‘up-up-down-down’ for 3 minutes. The test giver stops immediately on completion of the test, and the heart beats are counted for 15 seconds from 5-20 seconds of recovery. Multiply this 15 second reading (heart rate) by 4 and the beats per minute (bpm) value to be used in the calculation below.

**Scoring:** An estimation of VO₂ max can be calculated from the test results, using this formula (McArdle et al., 1972). A rating can be determined using the VO₂ max norms.

**Men:** $VO_2 max (ml/kg/min) = 111.33 – 0.42 \times \text{heart rate (bpm)}$
3.7.1.b COOPER TEST (12 MINUTE RUN-WALK TEST)

**Objective:** To measure cardiovascular fitness (Johnson, B. L., & Nelson, J. K. (1982)).

**Sex & Age:** Satisfactory for both boys and girls of junior high school through college.

**Facilities, Equipment, and Materials:** It is suggested that a specific course be measured in distance so that the number of laps completed can be counted and multiplied by the course distance. It is also helpful to divide the course into quarters or eighths by placing markers. This enables the tester to quickly determine the exact distance covered in 12 minutes. A stop watch, whistle and distance markers are needed for group testing.

**Directions:** it is usually most efficient to assign each runner to a spotter. The runners start behind a line and upon the starting signal, run and / or walk as many laps as possible around the course within the 12 minutes. The spotters maintain a
count of each lap and when the signal to stop is given, they immediately run to the spots at which their runners were at the instant the whistle or command to stop was given.

Plate 6: Cooper Test (12 Minute Run-Walk Test)

Scoring: The score in yards is determined by multiplying the number of complete laps times the distance of each lap, plus the number of segments of an incomplete lap, plus the number of yards stepped off between a particular segment. VO₂ max was measured by the following formula.

\[ VO₂ \text{ max} = (22.315 \times \text{Distance in Kilometer}) - 11.288 \]

3. 7. 2 ANAEROBIC VARIABLES

3. 7. 2. a 300 METER RUN TEST:

The 300 m run is a long sprint test, and a test of anaerobic capacity, which is important for performing short intense bursts of effort (http://www.topendsports.com/testing/tests300run.htm).

Purpose: Purpose of this test was to measure anaerobic capacity.

Equipment required: Oval or running track, stopwatch, and marker cones placed around the course (optional).
Procedure: The aim of this test is to complete 300 meters in the quickest possible time. Ensure that a good warm up is conducted before the test, including a jog, stretches and some short sprints. To start, all participants line up behind the starting line. On the command ‘go,’ the clock will start, and they will begin running.

Plate 7: 300 Meter Run Test

Scoring: The total time taken to run 300 m is recorded, to the nearest tenth of a second. The table below lists ratings for the test for adult males.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>&gt;77</td>
</tr>
<tr>
<td>Below Average</td>
<td>71.1 – 77</td>
</tr>
<tr>
<td>Average</td>
<td>65.1 – 71</td>
</tr>
<tr>
<td>Above Average</td>
<td>59.12 – 65</td>
</tr>
<tr>
<td>Good</td>
<td>54.1 – 59</td>
</tr>
<tr>
<td>Very Good</td>
<td>48 – 54</td>
</tr>
<tr>
<td>Excellent</td>
<td>&lt; 48</td>
</tr>
</tbody>
</table>

3. 7. 2. b VERTICAL JUMP

Vertical Jump tests are usually just reported as the distance jumped in centimetres or inches. This does not always test the full story. A heavier person jumping the same height as a lighter one has to do much more work to move a larger mass. Therefore
it is sometimes useful to convert the score to units of power or work (Baumgartner, T. A. & Jackson, A. S. (1982)).

Plate 8: Vertical Jump

The mechanical work performed to accomplish a vertical jump can be determined by using the jump height distance that was measured (using Work = Force x Distance where Force = Mass x Acceleration). However, Power cannot be calculated (Power = Work / time) since the time that force is acted on the body is unknown. Power can be directly measured using a force plate, though these are not readily available. Over time a few different formula have been developed that estimate power from vertical jump measurements. From these formulas, Sayers Formula (Sayers et al., 1999) was used to estimate anaerobic power for this study.

**The Sayers Equation for Peak Anaerobic Power** output (in watts) from the vertical jump is $= 60.7 \times \text{jump height (cm)} + 45.3 \times \text{body mass (kg)} - 2055$

3. 7. 3 CELLULAR BODY COMPOSITION (Bio-scan analyser, Maltron Bio-scan 915 Analyser. Maltron International Ltd. PO box 15, Rayleigh Essex, SS69 SM, UK.www.matonint.Com)
In the cellular body composition present researcher measured following variables; total body water, extra cellular water, intra cellular water, body cell mass, extracellular mass, protein mass, mineral mass, total body potassium mass, total body calcium mass, glycogen mass, extra cellular solid, extra cellular fluid, plasma fluid (intra vascular), interstitial fluid (extra vascular).

3. 7. 3. a  TOTAL BODY WATER (TBW)

A measure of total cellular water in one’s body can be very helpful in explaining rapid weight loss or gain. Most of the body’s fluid is contained in the lean body mass, which normally consists of 70-75% water. Total body water has been a common method for the assessment of body composition. This is a measurement of all the cellular water in the body.

3. 7. 3. b  EXTRA CELLULAR WATER (ECW)

Extracellular fluid is the non-metabolizing fluid around cells providing a medium for gas exchange, transfer of nutrients and excretion of metabolic products. Majority of the extracellular fluid is water by volume and distributed into the main compartments. Plasma is the intravascular space and interstitial fluid in the extravascular space. It can be divided further into interstitial, lymphatic, blood and trans-cellular water. Normal healthy ranges of ECW are 41% - 55%.

3. 7. 3. c  INTRA CELLULAR WATER (ICW)

On anatomical level intracellular water is found in the cytosol of every tissue in the body, interstitial water is water in the lymphatic system, plasma water, dense connective tissue water, that includes the water found in bone, cartilage and other dense connective tissues. Trans cellular water is a diverse collection of excretory of extracellular fluids like secretions, mucus’s, gastrointestinal, bile, cerebrospinal
fluids and minor other elements. Intracellular water is a ratio of TBW and ECW. Substance changes can take place with disease and contribute significantly to the overall increase in ECW and ICW. Clinical studies have shown in health and disease patients that cellular hydration is an important regulator of protein catabolism. Normal healthy ranges of ICW are 45% - 59%.

3.7.3.d EXTRA CELLULAR FLUID

Extracellular fluid referred to as the non-metabolizing fluid that surrounds cells providing a medium for transfer of nutrients, gas exchange, and expelling of metabolic end products. Extracellular fluid is approximately 94% water by volume and is distributed into two compartments one in the extravascular space containing interstitial fluids and the other in intravascular space having plasma. Reference man’s body weight accounts for approximately 5 and 20% of plasma and interstitial fluids.

Extracellular Fluid (ECF) = Extracellular water (ECW) & Re (Extracellular Residual)

3.7.3.e PLASMA-FLUID (INTRAVASCULAR)

Approximately 5% of plasma and 20% of interstitial fluid make up body weight in the reference man. Plasma in the intravascular space and interstitial fluid which is in the extravascular space is two compartments of extracellular fluid which accounts for 94% water volume.

3.7.3.f INTERSTITIAL-FLUID (EXTRAVASCULAR)

Interstitial fluid also known as tissue fluid is the presence of watery liquid in the tiny gaps between body cells. One component of extracellular fluid is tissue fluid. Tissue fluids also contain ions in addition to nutrients and wastes.
3. 7. 3. g DRY WEIGHT MASS

Dry weight is made up of essential, nonessential lipids, protein, mineral, glycogen and residual. Dry weight is commonly based on removal of inappropriate fluids.

3. 7. 3. h EXTRA CELLULAR SOLIDS

Extracellular solid in total body are in the form of bone tissue although small amounts do exists in other tissue (e.g. in skeletal muscle). Additional extracellular solids, bone tissue contains bone cells and extracellular fluid.

Extracellular Solids (ECS) = Organic Extracellular solids (ECS) & Inorganic (Extracellular Solids)

3. 7. 3. i PROTEIN MASS

In body composition the term protein in compasses almost all compounds containing nitrogen. This ranges from amino acid to nucleoprotein. The protein content of the average cell is approximately 16% of its total mass. Considerable variations may exist for example 10% of brain cell is protein, whereas 20% mass of red blood cells and cells of liver, skeletal muscles, glands, and heart are protein. The skeletal muscle protein representing 65% of the body protein can be increased with resistance training.

3. 7. 3. j GLYCOGEN MASS

Glycogen mass is highly variable and changeable component that is either measured or ignored due to the relatively small amount of total body glycogen. Glycogen is a Polysaccharide, and found in the cytoplasm of most cells. The primary distribution is mainly in the liver and skeletal muscles. The role of glycogen is to controlling blood sugar levels. Excess sugar (glucose) is converted into glycogen this takes place primarily mainly in the liver and muscle. When the opposite occurs meaning
low blood sugar level the glycogen is converted back to glucose and released into the blood stream.

3. 7. 3. k MINERAL MASS

Mineral is divided into two categories, osseous and extra-osseous. Osseous is the largest component, extra osseous mineral is the other element which contain potassium, sodium and chlorine. Potassium, sodium, calcium, magnesium, sulphur, chlorine and phosphorus are just some of the minerals that are essential to health. Trace elements like iron, zinc, selenium, iodine, fluorine, chromium, molybdenum, manganese and copper are only required in small amounts. Although our bodies are composed of around 31 known chemical elements only 24 are considered essential for sustaining life. Various structures of the body are formed by a combination of thousands of different essential elements. Oxygen is the most abundant non-metal chemical amounting to 65% of our body mass. The other three are hydrogen 10%, carbon 18% and nitrogen 3%. Mineral compose the rest of the elements. Mineral quantity of our body may be small, however, each is vital for proper cell functioning.

3. 7. 3. 1 TOTAL BODY POTASSIUM MASS

Potassium has been shown in clinical analysis to be essentially an intracellular cation which is not stored in triglyceride. It has also been shown potassium content of fat free mass in humans consistent. Compared with anorexic individuals it has been shown that in the early months of post natal life body weight and recumbent length increases with almost a threefold increase in weight 1.5 fold increase in length by the first year.
3. 7. 3. m TOTAL BODY CALCIUM MASS

Calcium at approximately 1400 gm is one of the most abundant minerals in the body representing 1.5 and 2% of body mass. Hydroxyapatite the crystalline structure of the bone and teeth is formed when calcium and phosphorus is combined. Calcium plays an important role in muscle building, blood clotting, enzymes activation, nerves impulse transmission and movement of fluid across plasma membranes. Calcium to bone mineral ratio is said to be constant around 0.364 and is similar to calcium and to calcium hydroxyapatite which is around 0.398. In both normal male and female the ratio is relatively stable. In intracellular and extracellular fluid, calcium has a concentration of 3 and 3 to 5 mmol/kg. In disease state only small deviations occur.

Procedure:

The entire above cellular body composition parameters were measured by Bio-scan analyser, Maltron Bio-scan 915 Analyser. Maltron International Ltd. PO box 15, Rayleigh Essex, SS69 SM, UK.www.matonint.Com.
Plate 10: Cellular Body Composition Measurement

All the final study subjects were tested 3 times to measured their cellular body composition, following a standard protocol. Before collecting the cellular body composition data all the subjects were given proper rest for at least 10 minutes then the electrodes of Bio-scan analyser were placed in the upper part of the palm. Then “ON” switch of the machine started and the recording was started automatically.

Score: The machine itself has a data recorder it stored all the data in its memory and could reproduce it in the digital print found after the scan is over. The mean of three times data were recorded for final analysis.

3.8 STATISTICAL TECHNIQUES USED

Data were analyzed using Microsoft Excel 2010 and IBM SPSS statistical software package (version 21.0; IBM Corp., Armork, NY). Analyses included standard descriptive statistics and Pearson’s Product moment method of Correlation (Verma. J. P. (2009, 2011). All tests were two tailed and a P value of <0.05 was required for statistical significance.