CHAPTER III

RESEARCH METHODOLOGY

In order to achieve all the objectives of the study, proper methodical procedure was required. In this chapter, the procedure adopted for selection of subjects, selection of variables, experimental design, reliability of data, instruments reliability, subjects reliability, testers competency, reliability of tests, criterion measures, procedure of testing, collection of data and statistical technique employed for the analysis of data is present.

SELECTION OF SUBJECTS

Ten university level male tennis players from Lakshmibai National Institute of Physical Education, Gwalior were selected. The age of tennis players were ranging between 18 to 28 years with (Mean ± SD; Age 22.02 ± 2.35 years, Height 174.9 ± 3.74 cms, Weight 67.77 ± 8.01 kgs, Fat Percentage by sum of 4 sides skin fold 13.83 ± 2.62 mm, Vital Capacity 3.81 ± 0.49 ltrs, Resting Heart Rate 59.6 ± 3.97). The training age of the subjects was 3.8 ± 2.25 years. Subjects were asked to provide written, voluntary, informed consent (appendix A) prior to participation. All were regular players and accustomed to high level of exertion. The subjects were studying in Bachelor and Master Degree in Physical Education and practicing for 2 hours during match practice time daily approximately for 10-12 hours per week. The subjects were informed about the purpose of the study. Further, they were also informed that the data will remain confidential and will not be used beyond any academic purpose. Each subject underwent each treatment of fluids and playing surfaces during simulated tennis match.

SELECTION OF VARIABLES

On the basis of review of literature, expert’s opinion, facilities & instruments availability and scholars own understanding of the problem following Physiological and Biochemical variables were selected:
Biochemical Variables

➢ Electrolyte Balance
   • Serum Sodium
   • Serum Potassium
➢ Blood Lactate
➢ Blood Glucose

Physiological Variables

➢ Body Temperature
➢ Sweat Rate

CRITERION MEASURES

• Blood lactate: to measure the blood lactate, lactic scout analyzer (EKF diagnostics) was used and measured in mmol/l.
• Body temperature: digital thermometer (Dr. Morepen Digiclassic MT220 Hardtip Thermometer) was used and measured in Degree Fahrenheit.
• Sweat Rate: Weighing Machine (Digital Weighing Machine Glass Heuer HD201) was used and Weight was measured in kgs, then to calculate sweat rate, formula was used (weight before the match – weight after the match) + fluid intake during the match and measured in l/hr.¹²⁵
• Blood Glucose: Glucometer (Accu Chek Active Glucometer) was used and measured in mg/dl.
• Electrolyte Balance: Blood Testing with ion selective electrodes was used and measured in mmol/l.

INSTRUMENTS’ RELIABILITY

The instruments used in the study were obtained from the lab of Lakshmibai National Institute of Physical Education, Standard firms and pathology laboratory, which were calibrated regularly and catered to the needs of various research laboratories in India and abroad. Hence, the instruments were considered reliable for the purpose of this study.

PROCEDURE OF TESTING AND COLLECTION OF DATA

The subjects were instructed to take rest for 36 hours before the day of testing as well as to take optimum amount of water, so that they remain fully hydrated and take sleep for at least 8 hours, just before the day of testing. The testing timing was in between 09:00 A.M. to 02.00 P.M. Before the administration of simulated tennis match experimental protocol, participants had taken rest for 1 hour and they had consumed 200 ml of water in every 15 minutes (Latzka & Montain, 1999)\(^{126}\), followed by simulated tennis match experimental protocol, which was played with the help of ball machine, which had predetermined set protocol. Immediately after the simulated tennis match, posttest was taken. The test was conducted on both the playing surfaces i.e. hard and clay at high temperatures (which was measured by hygrometer - HTC Digital Thermo Hygrometer 103-CTH). The difference between two treatment conditions of one particular subject was in between 5 to 7 days. Subjects were free to withdraw themselves at any time during the treatment or during the data collection if they felt uneasy or exhausted.

SWEAT RATE

Purpose: To measure the sweat rate

Equipment: Weighing Machine, Record Sheet and Pencil.

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Procedure: Sweat rate was measured with the help of body weight. Subjects were weighed nude before the match and immediately after the match. Subjects were asked to wipe all the sweat with the help of towel from his body and then weighed again in nude, after the match.

Scoring: Sweat rate was estimated by finding the difference between the weight before and after the match plus amount of liquid consumed during the simulated tennis match and measured in liters/hr.

**BODY TEMPERATURE**

**Purpose:** To measure the body temperature.

**Equipment:** Digital Temperature Thermometer, Record Sheet and Pencil.

**Procedure:** Subjects were asked to sit on a chair immediately after the match. The channel of the digital thermometer was set at normal and the rod was placed under the tongue of the subjects, as the digital thermometer beeped, the reading was noted.

**Scoring:** The body temperature was recorded in Degree Fahrenheit.

**BLOOD LACTATE**

**Purpose:** To measure the blood lactate concentration.

**Equipment:** Lactic Scout Analyzer, Prickling Needles, Lactate Strips, Score Sheet and Pencil.

**Procedure:** Subjects were asked to sit on a chair immediately after the match; a fresh new strip was placed in the lactic acid analyzer. A small capillary blood sample was taken from either 3rd or 4th finger of the non dominant hand. The finger was wiped clean with an alcohol (dettol) followed by wipe dry with cotton and then a needle was ingested in the finger and the first drop of the blood drawn was wiped clean with cotton. As the blood again came out, the tester placed the lactic acid analyzer with the lactate strip over the blood and measured the blood lactate.
Scoring: Blood lactate was measured in mmol/l.

**BLOOD GLUCOSE**

**Purpose:** To measure the blood glucose level

**Equipment:** Glucometer, Blood Glucose Test Strips, Score Sheet and Pencil

**Procedure:** Subjects were asked to sit on a chair, immediately after the match; a fresh new strip was placed in the glucometer. A small capillary blood sample was taken from either 3rd or 4th finger of the non dominant hand. The finger was wiped clean with an alcohol (Dettol) followed by wipe dry with cotton and then a needle was ingested in the finger and the first drop of the blood drawn was wiped clean with cotton. As the blood again came out, the tester placed the glucometer with glucose strip over the blood and measured the blood glucose level.

**Scoring:** Blood glucose level was measured in mg/dl.

**ELECTROLYTE BALANCE (SERUM SODIUM AND SERUM POTASSIUM)**

**Purpose:** To measure the electrolyte balance (Serum Sodium and Serum Potassium) of the blood.

**Equipment:** Syringe, Cotton, Blood Bottle, Score Sheet and Pencil.

**Procedure:** Subjects were asked to sit on a chair immediately after the match; tester instructed the subjects to uncover the right arm. A tight band (tourniquet) was put around the upper arm. Before taking the sample, the tester cleaned the area with an antiseptic wipe. A needle attached to a syringe was pushed into the vein. The syringe was used to draw out a sample of blood. When the sample was taken, the needle was removed out. Pressure was applied to the tiny break in the skin for a few minutes using a cotton-wool pad to stop the bleeding and to prevent bruising. After the test, the blood sample was put into a bottle and labeled with the name. Then, it was sent to a laboratory where it was examined via ion selective electrodes.
Scoring: Electrolyte balance (serum sodium and serum potassium) was measured in mmol/l.

FLUID SUPPLEMENTATIONS

Water Supplementation: 100 ml of water was given after each repetition i.e. 5 minutes. In total 1800 ml of water was provided to them in complete simulated tennis match.

Carbohydrate Drink Supplementation: Glucon – D i.e. (glucose manufactured by Heinz India private limited, Aligarh) was administered. The ingested dose (17.5 grams per 100 ml of water) was given to the subjects i.e. after each repetition i.e. 5 minutes, 100 ml of glucose water was given. In total 1800 ml of glucose water was provided to them in complete simulated tennis match.

Electrolyte Drink Supplementation: Oral Rehydration salts i.e. (Electral based on W.H.O Formula manufactured by FDC Limited, Aurangabad) was administered. The ingested dose (21.8 grams per litre of water) after each repetition i.e. 5 minutes, 100 ml of electral water was given. In total 1800 ml of water was provided to them in complete simulated tennis match.

Sports Drink Supplementation: Gatorade sports drink i.e. (energy drink manufactured by PepsiCo, United States) was administered. The ingested dose after each repetition i.e. 5 minutes, 100 ml of sports drink was given. In total 1800 ml of sports drink was provided to them in complete simulated tennis match.

SIMULATED TENNIS MATCH EXPERIMENTAL PROTOCOL

The protocol commenced with ball machine (tennis tutor plus player model) projecting 4 consecutive tennis balls at a frequency of 1 ball every 2.0 seconds, with a velocity of 70 kms/h, 70 cms over the net, and landing 60 cms from the opposite baseline and 90 cms from the singles sidelines (Fernandez – Fernandez, 2010)\(^{127}\), in front of the player. The player begun the experimental protocol from the forehand side of the court.

The participant’s role was to return each ball to the opposite end of the court. After the completion of the rally, participants rested at the baseline for 20 seconds, after which the next 8 seconds rally immediately commenced. This process continued until 8 points were completed. Thereafter, players sat and recovered courtside for 90 seconds and took their recommended liquid during that time. This above protocol comprised of 2 games i.e. equal to 1 repetition. Like this, 6 repetitions were performed for 1 set and 3 consecutive set were played with 120 seconds rest between sets. The successive sets replicated the format of the first set. Simulated tennis match timing was of 90 minutes.

### TABLE 8

**GENERAL CHARACTERISTICS OF EXPERIMENTAL PROTOCOL**

<table>
<thead>
<tr>
<th></th>
<th>1 Point</th>
<th>4 Balls = 8 Seconds</th>
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</thead>
<tbody>
<tr>
<td>Rest Between Two Points</td>
<td></td>
<td>20 Seconds</td>
</tr>
<tr>
<td>1 Repetition</td>
<td></td>
<td>8 Points = 2 Games</td>
</tr>
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<td>No. of Repetitions</td>
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<td></td>
</tr>
<tr>
<td>Rest Between Two Repetitions</td>
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<td>90 Seconds</td>
</tr>
<tr>
<td>1 Set</td>
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<td>6 Repetitions</td>
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<tr>
<td>Rest Between Two Sets</td>
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<td>120 Seconds</td>
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<tr>
<td>Position</td>
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<td>Running</td>
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<td>Running Pressure</td>
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</tbody>
</table>
ILLUSTRATION 1

SCHEMATIC ILLUSTRATION OF SIMULATED TENNIS MATCH

EXPERIMENTAL PROTOCOL
ILLUSTRATION 2

DIAGRAM TO SHOW SEQUENCE OF COMPLETE EXPERIMENTAL PROTOCOL

- WATER INTAKE DURING REST TIME FOR EVERY 15 MINUTES - 200 ml
- PRE DATA (BODY WEIGHT FOR SWEAT RATE)
- RECOMMENDED FLUID INTAKE DURING SIMULATED TENNIS MATCH FOR 5 MINUTES - 100 ml
- POST DATA (BODY TEMPERATURE, BLOOD GLUCOSE, SERUM SODIUM, SERUM POTASSIUM, BLOOD LACTATE AND BODY WEIGHT (SWEAT RATE)
STATISTICAL TECHNIQUE

In order to examine the hypotheses of the study, descriptive statistics such as mean, standard deviation, coefficient of variation, range, minimum score, maximum score, standard error of mean, skewness, standard error of skewness, kurtosis, standard error of kurtosis and correlation coefficient was used.

In order to compare effect of fluids and playing surfaces on selected biochemical and physiological variables during simulated tennis match, two way repeated measures ANOVA (within-within) was employed. In case of significant main effect result, bonferroni correction was employed for pair-wise comparisons to find the mean difference among the groups. In case of significant interaction effect, then one-way repeated measures ANOVA’s was employed and the level of significance was 0.05.