CHAPTER-III

METHODOLOGY

In this chapter the methodology useful in the selection of subjects, selection of variables, pilot study, collection of data, the orientation procedures, tools used and statistical procedure have been presented. The purpose of the study was to find out the relationship of selected physical, physiological, psychological and anthropometrical variables with the game performance of college men volleyball players.

3.1 SELECTION OF SUBJECTS

To achieve the purpose of the study, the researcher selected one hundred thirty engineering college male volleyball players who have represented intercollegiate competition and their age ranged from 18-25 years under the V.T.U. jurisdiction. The subjects were taken from Bangalore district studying Bachelor Degree in Engineering stream coming under Bangalore regional jurisdiction only.

3.2 SELECTION OF VARIABLES

The researcher reviewed number of books, journals, research articles, coaching manuals and found that game performance of volleyball player may have relationship with selected physical, physiological, psychological and anthropometrical variables and the research scholar made a series of discussion with subject experts in the field of sports and research and also with the help of the guide and experts, the following variables were selected.

I. Volleyball Game Performance: Game performance (Total scores of Serve, Pass, Attack and Block by coaches rated scale)

II. Physical Variables :
   1. Abdominal Strength
   2. Muscular Power
3. Flexibility  
4. Agility  
5. Speed  
6. Muscular Endurance  
7. Coordination  

III. Physiological Variables:  
1. Blood pressure: Systolic and Diastolic.  
2. Cardiovascular Endurance  
3. Lung Capacity  

IV. Psychological Variable: Mental Toughness  
1. Reboundability  
2. Ability to handle pressure  
3. Wining concentration Ability  
4. Self confidence  
5. Motivation/Goal Setting  

V. A) Anthropometrical variables  
1. Standing Height  
2. Body Weight  
3. Arm Length  
4. Arm Span  
5. Leg Length  

B) Circumference or Girth  
1. Arm Girth  
2. Thigh Girth  
3. Calf Girth  

C) Muscle bone and fat (Skin folds measurement)  
1. Biceps  
2. Triceps  
3. Subscapular  
4. Suprailiac
3.3 RESEARCH DESIGN

A repeated measure research design was used with game performance of volleyball as the criterion variable and selected the physical, physiological, psychological and anthropometrical variables as the correlated variables.

3.4 CRITERION MEASURES

By glancing the literature and in consultation with professional experts, the following measures were applied to collected data on selected criterion and predictor variables.

Table-3.1
Criterion Measures

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Variables</th>
<th>Tests</th>
<th>Criterion measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Gamer Performance</td>
<td>The performance of volleyball players was measured by coaches rated scale</td>
<td>Scores (Average total scores of selected skills such as serve, pass, attack and block)</td>
</tr>
<tr>
<td>II</td>
<td>Physical Fitness</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abdominal Strength</td>
<td>Sit ups</td>
<td>In Numbers</td>
</tr>
<tr>
<td></td>
<td>Muscular Power</td>
<td>Vertical Jump</td>
<td>In Centimeters</td>
</tr>
<tr>
<td></td>
<td>Flexibility</td>
<td>Sit and Reach Test</td>
<td>In Inches</td>
</tr>
<tr>
<td></td>
<td>Agility</td>
<td>Quadrant Jump</td>
<td>In Numbers</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>50 Meters Dash</td>
<td>In Secs.</td>
</tr>
<tr>
<td></td>
<td>Muscular Endurance</td>
<td>Push Ups</td>
<td>In Numbers</td>
</tr>
<tr>
<td></td>
<td>Coordination</td>
<td>Alternate Hand wall Toss Test</td>
<td>In Numbers/30 secs.</td>
</tr>
<tr>
<td>III</td>
<td>Physiological Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blood Pressure</td>
<td>Systolic and Diastolic</td>
<td>Mean Arterial Pressure</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular Endurance</td>
<td>Heart Rate Test</td>
<td>PEI scores</td>
</tr>
<tr>
<td></td>
<td>Lung Capacity</td>
<td>Peak Flow Measurement</td>
<td>Millimeters</td>
</tr>
<tr>
<td>IV</td>
<td>Psychological Variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mental Toughness</td>
<td>Developed by Dr. Allon Galdburg was used</td>
<td>In Scores</td>
</tr>
<tr>
<td>V</td>
<td>A) Anthropometric Measurements</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standing Height</td>
<td>Stadiometer</td>
<td>In Centimeter</td>
</tr>
<tr>
<td></td>
<td>Body Weight</td>
<td>Electronic Weighing Machine</td>
<td>In Kilogram</td>
</tr>
<tr>
<td>Sl. No</td>
<td>Variables</td>
<td>Tests</td>
<td>Criterion measure</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>3.</td>
<td>Arm Length</td>
<td>Measuring tape</td>
<td>In Centimeter</td>
</tr>
<tr>
<td>4.</td>
<td>Arm Span</td>
<td>Measuring tape</td>
<td>In Centimeter</td>
</tr>
<tr>
<td>5.</td>
<td>Leg Length</td>
<td>Measuring tape</td>
<td>In Centimeter</td>
</tr>
</tbody>
</table>

**B) Circumferences or Girth**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Variables</th>
<th>Tests</th>
<th>Criterion measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Arm Girth</td>
<td>Measuring tape</td>
<td>In Centimeter</td>
</tr>
<tr>
<td>7.</td>
<td>Thigh Girth</td>
<td>Measuring tape</td>
<td>In Centimeter</td>
</tr>
<tr>
<td>8.</td>
<td>Calf Girth</td>
<td>Measuring tape</td>
<td>In Centimeter</td>
</tr>
</tbody>
</table>

**C) Muscle bone and fat**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Variables</th>
<th>Tests</th>
<th>Criterion measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.</td>
<td>Biceps</td>
<td>Skinfold caliper</td>
<td>In millimeter</td>
</tr>
<tr>
<td>10.</td>
<td>Triceps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Subscapular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Suprailliac</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3.5 PILOT STUDY

The researcher conducted a pilot study with ten players who were not subjects of the research study to determine the methods of testing, evaluate the competency of the researcher testing, recording the timings and scores and field equipments used in the present investigation.

### 3.6 RELIABILITY OF DATA

The reliability of the data was ensured by establishing the instrument reliability, subject reliability and tester's reliability.

#### 3.6.1 Instrument Reliability

Four electronic stop watches, non stretchable steel tapes, Wet Spirtometers, and Digital Heart Rate and Blood Pressure Machine, were used in this study. The instruments were used from standard companies and their calibrations were accepted as reliable at par with international standards. The measurements were collected twice and correlated for reliability. The intra class correlation coefficient obtained by test-retest method is presented in Table-3.2.
Table-3.2

The Reliability Coefficient of the Subjects in Physical, Physiological, psychological, Anthropometrical Variables with Game Performance by Test and Retest Method

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Test Items</th>
<th>Coefficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Game Performance</td>
<td>0.88</td>
</tr>
<tr>
<td>II</td>
<td>Physical Fitness Variables</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Abdominal Strength</td>
<td>0.82</td>
</tr>
<tr>
<td>2.</td>
<td>Muscular Power</td>
<td>0.81</td>
</tr>
<tr>
<td>3.</td>
<td>Flexibility</td>
<td>0.90</td>
</tr>
<tr>
<td>4.</td>
<td>Agility</td>
<td>0.92</td>
</tr>
<tr>
<td>5.</td>
<td>Speed</td>
<td>0.86</td>
</tr>
<tr>
<td>6.</td>
<td>Muscular Endurance</td>
<td>0.86</td>
</tr>
<tr>
<td>7</td>
<td>Coordination</td>
<td>0.85</td>
</tr>
<tr>
<td>III</td>
<td>Physiological Variables</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Blood Pressure – Diastolic</td>
<td>0.88</td>
</tr>
<tr>
<td>2.</td>
<td>Blood Pressure – Systolic</td>
<td>0.85</td>
</tr>
<tr>
<td>3.</td>
<td>Cardiovascular Endurance</td>
<td>0.80</td>
</tr>
<tr>
<td>4.</td>
<td>Lung Capacity</td>
<td>0.82</td>
</tr>
<tr>
<td>IV</td>
<td>A) Anthropometric Measurements</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Standing Height</td>
<td>0.89</td>
</tr>
<tr>
<td>2.</td>
<td>Body Weight</td>
<td>0.91</td>
</tr>
<tr>
<td>3.</td>
<td>Arm Length</td>
<td>0.88</td>
</tr>
<tr>
<td>4.</td>
<td>Arm Span</td>
<td>0.90</td>
</tr>
<tr>
<td>5.</td>
<td>Leg Length</td>
<td>0.92</td>
</tr>
<tr>
<td>B) Circumferences or Girth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Arm Girth</td>
<td>0.90</td>
</tr>
<tr>
<td>2.</td>
<td>Thigh Girth</td>
<td>0.92</td>
</tr>
<tr>
<td>3.</td>
<td>Calf Girth</td>
<td>0.88</td>
</tr>
<tr>
<td>C) Skinfolds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Biceps</td>
<td>0.82</td>
</tr>
<tr>
<td>2.</td>
<td>Triceps</td>
<td>0.82</td>
</tr>
<tr>
<td>3.</td>
<td>Subscapular</td>
<td>0.80</td>
</tr>
<tr>
<td>4.</td>
<td>Suprailiac</td>
<td>0.88</td>
</tr>
</tbody>
</table>

* Significant at 0.01 level
The validity and reliability of psychological questionnaire administered were already determined by the authors and they were accepted for this study as reliable.

3.6.2 Tester's Reliability

The tester's competency was established together with reliability of test. To determine the reliability of the test, the performance of ten subjects were recorded twice under similar conditions by the investigator with the help of suitable and appropriate guidance. This was done by the test and retest method on consecutive days. The repeated measurement of subjects was conducted on the selected predictor variables to determine reliability in an univariate situation.

3.6.3 Reliability of the Subjects

The co-efficient of Correlation in Table-3.2 also indicated the subject reliability because the same subjects were used under similar conditions by the same test. No motivation techniques were used at the time of the testing periods.

3.7 ORIENTATION OF THE SUBJECTS

In order to get the full co-operation from the subjects, the researcher explained to the subjects the purpose of the study, tests to be administrated and procedure to be followed in the administration of the test. Practice trials were conducted to help the subjects to understand the method of testing.

3.8 TEST ADMINISTRATION

The following tests were administered to measure the game performance, physical, physiological, psychological and anthropometrical variables. The method of data collected from the inter college volleyball players on selected physical, physiological, psychological and anthropometrical variables along with game performance variables were explained below.
I. **GAME PERFORMANCE**

To determine the game performance of the volleyball players, the selected subject’s game performance was assessed by three experts subjectively. Three qualified coaches who served as experts rated each individual volleyball player in the game situation. The individual and team performance related volleyball skills were selected as criteria for subjective ranking of volleyball game performance by the experts.

**Skills**: The following skills were selected, namely, serve, pass, attack and block.

**Testing Arrangements**: To determine the subjects game performance (overall ability) in actual playing situation, the subjects were required to play in a volleyball court.

**Test Administration**: The experts ranked the skills of the subjects in a four versus four playing situations. In this way subjects were subjectively rated on the four individual skills.

**Rating Scale for assessing Skill Performances**

A four point rating scale corresponding to the rating scale prepared by (Schall, 1985) was employed to assess the skill performances of the volleyball players during game situations. Data in the four skills namely; serve, pass (service reception), attack, and block were rated on a scale from zero to three. These ratings are made using the following scale of values:

**Serve**

3 - Excellent (Service ace, ball not controlled, immediate score)
2 - Good (Aggressive serve that results in no attack)
1 - Poor (Serve that is passed well for multiple attack)
0 - Failure (Serving error)
Pass (service reception)

3 - Excellent (Perfect pass for multiple attack)
2 - Good (Pass that can be set for non-quick attack)
1 - Poor (Pass that results in no attack advantage)
0 - Failure (Passing error/Failure of reception)

Attack

3 - Excellent (Kill, return for point or side out / deep attack)
2 - Good (Play resulting in attaining attack advantage./touching the block, but not retrieved back).
1 - Poor (Play giving opponent attack advantage / smashed ball defended by opponent)
0 - Failure (attack which goes out side, net, dead block) /error or foul)

Block

3- Excellent (Dead block, or return for point)
2 - Good (Blocker touches the ball, and the defender is able to retrieve the ball / play that results in attaining attack advantage)
1 - Poor (Blocker touches the ball, but the defender cannot retrieve the ball (touch out) / play giving opponent attack advantage)
0 - Failure (Error / foul / blocker can’t be able to touch a successful attack)

With the help of the above rating system, data are used to calculate each player's percentage for each skill. The total score secured by a player in all the three sets divided by the number of attempts will give the average score for each skill. A skill with few attempts has equal weight as one with many. The rating of the players was done by three experienced and well known judges as per the rating scale during match situations. For the present study to know the game performance of the volleyball players only total average scores were taken into consideration (Overall skill performance).
II. PHYSICAL FITNESS VARIABLES

1. ABDOMINAL STRENGTH (SIT UPS)

Test: Sit – ups (Bend Knee in 1 minute)

Purpose: To measure abdominal strength.

Facilities and Equipments: Mats and stop watch

Procedure: The subject lies flat on the back with knees bent and feet on the floor with the heels no more that 1 foot from the buttocks. The knees angle should be no less than 90 degrees. The fingers are interlocked and placed behind the neck with the elbows touching the floor. The feet are held securely by a partner. The subject then curls up to a sitting position and touch the elbows to the knees. This exercise is repeated as many times as possible in the time requirement.

Instructions: Fingers must remain inter locked and in contact with the back on neck at all time. He curls up from the starting position, but he may not push off the floor with an elbow. When he returns to the starting position, his elbows must be flat on the floor or mat.

Scoring: One point is scored for each correct sit up. The score is the maximum number of sit ups completed in 60 seconds.

Testing Personnel: One tester can administer this item and count and record the score.

2. MUSCULAR POWER (VERTICAL JUMP)

Purpose: To measure the muscular power of the subjects.

Equipments: Wall, measuring tape

Procedure: The vertical jump test was completed from a 2-foot standing position without a step into the jump. The subject was asked to stand with side to the wall keeping both feet flat on the floor. He reached as high as possible with his middle finger touching the wall. This was his standing reach. Keeping color
chalk powder on his middle finger he stood comfortable at a distance from the wall. On signal the subject swung both arms upward and jumped vertically extending his hand and touching the wall with the chalked finger. This jump must be taken without any preliminary feet movement such as hopping or stepping.

Scoring: The difference between standing hand reach and the jump reach were recorded. Out of three attempts the best reach was taken and recorded.

3. FLEXIBILITY (SIT AND REACH TEST)

Purpose: To measure the flexibility of the subjects.

Equipment: Constructed box (12” x 12” x 21”) with measuring scale in which 23 centimeter is at the level of the feet.

Procedure: The subjects were asked to remove their foot wears and assume the long sitting position with the knees fully extended and feet against the apparatus with shoulder width apart. The subject’s arms were extended forward with one hand placed on top of the other, palms down, bending toward along with the measuring scale. Subjects were instructed to keep the palms even and slowly stretch forward four times and hold the position of maximum reach as the fourth count. The maximum reach was held for one second with the knees in full extension while the feet are in contact with the apparatus.

Scoring: The point zero was kept on the edge of the apparatus on the top, where the subjects kept their feet. From the zero point towards the other end of the apparatus it was marked positive and towards the body of the subject it was negative. If the subjects were unable to reach the top of the apparatus with their finger tips where zero was marked, the distance was counted in minus and if the subject crossed zero point further forward the maximum distance reached was measured to the nearest centimeter as positive.¹

4. **AGILITY (QUADRANT JUMP)**

**Purpose:** to test whole body agility

**Equipments:** tape measure, chalk or tape for marking the ground, stopwatch

**Procedure:** A quadrant is marked out on the floor, as illustrated in the diagram (3 feet is about 90 cm). Mark the starting line and number each quadrants. The subject stands with both feet together at the starting line. On the command 'go', they jump ahead across the line into the first quadrant, then in sequence successively into quadrants 1, 2, 3, 4, 1, 2, etc. This pattern is continued as rapidly as possible for 10 seconds. After a rest repeat the trial.

**Scoring:** The average score from two, 10 second trials is the subject’s score. The subject's score is the number of correct jumps less a penalty deduction. One point is awarded each time the subject lands with both feet entirely within the correct quadrant during the 10 second trial, with a penalty of 0.5 point subtracted each time the subject touches a line and for each time the subject lands with one or both feet in an incorrect quadrant.

5. **SPEED (50 YARD DASH)**

**Purpose:** The purpose of this test was to measure speed.

**Equipments:** Stop watches, score sheet and Chunnam.

**Procedure:** The subject was asked to take the starting position behind the starting line. The starter used the commands ‘Are you ready?’ and ‘go’ simultaneously with the command ‘Ready go’. Clapper was sounded for the help of the timers who stand at the finish line.

**Rules:** The score was the time clapped between the starter’s signal and the instant the subjects crossed the finished line.

**Scoring:** Score was recorded in seconds to the nearest one tenth of a second.
6. MUSCULAR ENDURANCE (PUSH-UPS)

**Purpose:** To estimate the muscular endurance/strength of the upper body

**Equipments:** Gymnastic Mats

**Procedure:** The subject being tested took prone lying position on the ground with the hands under the shoulders and fingers stretched, legs straight and parallel with comfortably apart and the toes tucked under the feet. On the command ‘go’ the subject performed push ups with the arms and extended it completely. The legs and the back were kept straight through out the test. Then the subject lowered her body using the arm until it came to 90 degree angle and upper arms were parallel to the ground. The action was repeated as many time as possible.

**Scoring:** Total number of correct push ups was recorded as the score of the test. (Yobu, 1987)

7. COORDINATION (ALTERNATE HAND WALL TOSS TEST)

**Purpose:** to measure hand-eye coordination

**Equipment required:** tennis ball or baseball, smooth and solid wall, marking tape, stopwatch (optional)

**Procedure:** A mark is placed a certain distance from the wall (e.g. 2 meters, 3 feet). The person stands behind the line and facing the wall. The ball is thrown from one hand in an underarm action against the wall, and attempted to be caught with the opposite hand. The ball is then thrown back against the wall and caught with the initial hand. The test can continue for a nominated number of attempts or for a set time period (e.g. 30 seconds). By adding the constraint of a set time period, you also add the factor of working under pressure.

**Scoring:** This table lists general ratings for the Wall Toss Test, based on the score of the number of successful catches in a 30 second period.
III. PHYSIOLOGICAL VARIABLES

1(A) Systolic Blood Pressure

**Objective:** To measure the Systolic blood pressure of the subjects

**Equipments:** Syhygmonometer or Erkameter, stethoscope and piece of paper and pen

**Procedure:** The subject was instructed to take a relaxed position either lying down with arm on bed or sitting with arm supported on the table at heart level to ensure accurate reading. The subject was told that the application of cuff might cause discomfort for a short time and he/she was asked to roll sleeve above the elbow about 5 inches (12.5 cm) usually on the left arm. The deflated cuff was smoothly and evenly applied with rubber bladder over brachial artery (two tubes going toward palm of hand) lower edge about 2 inch (5 cm) above elbow and the loose end was tucked. The screw on the rubber bulb of the apparatus was tightened. Placing the ear pieces of stethoscope in ears, the pulse of brachial artery was found out. The diaphragm of stethoscope should be kept lightly but firmly in place. Pulse was felt on the inner side or the bend of the elbow. Stethoscope must not touch cuff or tubes. The cuff was inflated by squeezing the bulb until the pulse disappeared. Then the cuff was inflated about 20mm higher. Rubber portion of the cuff should not be bulging or displaced. The valve was opened slowly while watching the level of the mercury in the manometer. The first sounds are sharp and snapping. This is systolic pressure reading. The reading was recorded. This procedure was carried out with the help of medical assistant.

1(B) Diastolic Blood Pressure

**Objective:** To measure the Diastolic blood pressure of the subjects

**Equipments:** Syhygmonometer or Erkameter, stethoscope and piece of paper and pen
Procedure: The subject was instructed to take a relaxed position either lying down with arm on bed or sitting with arm supported on the table at heart level to ensure accurate reading. The subject was told that the application of cuff might cause discomfort for a short time and he was asked to roll the sleeve above the elbow about 5 inches (12.5 cm) usually on the left arm. The deflated cuff was smoothly and evenly applied with rubber bladder over brachial artery (two tubes going toward palm of hand) lower edge about 2 inch (5 cm) above elbow and the loose end was tucked. The screw on the rubber bulb of the apparatus was tightened. Placing the ear pieces of stethoscope in ears, the pulse of brachial artery was found out. The diaphragm of stethoscope should be kept lightly but firmly in place. Pulse was felt on the inner side or the bend of the elbow. Stethoscope must not touch cuff or tubes. He cuff was inflated by squeezing the bulb until the pulse disappeared. Then the cuff was inflated about 20mm higher. Rubber portion of the cuff should not be bulging or displaced.

The valve was opened slowly while watching the level of the mercury in the manometer. The air was released slowly after the first sounds were sharp and snapping. The sounds were heard louder and clear and became dull and disappeared. The point where the sound ceased was noted and level of mercury column was also noted. This is diastolic pressure reading. This procedure was carried out with the help of medical assistant.

2. CARDIOVASCULAR ENDURANCE

Purpose: To measure cardiovascular endurance of an individual.²

Equipment: A bench, a stopwatch and a measuring tape.

Instruction: The physical educators have long been concerned with the measurement of cardiovascular or circulatory endurance this form of endurance involves the continued activity of the entire organism during which major

adjustments of the circulatory and respiratory systems are necessary as in running, swimming, climbing and the like this form of endurance is not only dependent upon the structure of the muscles involved in the activity but must rely greatly on the effective functioning of the circulatory system as a consequence of this relationships. Many tests involving responses to exercise of various aspects of the cardiovascular and respiratory system have been proposed as measures of circulatory endurance.

**Procedure**

**Step –1:** The subject steps up and down 30 times a minute on a bench of 20’ ht each time the subject should step all the way upon the bench with the body erect stepping is done in 4 counts as follows:

- Count–1 : Left feet is placed on the bench.
- Count–2 : Right feet is placed on the bench.
- Count–3 : Left feet is placed on the floor.
- Count–4 : Right feet is placed on the floor.

The subject should come to an erect position on the bench each time.

**Step-2:** The stepping exercise continues for exactly 4 minutes unless the subject is forced to stop sooner due to exhaustion in either case the duration of the exercise in seconds is recorded. The maximum no of seconds is 240 seconds for the full 4 minutes period.

**Step-3:** Immediately after completing the exercise the subject sits on a chair the pulse is counted between 1-1½ minutes after the stepping ceases.

**Step–4:** A physical efficiency Index (PEI) is computed utilizing the following formula.

\[
PEI\; scores = \frac{\text{Duration of exercise in seconds} \times 100}{5.5 \times \text{sum of the pulse counts in recovery}}
\]

---

3 Reported by Edward C. Schneider and Peter V. Karpovich, Physiology of Muscular Activity, 4th Ed. (Philadelphia: W.B. Saunders Co., 1953), p.270
3. LUNG CAPACITY (PEAK FLOW MEASUREMENT)

**Purpose**: To measure the maximum expiration levels of the subject, expiratory flow rate is the measure of maximum expiration, or to find out how much the lungs can push out the air from the lungs.

**Equipment**: The apparatus peak flow meter and the nose clip.

**Procedure**: The subject was asked to stand up right, and holds the instrument horizontally without obstructing the pointer throughout the range. He was asked to take a deep breath and exhale as forcefully as possible in one single blow through the mouthpiece. The test was repeated two times and the best score recorded in millimeters.

IV. PSYCHOLOGICAL VARIABLES

1. MENTAL TOUGHNESS QUESTIONNAIRE

   Mental Toughness Questionnaire developed by Dr. Allon Galzburg was used to assess the mental toughness of the volleyball player.

   (Answer ‘T’ for True and ‘F’ for False for each statement)

1. I frequently worry about mistakes.
2. I get really down on myself during performance when I mess up.
3. It’s easy for me to let go of my mistakes.
4. If I start out badly, it’s hard for me to turn my performance around.
5. I get distracted by what the coach thinks whenever I screw up.
6. I bounce back quickly from setbacks, bad breaks and mistakes.
7. I do my best when there’s more pressure on me.
8. I get too nervous to really perform to my potential.
9. I do better in practice than I do when it really counts the most.
10. I tend to get easily psyched out or intimidated.
11. I can keep myself calm and composed under pressure.
12. I don’t want the ball/dread competing at “crunch time.” (big game/race).
13. The coach’s yelling knocks me off my game.
14. I tend to get easily distracted.
15. Certain opponents can get into my head and throw me off my game.
16. Lousy playing conditions (weather, field conditions, temperature, etc.) negatively affect me.
17. I have no trouble focusing on what’s important and blocking everything else out.
18. I think too much about what could go wrong right before and during performance, (the “what if’s”).
19. One or two failures do not shake my confidence.
20. I tend to compare myself too much with teammates and opponents.
21. I’d rather compete against a better opponent and lose than go up against a weaker opponent and win.
22. I am a confident and self-assured athlete.
23. I tend to be too negative.
24. I have trouble dealing with negative self-talk (thoughts).
25. I get more motivated after failures and setbacks.
26. It’s easy for me to consistently train at a high level of intensity.
27. I think about how today’s practice will help me get to my goals.
28. I find myself just going through the motions a lot in practice.
29. I have clear goals that are important for me to achieve.
30. I am a highly motivated athlete.

Procedure: Subjects are made to sit on the ground. The researcher explained about the mental toughness questionnaire and the meaning of each question. The subjects had to write ‘True’ or ‘False’ against each question inside the bracket mark after assessing themselves.

Scoring: One point is awarded for each of the question and the total number of scores obtained by the subject is recorded.
Section 1, questions 1-6 deal with “Reboundability” or your skill at mentally bouncing back from setbacks and mistakes. Mental toughness depends on your ability to quickly leave your mistakes and failures behind you. Hanging onto your mistakes will get you into big trouble, performance wise. Athletes who dwell on their mistakes while the competition continues, end up making more. Score 1 point for each of the following answers:

1) F
2) F
3) T
4) F
5) F
6) T

Section 2, questions 7-12 deal with the ability to handle pressure. Without the ability to stay calm in the clutch, an athlete will always underachieve. Peak performance demands that you are relaxed once the performance begins. While a little nervousness is critical for getting “up” for a game/match/race and performing at your best, (“good nervousness”) too much nerves (“bad nervousness”) will tighten your muscles and send your performance down the tubes. Score 1 point for each of the following answers:

7) T
8) F
9) F
10) F
11) T
12) F
Section 3, questions 13-18 deal with your concentration ability. In every sport, your ability to focus on what’s important and block out everything else is one of the primary keys to performance excellence. Poor concentration is the major reason why athletes choke and get stuck in performance slumps. Getting psyched out or intimidated is a direct result of concentrating on the wrong things. Score 1 point for each of the following answers:

13) F
14) F
15) F
16) F
17) T
18) F

Section 4, questions 19-24 deal with your level of confidence and the factors that affect confidence. One characteristic of the mentally tough athlete is he/she possesses a confidence level that seems to be unshaken by setbacks and failures. Under the pressure of competition, low confidence will neutralize natural ability, hard work and talent. Similarly, high confidence will enhance an athlete’s training and God-given talents, lifting their performance to the next level.

Score 1 point for each of the following answers:

19) T
20) F
21) T
22) T
23) F
24) F
Section 5, questions 25-30 deal with motivation. Motivation is the fuel that will drive your training to a successful completion and the accomplishment of your goals. Without adequate motivation athletes get stuck having “permanent potential.” Without motivation you won’t put in the work necessary to become a winner. Your motivation allows you to pick yourself up after a setback and keep going. Score 1 point for each of the following answers:

25) T  
26) T  
27) T  
28) F  
29) T  
30) T  

**Interpretation:** A score of 6 in any one of the five sections indicates a special strength in that area. A 5 indicates solid skill and 4 or less highlights that particular area as a mental weakness that needs to be addressed. For example a “6” in ‘reboundability’ indicates consistent ability to bounce back quickly from mistakes, failures and losses. A score of ‘2’ or ‘3’ in section # 2, handling competitive pressure, indicates the need for arousal control/relaxation training. Low scores in each section highlight problem areas. These “mental weaknesses” should then form mental training goals for you to help raise your overall performance to the next level. For example, a low score in the concentration section means that some of your poor performance is a direct result of your inability to control your focus of attention before and/or during competition. By putting some time and energy into practicing concentration exercises you will become a better overall athlete.

**Overall Score:** A score of 26-30 indicates strength in overall mental toughness. Scores of 23-25 indicates average to moderate skill in mental toughness. Scores of 22 or below mean that you need to start putting more time into the mental training area.
V. (A) ANTHROPOMETRICAL VARIABLES

1. Standing Height

The height of the subjects was taken with the help of wall scale and hard board. Subjects were suggested to standing erect without shoes against a wall marked scale, subjects were instructed to keep the heels together body touching the wall with heels, buttocks and back, head erect without tilt and to take and hold a full breath and standing erect while height measurement was taken. A stiff hard board was held horizontally on his head, slightly pressing the head and touching the scale marked on the wall, at right angle. The subject was asked to step out by lowering the head and reading indicated by the lower end of the hard board was taken. The measurement was taken correct to the nearest half of a centimeter.

2. Body Weight

The weight of the subject was taken with a lever tight laboratory anthropometric weighing machine. The subject wearing shorts and vest only stood at the centre of the machine and the weight was recorded from the indicator needle of the dial. The weight was read and recorded correct to a half of a kilogram.

3. Arm Length

The arm length was measured by using flexible steel tape. The subject stood in a side view and arm length measured putting the steel tape from acromion process above the shoulder joint to the tip of the middle finger.

4. Arm Span

A hand is a unit of length measurement, originally based on the breadth of a male human hand and now standardized at 4 inches (about 10 cm). To measure hand span of the subject. A flexible tape, paper and pencil to record the measurements. The subject was asked to wide open his right hand and the hand span was measured from the tip of the thump to the tip of the little finger in a straight line.
5. **Leg Length**

Leg length of the subject was measured with flexible steel tape from the bottom outside edge of the centre of foot to the upper edge of the greater trochanter. Leg length was recorded correct to the nearest centimeter.

6. **Arm Girth**

To measure the circumference of the upper arm girth, the flexible measuring steel tape and score sheet. The upper arm girth was measured at the maximum circumference of the upper arm in a plane at right angle to its body axis. The measurement was taken to the nearest centimeter.

7. **Thigh Girth**

Thigh girth was measured with a steel tape placed around the thigh horizontally with its top edge under the fold of the buttocks. The subjects were asked to stand with his weight equally distributed on both feet. A cross handed technique was used to raise the tape to this level on the inner thigh.

8. **Calf Girth**

Calf girth was taken with flexible steel tape at the maximum circumference of calf in a plane at right angle to its long axis. The leg was held hanging over the table top so that tape measure were in horizontal plane in this position the calf muscle is quite relaxed. The measurement was taken to the nearest centimeters.

(C) **SKINFOLDS (BODY FAT PERCENTAGE)**

9-12. **Body Composition**

**Purpose** : To measure the body fat of the subject

**Equipment** : Lange’s skinfold caliper.

**Description** : A component model is used which commonly divides the body into a fat portion and fat free body weight (lean body weight mass). Skinfold
measurement method is probably the most widely used of all and it is based on the fact that about one half of the total adipose tissue is kept in specialized cells within the subcutaneous areas beneath the skin. The fold involving two layers of skin and subcutaneous strictures can be held between the thumb and index finger while the skinfolds calipers are being applied. The right side of the body is used to determine the percentage. It is recorded in millimeter. Measurement was taken at four sites i.e. biceps, triceps, subscapular and suprailiac. Body fat was calculated with the help of the Durnin and Womersley formula (1974).

Skin folds

9. **Biceps**: The skinfold was measured by raising a vertical at the marked mid-acromiae-radiale line on the anterior surface of the arm. The subject stood with the arm hanging down freely.

10. **Triceps**: It was taken over the triceps muscle at a point half way between the tip of the shoulder acromian process and process of the elbow. The spot was located with the forearm flexed to 90°. However during test the arm was allowed to hang freely.

11. **Subscapular**: This skin fold was taken at the tip of the scapular (interior angle) of the left scapula with the subject in the relaxed standing position. The fold was lifted into the diagonal plane about 45° from the vertical and horizontal plane.

12. **Suprailiac**: The subject was asked to stand erect and relaxed. The skin was lifted one centimeter above the superior margin of the iliac crest, the point where it is cut by an imaginary vertical line drawn about 2-3 cms. from the axillary fossa. The measurement was taken vertically.

**Caution**: To eliminate error, the reading is made in three to four seconds, when essentially all compression had taken place. If this precaution is not taken, the skin-fold will gradually decrease because the tissue is required to take out from the jaws of the caliper.
3.9 STATISTICAL ANALYSIS

Pearson’s Coefficient of Correlation was applied to establish the relationship among the variables [The relationship between criterion variable (game performance) with independent variable (physical, physiological, psychological and anthropometrical variables)] measured at 0.05 and 0.01 level of probability was used to indicate statistical significance. To determine the significance of the differences between the group means in different variables for the spikers, setters and allrounders of volleyball players, the One-Way Analysis of Variance (F Rato) was used. The significant was set at 0.05 level of confident. In case of significant F ratio obtained, Scheffe’s post hoc test was applied to test the significant differences between the ordered paired means. To identify the significant predictors and to develop solutions for the regression equations of game performance of volleyball players multiple correlation and regression was used. The Data were analyzed using SPSS (Statistical Package for Social Science) version 11.5.