Chapter - III

METHODOLOGY
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In this chapter the procedures adapted for the selection of subjects, classification of groups, selection of variables, Justification of criterion variables, selection of test, pilot study, training programme, experimental design, reliability of data, instrument reliability, reliability of test, tester’s reliability, subject reliability, orientation of subjects, administration of tests, collection of data and statistical techniques for the analysis of the data have been explained.

3.1. Selection of Subjects

The purpose of the study was to find out the impact of Battle rope and Slackline training on selected physical, physiological and performance variables among male volleyball players. To achieve the purpose of the study thirty six male volleyball players have been randomly selected from various colleges in and around Erode (N=36), Tamil Nadu state, India. The age of subjects ranged from 18 to 25 years. The subjects had past volleyball experience of at least three years in volleyball players and only those who represented their respective college teams is taken as subjects.

3.2. Classification of groups

<table>
<thead>
<tr>
<th>Group – I</th>
<th>Experimental group-A (Battle rope training)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group – II</td>
<td>Experimental group-B (Slackline training)</td>
</tr>
<tr>
<td>Group – III</td>
<td>Control group</td>
</tr>
</tbody>
</table>

The subjects were randomly divided into three equal groups of twelve each such as experimental groups and control group (n=12). The experimental groups participated in the
Battle rope training and Slackline training for 3 days a week, one session per day and for 12 weeks each session lasted 60 minutes, control group was not exposed to any training other than their daily routines activities.

3.3. Selection of Variables

The present study mainly focus on battle rope training, slackline training and its influences on selected physical, physiological and performance variables among volleyball players. The major components of volleyball that need to be developed are technical, tactical, strength endurance, speed and mobility. Similar studies clearly chapter-2 describe the influences the physical and physiological system, as a result directly affects the performance factors and also it was accorded by the professional experts. With these causes and affect, to visualize the status the variables underlie the physical, physiological and performance variables were chosen as the criterion variables.

Having the experts' consultation in the volleyball players, physical educators, sports scientists and through search of various literatures related to physical, physiological, sports training methods, the investigator have selected the following variables as criterion measures.

3.4. Justification of criterion variables

A. Physical variables

Sheppard et al., (2008) opined that strength and power contribute to jumping performance in elite volleyball players and a potential increase in volleyball performance can be achieved through strength and power improvements. Technical training and competition, in-season strength and conditioning programs are often designed to sustain adequate levels of strength and power over several months Graham (2002). The game
demands a greater amount of speed, strength, endurance, flexibility, co-ordination and maximum fitness of the organism Gandhi Indra(1982). 10-week training program significant improvements of agility, sprinting and jumping ability among female volleyball players Theos et al (2017). The ability to maintain or increase power and performance during the competitive season is an important consideration. A long competitive season, with its high volume of skill training and competition, has been reported to have detrimental effects on the power production of volleyball players Hakkinen (1993).

**B. Physiological variables**

High level of performance of volleyball might be dependent upon his physiological make up and recognized that physiological fitness was needed for high level performance. Hence resting heart rate, breath holding time, peak expiratory flow rate, vital capacity, forced vital capacity and slow vital capacity were selected as physiological components for this investigation. Ten week training program significant improvements of aerobic capacity female volleyball players Theos et al (2017).

**C. Performance variables**

Hakkinen opined that technical skills like serving, spiking, setting, blocking and passing accuracy along with tactical skills seem to play a critical role in volleyball performance. Skilled volleyball players could produce greater power and therefore perform better compared with the less skilled ones Graham (2002). Ten week training program significant improvements of passing skills improved female volleyball players Theos et al (2017).
3.5. Selection of the test

The investigator selected the following standardized test for testing the selected variables.

TABLE – 3.1

SELECTION OF THE TEST

<table>
<thead>
<tr>
<th>S.No</th>
<th>Variables</th>
<th>Test/Equipment used</th>
<th>Measuring unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Physical variables</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Grip strength</td>
<td>Grip dynamometer</td>
<td>In kilograms</td>
</tr>
<tr>
<td>2</td>
<td>Explosive strength</td>
<td>Vertical Jump Test</td>
<td>In Centimetre</td>
</tr>
<tr>
<td>3</td>
<td>Leg strength</td>
<td>Dynamometer</td>
<td>In Kilograms</td>
</tr>
<tr>
<td>4</td>
<td>Explosive power</td>
<td>Overhead Medicine Ball Throw (forwards)</td>
<td>In meters</td>
</tr>
<tr>
<td>5</td>
<td>Balance</td>
<td>Stork Balance Stand Test</td>
<td>In seconds</td>
</tr>
<tr>
<td>6</td>
<td>Flexibility</td>
<td>Sit and Reach Flexibility Test</td>
<td>In centimetres</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Physiological variables</strong></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Resting heart rate</td>
<td>Digital heart rate/blood pressure monitor</td>
<td>In Beats per minute</td>
</tr>
<tr>
<td>8</td>
<td>Breath holding time</td>
<td>Digital stop watch</td>
<td>In second(1/100)</td>
</tr>
<tr>
<td>9</td>
<td>Peak expiratory flow rate</td>
<td>Peak flow meter</td>
<td>In Litres per minute</td>
</tr>
<tr>
<td>10</td>
<td>Vital capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Forced vital capacity</td>
<td>Spiro meter</td>
<td>In liters</td>
</tr>
<tr>
<td>12</td>
<td>Slow vital capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Performance variables</strong></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Playing ability</td>
<td>Subjective rating</td>
<td>In points</td>
</tr>
</tbody>
</table>

3.6. Pilot Study

A Pilot Study was conducted to assess the initial capacity of the subjects in order to fix the load and to make sure that the duration of exercise included in the programme was within the limits of the subjects, to ensure the satisfactory effect. For this, fifteen volleyball players were selected randomly and divided into two groups of five each, in which Group-I underwent Battle rope training group and Group-II underwent Slackline training group under the supervision of investigator with experts in the field of Battle rope training and
Slackline training. Based on the response of the subjects in the pilot study the training programme for the experimental groups was fixed to the main study.

3.7. Training Programme

The Battle rope training and Slackline training package was specifically designed to improve the volleyball performance. The Battle rope training and Slackline training package designed by the researcher of the study was administered for 12 weeks, 3 days a week, one session per day and each session lasted 60 minutes. The subjects were free to withdraw their consent in case they felt any discomfort during the period of training but there were no dropouts in the study. A qualified physician examined the subjects medically and declared that they were fit for the study. The subjects underwent their respective programmes under the strict supervision of the investigator. Prior to every training session, the experimental group had a ten minute warm-up exercise, which included jogging and stretching.

All the subjects involved in the training programmes were questioned about their stature throughout the training period. None of them reported any injury. However, muscle soreness and fatigue were reported in the early weeks which subsided later. Attendance was calculated for experimental group by dividing the total number of training sessions by the number of sessions present. It was 97.98% for the experimental groups.

3.8. Experimental Design

This study was conducted to determine possible cause and effect relationship of 12 weeks Battle rope training and Slackline training on volleyball players. This study consisted of experimental and control groups, Group-I (n=12) underwent Battle rope training group, Group-II (n=12) underwent Slackline training group and Group-III (n=12) acted as control group. All the participants were tested prior to and after the
experimentation on physical variables namely grip strength, explosive strength, leg strength, explosive power, balance, flexibility; Physiological variables namely resting heart rate, breath holding time, peak expiratory flow rate, vital capacity, forced vital capacity, slow vital capacity and on volleyball performance.

3.9. Reliability of the Data

The reliability of data was ensured by establishing instrument reliability, tester competency reliability of test and subject reliability.

3.10. Instrument Reliability

Instruments reliability is defined as the extent to which an instrument consistently measures what is supposed to measure. The instruments used for this study were calibrated and standardized one. These equipments were taken from the Vinayaka Mission’s College of Physical Education, Seeragapadi, Salem. The following instruments were used to test the selected criterion variables medicine ball, grip dynamometer, leg dynamometer, digitalized stop watch and spiro meter. All the instruments used in this study were in good condition. These instruments were supplied by reputed scientific firms and the calibrations of the instruments were accepted as accurate enough for the purpose of the study.
Research Flow Chart

START

SUBJECTS
Thirty six male Volleyball players (18 to 25 years)

DESIGN
Related Group Design
On initial test of playing ability

Pre-test

Physical Variables
1. Grip strength
2. Explosive strength
3. Leg strength
4. Explosive power
5. Balance
6. Flexibility

Physiological Variables
1. Resting heart rate
2. Breath holding time
3. Peak expiratory flow rate
4. Vital capacity
5. Forced vital capacity
6. Slow vital capacity

Performance Variables
Subjective rating by three qualified volleyball coaches

Experimental Group - ‘A’
Battle rope training (12 weeks)

Experimental Group - ‘B’
Slack line training (12 weeks)

Control group
No specific training

Post-test

Dependent ‘t’ test
Statistical analysis (ANCOVA)
and Scheffe’s Post hoc Test

END
3.11. Reliability of Test

The tester’s competency was evaluated along with the reliability of the tests. Reliability of the test was established by test-retest method. whereby the consistency of result was obtained by interclass correlation. The repeated measurement of individuals on the same test was done to determine reliability as it was univariate and not abivariate situation. It is the distribution of a single variable. Therefore makes sense, to use a univariate statistics like Intra-class correlation co-efficient, (Baumgartuerte and Jackson 1987).

3.12. Tester’s Reliability

The tester’s reliability was established by test - retest procedures. For this purpose ten subjects were selected at random on the chosen variables, which were recorded twice under identical conditions on different occasions by the investigator. The score obtained was analyzed using intra – class correlation. This was further tested for significance at 0.05 level of confidence as shown in table-3.1 (Johnson and Nelson, 1986).

TABLE -3.2

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Criterion Variables</th>
<th>‘R’ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grip strength</td>
<td>0.85*</td>
</tr>
<tr>
<td>2</td>
<td>Explosive strength</td>
<td>0.90*</td>
</tr>
<tr>
<td>3</td>
<td>Leg strength</td>
<td>0.90*</td>
</tr>
<tr>
<td>4</td>
<td>Explosive power</td>
<td>0.84*</td>
</tr>
<tr>
<td>5</td>
<td>Balance</td>
<td>0.85*</td>
</tr>
<tr>
<td>6</td>
<td>Flexibility</td>
<td>0.86*</td>
</tr>
<tr>
<td>7</td>
<td>Resting heart rate</td>
<td>0.88*</td>
</tr>
<tr>
<td>8</td>
<td>Breath holding time</td>
<td>0.83*</td>
</tr>
<tr>
<td></td>
<td>Peak expiratory flow rate</td>
<td><strong>0.83</strong>*</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>10</td>
<td>Vital capacity</td>
<td><strong>0.89</strong>*</td>
</tr>
<tr>
<td>11</td>
<td>Forced vital capacity</td>
<td><strong>0.84</strong>*</td>
</tr>
<tr>
<td>12</td>
<td>Slow vital capacity</td>
<td><strong>0.89</strong>*</td>
</tr>
<tr>
<td>13</td>
<td>Playing ability</td>
<td><strong>0.84</strong>*</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of confidence.

Table value required for significance at 0.05 level of confidence was 0.74. Since very high correlation were obtained this established the investigator’s competency to administer the tests as well as reliability of tests.

3.13. Subject Reliability

In order to get uniform results from the same subjects, they were subjected to similar conditions by the same tester. The test and retest method was used to find out the subjects reliability.

3.14. Orientation of Subjects

The investigator had a meeting with the subjects prior to the administration of tests. The purpose and the significance of the study and the requirements of the testing procedure were explained to them in detail so that there was no ambiguity in their minds regarding the efforts required of them. All the subjects voluntarily came forward to co-operate in the testing procedures and in training, to put in their efforts in the retest of the scientific investigation and in order to enhance their own performance. The subjects were very enthusiastic and co-operative throughout the project.
3.15. Administration of the Tests

A. Physical variables

1. Grip strength (Grip dynamometer)

Purpose

The purpose of this test is to measure the maximum isometric strength of the hand and forearm muscles. Handgrip strength is important for any sport in which the hands are used for catching, throwing or lifting. Also, as a general rule people with strong hands tend to be strong elsewhere, so this test is often used as a general test of strength.

Equipments required

Handgrip dynamometer, Assistant, record sheet.

Procedure

The subject holds the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer is adjusted if required the base should rest on first metacarpal (heel of palm), while the handle should rest on middle of four fingers. When ready the subject squeezes the dynamometer with maximum isometric effort, which is maintained for about 5 seconds. No other body movement is allowed. The subject should be strongly encouraged to give a maximum effort.

Scoring

The best result from several trials for each hand is recorded, with at least 15 seconds recovery between each effort. These values are the average of the best scores of each hand.
2. Explosive strength (Vertical Jump Test)

Purpose

To measure the explosive strength of the subjects.

Equipments required

Measuring tape or marked wall, chalk for marking wall (or Vertec or jump mat).

Procedure

The subject stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height. The athlete then stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. The jumping technique can or cannot use a countermovement (see vertical jump technique). Attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded.

Scoring

The Vertical jump height was recorded correct to the nearest half centimeter.

3. Leg strength (Dynamometer)

Purpose

To measure the leg strength of the subjects.

Description of leg Dynamometer

The dynamometer consists of a dial, which measures from 0 to 100 Kilograms in 500 grams increments. The score shown in the dial has to be multiplied by two, to arrive
the final score. The dial is attached to a strong platform and has a chain and bar. The chain can be adjusted according to the height of the subject. High reliability has been reported for tests with this equipment and the investigator found the reliability of 0.918. Hence, the leg dynamometer was used in the present investigation.

**Testing Procedure**

The leg dynamometer was kept on a platform to have clear vision on the dial. The subject stood erect on the base of the dynamometer with hands in front of the thighs. The feet were placed parallel about six inches apart and body weight was equally balanced on both feet. The knees were flexed between 115 and 125 degrees. The bar was placed at top of the thigh and grasped firmly at the ends with pronated grip. The tester hooked the chain according to the height of the subject. The arms and back were straight, the head erect and the chest up throughout the lift. The subject pushes down with legs attempting to straighten the legs steadily without jerking. The maximum lift occurred when the subject’s legs were straight. The test was repeated whenever any deviations from proper procedures were noticed. For each subject the test was administered three times with adequate rest in between.

**Scoring**

As instructed in the leg dynamometer manual, the score shown in the dial, during the maximal lift was multiplied by two to arrive at the final score. The best of three trials was recorded in kilograms.

**4. Explosive power (Overhead Medicine Ball Throw)**

**Purpose**

To measure the upper body strength and explosive power of the subject.
Equipments required

2-5 kg medicine ball depending on the age group being tested, tape measure

Procedure

The subject stands at a line with the feet side by side and slightly apart, and facing the direction to which the ball is to be thrown. The ball is held with the hands on the side and slightly behind the center. The throwing action is similar to that used for a soccer/football sideline throw-in. The ball is brought back behind the head, then thrown vigorously forward as far as possible. The subject is permitted to step forward over the line after the ball is released, and is in fact encouraged to do so in maximizing the distance of the throw. Three attempts are allowed.

Scoring

The distance from the starting position to where the ball lands is recorded. The measurement is recorded to the nearest 0.5 foot or 10 cm. The best result of three throws is used.

5. Balance (Stork Balance Stand Test)

Purpose

To assess the ability to balance on the ball of the foot.

Equipments required

Flat, non-slip surface, stopwatch, paper and pencil.

Procedures

Remove the shoes and place the hands on the hips, then position the non-supporting foot against the inside knee of the supporting leg. Stork Balance Exercise. The subject is
given one minute to practice the balance. The subject raises the heel to balance on the ball of the foot. The stopwatch is started as the heel is raised from the floor. The stopwatch is stopped if any of the follow occurs: the hand(s) come off the hips, the supporting foot swivels or moves (hops) in any direction, the non-supporting foot loses contact with the knee and the heel of the supporting foot touches the floor.

**Scoring**

The total time in seconds is recorded. The score is the best of three attempts.

6. **Flexibility (Sit and Reach)**

**Purpose**

To measure the flexibility of the subject.

**Equipments required**

Sit and reach box (or alternatively a ruler can be used, and a step or box).

**Procedures**

This test involves sitting on the floor with legs stretched out straight ahead. Shoes should be removed. The soles of the feet are placed flat against the box. Both knees should be locked and pressed flat to the floor - the tester may assist by holding them down. With the palms facing downwards, and the hands on top of each other or side by side, the subject reaches forward along the measuring line as far as possible. Ensure that the hands remain at the same level, not one reaching further forward than the other. After some practice reaches, the subject reaches out and holds that position for at one-two seconds while the distance is recorded. Make sure there are no jerky movements.
Scoring

The score is recorded to the nearest centimeter or half inch as the distance reached by the hand.

B. Physiological variables

1. Resting Heart Rate

Purpose

To measure the resting heart rate of the subject.

Equipments required

Digitalized heart rate / blood pressure monitor, score sheet and stop watch.

Procedure

For the sake of accuracy, in this study, the resting heart rate was measured in the subject's hostel rooms as soon as they woke up from their sleep in the morning. They are instructed to remain in their beds till the investigator arrived to measure their resting heart rate. The digitalized heart rate monitor was used to measure the heart rate of the subjects. Two repetitions of resting heart rate of subjects are conducted one after another at the same time, and the best one of two trail will be considered.

Scoring

Number of beats per minute was noted.

2. Breath holding time

Purpose

The purpose of this test was to measure the breath holding time.
Equipments required

For recording the breath holding time, a stop watch (1/10th of second) and nose clip were used.

Procedure

The subject was instructed to stand at ease and to inhale deeply after which he holds his breath for a length of time possible by him. A nose clip was placed on nose to avoid letting the air through nostrils. The duration from the time of holding his breath until the movement he let air out was clocked by using the stop watch to the nearest one tenth of a second as breath holding time. The co-operation of the subject to let out the air by opening the mouth was sought to clock the exact breath holding time.

Scoring

The time is recorded in seconds and the best of two trials were recorded.

3. Peak expiratory flow rate

Purpose

To measure the maximum expiratory pressure of the subject.

Equipments required

Peak flow metre and score sheet were used.

Procedure

Peak flow metre is given to the subject and allowed to stand erect at the beginning of the test. Before that the investigator demonstrated to the subject. To ask the subject forcefully inhaled twice before the test. Care was taken by the subject so that the air did not escape through the nose or around the mouth piece. Ask to inhale deeply keep the peak flow metre immediately and forcefully flow the air into the peak flow metre calibre. Using
the peak flow metre as described by the proper method explained by peak flow metre procedures and experts. Peak flow metre should be in Horizontal position, won’t touch the finger on the scale and do not block the edge.

**Scoring**

Peak flow metre shows the measurement in litres per minutes shortly L/MIN. Recorded the score for subject and taken the value into the collection of the data

4, 5, 6 Vital capacity, Forced vital capacity, slow vital capacity.

**Purpose**

The purpose of the test was to measure the dynamic lung function by measuring the vital capacity, forced vital capacity (FVC), slow vital capacity (svc) and the maximum voluntary ventilation (MVN).

**Equipments required**

A computerized RMS spirometer Helios 401 was used in this study. Helios 401 is a spirometer which was used in conjunction with a windows based computer. It has a hand piece which houses a turbine transducer. The hand piece was connected to a computer through a USB interface cable. The software given along with the system was used to recorded spirometry manoeuvres and to suggest a diagnosis. The computer monitor was used to display the spirometry parameters, the device parameters, information messages and user guide messages. A printer attached to the computer used to obtain a hard-copy record of the manoeuvre and the related parameter values. The subjects ID number, name, age, sex, height and weight were fed in to the system.
Procedure

4. Vital capacity

The subject should stand erect before taking the test. The spirometer should be placed depends on the subject’s height. The subject should then forcefully inhale and exhale twice before taking the test. The subject should be cautioned not to allow air to escape through his nose or around the mouth piece. He should bend slightly forward to get as much air as possible into the spirometer. The tester should watch the needle to obtain the maximum reading.

Scoring

The subject’s score is read in cubic inches on a scale of the Spiro meter.

5. Forced vital capacity (FVC)

To perform the forced vital capacity manoeuvre, the players first breathed in deeply to his full extent. The race walker then placed the transducer to the mouth and expelled the air in their lungs as quickly as possible. Once all the air in the lungs has been expelled, the race walkers breathed in as quickly as possible, still with the transducer to the mouth, until the lungs were full.

6. Slow vital capacity (svc)

The slow vital capacity test was a less strenuous method of findings players’ vital capacity. The players were asked to breath regularly through the mouthpiece. The player then took a deep breath followed by a exhalation. Both inhalation and exhalation were performed to the maximum extent. After this slow manoeuvre the player took a few gentle and normal breaths.
C. Performance variable

The criterion measure of overall volleyball playing ability was measured by a panel of experts consisting of three persons. They were outstanding players at state level three years in the game of volleyball and have been serving as renowned and qualified coaches for about a decade. The experts were asked to make a subjective assessment of the overall playing ability of the players using the 10 point. The average rating of the three experts on the overall playing ability was considered as the score of subjects. To see the degree of agreement between the three qualified coaches, rank order correlation was used in this study. The results revealed high correlation, which means that there was a close agreement in rating between the coaches.

| TABLE-3.3 |
| TEST SCHEDULE |

<table>
<thead>
<tr>
<th>Day</th>
<th>Forenoon session</th>
<th>Afternoon session</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Vital capacity</td>
<td>Grip strength</td>
</tr>
<tr>
<td></td>
<td>Forced vital capacity</td>
<td>Vertical jump</td>
</tr>
<tr>
<td></td>
<td>Slow vital capacity</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Resting heart rate</td>
<td>Leg strength</td>
</tr>
<tr>
<td></td>
<td>Breath holding time</td>
<td>Explosive power</td>
</tr>
<tr>
<td></td>
<td>Peak expiratory flow rate</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Flexibility</td>
<td>Playing ability</td>
</tr>
<tr>
<td></td>
<td>Balance</td>
<td></td>
</tr>
</tbody>
</table>

3.16. Collection of Data

The data on physical, physiological and performance were collected by conducting various tests and are explained above. The pre-test and post-test data were collected before and after the training programme for a period of 12 weeks. All the data were collected in the same day.
3.17. **Statistical Techniques**

The data collected from the three groups before and after the experimental period were statistically analyzed for significant improvement by dependent ‘t’ test.

Thirty six male volleyball players (N=36) were divided at random and assigned them into three groups of twelve each (n=12). No attempt was made to equate the groups in any manner. Hence, to make adjustments for difference in the initial means and test the adjusted post-test means for significant differences, the analysis of covariance (ANCOVA) was used. Since three groups were involved, whenever the ‘F’ ratio was found to be significant for adjusted post means, Scheffe's test was followed as a post hoc test to determine which of the paired means difference was significant. In all the cases 0.05 level was fixed as level of significance to test the hypotheses.