CHAPTER – III

METHODOLOGY
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3.1 INTRODUCTION

In this chapter the selection of the subjects, selection of the variables, selection of tests, reliability of the instrument, reliability of the data, competency of the tester, orientation of subjects, pilot study, training programme, collection of data, test administration, experimental design and statistical procedure have been explained.

3.2 SELECTION OF SUBJECTS

To achieve the purpose of the study, one ninety two male basketball players from the teams qualified for the pre-quarter in the Bharathiar University Inter-collegiate tournaments were selected. To ensure the quality in selecting the overall playing ability of the subjects were taken into consideration as a criterion. The overall playing ability was rated by the panel of experts consisting of three persons. They were the outstanding players in the game of basketball and they are as renowned coaches for more than two decades. In establishing the reliability among the three experts towards the measure of overall playing ability of subjects, the inter rater reliability was done and presented in the table – 3.1. Based on the performance of overall playing ability of 192 basketball players, the players who scored in the lower end i.e. below to 33% and the upper end i.e. above to 67% were dropped from the study and the remaining subjects of 102 were selected for the further process. Its main purpose was to overcome the extraneous variance which would be in the form of heterogeneous formation of group. Among the 102 basketball player’s 80 basketball players were randomly selected for the present study.
### 3.3 SELECTION OF VARIABLES

The research scholar reviewed the available scientific literatures and had discussions with experts in the field of physical education and sports coaching to identify the components underlying physical, physiological, psychological and skill performance variables that are closely associating with overall playing ability of basketball players. Based on the opinions of the experts, and from the findings of the earlier studies in the field of training in basketball, the following factors were identified and considered as variables for the present study. Thus, the variables selected for the present study were: speed, flexibility, muscular strength and endurance, cardio respiratory endurance, agility, explosive power, systolic blood pressure, diastolic blood pressure, maximum oxygen uptake (V\textsubscript{O}\textsubscript{2} max) and resting pulse rate, cognitive anxiety, somatic anxiety, and self confidence, shooting ability, dribbling ability, and overall playing ability.

### 3.4 EXPERIMENTAL DESIGN

The selected subjects (N=80) were divided into four groups each consisting of twenty. The experimental group I underwent static stretching with resistance training (SRT), experimental group II underwent plyometric training with resistance training (PRT), experimental group III underwent combination of plyometric training, resistance training with martial arts training (CPRMAT) and group IV acted as control group (CG). All the three experimental groups were treated with their respective training for one and half hour per day for three days a week.
3.5 CRITERION MEASURES

Having the expert consultation in the field of physical education, sports sciences and scanning various literatures related to modern training method, the investigator has selected the following test items as criterion measures. The chosen tests are highly standardized, appropriate and ideal to assess the criterion variables and they are briefly explained here.

1. Speed

The speed of the player was measured by 50 meters dash. The time was taken to cover the distance and recorded to the nearest second to consider as score.

2. Flexibility

Flexibility was measured by using sit and reach test and recorded to the nearest centimeter.

3. Muscular Strength and Endurance

Muscular strength and endurance was measured by sit – up test and recorded in numbers.

4. Cardio respiratory endurance

Cardio-respiratory endurance was measured by the cooper 12 min run/walk. The distance covered by the player within 12 minutes was recorded in meters as score.

5. Agility

Agility was measured by using 10 x10 yard shuttle run test and recorded to the nearest one-tenth of a second.
6. **Explosive power**

Leg explosive power was measured through the standing broad jump; the distance covered by the subject was recorded in meters as the score.

7. **Blood pressure**

Systolic and diastolic blood pressure was measured by using sphygmomanometer and recorded in mm/hg.

8. **Resting Heart rate**

Resting heart rate was measured by using auscultation (bell of the stethoscope) method and counted for 30 seconds and then multiplied by two to get beats per minute.

9. **VO₂ max**

VO₂ max was measured by using 3 minute step test to evaluate the maximum oxygen uptake. The VO₂ max was computed in (ml/kg/min).

10. **Psychological variables**

Competitive sports anxiety inventory test (CSAI-2) is a psychological tool developed by Rainer Martens, 1986. It is a standardized and well established reliability, validity and objectivity one. It was used as a measure to assess the psychological variables of Cognitive Anxiety, Somatic Anxiety and Self confidence.

11. **Shooting ability**

Shooting ability accuracy was measured by using Leleich basketball test and the numbers of successful shoots were recorded.
12. Dribbling ability

Dribbling ability accuracy was measured by using Knox basket ball test to the nearest second.

13. Overall playing ability

Overall playing ability was measured by the panel of experts consisting three persons.

3.6 RELIABILITY OF DATA

The reliability of data was measured by ensuring instruments reliability, tester’s competency and subject reliability

3.6.1 INSTRUMENTS RELIABILITY

With the respect to the instruments used in measuring various variables, certificate of accuracy was obtained from appropriate instruments testing agency, and also by recalibrating the scale using known amounts of variables wherever required.

3.6.2 TESTERS COMPETENCY

The assistance of four specially trained physical education teachers was sought on administration of various test items. They were oriented about the procedures of measuring and recording the scores in each variable. All the assistance was asked to measure on a few subjects and coefficient of inter correlation of scores recorded by them was taken. The final measuring programme was conducted only on getting high coefficient of correlation.
3.6.3 SUBJECTS RELIABILITY

The subject reliability was established by test and retest coefficient of correlation for the scores in each of the criterion measures. Retesting was done within a period of a week of initial test in each of the criterion measures to get data for calculating test and retest coefficient of correlation.

Table 3.1

<table>
<thead>
<tr>
<th>S. No.</th>
<th>CRITERION VARIABLES</th>
<th>r- Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed</td>
<td>.941</td>
</tr>
<tr>
<td>2</td>
<td>Flexibility</td>
<td>.982</td>
</tr>
<tr>
<td>3</td>
<td>Muscular strength and endurance</td>
<td>.944</td>
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<tr>
<td>4</td>
<td>Cardio respiratory endurance</td>
<td>.991</td>
</tr>
<tr>
<td>5</td>
<td>Agility</td>
<td>.998</td>
</tr>
<tr>
<td>6</td>
<td>Explosive power</td>
<td>.990</td>
</tr>
<tr>
<td>7</td>
<td>Systolic blood pressure</td>
<td>.952</td>
</tr>
<tr>
<td>8</td>
<td>Diastolic blood pressure</td>
<td>.842</td>
</tr>
<tr>
<td>9</td>
<td>VO$_2$ max</td>
<td>.867</td>
</tr>
<tr>
<td>10</td>
<td>Resting pulse rate</td>
<td>.881</td>
</tr>
<tr>
<td>11</td>
<td>Cognitive anxiety (Rainer Martens, 1986)</td>
<td>.951</td>
</tr>
<tr>
<td>12</td>
<td>Somatic anxiety (Rainer Martens, 1986)</td>
<td>.896</td>
</tr>
<tr>
<td>13</td>
<td>Self confidence (Rainer Martens, 1986)</td>
<td>.806</td>
</tr>
<tr>
<td>14</td>
<td>Shooting ability</td>
<td>.913</td>
</tr>
<tr>
<td>15</td>
<td>Dribbling ability</td>
<td>.984</td>
</tr>
<tr>
<td>16</td>
<td>Overall playing ability</td>
<td>.842</td>
</tr>
</tbody>
</table>
3.7 ORIENTATION OF THE SUBJECTS

The researcher explained the subjects regarding the purpose of the study and their part during the training programme. In addition to this, testing procedures on tests used to measure the criterion variables and instructions to be followed while measuring were explained to the subjects clearly. To have the clarity and to make the subjects to perform the exercises properly on varied training modules used in the present study, the selected subjects were inducted into four sessions with the techniques involved in executing the static stretching with resistance training, resistance training with plyometric training and Combination of plyometric training, resistance training with martial arts training. The subjects were verbally motivated to attend the training session regularly. The resistance training, plyometric training and combination of resistance training, plyometric training with martial arts training was inducted for the male basketball players.

3.8 PILOT STUDY

The present study was mainly concerned with effects of static stretching with resistance training, resistance training with plyometric training and Combination of plyometric training, resistance training with martial arts training on physical, physiological, psychological and skill performance variables of male basketball players. The present study was mainly conceived with the varied types of training. Hence the investigator has to determine the intensity, frequency, specificity, recovery and type of plyometric training with resistance training and martial arts training in order to easily accommodate the subjects into the treatments used in the present study. For this purpose the investigator has conducted a pilot study, for which eighty inter collegiate basketball players were selected as subjects. They were inclined to treatments specifically designed for the present study of static stretching with resistance
training, resistance training with plyometric training and Combination of plyometric training, resistance training with martial arts training. The heart rate reserve method was used to determine the training intensity. The heart rate reserve method was made popular by Karvonen. The intensity (training heart rate) was determined as follows. First maximum heart rate was estimated by the following formula. HR max = 220 – age. Resting heart rate was subtracted from maximal HR to obtain the HR reserve. From the reserve heart rate 60% to 80% was taken as the intensity. This value was added to the resting heart rate to obtain the target heart rate (THR).

3.9 TEST ADMINISTRATION

The method of administration and procedures adopted in the tests used to measure the criterion variables were as follows.

50 Yard Dash

The test was used to measure the speed of the subjects. The subjects (two at time) stood behind the starting line. On getting signal (the clap), the subjects ran as fast as possible across the finishing line. The time elapsed between the start and the moment the subject crossed the finish line was recorded to the nearest one-tenth of a second.

Shuttle run

The test was used to measure the agility of the subjects. Running lanes were approximately six feet wide and exactly ten yards long. Bank boards were approximately twelve inches wide and were set at an angle of forty degree with the floor. The subject stood in front of the starting line and then he started, by the command "On your mark, set, go". Now the subject ran 100 yards over a ten-yard course; that was, he ran ten yards, made a 180-degree turn, and returned to the starting line. He made another 180-degree turn and continued...
for five complete round trips. The subject started and finished at the same line. During this shuttle run the subject turned in either direction but must touched the backboard in making the turns. Two trials were given to each subject. The time elapsed between the start and the moment the subject finished the shuttle run was recorded to the one-tenth of a second.

**Sit and reach test**

The test was used to measure the flexibility of the subjects. The test apparatus consisted of a specially constructed box (12 inches by 12 inches by 21 inches) with a measuring scale where 23 centimeters was at the level of the feet. The subject was sitting on the floor with his hips, back, and head against a wall, legs fully extended, and the bottom of his feet against the sit and reach box. To perform the test, the subject extended the arms forward, with hands placed on top of each other and reached forward as far as possible without letting the hips, back, or head came off the wall. The examiner should then slide the reach indicator touches, the tips of the subject's fingers. The subject's head and back came off the wall and he gradually reached forward three times, the third time stretching forward as far as possible on the indicator (scale), holding the final position for at least two seconds. He was sure that during the test the backs of the knees were kept flat against the floor. Four trials were given to each subject. The score was the farthest point reached by the subject and recorded to the nearest centimeter.

**Sit-ups**

The test was used to measure the muscular strength and endurance of the subjects. The subject was sitting on the floor with his hip, back, and head against a wall, legs fully extended, and the bottom of his feet against the sit-and-reach box. To perform the test, the subject extended the arms forward, with hands placed on top of each other and reached forward as far as possible
without letting the hips, back, or head came off the wall. The examiner should then slide the reach indicator touches, the tips of the subject's fingers. The subject's head and back came off the wall and he gradually reached forward three times, the third time stretching forward as far as possible on the indicator (scale), holding the final position for at least two seconds. He was sure that during the test the backs of the knees were kept flat against the floor. Four trials were given to each subject. The score was the farthest point reached by the subject and recorded to the nearest centimeter.

**Vertical Jump**

The test was used to measure the explosive power of the subjects. A take off line was drawn on the ground. The subject took a position with toes just touching the take off line, feet slightly apart. Taking off from both feet simultaneously, he jumped as far as possible, having on both feet. In jumping, the subject crouched slightly and scoring the arm to aid the jump. The score was the distance to the nearest centimeter from take off line to the closest heel position. The better of two trials was recorded.

**Coopers twelve minutes run and walk test**

The test was used to measure the cardio respiratory endurance of the subjects. It was suggested that a specific course was to be measured in distance so that number of laps completed can be counted and multiplied by the course distance. It was also helpful to divide the course into quarters or eight by pacing markers. This enabled the tester to quickly determine the exact distance covered in 12 minutes. A stopwatch, whistle, distance markers were used for group testing. It was usually more efficient to assign each runner to a spotter. The runners start behind a line and upon the starting signal, ran and / or walked as many laps as possible around the course within the 12 minutes. The spotters maintained a count of each lap, and when the signal to stop is given, they...
immediately ran to the spots at which their runners were at the instant. The whistles or command to stop was given. The score in meters was determined by multiplying the number of complete laps times the distance of each lap (e.g. 400 meters per lap), plus the number of segments of an incomplete lap, plus the number of meters stepped off between particular segments.

**Resting pulse rate**

The resting heart rate of each subject was recorded in the early morning after getting out of bed and sit at rest comfortably in a chair for few minutes. The resting heart rate was obtained through auscultation i.e. using the bell of the stethoscope was placed to the left of the sternum just above the level of the nipple. Then the stop watch was started with the heart beat. Counted the first beat as zero and continued for 30 seconds. This procedure was repeated on three separate mornings. Resting heart of the subjects was recorded on three successive mornings. The average of the three recordings was arrived at and recorded as the subjects resting heart rate. The unit of measurement was initially taken for 30 seconds and the beats per minute of the subjects were calculated by doubling the number of beats to arrive at and per minute calculation. (Nieman, 1995)

**3 minutes step test**

For the purpose of the maximum conception of oxygen was determined by this test. The step test was preferred on a stool of 16.2 inches height for a total duration of 3 minutes at the rate of 22 cycles per minute which was set by a metronome. After completion of exercise, the subject was asked to remain standing and the carotid pulse rate was measured from 5 - 20 seconds of the recovery period. This 15 second pulse rate was converted into beats per minute and the following equation was used to predict the maximum oxygen uptake capacity.
111.33 – (0.47 x Recovery heart rate in beats per minute).

**Description of csai-2**

The CSAI was revised to develop a sport specific inventory that measured the cognitive and somatic components of A-state. The CSAI-2 was originally constructed to include subscales to measure not only cognitive state anxiety and somatic anxiety but also fear of physical harm and generalized anxiety. The development of CSAI-2 as a sport specific measure of multidimensional A-state inventory designed to measure existing state of cognitive anxiety, somatic state anxiety, and state of self confidence in competitive situations. The CSAI-2 was constructed primarily as a research tool to be administered three hours before competition. When administering the CSAI-2, it was recommended that the title on the form given to the subjects should be the Illinois self evaluation questionnaire. This technique helped to reduce the bias to the inventory. In addition, antisocial instructions given by the investigator of CSAI-2 was committed to memory and orally communicated with conviction to the respondents. Before allowing subjects to begin completing the CSAI-2, it was made sure that instructions were completely understood and particularly that responses should be based on how the respondents felt at the moment.

**Scoring the CSAI-2**

The CSAI-2 is scored by computing a separate total for each of the three sub scales with scores ranging from low of 9 to high of 36. The higher the score, the greater the cognitive or somatic. A state or the greater the state of self confidence. Total score for the inventory was not computed.

The cognitive state anxiety sub scale is scored by totaling the responses for the following nine items 1,4,7,10,13,16,19,22 and 25. The somatic state
anxiety sub scale is scored by adding the responses to the following nine items 2,5,8,11,14,17,20,23 and 26. Scoring for item 14 must be reversed in calculating the score for the somatic state anxiety sub scale as indicated below:

\[
\begin{align*}
1 &= 4 \\
2 &= 3 \\
3 &= 2 \\
4 &= 1 
\end{align*}
\]

The state of self confidence subscale was scored by adding the following items 3,6,9,12,15,18,21,24 and 27.

Responses that were missing no more than one response per subscale can still be scored, but any inventory in which two or more items from any one subscale omitted should be invalidated. To obtain subscale scores, when an item is omitted, the researcher computed the mean item score for the eight answered items, multiplied this value by 9, and then rounded the product to the nearest whole number.

**Leleich Basketball test**

Leleich Basketball test was used to measure the shooting ability and accuracy in basketball. The bounce and shoot test was proposed by the investigator to analyze their basic skill in shooting. For that purpose bounce and shoot test was administered. Two dotted lines were drawn on the floor in a “V” shape with the apex at the middle of the end line under the basket and extending at 45 degree angles for 18 feet on both sides of the court. A 24 inch solid line was centered at the end of each dotted line and at right angles to them. One foot behind and 30 inches to the out side of the 18 feet lines, 18 inches lines were
drawn; at each of these, forward legs touching the line, was located and a basketball was placed on it. These markings were diagramed in the Figure.

On taking the test, the subject started behind the 24 inch line at the right of the basket. At the signal, the subject picked up the ball from the chair – bounced it once, shoted as for the basket, recovered the rebound and passed the ball to catches behind the chair on that left side and repeated as before. This performance was continued alternatively for five times on each side. Each bounce must start from behind 24 inch line. Fouls consisted of running with the ball, double bouncing, and failure to start each line at the 24 inch line. The test terminated when the subjects had retrieved the ball after the tenth shot at the basket. Two points were awarded, for each basket made one for hitting the rim but not making the basket, and no points for missing both the rim.

**Knox Basketball test**

Knox developed a Basketball battery composed of speed dribble, wall bounce, dribble shoot and penny-cup test Speed dribble test. 4 chairs were placed in a straight line such that the first one was 20 feet from the starting line and the others 15 feet apart, on signal the subject dribbled around the chairs in Zigzag manner and reached the starting point. Only one trail was given. The time was taken and recorded.

**Subjective rating** *(Overall playing ability)*

The panel of three experts judged the performance of the players during the competition. The criterion measure of overall playing ability was measured by the panel of experts consisting three persons. They were the outstanding players in the game of basketball and served as a renowned coach for about a decade. The subjective rating marks (scores) were given according to their performance
3.10 TRAINING PROGRAMME

Experimental groups were trained three days per week on nonconsecutive days (Monday, Wednesday and Friday) for twelve weeks under carefully administered and controlled conditions prior to each training session, all subjects participated in a 10 minute warm-up period which included jogging at a self selected comfortable pace. After the warm up session, subjects in the experimental group-I performed static stretching exercises for 20 minutes. Subjects in the experimental group-II and III performed plyometric exercises for 20 minutes. Following the completion of the static stretching or plyometric training protocols, all subjects participated in the same resistance training program for 50 minutes. Subjects in the experimental group-III performed martial arts (Taekwon-Do) training on Tuesday, Thursday and Saturday for thirty minutes, apart from plyometric and resistance training program. Each training session ended with five minutes of cool down activities. Throughout the study period, subjects exercised in small groups, and an instructor to subject ratio of at least 1:4 was maintained. If a subject fatigued and could not perform exercises correctly, the exercise was stopped.

3.10.1 STATIC STRETCHING EXERCISES

Subjects in the static stretching and resistance training were performed 9 stretching exercises in a slow and deliberate manner with proper body alignment during 12 weeks of training period. Subjects held each stretching exercise for 30 seconds at a point of mild discomfort, relaxed for 5 seconds then repeated the same for another 30 seconds before progressive to the opposite leg. The specific stretching exercises (in the order program) were low back stretch, hamstring stretch, quadriceps stretch, calf stretch, triceps and hip stretch, adductor stretch and v-sit stretch.
**3.10.2 PLYOMETRIC TRAINING**

The plyometric training program progressed from level – I, 1 – 4 weeks (2 sets of 10 repetitions), level II 5 -8 weeks (1 to 2 sets of 8 repetitions) and finally level – III 9 -12 weeks (1 to 2 sets of 6 repetitions) during 1,5,9 weeks, subjects performed one set of each exercises because plyometric training stressed proper training performance. During weeks two through four, six through eight, ten through twelve performed two sets of each exercise. Subjects performed eight plyometric exercises two through four, six through eight, ten through twelve.

**3.10.3 RESISTANCE TRAINING EXERCISES**

Subjects performed 1 – 3 sets of modified clean and snatch with the light weight. Following this subject performed selected resistance training exercises. From 1st week to 4th week all subjects performed 3 sets of 10 to 12 repetitions on the following exercises: half squat, bench press, lat pull down, standing calf raise, triceps extension and arm curl. From 5th week to 8th week, all subjects performed 3 sets of 10 to 12 repetitions of the following exercises: full squat, incline press, bend over row, seated calf raise, triceps press down, and concentration curl. From 9th week to 12th week, all subjects performed 3 sets of 10 to 12 repetitions on the following exercises. Lunging, shoulder press, upright row, standing calf raise, bend arm pull over and hammer curl.

**3.10.4 MARTIAL ARTS TRAINING**

The subjects performed selected Martial arts training exercises on Tuesday, Thursday and Saturday for 30 minutes. From 1st week to 4th week, all subjects performed 1-2 sets of 15 to 20 repetitions on the following exercises: dodging strike, downward strike, front strike, inward strike, elbow strike, side back strike, side front thrust, downward kick, vertical kick, side checking kick.
From 5th week to 8th week, all subjects performed 1-2 sets of 15-20 repetitions on the following exercise and in addition to one set of 15 repetitions as in 1st week to 4th week: outward strike, downward thrust, side thrust, ground thrust, back elbow thrust, side kick, turning kick, upward kick, rising kick and front rising kick. From 9th week to 12th week, all subjects performed 1-2 sets of 15-20 repetitions on following exercise and in addition to one set of 15 repetition as in 1st week to 4th and 5th week to 8th week: horizontal strike, horizontal thrust, back twin elbow thrust, front snap kick, back kick, stamping kick, grapin kick, twisting kick, side rising kick and hooking kick.

The schedule of the training programs are given in the table 3.2 and 3.5

**TABLE – 3.2**

**STATIC STRETCHING EXERCISES**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Exercise</th>
<th>Repetitions</th>
<th>Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hamstring Stretch</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Calf Stretch</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Groin Stretch</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Quadriceps Stretch</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Pectoralis stretch</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Medial and Posterior Deltoid stretch</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Iliopsoas (hip flexor) stretch</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>Iliotibial Band Stretch</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>Erector Spine (lower back) and Abductor stretch</td>
<td>3</td>
<td>2</td>
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### TABLE – 3.3

#### RESISTANCE TRAINING

<table>
<thead>
<tr>
<th>From 1&lt;sup&gt;st&lt;/sup&gt; week to 4&lt;sup&gt;th&lt;/sup&gt; week, 3 sets of 10 – 12 repetitions</th>
<th>From 5&lt;sup&gt;th&lt;/sup&gt; week to 8&lt;sup&gt;th&lt;/sup&gt; week, 3 sets of 10 – 12 repetitions</th>
<th>From 9&lt;sup&gt;th&lt;/sup&gt; week to 12&lt;sup&gt;th&lt;/sup&gt; week, 3 sets of 10 – 12 repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half squat</td>
<td>Full squat</td>
<td>Lunging</td>
</tr>
<tr>
<td>Bench press</td>
<td>Incline press</td>
<td>Shoulder press</td>
</tr>
<tr>
<td>Lat pull down</td>
<td>Bend over row</td>
<td>Upright row</td>
</tr>
<tr>
<td>Standing calf raise</td>
<td>Seated calf raise</td>
<td>Standing calf raise</td>
</tr>
<tr>
<td>Triceps extension</td>
<td>Triceps press down</td>
<td>Bend arm pull over</td>
</tr>
<tr>
<td>Arm curl</td>
<td>Concentration curl</td>
<td>Hammer curl</td>
</tr>
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</table>

### TABLE – 3.4

#### PLYOMETRIC TRAINING

<table>
<thead>
<tr>
<th>From 1&lt;sup&gt;st&lt;/sup&gt; week to 4&lt;sup&gt;th&lt;/sup&gt; week, 1 set of 10 repetitions</th>
<th>From 5&lt;sup&gt;th&lt;/sup&gt; week to 8&lt;sup&gt;th&lt;/sup&gt; week, 2 set of 8 repetitions</th>
<th>From 9&lt;sup&gt;th&lt;/sup&gt; week to 12&lt;sup&gt;th&lt;/sup&gt; week, 3 set of 6 repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box to Box jump</td>
<td>Side to side ankle hops</td>
<td>Diagonal cone hops</td>
</tr>
<tr>
<td>Power Drop</td>
<td>Standing long jump</td>
<td>Standing long jump with lateral sprint</td>
</tr>
<tr>
<td>Depth Jump</td>
<td>Lateral jump over barrier</td>
<td>Lateral cone hops</td>
</tr>
<tr>
<td>Double Leg Hops</td>
<td>Double leg hops</td>
<td>Cone hops with 180 degree turn</td>
</tr>
<tr>
<td>Front Box Jump</td>
<td>Lateral cone hops</td>
<td>Single leg bounding</td>
</tr>
<tr>
<td>Front Cone Hops</td>
<td>Diagonal cone hops</td>
<td>Lateral jump single leg</td>
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<tr>
<td>Barrier Hops(Hurdle hops)</td>
<td>Standing long jump with lateral sprint</td>
<td>Tuck jump with knees up</td>
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<tr>
<td>Single Leg Bounding</td>
<td>Lateral cone hops</td>
<td>Burpees</td>
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<tr>
<td>Single Leg Hops</td>
<td>Single leg bounding</td>
<td>Double leg hops</td>
</tr>
<tr>
<td>Split Squat Jump</td>
<td>Lateral jump single leg</td>
<td>Lateral jump single leg</td>
</tr>
</tbody>
</table>
### TABLE – 3.5

**MARTIAL ARTS TRAINING PROGRAM**

<table>
<thead>
<tr>
<th>1st week to 4th week</th>
<th>5th week to 8th week</th>
<th>9th week to 12th week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 sets of 15-20 repetitions</td>
<td>1-2 sets of 15-20 repetitions in addition to one set of 15 repetition as in 1st week to 4th week</td>
<td>1-2 sets of 15-20 repetitions in addition to one set of 15 repetition as in 1st week to 4th and 5th week to 8th week</td>
</tr>
<tr>
<td>Dodging strike</td>
<td>Outward strike</td>
<td>Horizontal strike</td>
</tr>
<tr>
<td>Downward strike</td>
<td>Downward thrust</td>
<td>Horizontal thrust</td>
</tr>
<tr>
<td>Front strike</td>
<td>Side thrust</td>
<td>Back twin elbow thrust</td>
</tr>
<tr>
<td>Inward strike</td>
<td>Ground thrust</td>
<td>Front snap kick</td>
</tr>
<tr>
<td>Elbow strike</td>
<td>Back elbow thrust</td>
<td>Back kick</td>
</tr>
<tr>
<td>Side back strike</td>
<td>Side kick</td>
<td>Stamping kick</td>
</tr>
<tr>
<td>Side front thrust</td>
<td>Turning kick</td>
<td>Grapin kick</td>
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<tr>
<td>Downward kick</td>
<td>Upward kick</td>
<td>Twisting kick</td>
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<tr>
<td>Vertical kick</td>
<td>Rising kick</td>
<td>Side rising kick</td>
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<tr>
<td>Side checking kick</td>
<td>Front rising kick</td>
<td>Hooking kick</td>
</tr>
</tbody>
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3.10.5 DESCRIPTIONS OF STATIC STRETCHING EXERCISES

**Hamstring Stretch**

The students were asked to sit on the ground with both legs straight out in front of the subjects. They bend the left leg and placed the sole of the left foot alongside the knee of the right leg and allowed the left leg to lie relaxed on the ground. Then Bend them forward keeping the back straight and then they repeated with the other leg.
Calf Stretch

The students were asked to stand tall with one leg in front of the other, hands flat and at shoulder height against a wall. Ease the back leg further away from the wall, keeping it straight and press the heel firmly into the floor. Kept the hips facing the wall and the rear leg and spine were in a straight line.

Groin Stretch

The students were asked to sit with tall posture, ease both of your feet up towards their body and place the soles of their feet together, allowing the knees to came up and out to the side. Hands rested on the lower legs or ankles and ease both knees towards the ground.

Quadriceps Stretch

The subjects were asked to lie face down on the floor, resting their forehead on your right hand. Press the hips firmly into the floor and brought the left foot up towards buttocks. Take hold of the left foot with the left hand and ease the foot closer to the buttocks.

Pectoralis (chest) stretch

Arms reached straight back; interlace fingers with palms facing toward the body. Arms were raised as far up as possible until a slight tension was felt in the chest muscles.

Medial and Posterior Deltoid (side and back shoulder) stretch

One arm reached across the body, with the opposite hand grab the elbow and pull until a slight tension is felt in the deltoids. Switch to the opposite side and repeat.
Iliopsoas (hip flexor) stretch

The subjects were asked to stand in an upright position, bend the right leg and hold the top of the foot between the toes and ankle joint with the right hand. Gently pull the right foot toward your buttocks and lean forward until a slight tension is felt in the hip flexor and front of the thigh. Switch to the opposite side and repeat.

Iliotibial Band Stretch

The students were asked to sit tall with legs stretched out in front and bend the right knee and place the right foot on the ground to the left side of the left knee. Turn the shoulders so that the subjects facing to the right. Using the left arm against the right knee to help ease further round. Use the right arm on the floor for support.

Erector Spinae (lower back) and Abductor stretch

In a seated position with the upper torso upright, extend the right leg and pull the left knee into the chest with their right hand and across their extended right leg. Switch to the opposite side and repeat.

3.10.6 DESCRIPTIONS OF PLYOMETRIC TRAINING EXERCISE

Box to Box jump

Box to Box jump was started with three sets of six repetitions at 40 centimeters height proceed to three sets of five repetitions at 50 centimeters in the second sessions, four sets of four repetitions in third sessions of six repetitions at 60 centimeters height.
Power Drop

The subjects were asked to lie supine on the ground with arms outstretched. Partner stood on the box holding the medicine ball at arms length. Partner drops the ball. Catch the ball and immediately back to the partner. Repeat the exercise for one to two minutes.

Depth Jump

The subjects were asked to stand on the box with toes placed close to the front edge. They were asked to Step from the box and drop to land on both feet. They tried to anticipate the landing and spring up as quickly as he can. They were asked to keep the body from “setting” on the landing, and make the ground contact as short as possible. They repeated the exercise for one to two minutes.

Double Leg Hops

The subjects were asked to stand with feet shoulder width apart. They were asked to squat down and jump as far forward as possible. Immediately upon touching down they jumped forward again. Using quick double arm swings and kept landings short. This was done in multiples of three to five jumps. They repeated the exercise for one to two minutes.

Front Box Jump

The subjects were asked to stand facing the box with feet shoulder width apart and hands behind the head. They were asked to jump up and land softly with both feet on the box. They stepped back down and repeated. For a more advanced exercise. They hopped down from the box and immediately jumped back onto it. They used a variety of box heights, starting with 12-inch boxes,
and build up to 42 inches with time. The exercise was repeated for one to two minutes.

**Front Cone Hops**

The subjects were asked to stand with feet shoulder width apart at the end of the line of barriers (with their length spread out before you). They kept the feet shoulder width apart, jumped over each barrier and landed on both feet at the same time. The subjects used a double arm swing and worked to decrease the time spent on the ground between each barrier. The exercise was repeated for one to two minutes.

**Barrier Hops (Hurdle Hops)**

The subjects were asked to start at the end of the line of barriers. They were asked to Jump forward over the barriers with feet together. Movement came from his hips and knees; they were asked to keep the body vertical and straight, and do not to let their knees move apart or to either side. They used a double arm swing to maintain balance and to gain height. The exercise was repeated for one to two minutes.

**Single Leg Bounding**

The subjects were asked to stand on one foot. They did bounding from one foot as far forward as possible, using the other leg and arms to cycle in the air for balance and to increase forward momentum. They were advanced athletes and they tried to touch the heel of the bounding foot to the buttocks with each bound. They continued bounding for a prescribed distance (about 40 meters). This drill was performed on both legs for equal strength. The exercise was repeated for one to two minutes.
**Single Leg Hops**

The subjects were asked to stand in one leg, push off with the leg he was standing on and jump forward, landing on the same leg. They used their strong leg swing to increase length of jump, and strive for height off each jump. They were immediately taken off again after landing, and continued for 10 to 25 meters. They performed this drill on both legs for symmetrical development. Beginning athletes used a straighter jump leg; advanced athletes tried to pull heel towards the buttocks during the jump. They repeated the exercise for one to two minutes.

**Split Squat Jump**

The subjects were asked to spread the feet far apart, front to back, and bent the front leg 90 degrees the hip and 90 degrees at the knee. Jump up; using arms to help lift, hold the split-squat position. The subjects were landed in the same position and immediately repeated the jump. The exercise was repeated for one to two minutes.

**Tuck Jump with Knees Up**

The subjects were asked to stand with feet shoulder width apart and the body in a vertical position; without bent at the hips. They jumped up, bringing the knees up to the chest and grasping the knees with the hands before the feet returned to the floor. They landed in a standing vertical position, without any forward bend. The exercise was repeated for one to two minutes.

**Burpees**

The subjects were asked to crouch on the floor with their legs straight out behind with their weight on their hands. Then they were asked to jump
upwards after bending their knees up to their chest and then spring down to kick their legs back again. This exercise was repeated for one to two minutes.

3.10.7 DESCRIPTIONS OF RESISTANCE TRAINING EXERCISE

**Half Squat**

The subjects were asked to stand with feet slightly wider than hip width apart and back straight in a neutral position. They lowered the body by flexing at the hips and knees. Upper body was flexed forward at the hips slightly (~5°) during movement. They were asked to "sit back" so that knees stood over the feet.

**Leg press**

The subjects were asked to place their shoulders under the pads and their feet should be about shoulder width apart on the platform. Released the safety bars and bend their knees into a squatted position. Once the thighs break parallel then extended their legs to a soft bend in their knees. Repeat for the prescribed number of reps.

**Leg extension**

The subjects were asked to sit in the machine and placed their shins behind the pad. They extended their legs by pushing into the pad until the legs were parallel to the ground. Then they were returned to the starting position.

**Leg curl**

The subjects were asked to lie face down on bench with pad adjusted to fit behind ankles. If machine did not angle upper torso downward, it was
recommended that a pillow be placed underneath stomach. Position knees below bottom edge of bench or pad. Legs should be straight with knees aligned to the lever arm axis of motion and hands grasping handles or side of bench (if applicable). Raise lever arm by flexing at the knees past 90°. Return to start position

**Upright Rowing**

The subjects were asked to start with the arms extended and grip the handles with the palms down. They were asked to pull their arms upward to the chin and then return to the starting position.

**Bench press**

The subjects were asked to stand with feet slightly wider than hip width apart. Back should be straight in a neutral position. They raise their body with the help of ankle and calf muscle. Whole body was erect and firm. The position should return to normal and also exercise repeated at the same. They returned to the normal position and also repeated the exercise at same time.

**Abdominal curl**

The subjects were asked to lie back onto an incline bench with knees bent and hands on their chest. They can place the bench at various angles. They holed a weight plate on their chest. Their head was in a neutral position with a space between chin and chest. Leading with the chin and chest towards the ceiling, they contracted the abdominal and raise the shoulders off floor or bench.
Shoulder Press

The subjects were asked to sit in an upright position on the shoulder press machine and grasp the bar wider than shoulder width. They pressed the bar all the way up until the arms were fully extended, then they returned to the initial position.

3.10.8 DESCRIPTIONS OF MARTIAL ARTS TRAINING EXERCISE

Dodging strike

The main objective of this technique was to attack an opponent who was to close for a decisive blow.

Front strike

This technique was performed when the body was fully facing the target and the attacking tool was remaining at the center of the attacker's body at the moment of impact. The back fist knife hand and reverse knife hand were chiefly used with this technique.

Horizontal strike

This technique was mainly performed with twin knife hand, twin side fist, and single back fist, and occasionally twin back fist or twin back hand was used. The surety was kept to the arm straight and horizontal at the moment of impact.
**Elbow Strike**

This skill was usually executed from a walking stance. A reverse strike was common in the case of a walking stance and it was employed for attacking the opponent at a side front angle. At the moment of impact the body is full facing with the back fist facing upward.

**Outward strike**

This skill was mainly performed when the attacking tool reached the target from inward to outward. The knife hand, back fist and side fist were usually employed, and occasionally a back hand or twin back fist was used.

**Side strike**

This skill was mainly performed if the body became half facing or side facing the target at the moment of impact, and it was executed in the form of an outward strike. It was performed with all stances. The knife hand and back fist were the primary weapons, though occasionally the side fist and back hand were employed. The attacking tool formed a straight line with the center of the shoulders at the moment of impact.

**Downward strike**

The attacking tool reached the target in a circular motion and was executed nearly from all stances, though L-, rear foot. Vertical and X-stances were most suitable. The forearms were kept crossed in front of the chest with both back fists faced upward, placing the striking one under the other at the start of blocking. All downward strikes were considered side downward strike unless special directions were given.
Side back strike

This skill was used as a technique for attacking an opponent standing at a side rear angle. It was executed from nearly every stance, though waking sitting and close stances are mostly employed. The back fist was chiefly used, though back hand was used in rare cases. Kept the attacking tool was kept full facing the target while extending the opposite arm to the side downward at the moment of impact.

Downward thrust

This technique was chiefly used for attacking the upper back, small of the back in the form of downward thrust. It kept the back fist facing the front and the forearm vertical at the moment of impact. However, it was used for defense in rare cases.

Horizontal thrust

This technique was performed with either a single or twin elbow. In both cases, the elbows were kept horizontal with the shoulder and the back fist faced upward at the moment of impact.

Side thrust

If the thrust delivered to the flank, it was called a side thrust. Although the flat fingertip and side elbow played the main part in this technique, the forefinger and double side elbow were frequently used too.

Ground thrust

Flat edge fingertip, double finger, forefinger, bende fingertip and thumb were the main attacking tool for this technique.
Side front thrust

This technique was used for attacking an opponent approaching from the side front.

Back elbow thrust

This technique was used for attacking an opponent approaching from the rear. And was mainly executed from a sitting or parallel stance and occasionally a close, one led or X-stance. The force of thrusting elbow was strengthened normally with the aid of the opposite finger belly. It was used for attacking an opponent at a side roar angle. The elbow was kept raised slightly higher than the first with the back fist facing downward at the moment of impact though the opposite side fist was placed on the under fist.

Back twin elbow thrust

This was mainly executed from close, parallel or X-stances and occasionally a sitting, walking or one-leg stance. It was used for attacking two opponents simultaneously approaching from the side rear. The elbows were kept slightly higher than the first with back fists faced downward at the moment of impact. This technique was executed only with a twin elbow.

Front snap kick

This technique was designed to attack an opponent in the front. The face, solar plexus, abdomen, scrotum, armpit and floating ribs were the targets. It was performed with the ball of the foot, instep, toes and knee, and it was broken down into low and middle front snap kicks as far as the ball of the foot and toes were concerned.
Back kick

This kick was quite effective for attacking an opponent approaching from the rear. The foot sword was used as an attacking tool. The advantage of this technique was the ability to reach a long distance even without changing the direction of the body. The toes of were kept the stationary foot pointed to the front with the ankle of the kicking foot bent at a 45-degree angle at the moment of impact.

Downward kick

This kick was useful for attacking an opponent by passing over an obstacle such as another person. The back heel reached the target in a downward line from the apex of the kick. The point of focus was not lower than the attackers own solar plexus because this caused loss of power. The skull is the main target, with the clavicle the secondary target.

Stamping kick

This kick was used to attack the opponent's foot. In this case of kick, situation where the defender is being held or clinched. The technique was also be used against an assailant approaching from the front. Moreover, it was highly effective against a floored opponent. The back of the foot sole was used for this technique, and in some rare case the side of the foot.

Grapin kick

This technique was only used to attack two attackers at the same time. One opponent was kicked with one or two foot while the other was being grasped with one or two hands.
**Twisting kick**

When the attacking tool approaches the target area describing an out-curved line the kick was defined as a twisting kick. The kick was divided into low, middle and high twisting kicks. The foot was vertical to the target at the moment of impact except for the case of a high twisting kick.

**Side kick**

This was one of the most effective techniques for attacking an opponent at the flank. The footsword was the attacking tool. The vital spots were the temple, armpit, floating ribs, neck artery, philtrum, point of the chin, and solar plexus.

**Turning kick**

The turning kick was ideal for attacking an opponent positioned at the side front, and was usually performed with the ball of the foot, instep and knee. However, the toe was used if shoes were weared. This kick was normally executed from the rear, though occasionally the front foot. This technique was classified into low, middle and high turning kicks.

**Upward kick**

This technique was used in attacking the solar plexus or chest at close range with the knee. It was made sure to pull down the opponent's head or shoulder with both hands while kicking.

**Vertical kick**

This technique was employed in attacking the target from a 90-degree angle. It was performed mainly with the footsword and occasionally with the reverse footsword. The foot was vertical to the target while bending the leg.
about 30 degrees at the moment of impact. The attacking tool reached the target in an arc.

**Side checking kick**

This technique had a dual function. One was to block the attacking foot directed to a low section and the other was to impede or check the opponent's movement. In both cases the foot was ready for a counter-attack or any type of consecutive action. The tibia or knee area was the target, and the blocking tool reached the target in an arc.

**Rising kick**

This consisted of a front rising kick and a side rising kick. The former used the ball of the foot, and the latter the footsword. Both of them were also widely used for muscle development though the primary purpose is to block the attack directed to the middle section and above. The blocking tool reached the target in an arc.

**Side rising kick**

Attacking hand or foot directed to the middle section or above. The footsword was the blocking tool and it reached the target in an arc. As with the front rising kick this technique was also used for muscle development and a dynamic stretching exercise.

**Front rising kick**

This kick was used to spring up the opponents punching fist at the under forearm or the opponents foot by kicking the inner tibia. With this technique, the knee joint of the kicking leg was be bent to severely. This kick was also used as a dynamic stretching exercise and for muscle development.
Hooking kick

The same method of a hooking block with a backhand was applicable to this technique. The target areas were the elbow joint and Achilles tendon. The blocking tool was the side instep, which reaches the target in an outward curve unlike a twisting kick. It was advisable to execute the kick at the outside of the attacking hand or foot. The kicking foot was also used as an instantaneous counter-attack motion. Keeps the outer tibia was kept facing downward at the moment of impact. This technique was divided into low and middle hooking kicks.

3.11 COLLECTION OF DATA

At the end of the treatment period, as post test, the subjects belonging to the treatment groups namely static stretching with resistance training (SSRT), plyometric training with resistance training (PRT) and combination of plyometric training, resistance training and martial arts training (CPRMAT) and control groups were tested with the variables of speed, flexibility, muscular strength and endurance, cardio respiratory endurance, agility, explosive power, systolic blood pressure, diastolic blood pressure, maximum oxygen uptake, resting pulse rate, cognitive anxiety, somatic anxiety, self confidence, shooting ability, dribbling ability and overall playing ability as such in the pre-test of the same. The collected data were processed with appropriate statistical tool and the detailed procedure of the same is given below.

3.12 STATISTICAL TECHNIQUES

The present study paid its attention mainly on testing the means of three treatment groups and control group and secondarily deals with the increase of means in each group from baseline to post treatment for various measures. The statistical tool used for these are described here. Analysis of covariance was
applied to determine whether the four programmes of training produced
significant different improvements among themselves in the selected variables
after twelve weeks of training. Since the initial means were not matched,
comparisons between actual could not be made, all means were adjusted by
regression to a common mean. The significance difference of pairs of adjusted
final group means was tested for significance by applying scheffe’s post hoc
test. Further, the group means gains recorded by the various groups during the
experimental period of twelve weeks to the criterion measures were tested for
significance by applying correlated ‘t’ ratio.