CHAPTER – III

METHODOLOGY

In this chapter selection of subjects, selection of variables and tests, experimental design, reliability of instruments, pilot study, tester's competency and reliability of the tests, reliability of data, reliability of the tests, subject reliability, orientation of the subjects, administration of tests, administration of training programs, collection of data and statistical techniques adopted for the analysis of data have been described.

3.1 SELECTION OF SUBJECTS

The purpose of the study was to find out the effect of plyometric and functional core training on selected physical fitness components, body composition and skill performances among basketball players. To achieve the purpose of the present study, forty five men basketball players from Ernakulam district, Kerala state, India were selected as subjects at random and their ages ranged from 18 to 25 years. The subjects were divided into three equal groups of fifteen subjects each. Group I acted as Experimental Group I (Plyometric Training), Group II acted as Experimental Group II (Functional Core Training) and Group III acted as Control Group. The requirement of the experiment procedures, testing as well as exercise schedule was explained to the subjects so as to get full co-operation of the effort required on their part and prior to the administration of the study.

3.2 SELECTION OF VARIABLES

The research scholar reviewed the available scientific literature pertaining to the problem from books, journals, magazines, websites, and research papers which revealed the importance of plyometric and functional core training. Taking into consideration of feasibility, criteria and availability of the instruments the following variables and the tests were selected for this study.

3.2.1 DEPENDENT VARIABLES

a. Physical Fitness Components

- Explosive Strength
- Muscular Endurance
- Speed
- Flexibility

b. Body Composition

- Body Mass Index
- Percent Body Fat

c. Skill Performance Variables

- Shooting
- Passing
- Dribbling

3.2.2 INDEPENDENT VARIABLES

- Group I – Plyometric Training
- Group II – Functional Core Training
- Group III – Control Group

3.3 EXPERIMENTAL DESIGN

The study was formulated as a true random group design, consisting of a pre-test and post-test. Forty five men basketball players from Ernakulam district, Kerala, India were selected as subjects at random and their ages ranged from 18 to 25 years. The subjects (N=45) were randomly assigned to three equal groups of fifteen subjects each. Pre test was conducted for all the subjects on selected physical fitness components, body composition and skill performances. This initial test scores formed as pre test scores of the subjects. The groups were assigned as Experimental Group I, Experimental Group II and Control Group in an equivalent manner. Experimental Group I was exposed to plyometric training, Experimental Group II was exposed to functional core training and Control Group was not exposed to any experimental training other than their regular daily activities. The duration of experimental period was 12 weeks. After the experimental treatment, all the forty five subjects were tested on their physical fitness components, body composition and skill performance variables. This final test scores formed as post test scores of the subjects. The pre test and post test scores were subjected to statistical analysis using Analysis of Covariance (ANCOVA) to find out the significance among the mean differences, whenever the ‘F’ ratio for adjusted test was found to be significant, Scheffe’s post hoc test was used. In all cases 0.05 level of significance was fixed to test hypotheses.

3.4 PILOT STUDY

A pilot study was conducted to assess the initial capacity of the subjects in order to fix the load. For this purpose ten subjects were selected randomly and underwent training packages under watchful eyes of the experts and the researcher. Based on the response of the subjects in the pilot study the training schedule were constructed, however the individual differences were also considered while constructing the training programme. The basic principles of training (progression, over load and specificity) were also followed.

3.5 CRITERION MEASURES AND SELECTION OF TESTS

The present study was undertaken primarily to find out the effect of plyometric and functional core training on selected physical fitness components, body composition and skill performances among basketball players.

The following tests were administered to measure the selected physical fitness components, body composition and skill performances. The tests were administered to the subjects before and after the training programme.

TABLE – I

TEST SELECTION

S.No	Variables	Tests	Units
1	Explosive Strength	Sargent Vertical Jump	Centimetres
2	Muscular Endurance	Sit Ups	Numbers
3	Speed	50 Metres Dash	Seconds
4	Flexibility	Sit and Reach	Centimetres
5	Body Mass Index	BMI = weight in kg / height in meter^2	Scores
6	Percent Body Fat	Bioelectrical Impedance Analyzer (Omron Body Fat Monitor HBF-306)	Percentage
7	Shooting	AAHPERD Basketball Skill Test	Numbers
8	Dribbling		Numbers
9	Passing		Seconds

3.6 RELIABILITY OF DATA

The reliability of data was established by using test-retest method. To achieve this purpose, ten subjects were randomly selected and the test was administered twice after a day's gap. Care was taken to keep all testing conditions uniformly during testing and retesting. The scores recorded for the ten subjects during the test and retests were correlated using Intra Class Correlation for the different variables. The co-efficient of correlation is presented in Table – II.

TABLE – II

RELIABILITY CO-EFFICIENT OF CORRELATION OF TEST-RETEST SCORES

S.No	Variables	Co-efficient of correlation 'r'
1	Explosive Strength	0.92*
2	Muscular Endurance	0.91*
3	Speed	0.88*
4	Flexibility	0.93*
5	Body Mass Index	0.90*
6	Percent Body Fat	0.91*
7	Shooting	0.86*
8	Dribbling	0.87*
9	Passing	0.88*

***** Significant at 0.05 level

3.7 RELIABILITY OF INSTRUMENTS

The instrument such as sit and reach, bioelectrical impedance analyzer, stop watch, measuring tape, football and cones were reliable and accurate enough to carry out the test procedures successively.

3.8 TESTER'S RELIABILITY

To ensure the tester's reliability of the tests the investigator had a number of practice sessions in the teaching procedure and well versed in the technique of conducting the test. Tester reliability of test was established by test-retest process. 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 different investigator.

3.9 SUBJECTS RELIABILITY

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

3.10 ORIENTATION TO THE SUBJECTS

The investigator held a meeting with the subjects prior to the administration of tests. The purpose, the significance of this 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 the training to put in their best efforts in the interest of the scientific investigation and in order to enhance their own performance. The subjects were very enthusiastic and co-operative throughout the project.

3.11 ADMINISTRATION OF TEST ITEMS

3.12 PHYSICAL FITNESS COMPONENTS

3.12.1 EXPLOSIVE STRENGTH (SARGENT VERTICAL JUMP TEST)

Purpose

To measure the explosive strength of the subjects.

Equipments

Measuring tape or marked wall, chalk for marking wall.

Procedure

The athletes stand at the side on a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips was marked. 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. 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 was the score. The best of three attempts was recorded.

Scoring

The difference between the standing reach and jumping reach was measures the explosive strength of the legs. The score was recorded as a distance in centimetre **(Morrow, et al. 2005).**

3.12.2 MUSCULAR ENDURANCE (SIT UPS)

Purpose

To measure the abdominal muscular strength of the subjects.

Equipments

Mats, stop watch.

Procedure

The subjects has lied flat on the back with knees have bent and have a feet on the floor with the heels no more than one foot from the buttocks. The knees angle have to should be no less than 90^{o} degrees. The fingers have interlocked and have placed behind the neck with the elbows touching the floor. The feet have held securely by a partner. The subjects have curled up to a sitting position and touch the chest to, the knees.

Scoring

The score is the maximum number of sit ups completed in 60 seconds **(Morrow, et al. 2005).**

3.12.3 SPEED (50 METRES RUN)

Purpose

To measure the speed of the subjects.

Equipments

Stopwatch, whistle, score sheet, pen and lime powder.

Procedure

Clear instruction was given to the subjects about the procedure of running 50 meters. The subjects were asked to stand at the starting line. The starters blow the whistle. On hearing the whistle sound, the subjects ran as fast as possible up to the finishing line.

Scoring

The score is the elapsed time to the largest one tenth of a second between the starting and the instant the subject crosses the finish line **(Barrow & McGee, 1979).**

3.12.4 FLEXIBILITY (SIT AND REACH)

Purpose

To measure the flexibility of the subjects.

Equipments

Sit and reach apparatus, score sheet.

Procedure

The sit-and-reach apparatus should have the 25cm mark equivalent to the point where the feet touch the box. The subject, has sit barefoot with the legs fully extended with the soles of the feet have placed flat against the horizontal cross board of the apparatus, with the inner edge of the sole have placed 2cm from the scale, keeping the knees have fully extended, arms evenly stretched and palms down. The subjects has bent and reached forward (without jerking) pushing the sliding marker along the scale with the fingertips as far forward as possible. The position of maximum flexion must be held for approximately two seconds. The test has repeated twice **(Baumgartner, 2003).**

Scoring

Record the maximum distance reached to the nearest 0.5cm.

3.13 BODY COMPOSITION

3.13.1 BODY MASS INDEX

Purpose

To measure the body composition of the subjects.

Equipment

Scales and stadiometer as for weight and height.

Procedure

BMI is calculated from body mass (M) and height (H). BMI = M / (H x H), where M = body mass in kilograms and H = height in meters. The higher the score usually indicating higher levels of body fat.

Scoring

Use the table below to determine the BMI rating **(Morrow, et al. 2005).**

Body Mass Index	Weight Status
Below 18.5	**Under weight**
18.5-24.9	**Normal**
25.0-29.9	**Overweight**
30.0 and above	**Obese**

3.13.2 PERCENT BODY FAT

Purpose

To measure the percent body fat body fat and BMR of the individual.

Equipment

(Bioelectrical Impedance Analyzer) Omron body fat monitor.

Procedure

Enter the subjects' gender, age, height and weight in the Omron body fat monitor. The subjects stood with feet slightly apart. Subjects wrap the middle finger around the grove of the handle. Subjects place the palm on the top and the bottom electrodes. Subjects put thumbs up position, resting on the top of the unit. Then subject hold the arms straight out at a 90^{o} angle to his body. On gripping with both hands, measurements will automatically begin.

Scoring

Only one trial was permitted, displayed score (Body Composition and BMR) in the Omron body fat monitor was recorded as the test score **(Morrow, et al. 2005).**

3.14 SKILL PERFORMANCES

3.14.1 SHOOTING (SPEED SPOT SHOOTING)

Purpose

To measure skill in rapidly shooting from specified positions

Equipments

Basketballs, regulation basketball court and board.

Preparation

Five floor makers 2 feet long and 1 inch wide are placed on the floor for grades 5 and 6 the markers are 9 feet from the backboard. For grades 7, 8, and 9, 12 feet from the backboard and for 10, 11, 12 and college, 15 feet from the backboard. The distance for spots B, C and D must be measured from the center of the basket.

Procedure

There were three trials of 60 seconds each. The first was a practice trial and the next two are recorded. The performer stands behind any marker designated for her age level. On the signal “Ready” “go” The performer shoots, retrieves the ball dribbles to and shoots from another designated spot. One foot must be behind the marker during each attempt. A maximum of four layup shots may be attempted during each trial, but no two may be is succession. The performed must attempt at least one shot from each designated spot. The player continues until “stop” is called.

Scoring

Two points are awarded for each shot made. One point is awarded for an unsuccessful shot that hits the rim from above either initially (or) after rebounding from the backboard. If a ball handling infraction (travelling, double dribbling) occurs, the shot following the violation will be scored as zero points. If two lay ups in succession occur, the second layup shall be scored as zero. If more than four lay ups are attempted, the excessive ones will be scored as zero. If more than the performer does not shoot from all the designated spots, the trial will be repeated. The final score is the total of two trials **(AAHPERD Manual, 1979).**

3.14.2 PASSING

Purpose

To measure skill in passing and recovering the ball accurately while moving.

Equipments

Basketballs, Stop watch, measuring tape, wall

Preparation

Six squares of 2 feet each are marked on the wall, so that the base of the square is either 3 (or) 5 feet from the floor. All adjacent squares are 2 feet apart. A restraining line is marked on the floor at a distance of 8 feet from the wall and parallel to it.

Procedure

A total of three trials of 30 second each. The firsts is a practice trial and the last two are recorded. The performer with a ball stands behind the restraining line and faces the target on the far left. On the signal “Ready”, “go” the performer chest passes to the first target recovers the rebound while moving to a location behind the second target and behind the restraining line and chest passes at a target B. This pattern continues until target 7 is reached where two chest passes are executed, following which the performer then passes to repeating the sequence by moving to the left.

Scoring

Each pass that hits the target (or) the boundary line of the target counted as two points. Each pass hitting the intervening spaces on the wall counts one point. If a pass is made from a point in front of the restraining line no points are awarded for the pass. If passes are made at a target B, C, D or E twice in succession, no points are scored for the second pass. If the pass is not a chest pass, no points are awarded for the pass. The final score is the total of the two trials **(AAHPERD Manual, 1979).**

3.14.3 DRIBBLING (CONTROL DRIBBLE)

Purpose

To measure skill in handling the ball while the body is moving.

Equipments

Basketball, stop watch, measuring tape and pencils

Preparation

An obstacle course marked by six cones is set up in the free throw lane as shown in figure.

Procedure

Three timed trials are given. The first is a practice trial, and the last two are scored for the record. With the ball, the performer starts on her non-dominant hand side of cone A. On the signal, “Ready”, “Go”. The performer dribbles with the non-dominant hand to the non-dominant hand side of cone B. The performer will then proceed to follow the course using the preferred hand, changing hands as demand appropriate until the finish line is crossed by both feet. If there is a ball handling in fraction (travelling, double dribble) the performer (or) the ball remains outside the cone, or the performer fails to begin at the point in course where control was last, the trial is stopped, the performer returns to the start and the trial timing begins again.

Scoring

The score for each trial is the elapsed time required to legally complete the course. Scores are recorded to the nearest tenth of a second for each trial and the final score is the sum of two trials **(AAHPERD Manual, 1979).**

3.15 TRAINING PROGRAMME

During the training period the experimental groups underwent their respective training programme in addition to their daily regular activities as per the schedule. Experimental groups namely plyometric training and functional core training underwent their respective experimental training on three alternate days per week for twelve weeks. The experimental training programmes were designed based on the resources collected from books, periodicals, e-materials and discussions with the experts. The duration of experimental training were planned for 60 minutes. The subjects reported for experimental training between 7.00 am and 8.00 am. All the subjects involved in this study were carefully monitored throughout the training programme and 90% of attendance.

TABLE – III

GENERAL STRUCTURE OF TRAINING PROGRAMS

GROUPS WITH TRAINING PARTICULARS	TRAINING
Group I	Plyometric Training
Group II	Functional Core Training
Group III	Control Group
Training Duration	Sixty Minutes
Training Session per week	Three days
Total length of training	Twelve Weeks
Training load progression	Every Four Weeks

TABLE – IV

PLYOMETRIC TRAINING PROGRAMME

Week & Session	Intensity (%)	Exercises	Repetition	Sets	Recovery
I to IV	50 to 60%	1. Standing Jump and Reach 2. Depth Jump and Reach 3. Three Step Vertical Jump 4. Medicine Ball Overhead Throw 5. Lateral Cone Hops 6. Explosive Push Ups	10	3 Sets	Recovery 2-3 Min
V to VIII	60 to 70%	1. Catch and Pass with Jump and Reach 2. Depth Jump and Reach 3. Three Step Vertical Jump 4. Pull Over Pass 5. Power Drop 6. Explosive Push Ups	8	3 Sets	Recovery 3 Min
IX to XII	70 to 80%	1. Lateral Cone Hops 2. Single Leg Push-Off 3. Kneeling Chest Pass 4.Explosive Push Ups 5. Power Drop 6. Multiple Jumps in the Run	6	3 Sets	Recovery 3-4 Min

TABLE – V

FUNCTIONAL CORE TRAINING PROGRAMME

Week & Session	Intensity (%)	Exercises	Repetition	Sets	Recovery
I to IV	50 to 60%	1. Medicine Ball Overhead Throw 2. Plank (Aka Bridge) 3. Alternating Push Ups 4. Side to Side Twist 5. Crunch 6. Plank Jack	10	3 Sets	Recovery 2-3 Min
V to VIII	60 to 70%	1. V Ups 2. Side Plank 3. Crunch 4. Wood Choppers 5. Vertical Leg Crunch 6. Toe Taps	8	3 Sets	Recovery 3 Min
IX to XII	70 to 80%	1. V Ups 2. Toe Taps 3. Bird Dog 4. Wood Choppers 5. Russian Twist 6. Reverse Plank	6	3 Sets	Recovery 3-4 Min

3.16 PLYOMETRIC TRAINING

3.16.1 STANDING JUMP AND REACH

Standing on both feet, have the athlete reach as high as the subjects can on a wall and mark that height. Have the athlete jump off both feet, reaching as high up on the wall as possible. Mark the height and record the difference between the two marks.

3.16.2 DEPTH JUMP AND REACH

Have the athlete drop from an 18 inch box. Upon landing the athlete must reach as high as the subjects can on the wall. Record the difference between the two heights.

3.16.3 THREE STEP VERTICAL JUMP

Using a three-step approach, the athlete jumps off the preferred foot and touches as high as the subjects can on the wall. Record the difference between the standing and three step marks.

3.16.4 MEDICINE BALL OVERHEAD THROWS

Stand with one foot in front (staggered stance) with knees slightly bent. Pull medicine ball back behind head and forcefully throw ball forward as far as possible into the wall. Catch ball on the bounce from the wall and repeat according to prescribed repetitions. Keep the time between pulling the ball back and starting the throw (transition phase) to a minimum. Can also be completed with a partner instead of a wall.

3.16.5 LATERAL CONE HOPS

Begin on the left foot, and then jump sideways over a cone, landing on both feet, followed immediately by jumping over another cone and landing on the right foot. This drill should be repeated continuously in both directions without pausing.

3.16.6 EXPLOSIVE PUSH-UPS

Start in traditional push-up position. Lower chest to floor, then forcefully push up so the hands leave floor. Land softly with elbows bent, and repeat. Keep core tight throughout entire movement.

3.16.7 CATCH AND PASS WITH JUMP AND REACH

Step offs the box and land on both feet. Explode up and forward, extend the arms, and catch a pass from his partner. Upon landing, explode up again and reach for the high object with the medicine ball.

3.16.8 PULL OVER PASS

Keeping the arms extended, pass the ball to his partner. The partner can back up to require to throw farther for increased intensity.

3.16.9 POWER DROP

Partner drops the ball. Catch the ball and immediately propel the ball back to the partner. Repeat.

3.16.10 SINGLE LEG PUSH OFF

Push off the foot on top of the box to gain as much height as possible by extending through the entire leg and foot. Land with the same foot on top

of the box and push off again. Use a double arm swing for height and balance.

3.16.11 KNEELING CHEST PASS

Forcefully rock forward while pushing the ball off the chest to the partner. Keep the stomach and buttocks tucked in and the body straight.

3.16.12 MULTIPLE JUMPS WITH RUN

These exercises must be done with high intensity - 11 stride run + 2 hops and a jump into sandpit, 2 stride run in + bounds.

3.17 FUNCTIONAL CORE TRAINING

3.17.1 MEDICINE BALL OVERHEAD THROW

Stand with the feet hip-width apart, and hold a medicine ball overhead with a slight bend in the elbows. Take one step forward and simultaneously throw the ball in the intended direction. Repeat for the desired number of repetitions.

3.17.2 PLANK (AKA BRIDGE)

Start out lying face down, palms flat on the floor. Push off the floor so that you are on toes and using the forearms and elbows to support the weight. Now tilt the pelvis and contract your abs so that the body remains in a straight line. This means keeping your back flat and keeping the pelvic bone tilted the whole time that are holding this position. Be careful to keep the pelvis tilted and the abs contracted the whole time. Hold this for a minimum of 30 seconds and continue to breath.

3.17.3 ALTERNATING PUSH UPS

Begin in a push-up position with one hand on the ball and the other on the floor. Perform a push up and then roll the ball to the other hand and repeat until failure.

3.17.4 SIDE TO SIDE TWIST

Assume the same starting position as the Over & Under. Holding the ball with both hands twist the shoulders and from side to side touching the ball on the ground next to the hip. Do the best to get the shoulders square to the direction of tapping.

3.17.5 CRUNCH

Lying flat on the ground with knees bent and hands behind the head, push lower back into the ground and lift upper back off the ground and slightly forward.

3.17.6 PLANK JACK

Get in a modified plank position, balancing on forearms (elbows aligned under shoulders) and toes. Tighten abs so body is straight from head to heels. Keeping torso tight, hop feet out wide. Hop feet back to starting position and repeat.

3.17.7 V UPS

Lie face up with legs and arms extended. Keeping knees and elbows locked, simultaneously raise upper body and lower body while trying to touch fingers to toes.

3.17.8 SIDE PLANK

Lie on side with lower arm bent at the elbow. Place lower elbow beneath shoulder and place upper hand on hip. Align ankles, hips, shoulders, and head. Push body toward the ceiling, balancing on the edge of the bottom shoe with one foot directly over the other.

3.17.9 WOOD CHOPPERS

Lye on the back with the legs slightly bent and the heels on the ground (a "crunch" position). Hold the ball firmly in both hands and perform a modified sit up. The subjects will touch the ball against the ground above the head and then on the ground in between the legs.

3.17.10 VERTICAL LEG CRUNCH

Lie flat on the floor with lower back pressed to the ground. Place hands behind head. Extend legs straight up, crossed at the ankles with a slight bend in the knee. Contract abdominal muscles by lifting torso toward knees. Make sure to keep chin off your chest with each contraction. Exhale as you contract upward; inhale as you return to the starting position.

3.17.11 TOE TAPS

Lie on back and place hands behind ears. Lift legs to tabletop position (90-degree angle). Press lower back into floor and crunch forward until shoulders are off the floor. With toes pointed down, lower right foot as

far as one can without lifting back off the floor. Return to starting position and repeat with left leg.

3.17.12 BIRD DOG

Balance on hands and knees. Lift right leg and left arm, extending right leg to the rear and reaching forward with left arm. Hold. Repeat with opposite arm and leg.

3.17.13 RUSSIAN TWIST

Sit on the floor, knees bent and feet flat. Hold arms straight out in front of chest, with palms facing down. Lean back so that your torso is at a 45-degree angle to the floor. Twist to the right as far as you can, pause, then reverse movement and twist to the left.

3.18 COLLECTION OF DATA

The variables used in the present study were assessed from all the subjects before they have to treat with the respective treatments. It was assumed as pre-test. After completion of treatment they were tested again as it was in the pre test on all variables and assumed as post test.

3.19 STATISTICAL TECHNIQUES AND ITS JUSTIFICATION

The following statistical techniques were adopted to treat the collected data in connection with established hypotheses and objectives of this study.

To find out the difference between pre and post test of each groups, paired ‘t’ test was used. Analysis of covariance (ANCOVA) was computed because the subjects were selected random, but the groups were not

equated in relation to the factors to be examined. Hence the difference between means of the three groups in the pre-test had to be taken into account during the analysis of the post-test differences between the means. This was achieved by the application of the analysis of covariance, where the final means were adjusted for differences in the initial means, and the adjusted means were tested for significance.

Whenever the adjusted post-test means were found significant, the Scheffe's post-hoc test was administer to find out the paired means difference. To test the obtained results on variables, level of significance 0.05 was chosen and considered as sufficient for the study.

RESEARCH FLOW CHART