CHAPTER III
METODOLOGY

The purpose of this study was to find out the influence of aerobic training, basketball skill training, and combined aerobic and basketball skill training on bio-motor, physiological and skill performance of collegiate Basketball players. This chapter deals in detail the procedures adopted for the selection of subjects, selection of variables, criterion measures, reliability of data, orientation of the subjects, pilot study, training program, collection of data, test administration, experimental design, and statistical analysis of data involved in the study.

SELECTION OF THE SUBJECTS

Sixty basketball collegiate players were randomly selected from Tiruchirappalli city colleges, Tiruchirappalli, Tamil Nadu. Their ages ranged from eighteen to twenty three years. Selected subjects were randomly divided into three experimental groups and one control group of 15 basketball players each namely Aerobic Training (AET), Skill Training (SKT), Combined Aerobic and Skill Training (CAESKT) and Control Training (CNT). Of the three experimental groups, AET (15) group was assigned aerobic training programs, the SKT (15) group was assigned skill training programs, the CAESKT (15) group was given combined aerobic and basketball skill training. The subjects of the control group were not allowed to participate in any of the training programs except in their routine activities. Subjects were informed to
abstain from any additional specific training during the course of the study. The investigator received a written consent from the subjects for participating in the experiment. The subjects were allowed to take rest whenever they feel discomfort. But they were not allowed to discontinue the training as a whole. All the subjects are attending the training sessions in prompt way. Subject’s characteristics are listed in the Table I.

**TABLE I**

**CHARACTERISTICS OF SUBJECTS**

(MEAN ± STANDARD DEVIATION)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Aerobic Training (AET) Group</th>
<th>Skill Training (SKT) Group</th>
<th>Combined Aerobic and Skill Training (CAESKT)</th>
<th>Control Group (CNT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (Cms)</td>
<td>170.3 ± 0.41</td>
<td>172.95 ± 0.86</td>
<td>171.7 ± 0.12</td>
<td>172.7 ± 0.12</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>71.15 ± 0.85</td>
<td>70.1 ± 0.83</td>
<td>72.1 ± 0.87</td>
<td>70.85 ± 0.87</td>
</tr>
<tr>
<td>Age (Years)</td>
<td>21.1 ± 0.84</td>
<td>21.4 ± 0.82</td>
<td>22.4 ± 0.86</td>
<td>21.3 ± 0.89</td>
</tr>
</tbody>
</table>

**SELECTION OF VARIABLES**

As with most team sports, there are many components of fitness that are important for success. In basketball, the various components of fitness are close in their relative importance. Having a very good aerobic fitness level is a very important attribute, and on the other hand being very quick and agile is also very important. Basketball is a sport that builds competitive success upon training and strength conditioning programs that encompass a broad variety of physical requirements. Like soccer and rugby, the basketball player must be able to perform all aspects of the game to at least a fundamental level.
Studies by the National Collegiate Basketball Association (NCAA) have found that an average segment of play during a game will last between 12 and 20 seconds. That is why, basketball places its primary demands on the human body's anaerobic energy system, with secondary reliance on the aerobic energy systems. For this reason, the most effective forms of basketball training develop the physical skills necessary to play the game by placing emphasis upon both energy systems. In previous basketball eras, it was thought that conditioning was best achieved in practice sessions that involved lengthy scrimmages, as well as running drills that were as much improved as they were productive. Modern basketball training, as with the development of any higher level athletic skills, requires methods that incorporate fitness and sport-specific skills into each element of training.

Practice involves several different elements. Drills that emphasize rapid, well-balanced and controlled movements in all directions, with the player sliding in a crouched, athletic stance, are very effective. Basketball is a fluid game, and the player's ability to react to changing situations on the floor will be founded upon a proper stance. It is sometimes said that there are three types of basketball players: the player with the one-dimensional, straight-backed stance; the player with the two-dimensional stance, using the same upright stance and the feet wider apart; and the three-dimensional player, with feet apart, knees bent, and the body center of gravity lowered into a stable crouch.
Sample drills reinforce speed and control and include "slide" drills, in which the payer mimics full-speed defensive coverage. Shooting and passing drills are carried out at full speed with specific practice targets. Jumping ability will be developed through specific drills based upon plyometric principles. This manner of training is calculated to build explosion when jumping on the floor. Hand-eye coordination and player agility can often be enhanced through individual drills with the basketball. Two- and three-ball dribbling exercises, in which the player must move at full speed keeping the balls under control with a proper dribble, are unique aspects in basketball dribbling skill training.

A feasible analysis to which the important variables could be taken for the investigation was made in consultation with the supervisor and the experts, the selected variables such as Speed, Agility, Cardio-respiratory endurance, Resting Pulse Rate, Basketball shooting, Basketball passing, and Basketball dribbling were selected as criterion variables.

**TABLE II**

**SELECTED CRITERION VARIABLES**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>Test Items</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed</td>
<td>50 meters Run</td>
<td>1 / 10&lt;sup&gt;th&lt;/sup&gt; Seconds</td>
</tr>
<tr>
<td>2</td>
<td>Agility</td>
<td>4 x 10 Shuttle Run</td>
<td>1 / 10&lt;sup&gt;th&lt;/sup&gt; Seconds</td>
</tr>
<tr>
<td>3</td>
<td>Cardio – Respiratory Endurance</td>
<td>Cooper’s 12 Minute Run &amp; Walk</td>
<td>Nearest 10 meters</td>
</tr>
<tr>
<td>4.</td>
<td>Resting Pulse Rate</td>
<td>Manual</td>
<td>Beats per minute</td>
</tr>
<tr>
<td>4</td>
<td>Respiratory Rate</td>
<td>Manual</td>
<td>Rate per Minute</td>
</tr>
<tr>
<td>5</td>
<td>Basketball Shooting</td>
<td>AAHPERD Basketball Test</td>
<td>Successive Points</td>
</tr>
<tr>
<td>6</td>
<td>Basketball Passing</td>
<td>AAHPERD Basketball Test</td>
<td>Number of Passes</td>
</tr>
<tr>
<td>7</td>
<td>Basketball Dribbling</td>
<td>AAHPERD Basketball Test</td>
<td>1 / 10&lt;sup&gt;th&lt;/sup&gt; Seconds</td>
</tr>
</tbody>
</table>
**Independent Variables**

The standard of sports is gaining momentum day by day. New records are coming into existence at National and International level. It is all because of technical as well as tactical training to compete with advanced sports countries. It will only be possible if the athletes are given advance training in the field of physical education and sports. It is only possible with the help of research of high caliber. (*Sharma, 1997*)

Sports training are the basic form of an athlete’s training. It is the preparation systematically organized with the help of exercise which in fact is a pedagogically organized process of controlling the development of an athlete. Today sports training are mostly based upon the competitive motive. Each nation is trying to achieve top level performance and to win laurels in international competitions. Today’s records are proved to be lower performance of tomorrow’s. This is because greater stress has been laid on the quality rather than quantity of training.

Aerobic capacity refers to the greatest amount of oxygen an individual can consume while performing physical exercise. The form of physical exercise that a person might perform can vary greatly, of course, from a simple act of involving just a few small muscle groups. Therefore, aerobic capacity is specific to a group of muscles, although we tend to think of it as the most oxygen an individual can consume while engaged in an exercise that brings into play as many muscles as possible. Aerobic involvement during exercise
actually has two major components. The first is the central component, which refers to the oxygen delivery system. The ability of the lungs to oxygenate the blood that is pumped through the pulmonary vessels, the ability of the blood to carry oxygen, and the ability of the heart to pump blood to the exercising muscles are all parts of the oxygen delivery system. The second is the peripheral component, which refers to the ability of the exercising muscles to take in and use the delivered oxygen to convert fuel aerobically to energy for muscular contractions.

Basketball is one of the most popular sports where variety of skills to be tackled. Nature and type of skills is determined by the nature of the competition in sports. Sports skill is an automatised motor action aimed at a tactical task. Acquisition of sports skill is important to enable the sportsman to do the required motor actions during competition without concentrating on the movement execution. This is a necessary prerequisite for effective observation and perception of rapidly changing situations during the competition. Hence aerobic, skill and combined aerobic and skill training were selected as independent variables for this study.

**RELIABILITY OF THE DATA**

Test and retest method was followed in order to establish the reliability of the data by using ten participants at random. All the dependent variables selected in the present study were tested twice by the same personnel under similar conditions. The intra class co - efficient of correlation was used to find
out the reliability of the data and the results are presented in Table – 3.3. Since, the obtained ‘r’ values on selected criterion variables were much higher than the required value, the data were accepted as reliable in terms of instruments, testers and the participants.

**TABLE III**

**INTRACLASS CORRELATION CO-EFFICIENT OF TEST RETEST SCORES ON DEPENDENT VARIABLES**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>TESTS</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50 meters run</td>
<td>0.81*</td>
</tr>
<tr>
<td>2</td>
<td>Astrand – Astrand Nomogram</td>
<td>0.78*</td>
</tr>
<tr>
<td>3</td>
<td>Cooper’s 12 Minute Run &amp; Walk</td>
<td>0.75*</td>
</tr>
<tr>
<td>4</td>
<td>Pulse Rate</td>
<td>0.79*</td>
</tr>
<tr>
<td>5</td>
<td>AAPERED Basketball Shooting</td>
<td>0.82*</td>
</tr>
<tr>
<td>6</td>
<td>AAPERED Basketball Passing</td>
<td>0.86*</td>
</tr>
<tr>
<td>7</td>
<td>AAPERED Basketball Dribbling</td>
<td>0.83*</td>
</tr>
</tbody>
</table>

*Significant at 0.05 level of confidence.

**ORIENTATION TO THE PARTICIPANTS**

The investigator explained the purpose of the study to the participants and their part in the study. For the collection of the data, the investigator explained the procedure of testing on selected dependent variables and gave instructions about the procedure to be adopted by them. Further, the control group was specially oriented, advised and controlled to avoid the special practice of any of the specific training programme till the end of the experimental period. The participants of all the groups were sufficiently motivated to perform their maximal level during training and testing periods.
INSTRUMENTS’ RELIABILITY

Instruments such as Digital Timer, weighing machine, measuring steel tape used for this study were purchased from reputed firms with ISI specification and government approval. Since all the instruments were new and in fine working condition, their conditions were accepted as accurate enough for the purpose of the study.

SUBJECTS’ RELIABILITY

The Intra-class correlation co-efficient of test–retest values also determined that subject reliability was adequate as the same tester used the same subjects under similar condition. Motivation techniques were not used. In order to get uniform results from the subjects, they were oriented about the study prior to the conduct of the test. The test and retest method was used to find out the subject reliability.

TESTER’S COMPETENCY

All the measurement in this study was taken by the investigator from affiliated colleges of Bharathidasan University, Tiruchirappalli, Tamilnadu. To ensure that the investigator is well versed with the techniques of conducting tests, they had a number of practice sessions in the correct testing procedure. The tester’s reliability was established by test and re-test method.

PILOT STUDY

A Pilot study was conducted for the purpose of finalizing and deciding upon the intensity, duration, and recovery of the two training programs. The
two programmes were fixed within the limits and capabilities of the subjects. Five subjects each from non linear periodisation group and linear periodisation group were utilized for the pilot study. They were asked to undergo the respective training programmes.

**TRAINING PROGRAMME**

During the training period, the experimental groups underwent their respective training programmes in addition to their regular programme.

AET group was assigned aerobic training programs, the SKT group was assigned skill training programs and the CAESKT group was given combined aerobic and basketball skill training for three alternative days per week for twelve weeks.

The duration of the training session in all days was between one hour to one and half hour approximately including warming up and training exercises. Group IV acted as control that did not participate in any specific training on par with experimental groups.

**TABLE IV**

**TRAINING PROGRAMME SCHEDULE**

<table>
<thead>
<tr>
<th>Duration</th>
<th>Training Programme Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AET Group</td>
</tr>
<tr>
<td><strong>Pre – Test</strong></td>
<td></td>
</tr>
<tr>
<td>1 – 2 Weeks</td>
<td></td>
</tr>
<tr>
<td>3 – 4 Weeks</td>
<td></td>
</tr>
<tr>
<td>5 – 6 Weeks</td>
<td></td>
</tr>
<tr>
<td>7 – 8 Weeks</td>
<td></td>
</tr>
<tr>
<td>9 – 10 Weeks</td>
<td></td>
</tr>
<tr>
<td>11 – 12 Weeks</td>
<td></td>
</tr>
<tr>
<td><strong>Post – Test</strong></td>
<td></td>
</tr>
</tbody>
</table>
All the subjects involved in this study were carefully monitored throughout the training programme to be away from injuries. They were questioned about their health status throughout the training programme. None of them reported with any injuries. However, muscle soreness appeared in the earlier period of the training programme and was reduced in due course.

**COLLECTION OF DATA**

The data on speed, agility, cardio respiratory endurance, resting pulse rate, respiratory rate and AAPERED Basketball Skill Test Variables as shooting, passing and dribbling were collected by administering 50 meters run, 4 × 10 shuttle run test, Pulse Rate, Cooper’s 12 minutes run and walk test, and the data on skill performance was generated by administering AAPERED Basketball test. The data were collected first at the beginning (pre-test), and finally at the end of the experimental period of 12 weeks (post – test).
TEST ADMINISTRATION

50 Meters Run

Purpose

The purpose of this test is to measure the speed of the player.

Requirement

Stop Watches - accurate to one tenth.

FIGURE I

50 METER RUN TEST

Description

The student takes the position behind the starting line. The subject has to start by own from the starting point and run to cross the finishing line, as fast as possible, which is thirty meters apart.

More than one pupil may run at a time if sufficient stop watches are available.

Scoring

The student’s score is the elapsed time between the subject starts from starting line and the instant the pupil crosses the finishing line. Out of two trials the best time is recorded to the nearest 1/10th of a second.
4 × 10 Meters Shuttle Run

Purpose

To measure the agility of the subject.

Requirement

Stop Watch - accurate to one tenth, 10 meters distance marked by two parallel lines of 5 meters each.

Procedure

The subject stands behind the starting line and on the start signal, she runs towards the other line touches it with the hand, turns and comes back to the starting line, touches it with the hand, and then runs and repeat the same for a total number of six times.

More than one pupil may run at a time if sufficient stop watches are available.

FIGURE II

4 × 10 METERS SHUTTLE RUN TEST

Scoring

The time taken to complete the course of 6 × 10 meters distance will be recorded in nearest 1 / 10th seconds. Two trials can were be given.
COOPER’S 12-MIN RUN & WALK TEST

Purpose

To test aerobic fitness (the ability of the body to use oxygen to power it while running)

Equipment Required

Flat oval or running track, marking cones, recording sheets, stop watch.

Procedure

Place markers at set intervals around the track to aid in measuring the completed distance. Participants run for 12 minutes, and the total distance covered is recorded. Walking is allowed, though the participants must be encouraged to push themselves as hard as they can.

FIGURE III

COOPER’S 12 – MINUTE RUN & WALK TEST
Scoring

There are several equations that can be used to estimate VO2max (in ml/kg/min) from the distance score VO2max (in ml/kg/min) from the distance score (a formula for either kms or miles):

\[ \text{VO2max} = (35.97 \times \text{miles}) - 11.29. \]
\[ \text{VO2max} = (22.351 \times \text{kilometers}) - 11.288 \]

Resting Pulse Rate – MANUAL METHOD

Purpose

To measure the pulse rate of an individual

Equipment Required

Recording sheets and stop watch.

**FIGURE IV**

PULSE RATE MANUAL TEST
**Procedure**

Radial Pulse (wrist) - The most common place to measure pulse rate using the palpation method is at the wrist (radial artery). The tester must always be placed on radial artery by fingers not by thumb, particularly when recording someone else's pulse. Place the index and middle fingers together on the opposite wrist, about 1/2 inch on the inside of the joint, in line with the index finger.

**Scoring**

Number of counts by beat within one minute of period.

**AAHPERD Basketball Skills Test**

**Age Level**

Ten through college – age.

**Equipments**

Basketball, stopwatch, floor and wall marking tape, tape measure, six cones.

**Validity**

Coefficients ranging from .37 to .91 for all ages and both sexed on individual test items and from .65 to .95 for test battery as a whole were found.

**Reliability**

With the test-retest method, coefficients ranging from .82 to .97 for all ages and both sexes on individual test items were found.
AAHPERD Speed Spot Shooting

Test Objective

To measure skill in rapidly shooting from different positions and to a limited extent, to measure agility and ball handling.

Administration and Directions

Floor markers are placed on the floor as shown in figure – 3.1. The distances for spot B, C and D are measured from the center of the basket. For fifth and sixth graders the shooting distance is 9 feet, for grades 7,8 and 9 it is 12 feet, and for grades 10 through college, it is 15 feet. Holding a basketball, the test performer begins the test with one foot behind any one of the five markers. On the signal, “Ready, Go,” the performer shoots, retrieves the ball, and dribbles to and shoots from another spot. At least one shot must be taken from each of the five markers. A maximum of four lay-up shots may be attempted, but no two may be taken in succession. Three 60-seconds trials are administered, with the first being a practice trial.

Figure V

AAHPERD SPEED SPOT SHOOTING TEST
Scoring

Two points are given for each shot made, and one point is given for each unsuccessful shot that hits the rim (from above). The item score is the sum of the scores for the two trials. The test administrator must record the number of lay-ups attempted, the point value of the attempted shots, and if the performer attempts at least one shot from each of the five markers. No score is given for shots that follow ball-handling infractions such as travelling and double dribbling or for more than four lay-up attempts. If the performer fails to shoot from each of the five markers, the trial is repeated.

AAHPERD Basketball Passing Test
Test Objective

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

FIGURE VI

AAHPERD BASKETBALL PASSING TEST
Administration and Directions

A restraining line is drawn on the floor 8 feet from the wall and parallel to it, and squares are marked on the wall (as shown in figure – 3.2). Only chest passes are permitted. Holding a basketball, the test performer stands behind the restraining line facing target A. On the signal, “Ready, Go,” the ball is passed to target A. The rebound is recovered while moving to be in line with target B. The ball is then passed to target B. This sequence is continued until target F is reached, where two passes are attempted. The performer then moves back toward the target A. Three 30 – second trials are taken, with the first being a practice trail.

Scoring

Each passes that lands in the target or on the target line earns two points. Passes hitting the wall between the targets earn one point. The item score is the sum of the two trails. No points are given if the performer’s foot is on or over the line; if a second pass is made at target B, C, D, or E; or if a pass other than a chest pass is used.

AAHPERD Basketball Control Dribble

Test Objective

To measure ball – handling skill (dribbling) while moving.

Administration and Directions

Six cones are placed as shown in figure - 3.3. On the signal, “Ready, Go,” the test performer begins dribbling with non dominant side of the cone B.
for the remainder of the course the performer may use the dominant hand, and hands may be changed when appropriate. Three timed trials are given, with the first being a practice trial.

**FIGURE VII**

AAPERED BASKETBALL CONTROL DRIBBLE TEST

**Scoring**

The trial score is recorded to the nearest one-tenth of a second. The item score is the sum of the two trails. The trial is retaken for ball-handling infractions, failure of the performer or ball to remain outside any cone, and failure to continue the test from the spot where loss of the ball control occurred.

**EXPERIMENTAL DESIGN**

This study was conducted to determine possible cause and effect of aerobic training, skill training and combined aerobic and skill training on bio-motor, physiological and skill performance at different stages. A pre and post test randomized design was employed for this investigation. This study consisted of three experimental groups consists of 15 basketball players each,
namely Aerobic Training (AET), Skill Training (SKT), Combined Aerobic and Skill Training (CAESKT) and Control Training (CNT) underwent Aerobic Training Programme, Skill Training Programme and Combined Aerobic and Skill Training Programme. All the participants were tested in the beginning of the programme (pre-test), and finally at the end of the experimental period of 12 weeks (post – test).

**STATISTICAL TECHNIQUE**

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 (Broota, 1989). The scheffe’s test was used as post-hoc test to determine which of the paired means differed significantly where the differences in adjusted post-test means resided in univariate ANCOVA among three groups. All of the statistical analysis tests were computed at 0.05 level of significance (P < 0.05).

**JUSTIFICATIONS FOR USING ONE-WAY ANCOVA**

One-way univariate analysis of covariance (ANCOVA) was used to determine how each dependent variable was influenced by independent variables while controlling for a covariate (pre-test) (Hari, Anderson, Tatham, and Black, 1998). Analysis of covariance adjusts the mean of each dependent variable to what they would be if all groups started out equally on the
covariate. In this study, pretest scores of selected variables have been shown to correlate with the post test scores, thus they were considered as appropriate covariates.

**Assumptions for ANCOVA**

A preliminary analysis was conducted to determine whether the prerequisite assumptions of ANCOVA were met before preceding the univariate analysis. Thus, the assumption of equality of variance (homogeneity) and the assumption of homogeneity of regression slopes were examined.

Levene’s test of equality of error variances on selected variables was calculated and presented in table V.

**TABLE V**

**LEVENE’S TEST OF EQUALITY OF ERROR VARIANCES ON SELECTED VARIABLES AMONG GROUPS**

<table>
<thead>
<tr>
<th>Variables</th>
<th>F- Ratio</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum strength</td>
<td>2.92</td>
<td>ns</td>
</tr>
<tr>
<td>Elastic strength</td>
<td>2.53</td>
<td>ns</td>
</tr>
<tr>
<td>Strength Endurance</td>
<td>2.39</td>
<td>ns</td>
</tr>
<tr>
<td>Power</td>
<td>1.48</td>
<td>ns</td>
</tr>
<tr>
<td>Power Endurance</td>
<td>1.26</td>
<td>ns</td>
</tr>
</tbody>
</table>

*(The table value required for 0.05 level of significance with df 2 & 57 is 3.15).*

Homogeneity of variances is a term that is used to indicate that groups have the similar variances. Thus, in Levene’s test of equality of error variances table, the obtained F-values of the selected dependent variables were lesser than the critical value of 0.05, indicates that the variance of each group was not significantly different from one another.
Therefore, the homogeneity of variance of comparing the three groups regardless of the ability level for each of the dependent variables indicated that homogeneity of variance has been met for all the four dependent variables. Hence it was concluded that the assumption of homogeneity of variance has been met for computing univariate ANCOVA.

The interaction terms were calculated to test the assumption of homogeneity of regression slopes and presented in table II A.

**TABLE VI**

**INTERACTION TERM ON SELECTED VARIABLES OF GROUPS AND PRE TEST**

<table>
<thead>
<tr>
<th>Variables</th>
<th>F- Ratio</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum strength</td>
<td>2.39</td>
<td>ns</td>
</tr>
<tr>
<td>Elastic strength</td>
<td>2.49</td>
<td>ns</td>
</tr>
<tr>
<td>Strength Endurance</td>
<td>2.38</td>
<td>ns</td>
</tr>
<tr>
<td>Power</td>
<td>1.48</td>
<td>ns</td>
</tr>
<tr>
<td>Power Endurance</td>
<td>1.92</td>
<td>ns</td>
</tr>
</tbody>
</table>

(The table value required for 0.05 level of significance with df 2 & 39 is 3.24)

The table VI shows that the interaction F-ratio of the covariate by dependent variables interaction (Group x Pre test), effect was not significant that the assumption of homogeneity of regression slopes has not been broken, therefore the assumption was met.

After determining the assumptions for computing ANCOVA have been met with the pre data analysis, the univariate ANCOVA statistical output was examined. Then, providing the ANCOVA result was statistically significant, the univariate results were examined for each dependent variable. For the
significant univariate results, the post hoc comparisons were performed to identify where the differences resided. The pairwise comparisons statistic was used for the post hoc results. The results of the descriptive analysis, dependent ‘t’ test, univariate tests, the pairwise comparisons among the four dependent variables are reported in chapter four.