In this chapter an attempt has been made to elucidate the method and procedure adopted to predict motor fitness variables as well as motor skill variables to evaluate the playing ability of male and female basketball players. To accomplish the purpose of the study, the design has been carefully formulated and systematically presented and explained in this chapter under the following heading:

1. Selection of the subjects
2. Selection of variables
3. Criterion measure
4. Reliability of data
5. Tools to be used
6. Administration of tests and collection of data
7. Statistical Procedure

Selection of Subjects

To accomplish the study random sampling technique has been used to select the subjects. The subjects were Sixty-six male and fifty female inter-college level basketball players between 18 to 25 years of age. These students were studying in various affiliated colleges and various department of Panjab University, Chandigarh. All the players used as a subject, participated in at least Panjab University Inter - college Basketball competition for men and women for the session 2003-2004. All the subjects were ensured about their health status.
from college and department health record, which was regularly maintained by their respective colleges and departments, and it was found that all the selected subjects were medically fit for going through the testing programme.

Prior to the administration of tests, a meeting of the subjects was held in the presence of the Lecturers in Physical Education, coaches and others tournament organizers. The requirements of the testing procedure were explained to them in details, so that there was no ambiguity in their minds regarding the efforts required of them and the hard work they had to endure in addition to their regular participation in the competition. All the students and others official agreed voluntarily to cooperate in testing procedure explained to them in the interest of scientific investigation and enhancing their own performance. Though no special techniques were used to motivate the subjects to put in their best efforts, the subjects were very enthusiastic and co-operative throughout the project.

**Selection of Variables**

The motor fitness variables and motor skill variables that influence the performance in the game of basketball were selected with greater care on the basis of personal experience of the researcher, long discussion with the coaches, and critical analysis of the related literature, with joint consideration of the feasibility of the tests, availability of the equipments and acceptability of the subjects. After having taken the above criteria into consideration the following motor fitness variables and motor skill variables were considered for the study.

(a) **Motor fitness variables**

   (i) Speed.

   (ii) Coordinative abilities.

   (iii) Explosive legs power.

   (iv) Shoulder strength.
(v)  Endurance.
    a.) Cardio vascular endurance
    b.) Abdominal muscle endurance.
(vi)  Flexibility.

(b)  Motor skill variables
(i)  Shooting
(ii) Lay-up Shooting
(iii) Dribble Control
(iv) Defensive movements
(v)  Passing

Criterion Measure
The criterion – measure chosen for this study was:
Overall basketball playing ability

Reliability of Data
The reliability of data was ensured by establishing the instruments reliability, tester competency and reliability of tests and subjects reliability.

Instrument Reliability
The stopwatch and flexo-measure case with yardstick were obtained from standard firm, which cater to the needs of various research laboratories in India and abroad. The reliability of these instruments was ensured and calibrated by their manufacturers. All the instruments used in this study to measure the performance of the subject on different variables were considered reliable and precise. Their reliability was further ensured by their repeated use on the same subject by the same tester under similar condition.

Tester Competency and Reliability of tests
To ensure that the investigator was well versed with the techniques of conducting the tests, the investigator had a number of practice sessions in
testing procedures under the expert, Dr. S.N. Sharma, Retired Reader from Panjab University Chandigarh. The tester competency was evaluated together with the reliability of the tests. To determine the reliability of tests, the scholar recorded the performances of ten subjects selected at random on the selected variables, twice under identical conditions. A Pearson’s Product Moment Coefficient of Correlation was computed between the two measures of each variable and these reliability coefficients shown in Table No- 3.1.

**Table- 3.1**

<table>
<thead>
<tr>
<th>Test</th>
<th>Coefficient of Reliability (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 yard dash</td>
<td>.897</td>
</tr>
<tr>
<td>SEMO Agility Test</td>
<td>.896</td>
</tr>
<tr>
<td>Shuttle run</td>
<td>.857</td>
</tr>
<tr>
<td>Sargent Jump</td>
<td>.98</td>
</tr>
<tr>
<td>Standing Broad Jump</td>
<td>.98</td>
</tr>
<tr>
<td>Basket ball throw for distance</td>
<td>.96</td>
</tr>
<tr>
<td>Sit-ups.</td>
<td>.98</td>
</tr>
<tr>
<td>9/12 minute run and walk test</td>
<td>.96</td>
</tr>
<tr>
<td>Bridge-up test</td>
<td>.898</td>
</tr>
<tr>
<td>Speed spot shooting from ‘9’ feet’s</td>
<td>.898</td>
</tr>
<tr>
<td>Speed spot shooting from ‘12’ feet’s</td>
<td>.897</td>
</tr>
<tr>
<td>Speed spot shooting from ‘15’ feet’s</td>
<td>.898</td>
</tr>
<tr>
<td>Dribble shoot test</td>
<td>.82</td>
</tr>
<tr>
<td>Control dribble</td>
<td>.898</td>
</tr>
<tr>
<td>Defensive movements</td>
<td>.857</td>
</tr>
<tr>
<td>Passing</td>
<td>.82</td>
</tr>
</tbody>
</table>
The correlation coefficients indicated that the reliability of the test-retest scores was found very high.

**Subjects reliability**

The above test-retest coefficients of correlation method also established that subject’s reliability was significant at .01 level of confidence, as the tester used the same were used subjects under similar condition and no motivational technique was used nor any training was given.

**Tools used to measure the motor fitness variables**

**Speed**

50-yard Dash (AAHPER Youth Fitness Test Battery 1976): To measure the speed.

**Coordinative Ability**

SEMO agility test (Ronald Kirby 1971): To measure the general agility of the body in maneuvering forward, backward and sideward running.

**Agility**

Shuttle run test (AAHPER Youth Fitness Test Battery 1976): To measure the agility of the performer in running and changing directions.

**Explosive Power**

Sargent jump test (Sargent, D.A., 1921): To measure the leg explosive power vertically.

Standing broad jump (AAHPER Youth Fitness Battery 1976): To measure leg explosive power horizontally.
Shoulder Strength

Basketball throw for distance (Scott Motor Ability Test Battery 1939): To measure arm and shoulder girdle strength.

Endurance

9/12 minutes run and walk test (Cooper 1968): To measure the cardiovascular endurance.

One-minute sit-ups test (AAHPER YOUTH Fitness test battery 1976): To measure abdominal strength and endurance.

Flexibility

Bridge up test (Johnson, Barry L. 1977): To measure the hyperextension of spine.

Tools used to measure the Motor skills variable:

Shooting, Dribble Control, Defensive movements and Passing

AAHPERD Basketball Skill Test Battery (1984): To measure the basketball skills i.e. ‘9’ feet’s ‘12’ feet’s and ‘15’ feet’s. Dribble control, Defensive movements and passing.

Lay up shooting

Lay up shoot test (Knox 1937): To use to measure Lay – up shooting ability.

Tools used to measure the overall basketball playing ability

Five point rating scale: To measure the basketball playing ability.
Administration of tests and collection of data

The necessary data were collected by administering the tests for the selected motor fitness variables and motor skill variables. All the tests were administrated ten day before and during the Panjab University Inter-colleges Basketball tournament for both male and female at Panjab University Campus Chandigarh, in the month of October and November 2003 respectively. This period was considered to be the best time for the collection of data for the main reason that the players had entered the competition period after having acquired optimum fitness and skill proficiency. The impact of their training and conditioning had reached the peak level. They were in position to respond to the load of tests without undue fatigue. The subjects appeared in the test in their full playing Kit.

The subjects were given a chance to practice the prescribed test so that they might become familiar with the tests and know exactly what was required to be done. To ensure uniform testing conditions, the subjects were tested only during morning and evening sessions.

Speed: 50-Yard Dash

The purpose of the test was to measure the speed of the subjects in running.

Equipment: Clapper and stop watches

Description

On the track, a 50-yard distance was marked with starting and finishing lines. After a short warm up, the subjects took their position behind the starting line. On the sound of the clapper, the subjects started their race and ran as fast as possible up to the finishing line. (Figure 3.1) Only three players were made to run at one time.

Scoring: The time was recorded to the nearest one hundredth of a second.
MARKING FOR 50 YARD DASH RACE

Fig. 3.1
Agility: SEMO Agility test

The purpose of this test was to determine the general agility of the body in maneuvering forward, backward and sideward.

Equipment

Four wooden cones 9X9 inches base with 12 inches height, stop watch, measuring tape, and marking tape.

Description

Four lines AB, BC, CD, and DA on smooth area in the form of a parallel rectangle of ‘12’ by ‘19’ feet’s with adequate running space around it, was marked. Four wooden cones ‘9’ by ‘9’ inches base with ‘12’ inches height, were put in every inside of the corner of the marked field. The subject stood on starting point A and on signal, started side step from A to B and passed outside the corner cone and back pedal from B to D and passed to the inside of the corner cone. Then he/she sprinted forward from D to A outside the corner cone. He/She made back pedal from A to C and passed to the inside of the corner cone. Then he/she made sprint forward from C to B and passed outside of the corner cone. In the last, he/she took side step from B to the finishing line at A. Fig-3.2 has illustrated the making area for SEMO-Agility Test.

Scoring

The score was the time taken on the better of two trials recorded to the nearest one hundredth of a second.
MARKING FOR SEMO AGILITY TEST

Fig. 3.2
Shuttle run test

The purpose of this test was to measure the agility of the subjects in running and changing direction.

Equipment

Marking tape, stop-watch and two blocks of wood (2"X2"X4").

Description

Two lines parallel to each other were marked on the floor 30 feet apart. Since the subject must overrun both of these lines, it was necessary to have several feet more of floor space at either end. The subject stood at one of the lines with the two blocks at the other line. On the signal to start, the subject ran to the block, took one and returned to the starting line and placed the block behind that line. He/She then returned to the second block, which he carried across the starting line on his/her way back. Fig.-3.3 has illustrated the marking area for shuttle in test.

Scoring

The Score were the time taken in the better of two trials recorded to the nearest one hundredth of a second.
MARKING FOR SHUTTLE RUN

Fig. 3.3
Explosive leg power vertically upward: Sargent Jump

The purpose of this test was to measure the explosive power of legs vertically upward.

Equipment:

Measuring tape, several pieces of chalk, and a smooth wall surface of at least ‘12’ feet from the floor are required.

Description:

The subject stood with one side towards a wall, heels together and hold a piece of chalk in the hand nearest to the wall. Keeping the heels on the floor, he/she reached upward as high as possible and made a mark on the wall. The subject then jumped as high as possible and made another mark at the height of his jump. This is illustrated in figure 3.4.

Scoring:

The number of inches between the reach and jump mark measured to the nearest half an inch as the score. Three successive trials were given and the best trial was recorded as the score.
SARGENT JUMP

Fig. 3.4
**Leg Explosive power horizontally: Standing broad jump**

The purpose of this test was to measure the leg explosive power in jumping forward.

**Equipment**

Marking tape, chalk, mats or an outdoor jumping pit

**Descriptions**

The subject stood behind a take-off line with his/her feet parallel and several inches apart. Before he/she could leap from the ground into the pit, he/she was permitted to swim arms forward and backward and allowed to flex his/her knees and lean back with his or her trunk to get advantage to attain maximum distance. There should not be any double jump and both the feet's should leave the ground simultaneously. Measurement was from the closest heel mark to the take off line. This is illustrated in figure 3.5.

**Scoring**

The score was distances between take off line and the nearest point where any part of the subject body touched the floor measure to nearest of inch. Three successive trials were given and the best trial was recorded as a score.
STANDING BROAD JUMP

Fig. 3.5
Arm and Shoulder girdle strength: Basketball throw for Distance

The purpose of this test was to measure arm and shoulder girdle strength and co-ordination.

Equipment

Several regulation basketballs, and an area marked off occupying a space of approximately ’20’by ‘150’ feet long, measuring tape, and marking tape.

Description

The subject stood behind the throwing line and use any technique of throwing he/she wishes, he/she made the throw down the course. He/ She must not step on or across the throwing line. Figure 3.6.

Scoring

Three consecutive throws were permitted, and the best throw was recorded to nearest feet.
BASKETBALL THROW FOR DISTANCE

Fig. 3.6
Abdominal muscle Strength and Endurance: Sit-ups

The purpose of this test was to measure the abdominal muscle strength and endurance.

Equipment

Mats

Description

The subject lies supine on the mat with his/her knees flexed, made an angle of 90° approximately between the thighs and the lower legs. His/Her hands were behind the neck with fingers interlocked. One person holds the feet of the subject. From this position, the subject raised his/her upper body till his/her chest touched the thighs. This constituted one sit-up. The upper body was lowered to the original position so that his/her shoulders again touch the mat or floor. In this manner the subject did as many repetitions as possible. Figure 3.7 illustrated the sit-ups methodology.

Scoring:

The total number of sit-ups performed in one minute was the score of the subject.
SIT UPS TEST

Fig. 3.7
Cardiovascular Endurance: 9/12 minute run and walk test

The purpose of this test was to measure the cardiovascular endurance.

Equipment

A stopwatch, whistle, Flags or markers

Description

A space of 110 yard straight away marked off in 10-yard intervals for conducting this test. The marking is shown in Fig 3.8. The subject started behind a line and upon starting signal, ran and or walked as many laps as possible around the course within the 12 minute for male and within 9 minute for female. The spotters maintained a count of each lap and when signal to stop was given. They immediately ran to the spots at which these runners were at the instant. When command to stop was given.

Scoring:

The total yards covered in 12 and 9 minute was the score of male and female subject respectively.
MARKING FOR 9/12 MINUTE RUN AND WALK TEST

Fig. 3.8
Trunk Hyper Extension: Bridge up Test

The purpose of this test was to measure hyperextension of the spine.

Equipment:

Flexo-measure case with yardstick.

Description:

The subject performed back lying position on the floor and tilted her head back as he/she pushed upward, arcing her back while walking the hands and feet as closed together as possible. The Zero end of the yardstick was placed on the floor and the flexo measure case was moved vertically upward until the rule guide touched the highest point of the subject-arched spine. The reading was recorded through the case window at the lower line. Diagram for trunk hyperextension is shown in figure 3.9.

Scoring:

The best score of three trials was recorded to the nearest half of an inch and then subtracted from the standing height (floor to navel) of the subject and considered as raw score of the subject.
DIAGRAM FOR BRIDGE UP TEST (FOR TRUNK HYPER EXTENSION)

Fig. 3.9
Motor Skill Variables

Shooting: Speed spot Shooting test

The purpose of this test was to measure the skill in rapidly shooting from specified positions and to a certain extent, agility and ball handling ability.

Equipment

Standard inflated basketball, standard goal, stopwatch, measuring tape for making floor.

Description

Five shooting spots (marking) were marked on the floor of the regulation basketball court in front of a basket at five different angles to the target (Basket) namely at Zero degree angle to the right and zero degree to the left, at 45° angle to the right 45° angle in the left and at 90° angle (in front) to the centre of the basket at three different distance ‘9’ feet’s, ‘12’ feet’s and ‘15’ feet’s from the centre of the ring, at 1.575 m from the mid-point of the base-line as shown in the diagram. Marking for speed spot-shooting test is illustrated in Figure 3.10.

Proper warming up was given to subject before start of the test. The subject was tested for the skill in shooting for each designated distance repeatedly. Three trials of 60 seconds each from distance namely ‘9’ feet’s ‘12’ feet’s and ‘15’ feet’s were given. The first was practice trial and the next two were recorded as a score. Performer shoots in the fashion by following ABCDE or EDCBA/ reversed from same distance spots. One foot must be behind the marks during each attempt. On the signal, the subject to attempt and retrieved the ball, dribble to the next designated spot and shoot. A maximum of four lay up shot could be attempted during each trial but no two successive lay up shot attempts were to be attempted. The subject must attempt at least one shot from each designated spot.
Scoring

Two points were awarded for each shoot made including lay-up shot. One point was awarded for an unsuccessful shot that hits the rim from above either initially or after rebounding from the backboard. The final score for this test items was the sum of best score of the two trials for each distance. The score for the shooting from spot at a distance of ‘9’ feet’s was recorded as a score for speed spot shooting from spot ‘1’ from ‘12’ feet’s distance as score for speed spot shooting from spot ‘2’ and from ‘15’ feet distance as score for speed spot shooting from spot ‘3’.

Lay-up Shooting: Knox Dribble Shoot test

The purpose of this test was to measure the lay up shooting proficiency in minimum possible time

Equipment

Standard inflated basketball, standard goal, stopwatch, measuring tape, marking tape and cones.

Description:

The subject placed the ball on the Start- Finish Line that was ‘65’ feet’s from the centre of ring. He/She stood back towards the ring and hand on Knees, with the signal “go” the subject picked the ball and dribble down and back through the line of three chairs or obstacles which were placed in following manner first obstacle at ‘20’ feet’s from starting line and other two at a distance of ‘15’ feet’s from first obstacle and second obstacle. The subject has required to used all the three obstacles and must made a basket before he/ he returned to starting line. If he/she fails to made a basket on his/her first attempt he/she must continued shooting until he / she was successful. Any type of shot may be used.
MARKING FOR SPEED SPOT SHOOTING '9' FEET'S, '12' FEET'S AND '15' FEET'S

Fig. 3.10
Scoring

The number of seconds was required to complete the test. Time was recorded to the nearest hundredth of a second.

Control dribble: Control dribble tests

The purpose of this test was to measure the skill in handling the ball while a player is moving.

Equipment

Standard inflated basketballs, a stopwatch, six obstacles and measuring tape.

Description

An obstacle course marked by and six cones were set-up in restricted area (Key area / Three seconds area) of a regulation basketball court as shown in Diagram 3.11 and 3.12.

The subject starts with the ball on his/her non-dominant hand side at cone A. On the signal ‘Go’ the subject dribbled with non-dominant hand to the non-dominant hand side to the middle of cone B. The subject then proceed to follow the course using the preferred hand, changing hands as demand appropriate until the finish line was crossed by both feet.

Scoring

The score in each trial was elapsed time required to legally complete the course. Score was recorded to the nearest hundredth of second for each trial. The final test score was the sum of the best two trials.
MARKING FOR RIGHT HANDED CONTROL DRIBBLE TEST

Fig. 3.11

MARKING FOR LEFT HANDED CONTROL DRIBBLE TEST

Fig. 3.12
Defensive movements: Defensive movements test

The purpose of this test was to measure the performance in basic defensive movements.

Equipment

Stop watch, measuring tape, marking tape and cones or obstacles.

Description

The test perimeters were marked inside the regulation basketball court by the end line behind the basket, by the free throw line, and the lines connecting the end line and free throw lane (restricted area). The spots A, B, C, D, E, F, G, H and I were marked outside the restricted area as shown in the diagram 3.13.

The subject was started at ‘A’ on the signal ‘Go’ must slide to the left without crossing foot and to continue upto marker ‘B’ and touched the floor outside the free throw line with left foot, then executed a drop step and slide to point ‘C’ and touched the floor outside the lane with the right foot and continue the sliding movement to the marker ‘D’ and touched the lane outside the left foot and again slide along with the end line upto ‘E’ touched the floor outside lane with right foot and sprint diagonally towards the free throw line corner (Free throw line and free throw lane junction point/ meeting each other). When the performer reached marker ‘F’ outside the free throw line again starts sliding towards ‘G’ touch the floor outside the free throw line with right foot, then execute a drop step and slide to point ‘H’ and touched the floor outside with left foot then a drop step and slide to points ‘I’ from there sprint towards the finishing line.

The finishing of the course occurs when the foot have crossed the finish line (extension of the free throw line). In all, three trials were conducted for this test, the first was practice trial and the last two trials were recorded for scoring purposes.

Scoring

The score was recorded to the nearest hundredth of a second for each trial and the final score for the test was the sum of the last two trial times.
MARKING FOR AAHPERD DEFENSIVE MOVEMENT TEST

Fig. 3.13
Passing: Passing test

The purpose of this test was to measure the skill in passing and recovering ball accurately while moving.

Equipment

Standard inflated basketball, stopwatch, smooth wall surface and measuring tape for making target and restraining line.

Description

Six squares of 60cm each marked on the wall so that the base of the squares was either 1.55m or 90cms from the floor. All adjacent squares were marked on the floor at a distance of 2.50m from the wall as shown in diagram 3.14

Subject got three trials of 30 seconds each. The subject (with a ball) stood behind the restraining line and face the target on the far left (A). On the signal ‘Go’ the subject chest pass to first target, recovered the rebound while moving to a location behind the second target and behind the restraining line and chest pass at target B. This pattern continued until target F was reached, where two chest passes were executed, following which the performer then pass to E, repeated the sequence by moving towards the left. The stopwatch was started on the signal ‘Go’ and on completion of 30 seconds the watch stopped. Number of hits made on the target was counted. Each throw, which hits the target or the boundary lines of the target, counts two points. Each throw hits the intervening spaces on the wall count one point.

Scoring

The sum of the best two trial points was the final score.
MARKING FOR PASSING TEST

Fig. 3.14
Playing ability: Five-points rating scale

The purpose of this test was to judge the playing ability of basketball players.

Equipment

Rating scale, pen and chairs

Description

The basketball playing ability was judged during the Panjab University inter-college basketball tournament for male and female in the month of October and November 2003 respectively, in the light of the five point rating scale by a panel of three judges who had sufficient experience in the game of basket ball. (Five point rating scale is given in the Appendix-'E') Experts assessed the playing ability of each individual according to their performance in Motor fitness level and motor skill proficiency as well as the techniques and tactics used during the tournament.

Scoring

The scores were the average of the three experts ratings. The scale is given below:

<table>
<thead>
<tr>
<th>Average</th>
<th>Above Average</th>
<th>Good</th>
<th>Very Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Statistical Analysis

The relationship between dependent variable (Basketball playing ability) and independent variables (Motor fitness and Motor skill) was established by computing Pearson's Product Moment Correlation (Zero order). The combined contributions of the motor fitness and motor skill variables to basketball ability were obtained through multiple correlations. Most versatile Motor fitness and Motor skill variables as predictor to the basketball playing ability were obtained through multiple step-wise regressions. Regression equations for both male and female were formed on the basis of predicted motor fitness and motor skill variables as well as regression equations for combined contribution of motor fitness and motor skill variables to predict the performances of basketball playing ability of male and female basketball players was also formed.