CHAPTER III

PROCEDURE
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in this chapter A has explained the various procedures adopted by her in the selection of subjects and the motor fitness tests, in gauging the reliability of the subjects, the data, instruments and the testers' competency, in identifying the criterion (composite scores) in the collection of data in two phases, in the organization and administration of tests, in adopting statistical methods and in the development of a test battery and norms.

SELECTION OF SUBJECTS

The sample consisted of 400 women volleyball players aged between 17 and 22 years. The minimum participation level of the chosen volleyball players was representation on the college team. The subjects were drawn from colleges affiliated to the universities of Punjab, that is, Guru Nanak Dev University, Amritsar; Punjabi University, Patiala; and Panjab University, Chandigarh.

Selection of Motor Fitness Tests

The first step taken was to prepare a list of
appropriate test items relevant for measuring the motor fitness of women volleyball players. In order to prepare such a list, the researcher banked upon related literature and on persons engaged in work in the field of volleyball, such as coaches and teachers in physical education. While preparing a comprehensive list of the test items, fitness components such as muscular power, endurance, muscular endurance, agility, flexibility, speed, body balance, hand-eye coordination and the growth factor were kept in mind for ordering the test items and preparing valid instructions on them. A pre-test was then conducted on these items. The pre-testing was followed by a pilot study in which data was collected on 100 women volleyball players on all the test items selected comprehensively.

**Fitness component and tests selected for the study**

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Reliability of the data

The reliability of the data was ensured by establishing instrument reliability, the testers' competency, the subjects' reliability and the reliability of the tests.
Instrument Reliability:

Stop-watches and steel tapes, softballs, handballs, goniometer, weighing machines, ruler guide etc. used in this study were calibrated and supplied by leading firms, their reliability being ensured by the manufacturers. The height measuring apparatus was checked each day, before conducting the tests, with a measuring tape. Thus the reliability of the instruments was considered adequate for the purposes of this study.

Tester's Competency

The investigator herself being a state-level volleyball player, she was well-versed with the technique of conducting tests. Nevertheless, she had a number of practice sessions in the testing procedure under the guidance of a supervisor to acquire proficiency in testing. All the measurements were taken by the investigator herself with the assistance of qualified personnel.

Subjects' Reliability

The test-retest co-efficients of correlation method established the subjects' reliability. The same subjects were used under similar conditions by the tester. No motivational techniques were used, nor were the subjects given any training.
Reliability of the Tests

Tests and re-tests on the same population by the same tester were conducted to find out the correlation between the two test samples so that the reliability of the test items could be established.

Criterion: Composite Scores

The composite scores of all the test items were considered as the criterion measure. Johnson and Nelson (1982) and Clarke (1976) also suggested that composite scores could be used as a criterion measure to establish the validity of the test items. The raw scores of all the basic test items were converted into standard scores and added up to serve as composite scores.

Collection of Data

The data was collected on the chosen test items in two phases. In the first phase, data on all the 27 test items was collected for establishing their validity. In the second phase, data was collected to establish the norms of the finally selected test items for the motor fitness test conducted for the selected women volleyball players.
COLLECTION OF DATA FOR THE FIRST PHASE OF THE STUDY

The data for the first phase of the study was collected on 100 skilled volleyball females, selected randomly from the age group 17-22. They represented their respective colleges and universities. The random sample was drawn from those subjects who had participated in at least inter-college competition.

All the data was collected during the peak season of the volleyball players. This period was considered to be the best period for the collection of data as the players were thought to have acquired maximum fitness. Before the testing programme was conducted, the investigator collected all the players together to brief them on the nature, the modalities and the objectives of the present investigation. The investigator gathered the subjects of each college, at different periods of time, and demonstrated before them the various tests so that they could, form for themselves a mental picture of the various tests they were going to take.

ORGANISATION OF TESTS

The help of qualified sports coaches and lecturers in physical education was taken by the investigator to administer the tests to the subjects. The investigator took care to explain the tests and the testing procedures
to the helper and subjects. All the test items were then demonstrated to them so that the subjects could form for themselves a mental picture of the various tests they were going to take. Every effort was made to ensure accuracy, uniformity and standardisation in the administration of the tests.

Ground markings etc. were completed one day before the start of the tests. The cooperation and help of the Principals of the colleges was taken when required. The subjects presented themselves in sports kit on the day of testing at the scheduled time. With the help of sports teachers, strict discipline was maintained to ensure the proper conduct of the tests.

All the tests were conducted either in the morning or in the evening and the testers were requested to follow the same timings as far as possible so as to minimize the effect of diurnal variations on the performance of different test items.

TEST ADMINISTRATION AND PROCEDURE

50-Metre and 20-Metre Run Test

To measure speed, the starting and finishing lines were marked and the measurements between them was
Fig. 3.1 20 METRE AND 50 METRE RUN TEST
made with a steel tape. A minimum of two subjects ran at a time. The subjects were permitted to take the standing or crouching start. The command for the start was: "Ready, go". On the command "go", (Fig. 3.1) the subjects ran to cover the distance in the shortest possible time and simultaneously the starter dropped her hand as a signal to begin recording the time. The subject ran as fast as possible across the finishing line. The time that elapsed from the starting signal until the runner crossed the finishing line was recorded nearest to one-tenth of a second with a stop-watch.

**Speed of Arm Movement Test**

To measure the speed of the movement of hands, each subject was asked to sit on a chair with her fingertips touching the edge of a table. Two lines, one foot apart, were marked on the table. The hands were placed in such a way that the palms faced each other on the two lines marked on the table. (Fig. 3.2). At the ready position, it was made sure that the subject's hands did not move before the falling of a measure scale, marked in centimetres. The hands were kept at the correct distance. The tester held the timer scale near its top so that it hung mid way between the subject's hands. After the preparatory word
Fig. 3.2  SPEED OF ARM MOVEMENT TEST
"ready" was given, the timer was released and the subject attempted to stop it as quickly as possible by bringing the hands together in a clapping motion. The score of the subject was noted at the point just above the upper edge of the hands after the catch. The timer was used by marking the distance in centimetres. The coaches could thus judge the speed of the subject's arm movement.

**Spike Jump Test**

To measure spike jumping ability (leg explosive muscle power) of volleyball players a vertical jump measuring apparatus (a 140 x 75 cm wooden board marked in centimetres and fitted at the top of a hollow iron pipe) was tied with the upper and lower edges of a volleyball court net, so that the apparatus stood in a vertical position, the scale extending above the top of the net (Fig. 3.3). The scale was fixed at the center of the net. The lower part of the apparatus rested on the ground, giving it a firm base and which ensured an exact measurement. After fitting the apparatus, it was ensured that there was no variation in the height marked on the board. This was again checked with a standard steel tape.

The performer was supposed to take the jump as if she was going to spike the ball. Therefore, the performer
Fig. 3-3 SPIKE JUMP TEST
took up position three strides away from the jumping spot. As the performer reached at the peak of her jumping height, she would touch the scale board with an opened hand her spiking arm fully extended. The performer was allowed to take three trials consecutively with proper rest intervals. The best of three jumps was recorded in centimetres to calculate the jumping height.

**Vertical Jump Test**

To measure the vertical jumping ability (leg muscle power) of volleyball players the board-and-pipe measuring apparatus was fixed to the upper and lower ends of the net so that the apparatus would remain in a vertical position, the board extending above the upper part of the net. The lower part of the apparatus rested on the ground, giving it a firm base, and which could provide an exact measurement.

The performer took up position along the board, facing any direction that she felt was convenient. The performer jumped upwards by adopting a crouching position and swinging both arms. As the performer reached up, her peak height was marked on the board with a little chalk dust on the subject's hand (Fig.3.4). The height achieved by the performer was thus recorded. The performer was
Fig. 3-4  VERTICAL JUMP TEST
allowed to take three trials continuously with proper intervals. The best height achieved by the performer was recorded in centimetres to calculate the jumping height.

Block Jump Test

To measure the vertical jumping ability (leg muscle power) of volleyball players, the board-and-pipe apparatus was fitted with the upper and lower ends of the net so that the apparatus might remain in a vertical position, extending the scale board above the upper end, of the net. The apparatus was fixed at the center of the net. The lower part of the apparatus rested on the ground, giving it a firm base. It was ensured that while fixing the board into the ground there was no variation in the height marked on the board. This was checked with a standard steel tape. The performer assumed her position in front of the jump measuring apparatus. The stance was similar to the blocking stance. She took her own time for jumping. For the jump, she flexed her legs slightly at the knees, jumped only with the power of legs and stretched both hands on the board, similar to the action of blocking a ball (Fig. 3.5). The tester stood on a small bench in front of the board, with a stick in her
hand to point out the maximum reach of the performer's hand on the scale board. The height achieved by the performer was recorded. The performer was allowed to take three trials consecutively, in her own time. The best height achieved out of three jumps was recorded in centimetres for calculating the jumping height.

**Softball Throw Test**

To measure the power of the arm, a straight restraining line about five feet long was marked. A point was marked in the centre of the line from where the subject was to throw the soft ball as far as possible. The subject was instructed to place her front foot just behind that point marked on the restraining line (Fig. 3.6). The feet were allowed to be placed according to her convenience. The performer was not allowed to use an approach run for the purpose of the throw. She was only allowed to move the rear foot as a part of the followthrough. The performer was allowed to take three trials in succession with her preferred hand. She was allowed to take her own time for the throw. The throw was performed over the shoulder. An assistant stood near the restraining line and the tester pegged numberplates at the point the ball fell. The best throw was measured in metres to the nearest of 20 centimetres.
Fig. 3-6  SOFTBALL THROW TEST
Fig. 3.7  HANDBALL THROW TEST
**Handball Throw Test**

To measure the power of the arm, a restraining line, five feet long, was marked. A point was marked at the centre of the line from where the subject was supposed to throw the handball. The subject was told to place her front foot just behind that point (Fig. 3.7) on the restraining line. The feet were to be kept as far apart as was convenient to the thrower. The throw was made from a standing position, without using an approach run. The subject was allowed to take three trials in succession with her preferred hand. She was allowed to take her own time for the throw. The throw was made over the shoulder. An assistant stood near the restraining line to detect any foul and the tester placed numberplates at the point at which the ball fell. The best of the three throws was recorded with a standard steel tape in terms of the distance to the nearest 10 centimetres.

**Push-Up Test**

This test was used to measure the muscular endurance of the arm and shoulder girdle. The performer adopted a position from a straight arm front leaning rest position, the performer lowered the body until the chest touched the mat (fig. 3.8) and then pushed upward to a straight-arm support. During this test the body was lowered and raised,
Fig. 3.8  PUSH UP TEST

Position - A

Position - B
keeping the body and legs in a straight line. The tester kept the time with a stop-watch. The tester activated the stop watch on the word "start" and stopped the watch after 30 seconds with the command "stop". The subject performed the test continuously for 30 seconds, as per the instructions. The performer was asked to maintain the body in a straight line throughout the test. The score was the number of correct push-ups executed in 30 seconds.

**Sit-Ups Test:**

The subject adopted the position of lying on the back (Fig.3.9), with her knees flexed over a yardstick, while she slid her heels as close to her seat as possible. The yardstick was held tightly under the knees. The subject was then instructed to slide her feet slowly forward. At the point at which the yardstick dropped on the mat, the tester marked the heel line and seat line to indicate how far the feet were kept from the seat while the knee was bent. The subject interlocked her fingers behind her neck and performed situps, alternatively the left elbow was to touch the inside right knee and the right elbow the inside left knee. The subject was helped by another subject who held her ankles and feet during the test to keep the body in a prone position. The test was performed for 30 seconds. The test was started on the command "ready-go" and ended with the word "stop".
Fig. 3-9  SIT-UP TEST
The performer was to continue the test, as fast as possible, according to the given instructions, for a period of 30 seconds. The tester kept the time within one-tenth of a second with a stop-watch. As soon as 30 seconds were over, the tester ordered the performer to stop. The assistant counted the number of sit-ups done during the 30 seconds. The total number of repetitions performed during 30 seconds was the score of the performer.

Up and Down Run Test:

To measure the agility of the performer in running and changing direction, this test was conducted on one half of a volleyball court. The service line, Point A, was the starting point and center line (net line) was Point B. Two volleyballs were placed, one on Point A and the other on Point B. On the command "ready-go", the performer ran from the service line and touched the volleyball lying on Point B and ran back to touch the volleyball lying on Point A (Fig. 3.10). In this way the subject, ran two rounds to finish the test at the starting point in the shortest possible time. The time was taken from the command "go" to second that the torso crossed the service line (the finish line) again. The performer was allowed to take two trials. The better time in the two
Fig. 3-10  UP AND DOWN RUN TEST

Net Line

Attack Line

Service Line

Volley Ball
trials was considered as the score. The time was recorded nearest to one-tenth of a second. A short recovery period of three to five minutes was provided between the two trials. The time taken by each subject to complete the test was considered as her raw score.

**W-M Agility Test**

To measure agility, six volleyballs were placed on six points—A, B, C, D, E and F—as shown in Figure 3.11. The subject took her starting position at Point A. On the command "ready-go", the subject ran to touch the ball at points B, C, D, E and F. Then she turned back to touch the balls in reverse order, i.e. F, E, D, C, B, and finished by crossing Point A. Touching the balls in a proper sequence was compulsory. For any break of this rule, another chance was given to the subject. The time taken from the start to the finish was recorded to serve as the raw score of the subject.

**Court Agility Test**

To measure agility, the volleyball court was marked properly. The test was started from the service line, Point A (Fig. 3.12). On the command "ready-go", the subject ran to touch the centre line, Point B. After that
Fig. 3:11  W-M AGILITY TEST

9m

VOLLEY BALL COURT

Net Line

3m

6m

E

F

D

C

B

A

Subject
Assistant
Tester
Volley Ball/Flag
Fig. 3-12  COURT AGILITY TEST

Tester

Finish Point

Attack Line

Net Line

Attack Line

Subject

Starting Point

Assistant

9 m

3 m

6 m
she touched the attack line, Point C, at a distance of three metres on the same side of the court. Thereafter she touched the attack line, Point D, on the other side of the court, then the center line, point B, and finished the test by crossing the service line at Point E.

In this way the subject completed the distance of nine metres plus three metres, plus six metres, plus three metres plus nine metres (9-3-6-3-9). In case a subject committed a mistake (foul) she was allowed to take another chance. She was to touch the line by leaning forward, with any hand. The time was recorded to the nearest one-tenth of a second. The time taken by the subject between the command 'go' to the end of the test was considered as the raw score of the subject.

Rope Skipping Test

To measure endurance, a rope skipping test was used. The subject was asked to start skipping at the command "ready-go" and to finish jumping at the word "stop". The subject started skipping for one minute continuously and the number of skips completed in one minute was taken as her score.

Six Point Run Test

To measure speed endurance, a volleyball court was marked. The test was conducted on one side of the
Fig. 3-13  SIX POINT RUN TEST

VOLLEY BALL COURT

Finish/Start
Tester\-Assistant
- Subject
- Volleyball
court. Balls were placed on seven points, i.e. A, B, C, D, E, F and "S" (Figure 3.13). The subject took her starting position at Point "S". On command "ready-go", the subject ran to touch each ball one by one. Any missed touch was considered an invalid attempt. Therefore, another chance was given to the subject. The time was recorded to the one-tenth of a second with stop-watch. The time taken by the subject between the start and end of the test was recorded to serve as the raw score of the subject.

W-M Run Test

To measure the endurance of volleyball players, flags were fixed on the attack line on each of three points— at A, B and C (Figure 3.14.A). Point "S" indicated the start and finish marks. On the command "ready-go", the subject moved with speed for a block jump at Point D and ran over to Flag B for a block jump at Point E, then again ran over to Flag C for a block jump at Point F. Thereafter she ran over to Flag B for a block jump at Point E, then ran over to Flag A for a block jump at Point D (Fig. 3.14.B). In this way she completed five rounds and, after the last block jump at Point D, finished her test at Point 'S'. The time was recorded to one-tenth of a second. The time taken to complete the
Fig. 3-14 W-M RUN TEST

A

Net

3m

6m

9m

4½m

4½m

Start

Finish

Subject

Tester

Assistant

Attack Line
Fig. 3.14 B
test from the start to the finish was recorded to serve as the raw score of the subject.

**Lateral Jump Test**

To measure endurance, a five-foot straight line was marked on the ground. The subject stood on one side of the line, keeping the line on her right side. The subject started jumping over the line in a hopping action. On the command "ready-go", the subject started jumping first to the right side of the line, then to the left and so on in a continuous action. The jump landing had to be on both feet. The subject kept her hands anywhere she felt was convenient. The jumping action was continued for one minute and the time was recorded from the command 'go'. The tester counted the total number of jumps made in one minute. The total number of jumps during the minute was recorded as the score of the subject.

**Jumping Endurance Test**

To measure jumping endurance, a one-meter straight line was marked on the center line of a volleyball court. The subject stood at the one end of the line, adopting a blocking stance. On the command "ready-go", the subject started jumping alternatively on the two ends of the line,
continuously. The jump landing was on both feet. The number of jumps completed in one minute were taken as her score.

**Wrist Flexion Test**

To measure the flexion of the wrist of the preferred hand, the subject assumed a standing position and extended her preferred arm in front of the body. The hand was held straight, the fingers in line with the extended forearm. The tester placed the fixed arm of the goniometer on the forearm (on the radial bone) in such a way that the moving point of the goniometer arm was placed on the wrist joint. The subject was asked to flex her wrist gradually by contracting her muscles and allow the moving arm of the goniometer to move along the hand. The subject stopped for a while when her wrist flexion was at the maximum. The recorded degree of the subject's wrist flexion was the score of the subject.

**Wrist Hyperextension Test**

To measure the extension of the wrist of the preferred hand, the subject adopted the standing position and extended her preferred arm in front of her body. The hand was held straight, the fingers in line with the extended forearm. The tester placed the fixed arm of the goniometer on the forearm in such a way that the moving point of the meter was placed on the wrist joint.
The subject was asked to extend the wrist slowly and allow the moving arm of goniometer to move along the hand. The subject stopped for a while after the wrist extension action was achieved to the maximum. The tester recorded the degree of the subject's wrist extension. The recorded degree of the wrist extension was the score of the subject.

**Bend and Reach Test:**

This test was used to measure the ability of the body to bend forward. A 60-centimetre scale was fixed on one side of a bench so that half the scale was above the bench and half below it, in a vertical position. The subject was asked to stand erect and then to bend the trunk forward, with the fingers in front of the scale. The subject slowly bent down and tried to reach as far as possible. The fingertips of both hands moved parallel to and together, down the scale (Figure 3.15). She was not allowed to flex the knees. The test was conducted after warming up. The score was taken when the fingers rested completely on the nearest centimetre indicated on the scale by the middle finger.

**Age**

To know the chronological age of the subjects (who were between 17 and 22-years-old) the age was recorded from the school records in months on the date of the
Fig. 3.15  BEND AND REACH TEST
administration of the tests. The number of months derived was the raw score of the subject.

Height:

To measure the standing height of the subject, a scale in centimetres was drawn on a plain cemented wall, using Freeman's standard measuring tape. The subject was asked to stand with her back to the wall, in an erect position. The tester stood facing the wall in front of the subject with a wooden scale in her hand. The scale was put on the vertex of the subject so that the end of the scale touched the wall. The height was recorded to the nearest centimetre. The subject's net height in centimetres was her raw score.

Hand Extended Height

To measure the extended hand height of the subject, a spike jump scale board was marked with a steel tape in centimetres and it was tied with the net. The subject stood close to the net, facing it and raising her preferred hand while keeping her feet flat on the ground. The subject extended her arm fully upward for a maximum reach. The tester stood close to the subject on a small bench so that she was able to see the point just parallel to the top of the middle finger. The subject was directed not to
raise her heels and not to bend her knees or arm. The height was recorded to the nearest centimetre. The height achieved by raising the preferred hand was the score of the subject.

Weight

The weight was measured with a portable weighing machine with an accuracy of 0.5 kg. The subject was asked to wear a sports kit. The subject stood on the weighing machine properly. The weight was also recorded in volleyball playing kit, to the nearest kilogram. The body weight of the subject was the score of the subject.

Arm Length

"Arm length", for the purposes of this study, has been defined as the length of the upper limb humerus from the coracoid process of the Scapula as a bony landmark to the styloid process of the radius in pronated position. The measurement of the subject's arm length was taken in centimetres.

Leg Length

"Leg length" has been defined as the distance between the interior superior iliac spine to the lateral malleolus along the outer border. The measurement of
The subject was taken in centimetres.

**The Second Phase of the Study and Collection of Data**

Having collected data on the 27 variables enumerated above, a new motor fitness test was developed.

In the second phase of the study, fresh data on 300 female volleyball players was collected. During the administration of newly developed motor fitness test, seven variables for the collection of data were identified and the same procedure was followed as mentioned in the first phase of data collection.

**Administration of the Selected Motor Fitness Test for the Development of Norms**

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<td>2</td>
<td>Spike jump</td>
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<td>3</td>
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</tr>
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In the normative survey of the motor fitness of 17 to 22-year-old female volleyball players, the subjects
were taken from all the leading colleges of three universities of Punjab (Punjabi University, Patiala; Guru Nanak Dev University, Amritsar; and Panjab University, Chandigarh). For the purposes of this study, no college was included which was not affiliated to these universities.

STATISTICAL PROCEDURE

The purpose of the study was to construct a motor fitness test and then develop norms for females in the age group 17-22.

The factor analysis technique was used as a tool to select test items out of 27 variables found to be best suited to measure the motor fitness of volleyball-playing females.

The correlation matrix of the intercorrelation between the 27 variables was obtained by applying the Pearson Product Moment Formula. The data was then subjected to factor analysis, utilizing the principal axis form of preliminary rotation, as suggested by H.H. Harman (1960), to obtain unrotated and rotated factors. The rotated matrix was selected for interpretation, as recommended by the Comrey (1973). For rotated factors the Kaiser's Varimax Criterion (1958) was used. All statistical analyses were done on an Edlin Computer at Panjab University’s Chandigarh Computer Centre.
DEVELOPMENT OF TEST BATTERY AND NORMS

Utilizing the factor loadings of variables on each extracted factor in the rotated factor solution as the criterion coefficient, the items for a test battery were selected. In all seven test items, one from each factor, except from factor II, VII and XI, were selected to represent the test battery.

The Scheffe Test was applied to six age groups on each test item to ascertain the mean difference between the scores of each age group. The Hull Scale and the T-Scale were used for the development of norms.