In this Chapter the procedure adopted for the selection of subjects, selection of physical fitness test battery, administration of testing programme, reliability of data, collection of data and the statistical techniques used for analysis of data have been described.

Selection of Subjects

Four thousand students from forty different colleges affiliated to Panjab University, Chandigarh, India, were randomly selected as subjects for the purpose of this study. The age of the subjects ranged between 17 years and 22 years, and these subjects belonged to Pre-University and Three-Years Degree Course classes, i.e. B.A. Parts I, II and III. Out of these subjects 2774 belong to rural areas and 1226 to urban areas and their age-wise break-up was as follows:

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>222</td>
</tr>
<tr>
<td>18</td>
<td>465</td>
</tr>
<tr>
<td>19</td>
<td>819</td>
</tr>
<tr>
<td>20</td>
<td>694</td>
</tr>
<tr>
<td>21</td>
<td>856</td>
</tr>
<tr>
<td>22</td>
<td>944</td>
</tr>
</tbody>
</table>
For selecting these subjects and to make available the services of the lecturers in physical education as well as to make use of the facilities, the principals of all the colleges affiliated to Panjab University, Chandigarh were requested through a common circular. They were also requested to spare the selected students for undertaking the physical fitness tests. All the principals readily agreed to this request and in fact encouraged the investigator through their wholehearted cooperation.

Selection of Physical Fitness Test Battery

A large number of physical fitness test batteries are available which have been critically reviewed in Chapter II. The investigator adopted Fleishman's Physical Fitness Test battery for the present study as this battery includes test items which measure almost all the components of physical fitness. The test items included in this battery were easy to be administered and did not require sophisticated type of instruments or equipment. All the facilities and equipment required for the conduct of this test battery were available in the colleges. Moreover, the test items involved natural movements devoid of skillful experience on the part of the subject.

Fleishman's Test battery has been used to ascertain the fitness levels of youth at various levels and in different countries, and the investigator is of the view that this test battery's utility would be more as compared to other test batteries.
The test battery selected for this project included the following test items:

1) Extent Flexibility
2) Dynamic Flexibility
3) Shuttle Run
4) Cricket Ball Throw
5) Pull-ups
6) Leg-lifts
7) Cable Jump
8) Standing Broad Jump
9) Dodge Run
10) 600 Metre Run/Walk

Administration of Testing Programme

Since the study was conducted on four thousand subjects studying in various colleges located almost all over the state of Punjab, it was not possible for the investigator to collect the data individually. Therefore the help of many other people was sought for the collection of data by conducting different items of the test battery. For this purpose the lecturers in physical education were requested to take few volunteers from their respective colleges who would help in the conduct of these tests. Investigator explained the tests and testing procedures to the helpers and all the items were then demonstrated to them. Later on the helpers were given sufficient practice to conduct
the tests. Wherever mistakes were committed the helpers were corrected. Three to five repetitions of each test enabled the helpers to conduct the tests correctly. When found fit the team of helpers under the charge of the lecturer in physical education was asked to conduct the tests on the students of that college. Same procedure was adopted for all the colleges.

All the tests were conducted either in the morning hours or in the evening hours each day 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 performances of different test items (the timings were 6.30 a.m. to 8.30 a.m. and 4.30 p.m. to 6.30 p.m.). For all the tests the subjects were required to be in playing kits, i.e. vests and shorts.

Reliability of Data

Prior to the actual collection of data the reliability of data was ensured by establishing the instrument reliability, tester competency and reliability of the test and the subject reliability.

Instrument Reliability

The stop-watches and steel tapes used in this study were all calibrated and supplied by the leading firms and their reliability was ensured by the manufacturers. Thus these instruments were considered reliable for the purpose of this study.
Tester Competency and Reliability of Tests

The tester competency was evaluated together with reliability of the tests. To determine the reliability of the tests the performances of twenty subjects, selected at random on the different test items were recorded twice under the identical conditions and the Pearson's Product Moment correlation were computed between the two performance scores on each item for each subject and the reliability coefficients are presented in Table 1.

Table 1. Reliability Coefficients of Test-Retest Scores

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item</th>
<th>Coefficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Extent Flexibility</td>
<td>.92*</td>
</tr>
<tr>
<td>2.</td>
<td>Dynamic Flexibility</td>
<td>.90*</td>
</tr>
<tr>
<td>3.</td>
<td>Shuttle Run</td>
<td>.87*</td>
</tr>
<tr>
<td>4.</td>
<td>Cricketball Throw</td>
<td>.88*</td>
</tr>
<tr>
<td>5.</td>
<td>Pull-ups</td>
<td>.95*</td>
</tr>
<tr>
<td>6.</td>
<td>Leg Lifts</td>
<td>.90*</td>
</tr>
<tr>
<td>7.</td>
<td>Cable Jump</td>
<td>.83*</td>
</tr>
<tr>
<td>8.</td>
<td>Standing Broad Jump</td>
<td>.93*</td>
</tr>
<tr>
<td>9.</td>
<td>Dodge Run</td>
<td>.85*</td>
</tr>
<tr>
<td>10.</td>
<td>600 Metres Run/Walk</td>
<td>.85*</td>
</tr>
</tbody>
</table>

* Significant at .01 level.
From Table 1 it is obvious that the data pertaining to different test items was quite reliable and further establishes that the tester reliability was significantly high, which ensured the competency of the investigator to administer the tests.

Subject Reliability

The above test-retest coefficients of correlation method also established that the subject reliability was significant at .01 level of confidence, as the same subjects were used under similar conditions by the same testers and no motivational techniques were used or training given.

Administration of Tests

The data on the different items of the Fleishman's Physical Fitness Test Battery were collected by administering each of the items as per standardized procedure described below:

**Extent Flexibility Test**

**Purpose**

This test was used to measure how far the subject could rotate his spine.

**Equipment**

Cemented wall, chalk, and lime powder.
Testing Procedure

A measuring scale, 75 centimetre long, was drawn on a wall and was marked off in one centimetre intervals from 0 to 75 centimetre. The scale was wide enough to suit the students of different heights. Another line, perpendicular to the wall and in line with 30 centimetre marked on the scale was drawn on the floor as given in Figure 1.

The subject to be tested was asked to stand with his left side towards the wall, his toes touching this line, feet together and perpendicular to the line marked on the floor. The subject stood at an arms length away from the wall so that he could just touch the wall with his left fist when his arm was held horizontal from the shoulder.

The subject was then asked to extend his right arm straight at shoulder height, keeping his both feet together and at the line. He was asked to keep his palm down, fingers together and extended. He was then asked to twist clockwise (around his back), as far as possible so that he could touch the scale marked on the wall with his right hand. During this movement, the tester helped the student to keep his feet in place by keeping his (tester's) feet along side the student's right foot.

Each student was given one trial to get the feel of the test. If he committed any errors these were corrected by the tester. His second try was counted and recorded as his score.

Scoring

The farthest point reached (in centimetres) on the scale and held for at least two seconds was the score of the subject.

NOTE: For left-handers the alternate scale was used and all directions of movement were reversed.
Fig. 1 EXTENT FLEXIBILITY TEST
Dynamic Flexibility Test

Purpose

This test was employed to measure the speed with which the subject could flex, extend, and rotate his spine.

Equipment

A cemented wall, chalk and stop-watch.

Testing Procedure

The subject was asked to stand with his back towards the wall and at a distance from the wall from where he could bend over without hitting the wall with his buttocks. He was asked to stand straight with his feet shoulder width a part. An "X" was marked on the wall, directly behind the middle of the subject's back and at his shoulder height. Another "X" was marked on the floor between the subject's feet as given in Figure 2.

On the command "go" the subject bent forward and touched the "X" marked between his feet with both hands and then straightened up, twisted to the left side and touched the "X" marked on the wall with both hands. This was counted as one cycle.

In the next cycle, the subject repeated the same procedure except that he twisted to his right side and continued to alternate the side to which he twisted in each successive cycle.
Fig. 2 DYNAMIC FLEXIBILITY TEST
The subject was instructed not to bend his knees while bending forward to touch the mark "X" on the floor.

The tester demonstrated three such cycles emphasising on speed. Then the subject was asked to perform the test as fast as he could.

**Scoring**

The number of cycles completed in 20 seconds was recorded as the score of the subject.

**Shuttle Run**

**Purpose**

This is an agility test and measures the speed with which the subject can abruptly and completely change his direction of body movement.

**Equipment**

Steel tape, stop-watch and lime powder.

**Testing Procedure**

Two parallel lines, 20 metres apart were marked on the track. One observer was stationed at the starting line and one at the finish line. The observer at the finish line had a stop watch to record the subject's time.
The subject was asked to stand behind the starting line with one toe on the line. On the command "go" he ran to the opposite line, 20 metres away touched the ground on the far side of it with either foot, returned to the starting line and repeated the process. He was told to cover the one way distance five times for a total of 100 metres as given in Figure 3.

The observers at each end noted that the student touched over the lines and did not get confused over the repetition of the laps. Every time he completed a lap he was told about the remaining laps. On the last lap he was told to run through the finish line to enable him to clock best time. Time-keeper started the watch when the command "go" was given to the subject and stopped it when the subject crossed the finish line after completing the fifth lap.

**Scoring**

The time to cover the five laps (5 x 20 = 100 metres) recorded to the nearest tenth of a second was the score of the subject.

**Cricket Ball Throw**

**Purpose**

The test was chosen to measure the explosive power of arms and shoulder.
Fig. 3  SHUTTLE RUN

START

20m

FINISH
Equipment

About 100 metres long open field, measuring tape, lime powder, 4 cricketballs.

Testing Procedure

This was typically an outdoor test requiring an open field approximately 100 metres long. A restraining line was marked on the ground and the subject was required to throw the cricketball as far as he could from standing position. He was not allowed even to move his feet. He was asked to take comfortable position behind the restraining line. He was not allowed to shift the position of his feet during the throw, as shown in Figure 4.

The subject was given three chances and the best among them was his score. If he lifted his either foot while throwing, the throw was not measured, but was counted as one of the three throws allowed to him. All the throws were made over head.

Scoring

Best throw among the three allowed to the subject was his score. The distance measured was recorded in metres.

Pull-ups

Purpose

This test was employed to measure strength endurance of biceps, triceps and other arm muscles.
Fig. 4. CRICKET BALL THROW (STANDING)
Equipment

A horizontal metal or wooden bar approximately four centimetres in diameter and 2.40 metres high so that the student can hang off the floor with his arms and legs fully extended.

Testing Procedure

The subject was asked to jump up and grip the bar with his palm facing his body (the underhand grip). From the hanging position at the signal "start" he pulled himself up by his arms until he could place his own chin over the bar. He then lowered his body to a fully extended position, as given in Figure 5. It was counted as one pull up.

The student was told to do as many pull-ups as possible and not to stop until he was no longer able to pull up. He was cautioned against kicking and twisting, or stopping at any one position for more than two seconds. Excessive swaying was also not allowed. When not complying with these instructions he was told to stop.

The tester counted the number of pull-ups aloud to the student each time he lowered himself fully.

Scoring

Number of times the student pulled himself up correctly was his score.
Fig. 5  PULL-UPS
Leg-Lifts

Purpose

This test was used to measure the strength endurance of abdominal muscles.

Equipment

A mat and a stop watch.

Testing Procedure

The subject was asked to lie flat on his back with his hands clasped behind his neck. Another student was asked to hold the subject's elbow to the ground, as given in Figure 6. The subject was asked to raise his legs, to a vertical position while keeping them straight. Then he was required to bring the legs down to the ground. He was told to do these leg-lifts as fast as he could.

The subject was not allowed the rocking of the body. The head, back and base of the spine were kept on the ground and the exercise was required to be stiff one-two motion. Elbows were kept on the ground throughout the process of the test.

The full cycle was demonstrated to the student. He was then asked to have two trials to get the feeling of the exercise. Corrections were made wherever required. The emphasis was put on the speed and continuity of the test without slowing down.
This process was to be carried on for 30 seconds. One tester was counting the leg-lifts aloud and the other tester was keeping time. The time keeper at the end of 30 seconds would say "stop".

**Scoring**

Number of times the subject raised his legs to vertical position in 30 seconds was his score.

**Cable Jump Test**

**Purpose**

The test was applied to measure the gross body coordination.

**Equipment**

A 60 centimetre long rope.

**Testing Procedure**

The subject was asked to hold the rope in front of him with one hand grasping each end as given in Figure 7. About 10 centimetre of rope were covered by each hand, leaving about 40 centimetre between his hands. The subject was advised not to stretch out the rope, but instead let it hang loose. Holding the rope in this way, he was told to jump over the rope without loosening his grip from it.
Fig. 7 CABLE JUMP TEST
Since the objective of this test item was to measure a co-ordinated performance, the subject was required to jump over the rope through his arms, land on the feet and maintain balance while jumping. Then only the jump was considered correct.

Scoring

Number of correct jumps out of the five attempts was the score of the subject.

Standing Broad Jump

Purpose

This test was employed to measure the explosive power of the legs.

Equipment

A soft jumping pit, lime powder, measuring steel tape and nails.

Testing Procedure

A take-off line was marked one metre away from the jumping pit. The subject was asked to stand behind the take-off line, keeping his feet apart. He was asked to jump as far forward as possible. Before take-off he was permitted to bend his knees, using his arms, and extend his knee simultaneously to enable him to jump maximum. No restriction was put on the movements of arms. The action is shown in Figure 8.
Fig 8  STANDING BROAD JUMP
The subject was told that the jump would not be counted if he fell back after landing. Three chances were given to the subject.

Scoring

Measurements were taken from the take-off line to the nearest break where he landed. The best jump out of the three jumps attempted, recorded in metres and centimetres was his score.

Dodge Run

Purpose

This test was applied to measure the ability to change direction laterally while moving the body forward.

Equipment

Steel tape, lime powder, six chairs, stop watch.

Testing Procedure

A starting line 2 metres in length was marked on the ground. Six chairs were arranged in such a manner that the first two chairs were at 3 metre distance from starting line and 2 metre apart from each other. In the same fashion other two pairs of chairs were arranged but the distances from previous chairs and between each other were 2 metre on either side.
Only one subject was tested at a time. On the command "go" the subject was asked to run around the chairs in the path shown on the Figure 9. Upon arriving at chair number six, the subject was instructed not to go back to starting line, but go directly around chair number one again and repeat the path around all the chairs. When he arrived at chair number six the second time he was asked to go directly to the starting line. The whole procedure was demonstrated by the tester to the subjects in order to give him clear mental picture.

**Scoring**

The subject's score was the total time taken to complete two trips and return to the starting line.

**600 Metres Run/Walk**

**Purpose**

This test was administered to measure the cardiovascular endurance.

**Equipment**

Stop watches, measuring steel tape, lime-powder, clapper or whistle.

**Testing Procedure**

This test was conducted outdoors. College track, football field, hockey field or any other even space, at least a square area 50 metre on each side was used for the test. With improvised
Fig. 9  DODGE RUN
tracks care was taken to keep the students from straying outside the track so that they do not run too short or too long a course.

Students were asked to run in the groups from 3 to 5 each depending upon the number of stop watches available. One stop watch was used to time one subject. The subjects were told that the object was to cover the distance of 600 metres in the shortest possible time. They were allowed to walk when tired, but were advised to try their best to complete the distance as quickly as possible.

**Scoring**

Total time taken to cover the distance, recorded in minutes and to the nearest seconds was the score of the subject.

**Statistical Techniques for Analysis of Data**

The scores for each test items were gathered for all the subjects separately and then pooled age-wise for preparing the norms. The age-wise norms for this study were computed in terms of Percentile Scale, Hull-Scale and T-Scale separately for each item as per the procedures recommended by Clarke and Clarke (1970).

One way analysis of variance ("f"-ratio) was used to make age-wise comparisons of subjects on the different items of physical fitness test battery and where "f"-ratio was found significant Scheffe's Post Hoc Test was applied to study the
significance of differences between the paired means. The students belonging to rural and urban areas were compared on different items of physical fitness by applying 't'-test.

To study the significance of differences the level of confidence chosen was .05.