Chapter IV

METHODOLOGY AND TOOLS OF DATA COLLECTION
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In the present investigation an attempt has been made to study the psycho-physical abilities of national gymnasts in relation to their performance level. The types of research, its design, sample and sampling, selection criteria and the tools used to measure psycho-physical ability variables are discussed in this chapter.

Type of Research

There are various methods of research such as social surveys, case study, experimental method, statistical method, inter-disciplinary approach etc. Statistical method is comparatively of a more recent origin and is being widely used in psychology and social sciences. In statistical research there are various methods of collecting and analysing data, like description of facts, objective evaluation, future estimation, comparative studies, establishing degree of relationship etc. In the present study an attempt has been made to establish the relationship of psycho-physical abilities with that of competitive performance in gymnastics to find-out the contribution of various psycho-physical abilities (i.e. personality factors, competition anxiety, concentration ability, strength and flexibility, age, height and weight) to competition performance in national gymnastics championships. Thus the study is a correlational study. The investigation was also aimed to study the differences in means of various variables among high, mediocre
and low performance groups of gymnasts to find out the differences among three groups so it is practically a comparative study too.

**Selection of Variables**

The psycho-physical variables which are considered as the basis of performance as gleaned from a review of professional literature and a feasibility analysis as to what are the variables that could be taken up for investigation in keeping with availability of equipment, acceptability to the subjects and the legitimate time that could be devoted for tests as well to keep the entire study unitary and integrated, the following variables were selected and they were classified into two categories i.e. dependent and independent variables.

Dependent Variables

The performance level, i.e. results obtained in national level gymnastics competition, was selected as dependent variables for the present study.

Independent Variables

The independent variables selected were classified into three categories i.e. psychological variables and physical ability variables, age, height and weight. The variables under each category were as follows:
A) Psychological Variables:

1. Personality Factors (16 PF)
2. Sport Competition Anxiety
3. Concentration Ability

B) Physical Ability Variables:

1. Strength Variables:
   a) Strength of arms and shoulders
      i) Pull-ups on Horizontal bar
      ii) Dips on Parallel Bars.
   b) Explosive leg strength
      i) Vertical Jump
   c) Right hand grip strength
   d) Left hand grip strength.

2. Flexibility:
   a) Trunk flexibility
      i) Trunk Flexion
      ii) Trunk Extension (Bridge)
   b) Shoulder Flexibility
      i) Stick Test
   c) Age, Height and Weight

Design of the Study

The present study was designed to obtain pertinent and precise information concerning personality characteristics (16 PF), sport compe-
tition anxiety level, concentration ability, strength ability (strength of arms, legs and hand grip), flexibility (flexibility of trunk and shoulders) and competitive performance level of the gymnasts, participating in senior national championships. As the present investigation is correlational research so as attempt has been made to study the relationship of performance level with that of personality factors (16 PF), sports competition anxiety, concentration ability, strength ability (strength of arms, legs and grip) and flexibility (flexibility of trunk and shoulders) age, height and weight by using zero order product moment correlation in case of high performance group only. Regression equations were prepared in case of each variable to predict performance. One way analysis of variance was also employed to compute differences in means in various variables among the three performance groups i.e. high, mediocre and low performance groups. When the results of one way analysis of variance indicated significant differences the Scheffe's Post-hoc Test was applied to assess the differences between means. For testing of the obtained F-ratio the level of significance was set at 0.05 level of significance.

Sample and Sampling

The sample of the present study consisted of national level male gymnasts of India. The study was conducted on 108 gymnasts who participated in Senior National Gymnastics Championships in January 1989 at Kottayam (Kerala) and in October 1989 at Udaipur (Rajasthan). This sample consisted of the selected gymnasts from various states.
For participating in national championship the gymnasts have to participate in district level. A selected district team further participates in state level competitions where teams from all districts of a state compete. From this competition a state level team, consisting of 6 persons is selected which is further sent for national championships (i.e. Inter-state competition). Thus all the gymnasts considered for the present study represented their respective states in national competitions.

About 90 per cent of the total participants of these national championships were taken as subjects for the present study. The remaining 10 per cent could not be studied as they did not extend cooperation to participate in various tests of psycho-physical abilities.

Sampling:

The total sample of 108 male gymnasts was divided into 3 groups i.e. high, mediocre and low performance groups. The data were arranged in ascending order on the basis of their performance level (i.e. scores obtained in competition 1 a). The subject scoring highest marks out of a maximum of 60.00 marks was placed on the top followed by the second, third, forth and so on. The three groups i.e. high performance, mediocre and low performance groups were made as per the normal distribution curve. To distribute the subjects in three groups the mean and standard deviation of the performance level (i.e. scores obtained in competition 1 a) were calculated. The middle
part i.e. mean ± upto 1 standard deviation was taken as mediocre group. The left tale scores i.e. mean minus one (-1) standard deviation was considered as low performance group. The right tale side i.e. scores above the mean + one standard (+1) deviation was considered as high performance group. By applying this method 20 subjects fell in the left side tale (i.e. low performance group and other 20 subjects fell in right side tale (i.e. high performance group). The rest of the 108 subjects came in the middle group hence they were designed as mediocre group.

**Tools of Data Collection**

In the present investigation following standardized tests and tools were used for the measurement of different independent and dependent variables:

**Measurement of Personality**

<table>
<thead>
<tr>
<th>Tool</th>
<th>Author.</th>
<th>Nature</th>
<th>Group/Individual</th>
<th>Age Range</th>
<th>Duration</th>
<th>Availability</th>
</tr>
</thead>
</table>
Structure:

It is an objectively-scorable test devised by basic research in psychology to give the most complete coverage of personality possible in brief time. Coverage of personality is ensured by the sixteen functionally independent and psychologically meaningful dimensions isolated by over twenty years of factor analytical research on normal and clinical groups (Manual of 16 Personality Factor).

In addition to the sixteen primary factors the test is also used as a measure of eight secondary dimensions which are broader traits scorable from the component primary factors.

The questions are arranged in a roughly cyclic order determined by a plan to give maximum convenience in scoring by stencil and to ensure variety and interest for the examinee. The scale has 187 items. The distribution of these items for 16 Personality Factors is as under:
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Factors</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A - Reserved Vs Out-going</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>B - Dull Vs Bright</td>
<td>13</td>
</tr>
<tr>
<td>3.</td>
<td>C - Affected by feeling Vs Emotionally stable.</td>
<td>13</td>
</tr>
<tr>
<td>4.</td>
<td>E - Humble Vs Assertive</td>
<td>13</td>
</tr>
<tr>
<td>5.</td>
<td>F - Sober Vs Happy go lucky</td>
<td>13</td>
</tr>
<tr>
<td>6.</td>
<td>G - Expedient Vs Conscientious</td>
<td>10</td>
</tr>
<tr>
<td>7.</td>
<td>H - Shy Vs Ventursome</td>
<td>13</td>
</tr>
<tr>
<td>8.</td>
<td>I - Tough-minded Vs Tender-minded</td>
<td>10</td>
</tr>
<tr>
<td>9.</td>
<td>L - Trusting Vs Suspicious</td>
<td>10</td>
</tr>
<tr>
<td>10.</td>
<td>M - Practical Vs Imaginative</td>
<td>13</td>
</tr>
<tr>
<td>11.</td>
<td>N - Forth right Vs Shrewdness</td>
<td>10</td>
</tr>
<tr>
<td>12.</td>
<td>O - Self assured Vs Apprehensive</td>
<td>13</td>
</tr>
<tr>
<td>13.</td>
<td>Q_1 - Conservative Vs Experimenting</td>
<td>10</td>
</tr>
<tr>
<td>14.</td>
<td>Q_2 - Group dependent Vs Self-sufficient</td>
<td>10</td>
</tr>
<tr>
<td>15.</td>
<td>Q_3 - Undisciplined Vs Controlled</td>
<td>10</td>
</tr>
<tr>
<td>16.</td>
<td>Q_4 - Relaxed Vs Tense</td>
<td>13</td>
</tr>
</tbody>
</table>

Description of the 16 PF

At present, the 16 PF has the six parallel forms, these are A, B, C, D, E, and F, each measuring the same sixteen personality dimensions.
It is a multi-dimensional set of sixteen questionnaire scale, arranged in omnibus form. These sixteen dimensions or scales are essentially independent, that is to say, the correlation between one and another is usually quite small. Therefore, having a certain position on one does not prevent the persons having any position whatever on (any) other. Thus, each of the sixteen scales brings an entirely new piece of information about the person, a condition not found in many alleged multi-dimensional scales.

The two forms, A and B, are provided to make possible the use of either one, alone, where circumstances prohibit the use of both together, as well as to give equivalent forms when a retesting is desired with only the interval of a few days between. The A and B forms are certainly the most appropriate forms for literate adults. Forms C, D E and F of the 16 PF are specially designed for adults of limited education and literacy. Form A was used for the present study.

Three alternative answers are provided for each of the questions, since the two alternative "forced-choice" situation, for bidding any "middly of the road" compromise, tends to force a distorted distribution and may produce aversion to the test on the part of the examinee. This is particularly the case with the person of average or higher intelligence for whom forms A and B are designed.
Reliability

The constituencies of the 16 PF scales have been given in all possible ways, namely as (i) Reliabilities (dependability, i.e. short-term test re-test correlation and stability, i.e. re-test after a longer interval) as (ii) Homogenetics (internal) and as (iii) Equivalence coefficients (between forms). Test re-test reliabilities, calculated as dependability coefficients of form A and B are .61 to .83 and .54 to .89 respectively. The dependability coefficients have been given in Manual for the 16 PF (1972), obtained on 243 Canadian subjects by test re-test method with 2 to 7 days interval, as .86, .79, .82, .83, .90, .81, .92, .90, .78, .75, .77, .83, .82, .85, .80, .72, for factor A, B, C, D, E, F, G, H, I, L, M, N, O, Q₁, Q₂, Q₃, and Q₄ respectively.

The investigator has also established the reliability of 16 Personality Factor on 20 gymnasts randomly selected from the sample after gap of 4 to 5 days by test re-test method. The reliability coefficients obtained for each factor are presented in Table I.
### TABLE 1

RELIABILITY COEFFICIENTS OF TEST - RETEST SCORES OF 16 PERSONALITY FACTOR

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Factor</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A</td>
<td>.92**</td>
</tr>
<tr>
<td>2.</td>
<td>B</td>
<td>.87**</td>
</tr>
<tr>
<td>3.</td>
<td>C</td>
<td>.85**</td>
</tr>
<tr>
<td>4.</td>
<td>E</td>
<td>.89**</td>
</tr>
<tr>
<td>5.</td>
<td>F</td>
<td>.90**</td>
</tr>
<tr>
<td>6.</td>
<td>G</td>
<td>.82**</td>
</tr>
<tr>
<td>7.</td>
<td>H</td>
<td>.90**</td>
</tr>
<tr>
<td>8.</td>
<td>I</td>
<td>.79**</td>
</tr>
<tr>
<td>9.</td>
<td>L</td>
<td>.88**</td>
</tr>
<tr>
<td>10.</td>
<td>M</td>
<td>.81**</td>
</tr>
<tr>
<td>11.</td>
<td>N</td>
<td>.89**</td>
</tr>
<tr>
<td>12.</td>
<td>O</td>
<td>.91**</td>
</tr>
<tr>
<td>13.</td>
<td>Q₁</td>
<td>.81**</td>
</tr>
<tr>
<td>14.</td>
<td>Q₂</td>
<td>.86**</td>
</tr>
<tr>
<td>15.</td>
<td>Q₃</td>
<td>.86**</td>
</tr>
<tr>
<td>16.</td>
<td>Q₄</td>
<td>.87**</td>
</tr>
</tbody>
</table>

N = 20

r at .01 (18 df) = .561.

**Significant at .01 level.
Validities:

The items in this final form is the survivors from several thousands of items originally tried, and constitute only those which continue to have significant validity against the factors after three successive factor (Cattell, 1970) analyses on different samples. These analyses have both verified the existence and natural structure of the sixteen factors, and cross validated the test items in their correlation with the factors on different adult population samples.

The validity of the test itself is meant to be a concept (or construct) validity. That is to say, the test questions (or items), as stated above, are chosen as being good measures of the personality factors, as these factors are represented in research analysis. The mean correlation of all single items with the factors they represent is about .37 and, the mean correlation of each group of items with the factor it represents, i.e. the concept validity turns out to be about .85, which is an acceptable performance for so brief a test.

Administration of the Test

Simple and clear instructions are printed for the examinee on the cover page of the test booklet. After making the subjects comfortably sit in a classroom and handing over test booklet and answer sheet and forming rapport with the examinee, they were asked to give their frank opinion and answer without spending much time for answering each question. The subjects were ensured that their
answers would have no effect on their competitive performance level. They were asked to fill their name, age and date of conducting test on the top of the answer sheet. The subjects were asked to read the instructions printed on the cover page of the test booklet. The investigator also read the instructions in loud voice along with the subjects. After reading the instructions the subjects were instructed to turn the page and begin. The test were scored by two card board stencil keys. Before using the scoring keys each answer sheet was checked properly to make sure that there were no odd, unscorable responses to an item. The raw scores for each factor, calculated by the stencil keys, were recorded at the place provided against each factor on the answer sheet. Raw scores were converted into "Sten Scores" with the help of Tabular supplement no. 1, Norms for 16 PF (1977).

Measurement of Sports Competition Anxiety

<table>
<thead>
<tr>
<th>Test</th>
<th>Sport Competition Anxiety Test (SCAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author</td>
<td>Rainer Martens</td>
</tr>
<tr>
<td></td>
<td>Indian Adaptation</td>
</tr>
<tr>
<td></td>
<td>Agyajit Singh</td>
</tr>
<tr>
<td>Nature</td>
<td>Verbal</td>
</tr>
<tr>
<td>Group/Individual</td>
<td>Both</td>
</tr>
<tr>
<td>Age Range</td>
<td>15 years and older.</td>
</tr>
<tr>
<td>Duration</td>
<td>About 5 minutes</td>
</tr>
<tr>
<td>Availability</td>
<td>Human Kinetic Publishers, Box 5076</td>
</tr>
<tr>
<td></td>
<td>Champign, Illinois 618820.</td>
</tr>
</tbody>
</table>
Structure:

Sport competition anxiety test (SCAT) is an A-trait scale designed for measuring a pre-disposition to respond with ranging levels of A-state in competition sports situations. The test was developed by Martens (1977) to assess trait - anxiety in competition situations. SCAT was constructed primarily for research purposes to identify subjects varying in competitive A-trait. SCAT has both a child form (SCAT - C) for children ranging in age from 10 through 14 years and an adult form (SCAT - A) for sportsmen of 15 years of age and older. The norms are available for both males and females. Adult form of SCAT was used for the present study.

The test is a self-administering. The inventory has no time limits, but normally less than 5 minutes are required for its completion. The test consists of 15 statements related to competitive situations. Each item has a three-point scale. For each item one of the three responses are possible: (a) Hardly ever, (b) Sometimes, and (c) Often. Out of 15 statements five are spurious items. These five spurious items are not scored.

Scoring:

There can be three alternative of answering each statement i.e. 1) Hardly ever, 2) Some times and, 3) Often. Out of 15 statements only 10 items are scored. The five spurious items which are not scored are items 1, 4, 7, 10 and 13. These items have been included in
the inventory to direct some attention to other elements of competition. Items 2, 3, 5, 8, 9, 12, 14 and 15 are worded so that they are scored according to the following key:

One Mark for hardly ever
Two Marks for some-times
Three Marks for often.

Item 6 and 11 are scored according to the following key:

One Mark for often
Two Marks for sometimes
Three Marks for hardly ever.

The range of scores of SCAT is from 10 (low competitive A-trait) to 30 (high competitive A-trait). The inventory is also accompanied by the norms.

Reliability of Test

The test has quite high reliability and validity. The test re-test reliability coefficients as reported by Martens (1977) is .77. The reliability coefficient of the adapted form of the test found by Singh (1987) by split half method and test re-test method were .790 and .705 respectively. The present investigator also established the reliability by test re-test method after 4-5 days gap on 20 subjects randomly selected from the entire sample. The test re-test dependability coefficient found by the investigator was .823.
Validity of the Test

The content validity or face validity of SCAT is a matter of judgement about the representativeness of the items in SCAT for measuring competitive A-trait. The concurrent validity of the test has been determined by the author by correlating other personality constructs with SCAT. Concurrent validity was examined by correlating scores on SCAT-C with scores on children Manifest Anxiety Scale Short Form (Levy, 1958). The concurrent validity for the adult scale was examined by correlating SCAT-A with Trait Anxiety Inventory for Adults (Spielberger et al. 1970) using sample of university under graduates. The correlation coefficient obtained was .44. Correlation coefficients of .28 to .46 between general A-trait scales and a spot-specific A-trait scale is a clear support for the concurrent validity of SCAT-A (Martens 1977).

Administration of the Test

The test is self administering. The instructions to complete the test are printed on the test form. After making the subjects comfortably sit in a group of 10 to 12 gymnasts, they were instructed to give their frank opinion and true answer. They were given full assurance that the data would be only used for research purpose and would in no case be considered for the evaluation of their performance. The subjects were asked to read the instructions along with the investigator. Scoring of the test was done as per the procedure described above.
Measurement of Concentration Ability

Tool : $d^2$ test
Author : Brickenkamp
Nature : Verbal
Group/Individual : Both
Duration : About two minutes

Structure:

In the present study "$d^2$ test" was used to measure concentration ability of National Level Gymnasts. Concentration is to arrive at a maximum degree of stimulation i.e. mobilization of one's all physical and physic measures during a determined time. In other words fitting one's attention at one point for some duration can be called concentration.

There are several psychological tests which are utilized for assessment of concentration. However, the test used for the present study, i.e. the "$d^2$ test" was found to be more suitable because of its easy administration and wide recognisation in the field of sports. This test was originally developed by Bricken-Kamp for the assessment of concentration of these professions which demand a very high degree of concentration, viz. piloting a plane, driving high speed automobiles, military operations, etc. This test was further utilized by sports psychologists of G.D.R. for predicting the concentration fitness of their national players (Sharma 1984). This test is basically a cancellation
test where a subject has to cancel out the small d's having two dots. There are total of 212 correct d's randomly printed on a sheet along with incorrect d's and p's. The subject has to cancel-out only correct d's within a stipulated time i.e. 10 seconds for one row. The same procedure is followed for all the 10 rows of the d's. The example of the test items is as follows:

```
  d  p  d  d  d  p  d  d  d  p  d  d  d  d
```

The total number of d's correctly cancelled out becomes the concentration score of the subject.

**Reliability of the Test**

To assess the reliability of the $d^2$ test, the test re-test method was applied. The test was re-administered on 20 randomly selected subjects from the entire sample after a gap of 4 days under similar conditions. The test re-test reliability coefficient found was .84.

**Administration of the Test**

A group of 10 to 12 gymnasts were made to sit comfortably in a class room. Each subject was given a $d^2$ test form and a pencil. The necessary informations regarding cancellation of correct ds were given to the subjects. The subjects were asked to fill their name and age at the place provided on the form. Before actual and final cancellation of the correct ds', each subject was given three trial attempts to acquaint him with the correct method of eliminating (cancelling) correct ds'. In each trial attempt 10 seconds
were provided for cancelling "correct d's" in each line. After the trial attempts 1 to 2 minutes rest was given. To start cancelling correct ds in first row the command "start" was given and at the end of 10 seconds the command "stop" was given. Immediately they were given command "Ready" and "start" for cancelling the correct ds in second time. The same procedure was followed for 10 lines. The time was taken with standard stop watch.

The total number of ds correctly cancelled out by a subject was considered as his concentration score.

Measurement of Physical Ability Variables

To measure physical ability variables, height and weight, the instruments like, steel tape, stop watch, calibrated rod, hand grip dynamometer, horizontal bar and parallel bars, portable weighing machine and anthropometric rod used in this investigation, were obtained from standard firms which cater to the needs of various research laboratories and gymnastics centres in India. All equipments were available and their calibration was accepted as accurate enough. The tests which have been used and the equipment used to conduct the test are universally used in measuring arm strength, flexibility, height and weight.

The procedures followed for conducting tests for measuring strength ability variables (i.e. pull-ups, on horizontal bar, dips on
parallel bars, right grip strength, left grip strength and vertical jump) and flexibility variables (i.e. trunk flexion, trunk extension and shoulder flexibility) height and weight are as follows:

Measurement of Strength Ability Variables

1. **Pull-ups on Horizontal bar**

   The test was administered on horizontal bar fixed at a height of 255 cms. so as to prevent the feet touching the ground during the performance. The subject held the bar at shoulders width apart with over grip. From a complete over-grip hang, the subject was advised to pull himself up. One complete pull-up was considered only when the subject pulled himself upwards with his chin coming up over the bar from complete stretched hang. Counting during the performance was made quite audible to the subjects. Maximum number of pull-ups performed in one attempt were considered as the scores of the subject. The test retest reliability coefficient found by the investigator was 0.87. The procedure of conducting test is given in Photograph 1 and 2.

2. **Dips on Parallel Bars**

   The test was administered on the parallel bars which was adjusted at a height of 1.70 m. Width of the two bars was fixed at 45 cm. The subject was made to come to support through a jump at the end of parallel bars. Subject was directed to lower the body until the angle between upper arm and fore-arm was less than right angle. From this position the subject was advised to stretch arm to support position. This process was repeated to the maximum times by the performer. Counting was so made that it was quite audible to the performer. Maximum numbers of dips completed by each subject were considered as scores of a subject. The reliability coefficient by test-retest method found was .89. The procedure to conduct the test is presented in Photograph 3 and 4.
MEASUREMENT OF ARMS AND SHOULDER STRENGTH
(PULL-UPS ON HORIZONTAL BAR)

Photo 1. INITIAL POSITION OF PULL-UPS ON HORIZONTAL BAR.

Photo 2. FINAL POSITION OF PULL-UPS ON HORIZONTAL BAR.
MEASUREMENT OF ARMS AND SHOULDER STRENGTH
(DIPS ON PARALLEL BARS)

Photo 3. INITIAL POSITION OF DIPS ON PARALLEL BARS.

Photo 4. FINAL POSITION OF DIPS ON PARALLEL BARS.
3. **Right Grip Strength.**

Grip dynamometer was used to measure the grip strength. The subject was asked to hold the dynamometer in his right hand and press (squeeze) the dynamometer with maximum force. The reading was taken from the dial of the dynamometer in kilograms. Each subject was given three attempts and the best of the three was considered for scoring purpose. The reliability coefficient by test-retest method found was 0.90. The procedure for conducting the test has been given in Photograph 5.

4. **Left Grip Strength.**

Grip dynamometer was used to measure the grip strength. The subject was asked to hold the dynamometer in his left hand and press (squeeze) the dynamometer with maximum force. Each subject was given three attempts. The best out of the three was considered for scoring purpose. The reading was taken from the dial of the dynamometer in kilograms. The reliability coefficient by test-retest method found was .96. The method of administering test is shown in Photograph 6.

5. **Vertical Jump for Measuring Legs Strength.**

Vertical jump was administered to measure explosive leg strength. A scale was placed on the wall at a height of 150 cms. from the ground up to a height of 3 meters. The subject was asked to raise
Photo 5. MEASUREMENT OF RIGHT GRIP STRENGTH

Photo 6. MEASUREMENT OF LEFT GRIP STRENGTH
his arms along the scale. The point at which the tip of the middle finger touches was taken as initial reading. Then the subject was asked to jump as high as possible to touch at the maximum high point on the scale. Each subject was given three attempts. The highest reading of the three jumps was recorded in centimetres as final reach. The initial reading was subtracted from the final reach to obtain score for vertical jump. The reliability coefficient by test - retest method found was 0.86. The method of conducting test is given in Photograph 7 and 8.

Flexibility

1. Trunk Flexion.

The subject stood bare footed on the 30 cm. high box with feet together and toes extending to the edge of the box without bending the knees. The subject stretched his hands down wards, along the scale which was placed along the box, as long as possible. Both hands were kept parallel and at the maximum reach the position was held for about 2 seconds. The maximum reach recorded from the scale in centimetres was considered as score of the subject. The reliability coefficient by test - retest method was found to be 0.89. The procedure of administering the test is given in Photograph 9.
MEASUREMENT OF LEGS STRENGTH (VERTICAL JUMP)

Photo 7. INITIAL POSITION OF VERTICAL JUMP.

Photo 8. FINAL POSITION OF VERTICAL JUMP.
2. **Trunk Extension** (Bridge)

The subject laid in supine position on the mat. From this position he raised his trunk up by supporting his body weight on hands and feet. The subject brought his feet and arms as close as possible. Distance between the heels and palms (inner edges) was considered as score of the subject for trunk extension. This distance was recorded in centimetres by 1/10th of a centimeter. The reliability coefficient found by test - retest method was 0.88. The procedure of administering test is presented in **Photograph 10**.

3. **Shoulder Flexibility** (Stick Test).

The subject held the calibrated rod with over hand grips. The width of the hands was decided by the subject. From this position, the subject carried the rod from above his head to the back of the body with straight arms with shoulders rotation (flexibility). The distance between the outer edge of one hand and inner edge of other hand was recorded for evaluation. The distance was recorded in centimetres. The reliability coefficient by test - retest method was found to be .90. The method of conducting the test is given in the **Photograph 11 and 12**.
Photo 9. MEASUREMENT OF TRUNK FLEXIBILITY

Photo 10. MEASUREMENT OF TRUNK EXTENSION
MEASUREMENT OF SHOULDER FLEXIBILITY

Photo 11. INITIAL POSITION OF MEASURING SHOULDERS FLEXIBILITY.

Photo 12. FINAL POSITION OF MEASURING SHOULDERS FLEXIBILITY.
Reliability of the Physical Ability Tests

Reliability of the tests measuring physical ability was established by the investigator by test - retest method. All the physical abilities measuring tests were administered again on 20 randomly selected subjects after difference of two - three days between the first and second testing. The reliability of coefficients obtained for the tests are presented in the following Table.

**TABLE II**

RELIABILITY COEFFICIENTS OF TEST - RETEST SCORES OF PHYSICAL ABILITY VARIABLES

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Tests</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pull ups on horizontal bar</td>
<td>.87**</td>
</tr>
<tr>
<td>2.</td>
<td>Dips on parallel bars</td>
<td>.89**</td>
</tr>
<tr>
<td>3.</td>
<td>Right grip strength</td>
<td>.90**</td>
</tr>
<tr>
<td>4.</td>
<td>Left grip strength</td>
<td>.96**</td>
</tr>
<tr>
<td>5.</td>
<td>Vertical Jump</td>
<td>.86**</td>
</tr>
<tr>
<td>6.</td>
<td>Trunk flexion</td>
<td>.89**</td>
</tr>
<tr>
<td>7.</td>
<td>Trunk Extension (bridge)</td>
<td>.88**</td>
</tr>
<tr>
<td>8.</td>
<td>Shoulder's flexibility</td>
<td>.90**</td>
</tr>
<tr>
<td>9.</td>
<td>Body Height</td>
<td>.995**</td>
</tr>
<tr>
<td>10.</td>
<td>Body Weight</td>
<td>.992**</td>
</tr>
</tbody>
</table>

N = 20
Significant at 0.01 level.
r at .01 (18 df) = 0.561.
Measurement of Age, Height and Weight

1. **Age.**

   The Calendar date of birth of a subject was taken as his age.

2. **Height.**

   It is the vertical distance from the vertex to the horizontal floor. The height was measured with an anthropometer rod. The measurement was taken with the individual standing straight against an upright wall, touching it with heels, buttocks and back. The anthropometer was held vertically in front of the subject in midsagittal plane and the horizontal movable bar was brought down to touch the point vertex. The stature was measured in centimetres. To find the reliability of testing, height was obtained on ten subjects for five times. The correlation between first and fifth attempt was computed to establish the reliability. The reliability coefficient was found .995. The method of taking height is presented in Photograph 13.

3. **Weight.**

   The subject wearing minimal clothing, i.e. short and a sport shirt, stood erect in the centre of the platform a portable weighing machine and the weight was recorded. The needle at zero was checked before taking weight of each sportsmen. The measurement was recorded in kilogram, nearest to half a kilogram. To assess the reliability of test the weights of the ten subjects were recorded five times. The zero-order correlation of coefficient was computed between the first and fifth attempt. The reliability coefficient obtained was .992. The procedure for taking body weight is presented in Photograph 14.
Photo 13. MEASUREMENT OF HEIGHT

Photo 14. MEASUREMENT OF WEIGHT