Chapter III

PROCEDURE

In this chapter the procedure adopted for the selection of subjects, selection of variables, criterion measures, reliability of data, procedure for administering the tests and the methods employed for statistical treatment of data are described.

Selection of Subjects

From the list of male students studying in ninth, tenth and eleventh classes of the Scindia School, Fort, Gwalior, students who were likely to be selected for various school teams excluding track and field were eliminated. The students who were concentrating on track and field were classified into four disciplines according to their inclination and performances. From each discipline, namely sprint, middle and long distance, jumps and throws, 25 students were selected at random as subjects for the present study. It was ensured from the health examination records of the subjects maintained as a part of regular school procedure that all the subjects were medically fit for
going through the testing programme.

The requirements of the project were explained to the school Principal in detail and explained to all the subjects in the presence of the School Physical Education Teachers and Coaches. The Physical Education Teachers exhorted the subjects to co-operate in the project even though they might have to work hard to their utmost limit of capacity in the interest of scientific enquiry and enhancing their own performance.

According to the school records, the average age of the subjects was sixteen years, ranging between fifteen and seventeen years.

Since the subjects selected for the study belonged to different states and union territories, they may be considered as representation sample of children from national cross section of high economical income and upper class educated families. The subjects were well developed physically according to the Indian standards. They had good acquaintance and appreciation for sports because they had daily programme of physical education and evening match practice for all.
All subjects resided in the hostels of the school and had more or less the same type of diet in the school mess.

**Selection of Variables**

The variables that influence performance in jumping, throwing and running events as gleaned from a review of professional literatures i.e. physical education, sports and allied subjects were taken into consideration.

A feasibility analysis as to which of the variables could be taken for investigation was taken into account from the point of view of the availability of equipment, acceptability to the subjects and the legitimate time that could be devoted for tests requirements. This was done in consultation with experts.

Keeping the above criteria in view the following physical, physiological and psychological variables were selected as they are directly related to the study.

**Physical Variables**

Speed

Strength
Endurance
Agility
Flexibility

Physiological Variables

Heart Rate
Vital Capacity
Blood Pressure
Anaerobic Capacity
Wo2 Max
Body Composition
Haemoglobin Content

Psychological Variables

Personality Characteristics (traits) and Percepcion

Criterion Measures

The criterion measures chosen for testing the hypothesis were:

1. Time taken to run a distance of 50 metres as fast as possible and recorded to the nearest 1/10th of a second with the help of a stop watch.
2. Number of correctly executed pull-ups using overhand grip.

3. Number of correctly executed bent-knee sit-ups.

4. Maximum horizontal distance jumped using standing broad jump and recorded in metres and centimetres. The distance covered in the best of the three trials was credited to the subject.

5. Distance covered in Cooper's 12 Minute Run/Walk Test to the nearest 50 metres.

6. Time taken to shuttle a distance of ten metres four times and recorded to the nearest of 1/10th of a second with the help of stop watch.

7. Distance reached recorded to the nearest centimetres using Sit and Reach Test.

8. Distance between the hands recorded in centimetres after executing backward arms rotation.

9. Number of heart beats/minute recorded at the radial artery under basal condition.

10. Maximum volume of air expired followed
by forced inspiration correct to 1/10th of a litre, using Dry Spirometer.

11. Pressure exerted by the walls of the arteries on the circulating blood in terms of millimetres of mercury.

12. Anaerobic capacity as measured by the test of Margaria.

13. \( \text{Vo}_2 \text{ Max} \) as measured by the test of Astrand and Ryhming using Bicycle Ergometre.

14. Amount of body fat obtained after taking skinfold thickness expressed in millilitre using skinfold caliper.

15. Amount of haemoglobin content recorded in grams per hundred millilitre of blood using Sahli's Acid Haematin Method.

16. Dimensions of personality - The fourteen dimensions as described in the Handbook for the Junior Senior High School Personality Questionnaire, each as a continuum from negative to positive aspect of the concerned dimension is presented in Table 1.
<table>
<thead>
<tr>
<th>Professional Term</th>
<th>Low Stem Score Description (1-3)</th>
<th>Alphabetic Designation of Factor</th>
<th>High Stem Score Description (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A-) Sirotthymia</td>
<td>A</td>
<td>Affectathymia (A+)</td>
<td></td>
</tr>
<tr>
<td>Reserved, detached, critical, aloof, stiff</td>
<td></td>
<td>Warm hearted, outgoing, easygoing, participating</td>
<td></td>
</tr>
<tr>
<td>(B-) Low intelligence (Crystallized, power measure)</td>
<td>B</td>
<td>High Inte- (B+) intelligence, (Crystallized, power, measure)</td>
<td></td>
</tr>
<tr>
<td>(C-) Lower ego Strength</td>
<td>C</td>
<td>High ego (C+)</td>
<td></td>
</tr>
<tr>
<td>(D-) Phlegmatic temperament undemonstrative deliberate inactive</td>
<td>D</td>
<td>Excitability (P+) bility Excitable, demanding, over active, unrestrained</td>
<td></td>
</tr>
</tbody>
</table>

Popular Term

Dull

Affected by feeling, emotionally less stable, easily upset, changeable.

Emotionally stable active faces reality calm
### TABLE 1 (Continued)

<table>
<thead>
<tr>
<th>Low Stan Score Description (1-3)</th>
<th>Alphabetic Designation of Factor</th>
<th>High Stan Score Description (E-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional (E-) Submissiveness</td>
<td>E</td>
<td>Dominance (E+)</td>
</tr>
<tr>
<td>Popular</td>
<td>Obedient, mild, easily led, docile accommodating</td>
<td>Assertive, Aggressive, Competitive, Stubborn</td>
</tr>
<tr>
<td>Professional (F-) Desurgency</td>
<td>F</td>
<td>Surgency (F+)</td>
</tr>
<tr>
<td>Popular</td>
<td>Sober, Taciturn, Serious</td>
<td>Enthusiastic, Headless, Happy, Lucky</td>
</tr>
<tr>
<td>Professional (G-) Weaker Superego</td>
<td>G</td>
<td>Stronger (G+)</td>
</tr>
<tr>
<td>Popular</td>
<td>Disregards rules, expedient</td>
<td>Super ego Strength</td>
</tr>
<tr>
<td>Popular</td>
<td></td>
<td>Conscientious, persistent, moralistic stated</td>
</tr>
<tr>
<td>Professional (I-) Chrectia</td>
<td>H</td>
<td>Farmaia (H+)</td>
</tr>
<tr>
<td>Popular</td>
<td>S</td>
<td>Adventurous, &quot;Thick-skinned&quot; Socially bold.</td>
</tr>
<tr>
<td>Professional (I-) Harria</td>
<td>I</td>
<td>Fresmaia (I+)</td>
</tr>
<tr>
<td>Popular</td>
<td>Tough minded, rejects illusions</td>
<td>Tender minded, Sensitive, dependent, over protected</td>
</tr>
<tr>
<td>Description</td>
<td>Low Stan Score (1-3)</td>
<td>Alphabetic Designation</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Professional Zeppia</td>
<td>J</td>
<td>Coasthenia (J+)</td>
</tr>
<tr>
<td>Popular Restful, liking group action</td>
<td></td>
<td>Circumspect, Individualism, reflective, internally restrained.</td>
</tr>
<tr>
<td>Professional Untroubled adequacy</td>
<td>0</td>
<td>Guilt (0+) Proneness</td>
</tr>
<tr>
<td>Popular Self-assured, placed, secured, complacent, serene</td>
<td></td>
<td>Apprehensive, Self-reproaching, insure, Worrying, troubled.</td>
</tr>
<tr>
<td>Professional Group dependency</td>
<td>O₂</td>
<td>Self- Sufficiency (O₂+)</td>
</tr>
<tr>
<td>Popular Socially groups dependent, a &quot;Joiner&quot; and a sound follower</td>
<td></td>
<td>Self-sufficient resourceful, prefers own decisions</td>
</tr>
<tr>
<td>Professional Low-self-sentiment Integration</td>
<td>O₃</td>
<td>High (O₃+) Strength of self sentiment</td>
</tr>
<tr>
<td>Popular Sociably groups dependent</td>
<td></td>
<td>Controlled, exacting, will-power, socially precise, compulsive, following self-image.</td>
</tr>
</tbody>
</table>
TABLE 1 (Continued)

<table>
<thead>
<tr>
<th>Low Stress Score</th>
<th>Alphabetic Designation</th>
<th>High Stress Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Description</td>
<td>Score</td>
</tr>
<tr>
<td>(1-3)</td>
<td>(8-10)</td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td></td>
<td>Q_4</td>
</tr>
<tr>
<td>(Q_4-) Low ergic tension</td>
<td></td>
<td>High ergic (Q_4+) tension</td>
</tr>
<tr>
<td>Popular</td>
<td>Relaxed, tranquil, torpid, unfrustrated, composed</td>
<td>Tense, driven, Overwrought, fretful</td>
</tr>
</tbody>
</table>

17. Perception - Distance reached recorded to the nearest centimetres using Depth Perception Test.

Reliability of Data

To establish reliability of data, tests in 50-metre dash, pull-ups, bent knee sit-ups, standing broad jump, 12 minute run/walk, shuttle run, sit and reach, shoulder rotation, blood haemoglobin, personality traits, and depth perception were administered to the subjects on two days with an interval of one day in between. The coefficient of reliability of the scores of two different days was computed. In the case of resting pulse rate, systolic and diastolic blood pressures, vital capacity, and
body composition the measurements were made three times. The coefficient of correlation of the scores in the first and second measurements of each of the above variables was computed. The reliability coefficient of the scores in selected physical, physiological and psychological are presented in Table 2.

**Table 2**

**Reliability Coefficients of Test Retest Scores**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-metre Run</td>
<td>0.98</td>
</tr>
<tr>
<td>Pull-ups</td>
<td>0.88</td>
</tr>
<tr>
<td>Bent-knee sit-ups</td>
<td>0.97</td>
</tr>
<tr>
<td>Standing Broad Jump</td>
<td>0.85</td>
</tr>
<tr>
<td>12 Minute Run/Walk</td>
<td>0.60</td>
</tr>
<tr>
<td>Shuttle Run</td>
<td>0.91</td>
</tr>
<tr>
<td>Sit and Reach</td>
<td>0.92</td>
</tr>
<tr>
<td>Shoulder Rotation</td>
<td>0.83</td>
</tr>
<tr>
<td>Resting Pulse Rate</td>
<td>0.86</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>0.95</td>
</tr>
<tr>
<td>Diastolic</td>
<td>0.95</td>
</tr>
</tbody>
</table>
### Table 2 (Continued)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaerobic Capacity (Margaria)</td>
<td>0.87</td>
</tr>
<tr>
<td>( V_{O2} ) Max</td>
<td>0.82</td>
</tr>
<tr>
<td>Skinfold Measurements</td>
<td>0.94</td>
</tr>
<tr>
<td>Personality Traits</td>
<td>0.90</td>
</tr>
<tr>
<td>Depth Perception</td>
<td>0.96</td>
</tr>
</tbody>
</table>

**Tester Reliability**

All the measurements were taken by the research scholar himself with the assistance of M.Phil. scholars working under his instructions as and when needed. Before conducting tests in selected physiological and psychological variables the scholar took a number of measurements in the selected variables under the guidance of Dr. A.K. Uppal, to ensure accuracy of measurements. To establish test reliability, five subjects were chosen at random and measurements were taken on them both by the research scholar and Dr. A.K. Uppal under identical conditions. The reliability coefficients of measurement between the two are presented in Table 3.
TABLE 3

TESTER COMPETENCY FOR TEST IN SELECTED PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resting Pulse Rate</td>
<td>0.97</td>
</tr>
<tr>
<td>Vital Capacity</td>
<td>0.95</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>0.94</td>
</tr>
<tr>
<td>Diastolic</td>
<td>0.96</td>
</tr>
<tr>
<td>Body Composition</td>
<td>0.89</td>
</tr>
<tr>
<td>Blood Haemoglobin</td>
<td>0.87</td>
</tr>
<tr>
<td>Personality Traits</td>
<td>0.90</td>
</tr>
<tr>
<td>Depth Perception</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Instrument Reliability

The instruments used in the study namely Dry Spirometer (Switzerland made), blood pressure apparatus, (Japan made), Haemometer (Superior Company, West Germany), Lange Skinfold Caliper (Cambridge Scientific Instruments, Cambridge, Maryland, U.S.A.), Junior Senior High School Personality Questionnaire of Raymond B. Cattle (India) had been supplied by well known manufacturers who cater to the needs of research laboratories and pathology.
laboratories in the country and hence were considered accurate and reliable for the purpose of the present study.

Procedure for Administering of Tests

Dependent Variables

The dependent variables (selected track and field events) chosen for the study were 100 metres run, 800 metres run, long jump and shot put. The subjects were tested in all the four selected track and field events on the 400 metres track and field of the Sciendia School, Fort, Gwalior.

A crouch start was used for 100 metres run, whereas for 800 metres run standing start was employed. In both the running events two subjects started together to enable them to have some sort of competition so that subjects could elicit their best performance. Time was recorded with the help of calibrated and synchronized stop watch to the nearest 1/10th of a second. With regard to long jump and shot put three attempts were provided to each subject and the best of the three attempts was recorded in metres as performance of the subjects. While testing the subjects the I.A.A.F. rules as adopted by A.A.P.I. were strictly applied.

The subjects were urged to put in their best
performance even though no special motivational technique was adopted by the scholar in this regard. Time trial and performance trial were permitted in case the subjects were not personally satisfied with their performance.

Independent Variables

50-Metre Dash (Speed)

On the track of the school a 50-metre distance was marked with starting and finishing lines. After a short warm-up period the subjects took their positions behind the starting line. For obtaining the best results two subjects ran at a time. On signal, the subject started his race and ran as fast as possible up to the finishing line.

The score was the time taken to complete the course and recorded to the nearest 1/10th of a second, from the starting signal to the instant the subject
crossed the finishing line.

**Pull-ups (Arm and Shoulder Strength)**

To measure shoulder and arm strength, a metal bar approximately three centimetres in diameter was placed at a convenient height. The bar was adjusted at a height where subject was able to hang free off the floor. The subject grasped the bar with his palms facing away from the body. The subject raised his body until the chin was over the bar and then lowered it again to the starting position with his arms fully extended.

One point was scored each time a pull-up was completed. Part scores were not counted and only one trial was permitted.

**Bent Knee Sit-ups (Abdominal Strength)**

The subject lays on the back with knees bent and angle at the knees less than 90 degrees, feet on the floor and heels not more than 30 cm. from the buttocks.

The subject placed his hand on the back of the neck with fingers clasped and placed his elbows separately on the floor.
Feet were held by a partner to keep them in touch with the surface. Then, subject tightened his abdominal muscles, and brought the head and elbows forward as he curled up, finally touched elbows to the knees. This action constituted one sit-up, subject returned to the starting position with the elbows on the surface before performing the sit-ups again.

The number of sit-ups the subject could perform at a stretch were recorded.

**Standing Broad Jump (Leg Strength)**

To measure the explosive strength of legs, the subjects stood behind a take off line. Preliminary to jumping the subject dipped his knees and swung his arms backward. He then jumped forward, simultaneously extending his knees and swinging his arms forward. He took off with both the feet simultaneously, jumped as far forward as possible and landed on both the feet. Measurement was taken from the heel mark made in the jumping pit to the inside edge of the take off line. Three trials were permitted.

The score was the best of three distances recorded to the nearest metre.
Cardio-respiratory Endurance

All the subjects were assembled at the track one evening. They were briefed on the objectives and the requirements of the Cooper's 12 Minute Run/Walk Test. It was clearly explained to them that they were expected to cover maximum possible distance by running in twelve minutes; if they found themselves exhausted even before the completion of twelve minutes they might slow down and even walk till twelve minutes were completed. That distance covered by them was a measure of endurance of their circulo-respiratory systems was explained to them so that their cooperation in an intelligent manner was ensured. A demonstration run was conducted in order to familiarise them with the manner in which they would start, at what signal they would stop and how the measurements would be taken. They were asked to remove their doubts, if any.

The test was conducted on the 400 metres track of the Scindia School, Fort, Gwalior. The track was marked off in 50 metres segments. The subjects were started in groups of twenty, a lap score was assigned for every batch of five subjects. The subjects had chest numbers for identification by the lap scorers. Simultaneously
with starting off a group by sounding a clapboard by the investigator, a stop watch was started by a time keeper. The time keeper blew a whistle at the end of twelve minutes at which signal the subjects stopped in their places. The lap scorers noted down the distance covered by each subject to the nearest 50 metres.

The maximum distance covered by the subjects in Cooper's 12 Minute Run/Walk Test was recorded nearest to 50 metres as the cardio-respiratory endurance score.

**Agility (Shuttle Run)**

To measure agility, two lines parallel to each other and 10 metres apart were marked in the school Gymnasium. The subject stood behind one of the lines with two blocks beyond the other line. On the signal "start" the subject ran to the blocks, took one block and returned to the starting line and placed the block behind the line. He again returned to the second block which he carried across the starting line on his way back. Two subjects ran at the same time. Most of the subjects ran bare footed and only a few ran with canvas shoes on.
The score was the total time taken to complete the course recorded to 1/10th of a second. One trial was allowed unless it was obvious that the subject had not done as well as he could have.

**Flexibility**

**Sit and Reach Test**

The subject took a sitting position on floor with knees fully extended and seat off his feet placed against the box. The subject reached forward with flexed trunk palm down, along the scale. The final position was held for one second to facilitate measurement. The best of three distance reached was recorded to the nearest centimetres.

**Shoulder Rotation Test**

The subject grasped the rod graduated in inches so that the tap measure would feed out just below the index finger with arms fully extended so that the rod was at arms length infront of his chest. The subject then raised his arms upward and rotated the rod over his head and lowered his arm with elbow locked, until the
measuring rod was resting across his back.

Minimum distance reached (between hands) recorded to the nearest centimetre indicated the best performance. Best of the three trials was credited to the subject.

Resting Pulse Rate

The resting pulse rate was taken at a time when the subjects reported for tests in the morning.

When the subjects reported at the Gymnasium of the Scindia School, Fort, Gwalior, they were asked to lie down supine and rest themselves for thirty minutes. The pulse rate was counted by palpating at the wrist (radial artery). The score was expressed in terms of number of pulse beats per minute.

Vital Capacity

Vital capacity was measured with the help of Dry Spirometer.

It was ensured that the pointer of the scale was at the zero mark at the beginning of the test. The subject took two deep breaths before starting the test, and then, after fullest inhalation the subject placed
the mouth piece attached to the nose connected to the spirometer in his mouth, taking care to see that no air escaped through the edges of the mouth piece. The subject exhaled slowly and steadily while bending forward slightly until the maximum volume of air could be expelled without taking in a second breath. The subjects were instructed to take care that they blew out only through the mouth and not by the nose even partially. The nose of each subject was clipped by a nose clip to prevent the air from escaping through the nose. The score of vital capacity for each subject was recorded in litres.

Blood Pressure

A dial type of sphygmomanometer and a stethoscope were used for measuring the systolic and diastolic blood pressures. Before the measurements were taken each subject was given ten minutes to relax in an easy chair. It was ensured that each subject was placed in a comfortable position. While taking blood pressure the subject's left arm was completely bared to make sure that the clothing did not constrict the blood vessels. The blood pressure measurement was taken with the subject in a sitting position, his forearm was supported on the
handle of the chair. The cuff was wrapped around the arm evenly, with the lower edge approximately one inch above the antecubital space. The stethoscope receiver was placed gently over the artery in antecubital space. It was made sure that stethoscope was free from contact with the cuff. The cuff was inflated until the artery was fully pressed to the extent that no pulse beat could be heard.

Pressure was then slowly released as the investigator watched the dial. When the first sound of the pulse became audible the reading in millimetres of mercury (mm.Hg.) instant was recorded as the systolic blood pressure. The pressure was further released gradually, as the sound of the pulse changed in intensity and quality. The index of diastolic pressure was noted in mm.Hg. when the heart sound completely ceased.¹

Anaerobic Capacity

The subjects were assembled at one of the hostel of the Scindia School, Fort, Gwalior, the steps

of the hostel were made use of for taking the Test of
Margaria.

The subjects were explained the meaning and
significance of anaerobic test and the rationale of the
testing procedure. The test procedure was demonstrated
with the help of physical education teachers of the school.
The subjects were allowed to take a number of trials in
the course of three days to give reliable performance
avoiding the effects of learning the test technique.

Each subject was started off from a starting
line, six metres from the base of the first step. The
fourth and the twelfth steps were marked with white
indicators. The subjects were given the cues, "Ready"
and "Go", as in any standing sprint start. A stopwatch
was started as the subject stepped on the fourth step and
it was stopped when the same foot hit the twelfth step,
as the subject attempted to run through a flight of
steps as fast as he could. However, as the subject hit
the twelfth step the stop watch was stopped. He was
given oral signal to stop. Of course, he was instructed
not to stop all of a sudden and he might slow down in
coming to a stop.
Each subject was given three trials with adequate rest in between the trials. The average timing of three trials was used in calculation.

On the day of the test, the weight of the subject was recorded in the office of the physical education teacher of the school.

Anaerobic capacity was calculated using the formula:

\[ P = \frac{W \times D}{t} \]

Where \( P \) stands for power, \( W \) stands for the weight of the subject, \( D \) stands for the vertical distance, the centre of gravity went up in running through the eight steps, and \( t \) stands for the mean time taken to run through the eight steps.

A plan of the Test of Margaria is illustrated in Fig.1.

**Maximal Oxygen Uptake** (\( \text{VO}_2 \text{ Max} \))

The subjects were taken to the gymnasium of the Scindia School, Gwalior, and they were briefed on the functions of the Bicycle Ergometer to elicit their
intelligent cooperation in giving the performance of their maximum work capacity as required for the project. A demonstration of the Bicycle Ergometer test for measuring maximal oxygen uptake was arranged. Each subject was given practice in synchronising their frequency of pedalling with the beats of the metronome, first without any resistance, and then with resistance. After ensuring that the novelty of the gymnasium atmosphere was worn out, and they had learnt the correct skill of going through the test for consistent and reliable performance, the initial test was undertaken.

The height of the ergometer seat was so adjusted that the subject's leg was almost straight at the knee at the bottom of pedal throw, with the balls of the feet on the pedals. The metronome was set at 100 beats/min, to allow one beat for each cycle of pedalling at the rate of 50 cycles/min. Each subject was asked to pedal without load until he was able to maintain the rhythm set on the metronome. Load was set at 450 kgm/min, to produce a heart beat rate between 125 and 170 per minute for each subject. The load was determined by trial and error method before starting this test. At the signal 'go' the subject started pedalling and
simultaneously a stop watch was started. Heart rate was taken in the last half of every minute for a six minute work bout by the method of palpation at the carotid artery just below the angle of jaw by applying light finger pressure. The mean of heart rates recorded in the fifth and the sixth minutes was used as the working heart rate for that work load. If the difference between these two rates exceeded five beats per minute, the work bout was prolonged until a near constant level was attained. Maximal oxygen uptake (Vo$_2$ Max) was read in litres/min. for the mean heart rate achieved in the fifth and the sixth minutes using the nomogram prepared by Astrand and Rhyming. The maximal oxygen uptake in litres per minute of the subject was divided by his body weight in kilograms to normalise his maximal oxygen uptake for his body size. The final score of the test was in ml. of O$_2$/kg./min.

**Skinfold Measurements**

Lange skinfold caliper was employed for measuring the fat component at specified sites. The skin at a specific site was held between the thumb and index finger.

---

Ibid., p.507.
and pulled out to form a fold so as to include two thicknesses of skin and subcutaneous fat in between them. The subject was asked to make appropriate movements to ensure that the skinfold enclosing the subcutaneous fat only was pinched and the muscle tissue which freely contracted and relaxed with movements was not included in the fold. The caliper was applied about one centimetre from the spot pinched with thumb and finger and to a depth equal to the fold approximately. The measurement was read nearest to one tenth of a millimetre. Three readings were taken and the average of the three readings was recorded as the thickness of the skinfold at that site.

This measurement was taken at the following four sites: Front of the upper arm, Back of the Upper arm, Inferior angle of scapula and Supra iliac, as recommended by Buskirk. All the measurements were taken on the dominant side of the subject.

Front of the Upper Arm

The subject was asked to stand in anatomical

position with the arms freely hanging. The skinfold was lifted over the biceps muscle at a point halfway between the forearm and the tip of the elbow. The method of measuring skinfold measurement (Front of the arm) is illustrated in Fig. 2.

Back of the Upper Arm

The subject was asked to stand in anatomical position with the arms freely hanging. He was asked to flex the arm at the elbow to 90 degrees. A point on the triceps midway between the acromial process of the shoulder and olecranon process of the ulna was located and skinfold measurement was taken as described above (Fig. 3).

Inferior Angle of Scapula

The subject was asked to stand in anatomical position. A site parallel to the inferior angle of scapula was chosen. The fold in this position made a diagonal line, upper end towards the medial side and lower end towards the lateral side. The thickness of the fold was measured as per description given above (Fig. 4).

Supra Iliac

The subject was asked to stand in anatomical
Fig. 2: Skinfold Measurements: Front of the Upper Arm.

Fig. 3: Skinfold Measurements: Back of the Upper Arm.
position. A site on the abdomen (on the side of the trunk) above the iliac crest at the level of the umbilicus was selected. The thickness of the skinfold was measured as per description given above (Fig. 5).

Estimation of Blood Haemoglobin Content

Sahil’s Acid Haematin Method was used for the estimation of haemoglobin content of the blood. The instrument was designed and calibrated in accordance with the standards laid down by the German Medical Association.

The haemometer pipette, the haemometer tube and the stirrer were thoroughly cleaned and dried. In the haemometer tube N/10 Hydrochloric Acid was taken up to the 20th division on the comparator in the space provided for it. The pricking needle was sterilised by swabbing it with rectified spirit and then heated over the flame of a Bunsen Burner. The top of the left ring finger of the subject was cleaned using rectified spirit. The finger was allowed to dry up and then punctured boldly with the pricking needle. Exactly 30 cubic mm of blood was drawn into the pipette by suction. The pipette was then dipped into the N/10 Hydrochloric Acid contained in the haemometer tube and thoroughly mixed by rinsing the pipette
Fig. 4: Skinfold Measurements
Inferior Angle of Scapula

Fig. 5: Skinfold Measurements
Supra-Iliac
with the acid several times. The tube was then allowed to stand in the comparator for about ten minutes for the maximum development of colour. Distilled water was added drop by drop to the mixture. On every drop of distilled water added to solution, it was stirred to ensure thorough mixing. When the colour of the mixture matched with that of the standard, the tube was taken out of the comparator and the stirrer was removed from the tube. The reading on the haemoglobin scale on the tube was read at the level of the lower meniscus of the solution avoiding parallax error. The scale was provided in grams of haemoglobin content per 100 ml. of blood.

**Personality Traits**

A survey was made of various standard tests to measure personality traits in high school students after discussion with the guide Dr. A.K. Uppal and in a colloquium of Research Degree Committee. It was decided to use Junior Senior High School Personality Questionnaire of Raymond B. Cattell. This has been used in psychological research widely in many English speaking countries. The test manual documents have high validity and also high reliability co-efficient for dependability and stability.
S.D. Kapoor and K.K. Mehrotra⁴ have computed norms for Indian population after establishing its validity and reliability under Indian conditions. In a pilot study, by administering a few of the questions to a sample of students comparable to the experimental groups, it was made sure that the linguistic vocabulary, expressions and experimental situation in the questions of the HSPQ was within the competence of the subjects in the experimental groups to respond adequately without feeling any linguistic or conceptual difficulties.

The students were assembled in batches of 25 each in a classroom. A model answer sheet with examples of answers was reproduced in an enlarged form on a chart paper and displayed on the blackboard so that everyone could see the entries in it clearly. The example given in the booklet was also written on the chart. The students were explained the purpose of the questionnaire after which they test booklets and hand scorable answer sheets were distributed to them. They were asked to write their respective names on it and to follow the "what to do"

section on the cover of the booklet while the research scholar read it aloud at dictation speed. When the examples were to be answered, the research scholar marked his answers on the model answer sheet, hung upon the blackboard, asking the students to mark whatever alternatives seemed to be the most appropriate answers to the individual subjects. The research scholar and his associates went around and verified the answers for the examples entered by the subjects. Such a step was taken as completing an answer sheet of this nature was a novelty to the students.

After making sure that the subjects had understood clearly, how to enter their responses in the answer sheet, they were asked to turn the page and proceed with answering. The research scholar and his associates went around verifying that the subjects recorded answers sequentially and all of them completed answering all the 142 items. However, they were not hurried into completing in any stipulated time.

The answer sheets were scrutinized to eliminate those answer sheets which were incomplete, those in which more than one answer were given to an item and those in which answers fell into a pattern of yes or no
or neutral predominantly. Using two card boards stencil keys with simple digital weighing, the raw scores for all the fourteen factors were counted and entered in the space provided for it in the score sheet. The score corresponding to the raw scores were read out from the norms for the Indian male subjects compiled by Kapoor and Mehrotra, and entered against the corresponding raw scores on the score sheet.

**Depth Perception**

The depth perception was measured by using the Depth Perception Box, supplied by the Biological Concern, Calcutta. This box contained three steel rods of similar diameters which could be seen through the slit against an illuminated white background. Two of the rods (outers) were fixed whereas the middle rod (inner) could be moved towards or away from the observation slit. A metric scale on the top of the box indicated the distance of the moveable rod from the fixed rods on either side as desired. The centre point of the metric scale which was directly above the line joining the fixed rods was marked zero, and the scale read from zero to fifty centimetres on either side of zero. An iron plate of the same width as that...
of the box but projected upward prevented the subject to see the metric scale.

Before collecting the data on depth perception all the subjects were explained the test clearly and the necessary amount of practice trials were given to all till they became familiar with the procedure of the test.

The subject sat on a stool of adjustable height in such a position that the observation slit of the box was in level with his eyes and at such a distance from where he could see the steel rods only against the illuminated white background and no other part inside the box. The research scholar stood on one side of the box and moved the middle rod towards inner side of the box (slit side) and then slowly towards fixed rods (inner to middle) and asked the subject to indicate when he (subject) felt that the middle rod had come in line with the fixed rods. The research scholar noted the actual distance from the zero mark. Similarly outer to middle (from illuminated white background side to middle) the rod was moved and reading noted.

Three trials each from inner to middle and
from outer to middle were given to each subject and the least distance for both sides out of three trials was taken as the depth perception score. This score was further rounded off to the nearest centimetres as per the prescribed procedure.

The inner to middle score and the outer to middle score were then correlated to reduce the depth perception score to single instead of two scores but based on a very high correlation ($r = .86$).

**Statistical Methodology Used in the Study**

The relationship between dependent variables i.e. (100 metres run, 500 metres run, long jump and shot put performance) and independent variables (physical, physiological and psychological) was established by computing Pearson Product Moment Correlation (zero order), and the relative contribution of a single independent variable (physical or physiological or psychological variable) to dependent variables (100 metres run, 500 metres run, long jump and shot put) by eliminating or partialing out the effect of one or more than one independent variables was found through partial correlation. The combined effect of
contribution of physical, physiological and psychological variables to 100 metres run, 800 metres run, long jump and shot put was obtained through multiple correlation. Moreover, dependent variables were predicted from physical, physiological and psychological variables by utilising regression equations.

For testing the hypothesis, the level of confidence was set at .05.