Chapter III
METHODOLOGY
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In this chapter, the procedure adopted for the selection of the subjects, selection of variables, criterion measures, reliability of data, administration of tests and statistical procedures used for the analysis of data are described.

Selection of Subjects

The present study was conducted on 600 male subjects of 12 to 15 years of age. The subjects consisted of two different groups namely normal and deaf and dumb. A sample consisting of 75 subjects belonging to each age group was taken from both the population, thus adding to a total of 300 in each age group. The subjects were selected randomly from various educational institutions of higher primary and higher secondary level of Karnataka State. The venues of data collection and the names of institutions are presented in Appendix I.

The date of birth of the subjects was collected from the school records. The four age groups with one-year interval were formulated by calculating the exact age of each subject from the date of test by
converting the present age into decimal age\textsuperscript{1}, which is presented in table 3.1.

**Table: 3.1**

**TANNER DECIMAL AGE CONVERSION**

<table>
<thead>
<tr>
<th>AGE RANGE</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.50 - 12.49</td>
<td>12</td>
</tr>
<tr>
<td>12.50 - 13.49</td>
<td>13</td>
</tr>
<tr>
<td>13.50 - 14.49</td>
<td>14</td>
</tr>
<tr>
<td>14.50 - 15.49</td>
<td>15</td>
</tr>
</tbody>
</table>

**Selection of Variables**

The investigator has examined the scientific literature pertaining to physical development, health related physical fitness and motor performance variables from different library sources and also consulted experts in this area to select the appropriate physical development, health related physical fitness and motor performance variables and test items for the present study. Along with the literatures and experts opinion, the administrative feasibility in terms of availability of infrastructures, instruments, time factor and cost factor were also given due consideration.

while selecting the physical development, health related physical fitness and motor performance variables and its test items.

By adopting the above criteria, the following physical development, health related physical fitness and motor performance variables were selected and tested for the purpose of this study.

### TABLE 3.2

SELECTED VARIABLES AND TEST ITEMS

<table>
<thead>
<tr>
<th>Physical development</th>
<th>Variables</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>Anthropometric</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body composition</td>
<td>Skin fold measurements</td>
<td></td>
</tr>
<tr>
<td>Aerobic fitness</td>
<td>20 M. multistage shuttle run.</td>
<td></td>
</tr>
<tr>
<td>• Absolute Maximal Oxygen Uptake Capacity (Absolute VO\textsubscript{2}Max.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Relative Maximal Oxygen Uptake Capacity (Relative VO\textsubscript{2}Max.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>Modified sit and reach</td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>30 M. fly start</td>
<td></td>
</tr>
<tr>
<td>Explosive strength</td>
<td>Standing broad jump</td>
<td></td>
</tr>
<tr>
<td>Muscular endurance</td>
<td>Bent knee sit-ups (Max)</td>
<td></td>
</tr>
<tr>
<td>Agility</td>
<td>6x10m. Shuttle run</td>
<td></td>
</tr>
</tbody>
</table>
**Criterion Measures**

The criterion measures chosen for testing the hypothesis were:

1. Height recorded in Centimeters
2. Body weight recorded in Kilograms
3. Percentage of body fat in Kilograms.
4. Relative maximal oxygen uptake recorded in Milliliters. Kg\(^{-1}\) Min\(^{-1}\).
5. Absolute maximal oxygen uptake recorded in Liters. Min\(^{-1}\).
6. Flexibility recorded in Centimeters.
7. Speed recorded in Seconds.
8. Explosive Strength recorded in Centimeters.
9. Muscular endurance recorded in number of sit-ups performed.
10. Agility recorded in Seconds.

**Reliability of Data**

The reliability of data was ensured by estimating the instrument reliability, tester's competency and reliability of tests.

**Instrument Reliability**

The stop watch used for recording the timings, the measuring tapes used for the measurement of distance and height, the weighing machine used for measuring the body weight, the wall-mounted stadiometer cum vertical jump chart for measuring the standing height and vertical jump test performance and the flexomeasurer for measuring the flexibility were
calibrated and found accurate. In order to measure the Maximal Oxygen uptake capacity, a pre-recorded compact disc (MP3) with audio-visual programme was developed based on world-renowned exercises physiologist Luc Lager’s 20meter multistage shuttle run test protocol. The light and sound emitted by the MP3 package enabled both the normal and deaf & dumb subjects to hear and visualize light signals to execute the test. To measure body fat, skin fold caliper, which is being used in the universities for research purposes.

**Tester Competency and Reliability of Test**

The tester competency was evaluated along with the reliability of the test. To determine the reliability of test 20 subjects were selected at random and the research scholar conducted the tests twice under identical conditions. The reliability coefficient was computed for two measures of each variable. The reliability coefficients obtained are presented in table 3.3.

\[
\begin{align*}
R_h & = 0.96 \\
R_{vis} & = 0.81
\end{align*}
\]

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### TABLE: 3.3

**RELIABILITY COEFFICIENT OF TEST RETEST SCORES OF SELECTED PHYSICAL DEVELOPMENT, HEALTH RELATED PHYSICAL FITNESS AND MOTOR PERFORMANCE VARIABLES**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Test</th>
<th>'r' value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>30 metre run with flying start test</td>
<td>0.89</td>
</tr>
<tr>
<td>2.</td>
<td>Standing Broad Jump Test</td>
<td>0.93</td>
</tr>
<tr>
<td>3.</td>
<td>6 x 10 Metres Shuttle run Test</td>
<td>0.91</td>
</tr>
<tr>
<td>4.</td>
<td>Modified Sit and Reach Test</td>
<td>0.89</td>
</tr>
<tr>
<td>5.</td>
<td>Relative VO₂ Max. (20 MST)</td>
<td>0.90</td>
</tr>
<tr>
<td>6.</td>
<td>Absolute VO₂ Max. (20 MST)</td>
<td>0.90</td>
</tr>
<tr>
<td>7.</td>
<td>Skin fold measurements</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>• Biceps</td>
<td>0.92</td>
</tr>
<tr>
<td>9.</td>
<td>• Triceps</td>
<td>0.91</td>
</tr>
<tr>
<td>10.</td>
<td>• Sub-scapular</td>
<td>0.88</td>
</tr>
<tr>
<td>11.</td>
<td>• Supra-iliac</td>
<td>0.89</td>
</tr>
</tbody>
</table>

The test used to assess the speed, explosive strength, agility, flexibility, relative and absolute maximal oxygen uptake capacity and body composition were all standard tests.

**Administration of Tests**

The tests for physical development, health related physical fitness and motor performance variables were conducted at the school grounds, stadia, wherever adequate facilities to conduct the tests were found.
Before the conduct of every test, the subjects were assembled on the testing venue and the purpose of the test was explained to them. The investigator took the help of sports coaches and physical education teachers for conducting the test. Demonstration of all the tests were conducted before the subjects and all sorts of efforts were made by the research scholar to ensure accuracy and uniformity in the administration of the test. A short warm up period of eight to ten minutes duration was given to the subjects before the conduct of the test. All the tests were conducted on each subject.

**Procedure for Administration of Tests**

**Physical Development**

**Height**

The standing height was measured with the subject standing erect on the flat uniform horizontal surface without shoes and socks against the wall, with portable wall mounting stadiometer. The subject was asked to stand with heels together, buttocks and back touching the wall and the head oriented in F.H. plane. The subject was asked to take a deep breath and stand still, while the measurement was taken. A stiff wooden foot scale was held vertically on the landmark vertex, slightly pressing the subjects head and touching the wall mounted stadiometer at a right angle. The subject was asked to step out by lowering the head and the reading
indicated by the lower end of the wooden scale on stadiometer graduations was recorded to the nearest centimeter.

**Body Weight**

The body weight of each subject was taken on a portable weighing machine. The subject was asked to wear only under clothing and be barefooted. The accuracy of the weighing machine was checked at intervals with standard weights. Before taking the measurements, care was taken to see that the pointer of weigher stood at zero when there was no weight on it. The measurement of body weight was recorded to nearest half a kilogram.

**Health Related Physical Fitness**

**Body composition**

To obtain the percent body fat and lean body mass, skin fold thickness was measured from the following four sites as recommended by Durnin and Rehaman\(^3\) was adopted. The skin fold thickness was measured with a skinfold caliper and sites of skin folds were 1. Biceps, 2. Triceps, 3. Sub scapular and 4. Supra-iliac. Percent Body fat was calculated using a regression formula with four measurements.

\[
\text{Body Density} = (1.1620 - 0.0630) \log ( \text{sum of four measurements} )
\]

**Biceps:** Biceps skin fold was taken by the mid way of the landmarks acromion and radial on the anterior part of the biceps (PLATE I). The vertical skin fold was lifted at this site with the thumb and the forefinger and the caliper was applied one centimeter below the finger and the grip on the caliper was slowly released so that the full tension of the caliper was applied on the lifted skin fold.

**Scoring:** the skin fold thickness was measured to the nearest half millimeter.

**Triceps:** Triceps skin fold measurement was also taken with the help of skin fold caliper at the mid way of landmarks acromion and radial on the posterior side of the upper arm (PLATE II). A vertical skin fold was lifted at this site with thumb and forefinger and the caliper was applied one centimeter below the finger and the grip of the caliper was slowly released so that the full tension of the caliper was applied on the lifted skin fold.

**Scoring:** the skin fold thickness was measured to the nearest half millimeter.

**Sub-scapular:** A skin fold was raised beneath the inferior angle of the left scapular in the direction running obliquely downwards at an angle
PLATE I: MEASURING SKINFOLD OF BICEPS

PLATE II: MEASURING SKINFOLD OF TRICEPS
of about scapular at 45 degrees from the horizontal angle (PLATE III). A skin fold was lifted at this site with thumb and forefinger and the caliper was applied one centimeter below the finger and the grip of the caliper was slowly released so that the full tension of the caliper was applied on the lifted skin fold.

**Scoring:** the skin fold thickness was measured to the nearest half millimeter.

**Supra iliac:** A diagonal skin fold was lifted with the thumb and the forefinger just superior to the iliac crest at the mid auxiliary line (PLATE IV). A skin fold was lifted at this site with thumb and forefinger and the caliper was applied one centimeter below the finger and the grip of the caliper was slowly released so that the full tension of the caliper was applied on the lifted skin fold.

**Scoring:** the skin fold thickness was measured to the nearest half millimeter.

**Calculation of percent body fat:** To calculate percent body fat, the skin fold measurements taken at four sites were added up and compared to ready reckoner prepared by Durmin and Rehman.
PLATE III: MEASURING SKINFOLD OF SUB-SCAPULAR
PLATE IV: MEASURING SKIN FOLD OF SUPRA-ILIAC
20 Metres Shuttle Run Test with One Minute Stages

Equipments:

Pre programmed MP3 with audio and light signal emitting unit (PLATE V) with 20metres shuttle run test protocol, and a measuring tape.

Markings:

Two parallel lines of 15 to 25 meters each on an even and non-slippery surface marked 20 meters of distance. A free space of at least one meter at either sides of the piste has been given. The wider the area used - greater the number of subjects that can be tested simultaneously with an inter space of minimum one meter (Figure 1).

Organization and Description of the Test:

A calibrated MP3 audio test protocol was used for the purpose of the test. The functioning of the MP3 audio player and the sound track were checked and ensured the audibility of the protocol to every one participating in the test. The subjects were made to stand on the start line and asked to commence the test at the first beep from the audio system. The test as per the protocol starts at slow running pace of eight kilometer per hour and increases by 0.5 Kilometer per hour at each minute. The test
PLATE V: MP3 DEVICE FOR 20M. MULTI STAGE SHUTTLE RUN TEST WITH BOTH AUDIO AND VISUAL SIGNALS

FIGURE 3.1: MARKINGS FOR 20 METERS MULTISTAGE SHUTTLE RUN TEST
A calibrated MP3 audio test protocol was used for the purpose of the test. The functioning of the MP3 audio player and the sound track were checked and ensured the audibility of the protocol to every one participating in the test. The subjects were made to stand on the start line and asked to commence the test at the first beep from the audio system. The test as per the protocol starts at slow running pace of eight kilometer per hour and increases by 0.5 Kilometer per hour at each minute. The test protocol comprises of 20 minutes or 20 stages reaching to the maximum shuttle run speed of 18 Kilometers per hour. The graphical representation of the testing protocol is given in the figure 2. The subjects were instructed to carefully follow the pace, not to run faster or slower than the required pace and to execute shuttle run by touching one foot every time on the end line in accordance with the pace dictated by the sound and light signal emitted by MP3 player. The subjects were asked to stop if on two consecutive laps they failed to reach the line three meters from the end of the piste or felt undue distress. The length of the test varied according to the individual; the fitter the subject, the longer the test lasts

**Scoring:**

The stage at which the subject stopped or dropped out was noted with an accuracy of a half a stage, which serves to predict the VO₂ Max.
FIGURE 3.2: GRAPHICAL REPRESENTATION OF GRADED TEST PROTOCOL FOR 20 METERS SHUTTLE RUN TEST
Estimation of Maximal Oxygen Uptake capacity:

The *Relative maximal oxygen uptake* ($VO_2\text{Max}$ in ml. Kg$^{-1}$.min$^{-1}$) has been estimated from the test results by using a regression equation$^4$,

$$VO_2\text{Max (ml/kg/min)} = [31.025 + 3.238 \times \text{speed (Km/h)} - 3.248 \times \text{Age (yrs)} + 0.1536 \times \text{speed} \times \text{age}]$$

The *Absolute maximal oxygen uptake* ($VO_2\text{Max}$ in liters. min$^{-1}$) has been estimated from the test results by using the equation:

$$VO_2\text{Max.} = [VO_2\text{Max. ml/kg/min} \times \text{Body weight (kilograms)}] / 1000$$

(l/min)

**Modified Sit and Reach Test**

**Equipment:** Flexomeasurer.

**Procedure:** In order to measure the development of hip and back flexion as well as extension of hamstring muscles of the leg, modified sit and reach test was conducted. A calibrated modified flexomeasurer was used for the purpose as shown in **PLATE VI**. The subject was asked to sit down in long sitting position and line up heels with the "0" (zero) line marker of the flexomeasurer and slide the seat back beyond the zero end of the flexomeasurer. Keeping both the knees locked straight, (**PLATE VII**) the flexomeasurer case has been pushed by the subject from the

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PLATE VI: FLEXOMEASURER

PLATE VII: SIT AND REACH TEST USING FLEXOMEASURER
fingertips as far as possible without any jerk movement.

Score: The best of three trials measured to the nearest centimeter was considered as the test score.

Motor Performance

30 Meters Run with Flying Start

Equipments:

Stop watch, five flag posts and measuring tape.

Markings:

The 45 meters distance was divided into two zones of 15 meters and 30 meters as shown in figure 3. The 30 meters intersecting point 'C' was measured from A and B. To fix the flags, the point C and A were joined and extended to point E. Similarly the point C and B were joined and extended to point 'D'. Five flags were fixed on the points C, D, E, F and G.

Procedure:

The subject was asked to take the standing start position behind the 45 meters end line the point H and on signal, accelerated forward through the flag posts and crossed point 'B' with maximum possible speed.
FIGURE: 3.3 MARKINGS FOR 30 METERS RUN WITH 15 METERS FLYING START
Procedure:

The subject was asked to take the standing start position behind the 45 metres end line the point H and on signal, accelerated forward through the flag posts and crossed point 'B' with maximum possible speed.

Scoring:

The timekeeper was standing on point C behind the flag post and when the subject came in line with the flags F and E, he started the watch and when the torso of the subject came in line with flags G and D stopped the watch. Two chances were given to the subject with comfortable full recovery span of time in between the runs.\(^5\)

The times were noted down from the watch with 1/10\(^{th}\) of a second accuracy. The best one timing has been considered as the score for the study.

Standing Broad Jump test:

Requirements:

1. Out door jumping pit
2. Measuring tape

Procedure:

The subjects were asked to stand behind the takeoff line with feet placed comfortably apart. Preparatory to the jump, the subjects swing their arms forward and backward and also flex the knees. Simultaneous extension of the knees and forward swinging of arms accomplished the jump. The measurement was taken from the take off line to the heel or any part of the body that touches the pit nearest to the take off line.

Scoring: The best of three trails was recorded in centimeters.  

Bent Knee Sit Ups:

Equipments:

Floor mats

Procedure:

The subjects were asked to take supine lying position on the mat with their knee flexed. A scale was kept in between the calf and hamstring muscles and they were asked to move the feet slowly forward. The position in which the scale fell down was fixed for performing the bent knee sit-ups. From this position the subjects were asked to keep their hands interlocked and placed at back head. The subjects were asked

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to lift their upper body till they touch their thighs with the chest. (PLATE VIII).

**Scoring:** Maximum number of correctly executed sit-ups was taken as score.

**6 x 10 meters Shuttle Run Test**

**Equipments:**
Stop watch and measuring tape.

**Markings:**
Ten meters of distance, marked by two parallel lines of five meters each.

**Procedure:**

The subject was asked to stand behind the starting line. On getting the starting signal "Go", the subject run faster, goes nearer to the other line and touches it with the one hand, turns and came back to starting line and touches it by hand. The subject to do the shuttle run six times and finish across the starting line by run through adopted similar procedure.
PLATE VIII: BENT KNEE SIT UPS
Scoring:

The time elapsed between start signal "go" and six shuttle runs finishing has been recorded to nearest 1/10th of a second. Two trials were given to the subject. The best performance was used as a score for the purpose of the study.

Statistical Techniques used for Analysis of Data

1. To compare the data of selected physical development, health related physical fitness and motor performance of four different age groups of normal and deaf and dumb boys, One-way Analysis of Variance (ANOVA) was applied, followed by Least Significant Difference Post-hoc comparison to determine the significance of differences between paired means.

2. Student ‘t’ test was applied to find out the significance of difference between the means of normal and deaf and dumb boys of four different age groups.