Chapter III

METHODOLOGY

In this chapter, the procedure adopted for the selection of the subjects, selection of variables, criterion of 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 1200 male subjects of 12 to 16 years of age, who are the natives of the four physiographic regions of Karnataka State. A sample consisting of 60 subjects belonging to each age group was taken from four physiographic regions, thus adding to a total of 240 in each age group. The subjects were selected randomly from various educational institutions of higher primary and higher secondary level, situated in four physiographic regions of Karnataka State. The physiographic regions and an overview of the stations of the data collections are presented in figure 3.1. 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 five age group 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\(^1\), which is presented in table 3.1.

Figure 3.1: Four Physiographic regions of Karnataka State and an overview of the Stations of data collection
Selection of Variables

The investigator has examined the scientific literature pertaining to physical and physiological variables from different library sources and also consulted experts in this area to select the appropriate physical and physiological 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 and physiological variables and its test items.

By adopting the above criteria, the following physical development, motor performance and physiological variables were selected and tested for the purpose of this study.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Height</td>
<td>-</td>
</tr>
<tr>
<td>2. Body Weight</td>
<td>-</td>
</tr>
<tr>
<td>3. Speed</td>
<td>30 metres run with flying start</td>
</tr>
<tr>
<td>4. Explosive strength</td>
<td>Vertical Jump Test</td>
</tr>
<tr>
<td>5. Agility</td>
<td>6 x 10 Metres Shuttle run Test</td>
</tr>
<tr>
<td>6. Flexibility</td>
<td>Modified Sit and Reach Test</td>
</tr>
<tr>
<td>7. Maximal Oxygen uptake</td>
<td>20 metres Shuttle Run Test with one minute stages</td>
</tr>
<tr>
<td>(Relative VO₂ Max.)</td>
<td></td>
</tr>
<tr>
<td>8. Maximal Oxygen uptake</td>
<td>20 metres Shuttle Run Test with one minute stages</td>
</tr>
<tr>
<td>(Absolute VO₂ Max.)</td>
<td></td>
</tr>
</tbody>
</table>

**Criterion Measures**

The criterion measures chosen for testing the hypothesis were:

1. Standing height recorded in Centimetres.
2. Body weight recorded in Kilograms.
3. Speed recorded in Seconds.
4. Explosive Strength recorded in Centimetres.
5. Agility recorded in Seconds.
6. Flexibility recorded in Centimetres.
7. Relative maximal oxygen uptake recorded in Millilitres. Kg\(^{1}\) Min\(^{1}\).
8. Absolute maximal oxygen uptake recorded in Litres. Min\(^{1}\).
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. A pre-recorded audio cassette with computer-generated graded protocol, signaling the pace of 20 metre shuttle run test was used for measuring both relative and absolute maximal Oxygen uptake capacities. The cassette is manufactured by Leader Sports Product, Canada, designed by world-renowned exercise physiologist, Dr. Luc Leger. Around the world, several sport, health and fitness awared countries are using these tests to measure the maximum aerobic capacity of their population because of its high validity and low cost in comparison with laboratory methods. A portable audio cassette player with variable speed adjustment was used to play the cassette. In order to check the speed of the cassette player, one minute calibration period was recorded at the beginning and end of the test. When the playing time of this calibration period differs by more than one second,
the adjustments were made on the shuttling distance, in order to maintain the right speed. The distance corrections table is presented in Appendix II.

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 tests were conducted twice under identical conditions by the research scholar. The reliability coefficient was computed for two measures of each variable. The reliability coefficient obtained are presented in table 3.2.

TABLE : 3.2

RELIABILITY COEFFICIENT OF TEST RETEST SCORES OF SELECTED PHYSICAL AND PHYSIOLOGICAL VARIABLES TEST ITEMS

<table>
<thead>
<tr>
<th>TESTS</th>
<th>Coefficient of correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 30 metre run with flying start Test</td>
<td>0.89</td>
</tr>
<tr>
<td>2. Vertical Jump Test</td>
<td>0.93</td>
</tr>
<tr>
<td>3. 6 x 10 Metres Shuttle run Test</td>
<td>0.91</td>
</tr>
<tr>
<td>4. Modified Sit and Reach Test</td>
<td>0.89</td>
</tr>
<tr>
<td>5. Relative VO₂ Max. (20 MST)</td>
<td>0.90</td>
</tr>
<tr>
<td>6. Absolute VO₂ Max. (20 MST)</td>
<td>0.90</td>
</tr>
</tbody>
</table>

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

The tests for physical and physiological variables were conducted at the school grounds, stadia, where ever 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 land
mark 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 centimetre.

Body Weight

The body weight of the each subject was taken on a portable weighing
machine. The subject was asked to wear only under clothing and be bear footed.
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.

Motor Performance Variables

30 Metres Run with Flying Start

Equipments :

Stop watch, five flag posts and measuring tape.

Markings :

The 45 metres distance was divided in to two zones of 15 metres and 30
metres as shown in figure 3.2. The 30 metres 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.
Figure 3.2: Markings for 30 metres run with 15 metres 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 time keeper 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.

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

Vertical Jump Test

Equipments:

Calibrated wall mounting vertical jump test chart with centimeter graduation, duster, chalk powder, measuring tape and adhesive tape.

Organisation of the Test:

A plane vertical wall with a minimum height of 3.25 metres from the ground, with a flat, even non slippery floor was used to arrange vertical jump test. The calibrated chart was mounted vertically on the wall with help of adhesive tapes. The lower end of the chart was kept at 1.25 metres from the floor to the
highest end at 3.25 metres.

**Procedure:**

The subject was asked to dip his finger in chalk powder and stand side wise against the wall chart keeping his strong arm raised completely above the head and finger straight. The height reached at fingers tip on the chart was recorded as initial reach (Plate I. a). Then the subject was asked to jump up (Plate I. b) as high as possible and to touch the wall chart leaving the chalk impression (Plate I. c). Three chances were been given to exhibit the performance.

**Scoring:**

The difference between the standing initial reach and the best jump was recorded as score for the study in centimeters.

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**6 x 10 metres Shuttle Run Test**

**Equipments:**

Stop watch and measuring tape.

**Markings:**

Ten metres of distance, marked by two parallel lines of five metres 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. Similar procedure was adopted by the subject to do the shuttle run six
PLATE I: VERTICAL JUMP TEST EXECUTION
times and finish across the starting line by run through.

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.

**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 II. 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, the flexomeasurer case has been pushed by the subject from the finger tips as far as possible without any jerk movement (Plate III).

**Score:**

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

PLATE III: MODIFIED SIT AND REACH TEST USING FLEXOMEASURER
Physiological Variables

20 Metres Shuttle Run Test with One Minute Stages

Equipments:

Pre-recorded audio cassette with 20 metres shuttle run test protocol, a audio cassette player and a measuring tape.

Markings:

20 metres of distance were marked by two parallel lines of 15 to 25 metres each on a even and non slippery surface. A free space of atleast one metre 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 metre (Figure 3. 3).

Organization and Description of the Test:

A calibrated audio cassette test protocol was used for the purpose of the test. The functioning of the audio cassette 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 cassette player.

The test as per the protocol starts at slow running pace of eight kilometre per hour and increases by 0.5 Kilometre per hour at each minute. The test protocol comprises of 20 minutes or 20 stages reaching to the maximum shuttle
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Figure 3.3: Markings for 20 metres Shuttle Run Test with One Minute Stages.
run speed of 18 Kilometres per hour. The graphical representation of the testing protocol has been presented in the figure 3.4. 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 signal emitted by cassette player. The subjects were asked to stop if on two consecutive laps they failed to reach the line three metres 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 the result which served as the indicator of his cardio-respiratory endurance. After the subject stops, the last completed stage was noted with an accuracy of a half a stage.

Calculations for the Prediction of Maximal Oxygen uptake:

The Relative maximal oxygen uptake ($\text{VO}_2 \text{ Max}$ in ml. Kg$^{-1}$.min$^{-1}$) has been estimated from the test results by using a regression equation $^3$:

$$\text{VO}_2 \text{ Max.} = [31.025 + 3.238 \times \text{speed(Km/h)} - 3.248 \times \text{age(yrs)} + 0.1536 \times \text{speed} \times \text{age}]$$

(ml/kg/min)

Figure 3.4: Graphical Representation of Graded Test protocol for 20 metres Shuttle run test.
The Absolute maximal oxygen uptake \((\text{VO}_2 \text{ Max in litres. min}^{-1})\) has been estimated from the test results by using the equation:

\[
\text{VO}_2 \text{ Max.} = \frac{\text{[VO}_2 \text{ Max. ml/kg/min x Body weight (kgs)]} \times 1000}{\text{litres/min}}
\]

**Statistical Techniques used for Analysis of Data**

1. To compare the test performances in selected physical and physiological variables among the boys of four physiographic regions of Karnataka state, the 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. Mean and standard deviations were also computed to assess the developmental patterns in the selected physical and physiological variables among the boys of 12 to 16 years of age group belonging to four physiographic regions of Karnataka state.