CHAPTER III
METHODOLOGY

In view of the numerous quantifications involved, investigation demands the collection and interpretation of a mass numerical data. Such studies tend to be manageable when specific tests are developed in different phases. Such phases represent different steps of arriving at a conclusive physical fitness test for high school boys and the standardising of the same.

The First Phase of Study

Initially thirty two physical fitness tests, predicted to measure different components of physical fitness of high school boys, were selected by the investigator. This process of selection of test item was done by the researcher through consulting the experts, study of reported literature and also researcher's own experience in the field. The criterion used while selecting the different test variables was the face validity of the respective test.

Pilot Study

In order to know the theme of study, to acquaint well with the procedure, to understand better the processing of data, to identify the administration difficulties of the selected test variables etc. a pilot study was conducted by the investigator.
selected 32 test items were administered to 32 sports boys, of a high school having good sports reputation, at Mangalore city. The tests were administered on two consecutive days, two sessions per day and by giving sufficient rest between the tests. Proper measures had been taken to motivate the boys to perform their best on test items.

The data so collected was subjected to factor analysis and multiple regression analysis in IBM PC AT computer having SPSS package.

Factor analysis generated nine factors that accounted for 81.5 per cent of the total variance. Only the first six factors that accounted for 69.1 per cent of the total variance were identified and named as muscular strength, explosive strength, speed, dynamic strength, endurance and agility. Through face validity, five test variables were considered as dependent variables for multiple regression analysis. Four components of physical fitness supported the factor analysis findings: the factors are muscular strength, agility, speed and explosive strength.

By considering rotated factor loadings, communality and significant T-values a test battery of 4 items was constructed. Physical fitness test battery, so constructed was administered on to a representative sample (N=340) of high school boys from 5 different schools of 2 different taluks of Dakshina Kannada
district. The raw scores have been converted into standard T-scores for the age groups of 13 to 15 year high school boys.

Pilot study helped the researcher to know and infer the following for the main study:

1. The students' behaviour and their limitations while performing test items.
2. Enabled the researcher to modify 14 of the 32 test items to the required standard for the present study.
3. To plan well in advance the mode of administration of 32 tests at different identified high schools.
4. To organise smoothly, the administration of different tests as per the capacity of the students.
5. Enabled the investigator to acquaint well with the advanced statistical procedures and interpretations such as factor analysis and multiple regression analysis.
6. To motivate the students to get their maximum performance on the test items.

The selected test variables with predicted physical fitness component or factor in respect of high school boys are cited in the following pages along with details of test administration, instructions, scoring etc. The familiar tests have been considered with some minor modifications. For example, standing broad jump scoring was in metres, instead of inches. In Sargent vertical jump coloured chalk powder was used instead of chalk and
the student, used the middle finger to mark on the wall. Likewise most of the selected tests were modified and used for this study, and such modifications are recorded accordingly. The figures of the familiar test are not incorporated. However unfamiliar tests are discussed along with figures. For marking purpose of all the out-door test items marking powder was used and for in-door activities chalk piece markings were used.

Prediction Factor: General Physical Fitness

1. Age: The age of the student was taken from the records of school register maintained in respective high schools. Subject's chronological age in completed years was recorded.

2. Weight: Subject's weight without footwears was recorded to the nearest kilograms. Standard portable weighing machine was used to weigh the students weight.

3. Height: Subject's standing height without footwears was taken. The height of the student to the nearest centimetre was recorded in centimetres. In most of the places stadiometer was used and in some places, wall markings were used to measure the height.
Prediction Factor: Muscular Strength

4. Push-Ups\(^1\) (15 Seconds)

Objective: To measure the strength of arms and shoulder girdle. (The test was modified against time)

Equipment: A stop-watch, and a mat on the floor.

Procedure: The subject assumed prone support position on the mat. On being signalled 'go' he flexed his elbows and lowered his body horizontally, so that his chest almost touched the ground. He returned back to the starting position by pushing up the body and by extending the elbows straight. He repeated this activity as fast as possible for a period of 15 seconds.

Instructions: The body was not to slag or pike, but the straight line of the body was to be maintained throughout the testing period. Incomplete push-ups are not counted.

Scoring: Correct numbers of completed Push-Ups in 15 seconds were recorded. Assistance of a partner for the subject in counting was used.

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5. Reverse Sit-Ups\(^2\) (10 Seconds)

Objective: To measure the strength of trunk muscles.

Equipment: One stop-watch

Procedure: "The subject lay on the floor with hands behind his neck; his partner held his legs to the floor. He then raised the upper half of his body as high as possible. This height was noted, as the subject returned to his original position. On the signal 'go' the subject has to repeat as many of those "Reverse sit-Ups" as possible in 10 seconds, (20 seconds was reduced to 10 seconds in this study) raising his tarso as far as possible (the first trial position) each time. The "one-two", sharp movement required (as opposed to a rolling movement) was first demonstrated."

Scoring: Numbers of completed Reverse Sit-Ups in 10 seconds were recorded. The partner assisted the tester in counting.

6. 2-Hops by Dominant Leg:

Objective: To measure the muscular strength of leg muscles.

Equipment: A measuring tape.

Marking: A metre line was marked on the out-door area of a smooth surface. This could be conducted even in-doors.

procedure: The subject stood behind the line marked on his dominant leg. He took two consecutive hops in front by his dominant leg. He tried to reach as far as possible (as shown in illustration 1)

Instructions: The subject is not allowed to make any initial movements of the dominant foot, he is permitted to bend his knee and to swing his arms before and during the hops. He should not stop or take a pause after a hop. Both the hops should be performed at a stretch.

Scoring: Two trials were given. Best of the two trials was recorded in metres. The measurement was taken as in the case of standing broad jump. Part of the meter was rounded off to nearest 5 centimetre.

7. 2-Jumps by Both Legs:

Objective: To measure the muscular strength of leg muscles.

Marking: One metre line was marked on the out-door area preferably near the jumping pit. If the pit is not available, any suitable surface can be selected. However, proper care should be taken to avoid the possibilities of injuries, if conducted indoors.

Equipment: One measuring tape.

Procedure: The subject stood behind the line marked with his feet kept parallel and in a comfortable position. He took two
ILLUSTRATION 1

2-Hops by Dominant Leg
(Subject Taking a Second Consecutive Jump)
consecutive jumps - as in standing broad jump - by both legs as far as possible (as shown in the illustration 2).

Instructions: The subject was not to make any initial movements of his toes; he was permitted to crouch before taking his jump; he was allowed to swing his arms backward and forward during the jump. He was not allowed to stop or take a pause after first jump. Both the jumps were to be performed at a stretch.

Scoring: Same as in the case of 2-Hops by Dominant leg.

8. Medicineball Throw (2kg):

Objective: To measure the strength of arm and shoulder girdle.

Marking: Two metre line on out-door area.

Equipment: One measuring tape

Procedure: The subject stood behind the marked line. He threw a two Kilogram medicineball from his standing position as far as he could in one maximum effort.

Instructions: He was to throw the ball with the help of one hand only; he was to throw the ball in any manner he wished; he was to throw the ball only in standing position.

Scoring: Two trials were given. Best of the two trials was considered. Nearest ball impact perpendicular to the line marked was recorded in metres. Fraction of a metre was rounded off to the nearest five centimetres.
ILLUSTRATION 2

2-Jumps by Both Legs
(Position after Second Consecutive Jump)
9. **Over Head Medicineball Throw (3kg – Sitting Position):**

**Objective:** To measure the strength of arm muscles and upper back muscles.

**Marking:** Two metre line in an indoor area.

**Equipment:** One measuring tape.

**Procedure:** The subject sat on the marked line in a long-sitting position with his legs spread comfortably apart as shown in illustration 3. His upper body was to be behind the starting line. The subject held the ball above the head in both hands with elbows extended. He then threw the ball forward outward as far as he could in one maximum effort (as shown in illustration 4).

**Instructions:** He was allowed to make initial movements of hands holding the ball by swinging backwards and by flexing the elbows; he was permitted to bend his upper body backwards before throw; he was not to move or lift his legs before or during the execution of throw.

**Scoring:** Similar to that of Medicineball throw (2 kg).

10. **Basketball Throw:**

**Objective:** To measure the strength of arm and shoulder girdle muscles.

**Marking:** Five metre line on out-door area.

**Equipment:** A measuring tape.
ILLUSTRATION 3

Over Head Medicineball Throw
(3 Kg - Sitting Position)
ILLUSTRATION 4

Over Head Medicineball Throw
(3Kg Throwing action)
Procedure: The subject stood behind the marked line. He threw the basket ball in standing position with one hand as far as he could in one maximum effort.

Instructions: He was to throw the ball in any manner he wished; he was to throw the ball only in standing position.

Scoring: Two trials were given. Best of the two trials was considered. Nearest ball impact perpendicular to the marked line was recorded in metres and part of the metre was rounded off to the nearest 10 centimetres.

11. Leg Raise\(^3\) (10 Seconds):

Objective: To measure the strength of abdomen muscles (Fleishman's Leg Raise Test has been modified here).

Equipment: One stop-watch, a mat on the floor and a rectangular wooden frame open on one side with measurements as shown in the figure 1.

Procedure: The subject lay on the mat in supine position with his hands locked and placed behind the neck; elbows flexed and feet together; knees locked & wooden frame was kept near the knees, so that both the legs were inside the frame. The subject would lift the leg together on signal 'go' and touch the upper part of knees to the lower surface of the wooden frame kept as in illustration

He then repeats this process of leg lifts as many times as possible in ten seconds. The feet must be held by the partner firmly.

Instructions: The subject takes the starting position and stands with his fingers interlaced behind the neck. A partner held the legs of the subject while he raised his upper body to an angle of about 40°. Initially the subject was allowed to familiarise himself with the position of body raise and held the position as long as possible.

Figure 1. Measurements of Wooden Frame
5. He then repeats this process of leg lifts as many times as possible in ten seconds. The frame was held by the partner firmly.

Instructions: The subject is not to bend his knees till the completion of the test. For all leg lifts heels were to touch the ground and when lifted, upper part of the knees should touch the inner part of the frame. Incomplete lifts were not counted. Lifting of elbows from the ground was not permitted.

Scoring: Lifting legs up and returning to the starting position was counted as one. Total number of correct, completed leg lifts in ten seconds were counted by the scorer and recorded in numbers.

Prediction Factor: Muscular Endurance

12. Upper Body Raise (Seconds Held):

Objective: To measure the muscular endurance of abdomen and lower back muscles.

Equipments: A Stop-Watch and a mat on the floor.

Procedure: The subject took supine position with his fingers interlaced behind the neck. A partner held the legs of the performer. On signal 'go' the subject raised his upper body to an angle of about 40°. Initially the subject was allowed to familiarise himself with the position of body raise and held the position as shown in illustration 6 as long as possible.
ILLUSTRATION 5

Leg Raise (10 Sec.)
ILLUSTRATION 6

Upper Body Raise (Sec. Held)
Instructions: He was not to vary the position of raised upper body.

Scoring: Total period of the raised position of the upper body held by the subject was recorded in seconds and rounded off to the nearest complete second. An upper limit of 300 seconds was put to the performers who could perform above five minutes.

13. Push-Ups (30 Seconds): Same as in the case of Push-Ups (15 seconds). But here the subject continued the activity for 30 seconds. Correct numbers of completed Push-Ups in 30 seconds were recorded.

14. Burpee (Squat Thrust)⁴:

Objective: "To measure the general muscular endurance of the body."

Equipment: A Mat on floor.

Procedure: "From a standing position (a) bend at the knees and waist and place the hands on the floor in front of the feet, (b) thrust the legs backward to a front leaning rest position, (c) return to the squat position as in the first count, and (d) stand erect. From the signal 'go' repeat this exercise at a constant rate of movement for as long as possible."

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scoring: "The score is the number of correct repetitions executed. The score is recorded to the nearest whole number." The subject was given an upper limit of 125 numbers notwithstanding his ability to perform more than he was asked.

Additional Pointers: "(a) the score is terminated if the performer stops to rest. (b) repetitions which are incorrect are not counted toward the score."

15. Sit-Ups (Bent Knee)\(^5\)

Objective: "To measure the endurance of the abdominal muscles."

Equipment: A mat on the floor and a yardstick.

Procedure: "From a lying position on the back, the performer flexes his knees over the yardstick while sliding his heels as close to his seat as possible. The yardstick should be held tightly under the knees until the performer is instructed to slowly slide his feet forward. At the point where the yardstick drops to the mat, the tester marks the heel line and seat line to indicate how far the feet should remain from the seat during the bent-knee sit-up exercise. The performer should interlace the fingers behind the neck and perform sit-ups alternating a left elbow touch of the inside right knee and a right elbow touch of the inside left knee. The exercise should be repeated as many times as possible."

\(^5\)Ibid., p. 120-124.
scoring: "The total number of repetitions is recorded for the score. However, repetitions should not be counted when fingertips do not maintain contact behind the head, when the knees are not touched, or when the pupil pushes off the floor with the elbow."

Additional Pointers: "(a) The feet should rest flat on the floor and may be separated a few inches. (b) The back of the hands should touch the mat each time before curling the sit-up position. (c) Taping the yard stick to the floor for the seat line helped the performer to maintain proper distance between seat and feet."

16. Leg Raise (Seconds Held):

Objective: To measure the muscular endurance of abdominal muscles.

Equipments: Same as Leg Raise (10 Sec.) Test.

Procedure: Similar to that of Leg Raise (10 Sec.); but here the subject held the position of one leg lift in the air as long as possible.

Instructions: The subject was not to bend his knees till the completion of the test. Lifting of elbows from the ground was allowed. He was not to lift his head. He was not to over lap the feet. He was to always keep the legs together. Dropping of the legs slightly from the final position was allowed.

Scoring: The total period of the leg raise position held by the subject from the signal 'go' till his heels touch the ground was recorded in seconds and rounded off to 1/10 of a second.
17. 50 mts. Hopping:

Objective: To measure the muscular endurance of leg muscles.

Markings: Two lanes of 50 metres in length and 1.22 metres in width were marked on an out-door area. Starting and finishing lines were also marked as shown in the figure 2 (Same markings were used for 40 mts and 50 mts runs).

Equipments: A stop-watch and a flag to indicate the finish near finish line.

Procedure: The subject stood behind the starting line. On signal 'go' by the starter he hopped on his convenient leg (either left or right leg) and completed the distance. This test was administered to two students at a time.

Instructions: The subject was not to change his hopping leg during the race.

Scoring: For incorrect hopping re-race was conducted. Time taken to hop the distance in seconds was recorded and rounded off to 1/10 of a second. A hand signal was given by the starter to the time keeper at the time of starting the race.
18. Shuttle Run

Objective: To measure the agility of an individual.

Markings: Two 3-metre parallel lines were drawn 30 feet apart as shown in the Figure 3.

Equipment: A stop watch and two blocks of wood (2" x 3" x 4") or old classroom duster.

The performer starts behind the starting line on the signal 'go' and runs to the blocks, picks up one, returns to the starting line, and places block behind the line; he then repeats the process with the second block. Allow some rest between the two trials.

Scoring: "The score for each performer is the length of time (to the nearest tenth of a second) to complete the course." (See the test sheet provided.)

Additional Pointers: "(a) Stress the importance of running as hard as possible across the finish line with second block. (b) Marking tape should be used to designate the starting and finishing line. (chalk mark was used in this study instead of marking tape) (c) A person may touch behind the line and not use blocks since blocks may be tumbled, dropped, kicked or thrown and thus require an

Figure 2. Marking of 40 and 50 mts Races

Prediction Factor: Agility

18. Shuttle Run:

Objective: To measure the agility of an individual.

Markings: Two 3 metre parallel lines were drawn 30 feet apart as shown in the figure 3.

Equipments: A stop watch and two blocks of wood (2" x 2" x 4") or old class room duster.

Procedure: "The performer starts behind the starting line on the signal 'go' and runs to the blocks, picks up one, returns to the starting line, and places block behind the line; he then repeats the process with the second block. Allow some rest between the two trials."

Scoring: "The score for each performer is the length of time required (to the nearest tenth of a second) to complete the course." Only the best trial were recorded.

Additional Pointers: "(a) Stress the importance of running as hard as possible across the finish line with second block. (b) Marking tape should be used to designate the starting and finishing line. (chalk mark was used in this study instead of marking tape) (c) A person may touch behind the line and not use blocks since blocks may be tumbled, dropped, kicked or thrown and thus require an

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13. Agility Test II

Objective: To measure the agility of an individual.

Markings: Two parallel lines marked on the outdoor area. Four points of two lines were named as 'A', 'B', 'C' and 'D'. A diagonal line of 50 ft was joined from 'B' to 'C'. Fourteen wooden blocks or flags were placed (5 on line 'AB' at 6 ft apart, 5 on line 'CD' at 10 ft apart, and 4 on 'CD' at 6 ft apart leaving last 6 ft clear). Two feet in diameter was marked as start. Measurements were also marked as shown in the illustration.

Equipment: stop-watch and 14 Indian clubs or flags.

Procedure: The subject stood behind the starting line. On signal 'go', he ran in a zigzag manner from 'A' to 'B'. 'B' to 'C' and 'C' to 'D'. He ran in a straight line after touching the starting line extended from point 'B'. Measurements of the run were made using an instant camera. He was not to jump or run over the Indian flags fixed on the ground. If he did not take the proper turns, he was re-administered the test.

Two trials were given. The best time taken to complete for figures.

Figure 3. Marking of Shuttle Run
additional testing or problem in standardization."

19. Agility Test I:

Objective: To measure the agility of an individual.

Markings: Two parallel lines of 30' each and 40' apart were marked on the outdoor area. Four points of two lines were named as 'A', 'B', 'C' and 'D'. A diagonal line of 50' was joined from 'B' to 'C'. Fourteen Indian clubs or flags were placed (5 on line 'AB' at 6' apart; 5 on 'BC' at 10' apart and 4 on 'CD' at 6' apart leaving last 6' line free). At point 'D' a circle two feet in diameter was marked. Start and finish lines were also marked as shown in the figure 4.

Equipments: A stop-watch and 14 Indian clubs or Flags.

Procedure: The subject stood behind the starting line. On signal 'go' he ran in a zig-zag manner from 'A' to 'B', 'B' to 'C', 'C' to 'D' and ran in a straight line after touching the circle marked at 'D' to finish line extended from point 'B' as shown in illustration 7.

Instructions: The subject was to go in a zig-zag manner as demonstrated; he was not to jump or run over the indian clubs/flags fixed on the ground; if he did not take the proper turns, he was re-administered the test.

Scoring: Two trials were given. The best time taken to complete the race was taken and recorded in seconds and rounded off to the
Figure 4. Marking of Agility Test 1
(a) Subject Going in Zig-Zag Manner

Subject Runs in a Straight Line After Touching Circle at 'D'

ILLUSTRATION 7
Agility Test I
nearest 1/10 of a second.

20. Agility Test II:

Objectives: To measure the agility of an individual.

Markings: Two 3 metre lines were marked in an indoor hall. One line was marked on the wall, 1 metre above and parallel to the ground. Another line was marked on the ground 3 metres away and parallel to the wall as shown in the figure 5. A mat on the floor behind the marked line was preferred.

Equipments: A stop-watch and a mat.

Procedure: The subject lay in supine position and the head was to be positioned behind the marked line with arms stretched sideways. Feet were to be comfortably apart as shown in illustration 8. On signal 'go' he was to get up from the starting position as fast as possible and was to run towards the wall and was to touch the wall below the one meter mark and was to return back to assume the starting position.

Instructions: The subject was to get up from the starting position on either side and in any manner he wished; bending the knees before signal 'go' was not allowed. He was allowed to touch the wall with any of the hand he wished; he was permitted to slide over the floor at the time of re-assuming the starting position.

Scoring: Two trials were given. The best time taken by the subject to perform the test was recorded in seconds and rounded off to the nearest 1/10 of a second.
Figure 5. Marking of Agility Test II
(a) Starting Position

ILLUSTRATION 8

Agility Test II
(b) Subject Touching the Wall

ILLUSTRATION 8
Agility Test II
21. Agility Cycle:

Objective: To measure the agility of an individual.

Markings: Two lines 8 metres in length were marked on an outdoor area. Mid point of each line passed through point 'o' forming a '4' shape. Small circles of 30 centimetres in diameter were marked on points 'B', 'C' & 'D'. A circle of one metre in diameter was marked at point 'o'. A starting line, two metres in length was marked at point 'A' as shown in the figure 6.

Equipment: A stop-watch.

Procedure: The subject stood behind the starting line. On signal 'go', he ran forward from 'A' to 'O', then did a cross-step sideward running from 'O' to 'B' and 'B' to 'O'; then ran forward from 'O' to 'C' and backward from 'C' to 'O'; then did a cross-step sideward running from 'O' to 'D' and 'D' to 'O' and at the end ran backward from 'O' to 'A' to complete the Agility Cycle. The sample of the test is shown in illustration 9.

Instructions: The body was to face forward till the completion of the test; he was to touch the centre circle each time during the course of his run; he was to do cross-step sideward running when he was running sideways.

Scoring: Two trials were given. The best time taken to complete the Agility Cycle was recorded in seconds and rounded off to the nearest 1/10 of a second.
Figure 6. Marking of Agility Cycle
ILLUSTRATION 9
Agility Cycle

(Subject Performing a Cross-Step Running)
22. Cross-Step Sideward Running:

Objective: To measure the agility of an individual.

Markings: Two parallel lines three metres in length and eight metres apart were marked on an outdoor area as shown in the figure 7.

Equipment: A stop-watch.

Procedure: The subject stood behind the line 'A'. On signal 'go' he did a cross step sideward running to the line 'B' and returned in the same manner without changing his body direction as shown in illustration 10.

Instructions: The subject was to keep one leg behind line 'B' when he reached the other end; changing of his body direction was not permitted. Throughout the race he was to do only cross-step sideward running.

Scoring: Two trials were given. The best time taken by the subject to complete the test was recorded in seconds and rounded off to the nearest 1/10 of a second.

Prediction Factor: Speed

23. 40 metres Run:

Objective: To measure the speed of the gross body of an individual.
Figure 7. Marking of Cross Step Sideward Running
ILLUSTRATION 10

Cross Step Sideward Running
Markings: Two lanes of 40 metres in length and 1.22 metres in width were marked on an outdoor area. A starting and finish line were also marked (refer figure 2).

Equipment: A stop-watch, and a flag to indicate the finish line.

Procedure: Two subjects stood behind the starting line. On signal 'go' by the starter, they ran the distance of 40 metres as fast as possible and completed the race. Starter gave hand signal to the time keeper to indicate the start of the race.

Scoring: One trial was given. The time taken by the subject to complete 40 metres was recorded in seconds and rounded off to the nearest 1/10 of a second.

24. 50 metres Run:

Similar to that of 40 metres run, but here the subject ran the distance of 50 metres at a stretch.

25. Tapping by Hand:

Objective: To measure the speed of Hand.

Markings: A 90 centimetre line and another line 45 centimetre in length was marked perpendicular to the first line and intercepting at mid-point were marked on the table. Small circles were drawn on each points and named `A', `B', `C' as shown in the figure 8.

Equipment: A stop-watch and a table.
procedures, the subject stood comfortably in front of the table marked with his convenient hand on circle 'A' as shown in Illustration 11. He would tap the point 'A', 'B' and 'C' in a clockwise direction as many times as possible in five seconds.

Instructions: Tapping was to be done by tips of the fingers. Tapping the circles was to be only a clockwise direction. Tapping all the three circles once was to be counted as one cycle. Half completed cycles were not counted. Support of the table was not to be taken while tapping.

Scoring: A completed cycles in five seconds was recorded. The tester took the assistance of one person to count the cycles. The assistant stood near the circle 'C' for counting, as shown in Illustration 11.

26. Tapping by Leg

Objective: To measure the speed of leg.

Markings: A 60 centimetre line was marked on the ground. Two small circles were drawn on each points and named as 'A' and 'B'. A 30 centimetre line parallel to the line at centre point. A 20 centimetre away was also marked as shown in the figure 9.

Equipment: A stop-watch.

Procedure: The subject stood on the 30 centimetre marked line and kept his convenient leg on circle 'A' as shown in Illustration 12. On signal 'go' he tapped the circles 'A' to 'B', 'B' to 'A' and

--- Figure 8 Marking of Tapping by Hand ---
procedure: The subject stood comfortably in front of the table marked with his convenient hand on circle 'A' as shown in illustration 11. On the signal 'go', he would tap the point 'A', 'B', and 'C' in a clock wise direction as many times as possible in five seconds.

Instructions: Tapping was to be done by tips of the fingers. Tapping the circles was to be only in clock wise direction. Tapping all the three circles once was to be counted as one cycle. Half completed cycles were not counted. Support of the table was not to be taken while tapping.

Scoring: Number of completed cycles in five seconds was recorded. Tester took the assistance of one person to count the cycles. The assistant stood near the circle 'C' for counting, as shown in illustration 11.

26. Tapping by Leg:

Objective: To measure the speed of leg.

Markings: A 60 centimetre line was marked on the ground. Two small circles were drawn on each points and named as 'A' and 'B'. A 30 centimetre line parallel to the line at centre point, 20 centimetre away was also marked as shown in the figure 9.

Equipment: A stop-watch.

Procedure: The subject stood on the 30 centimetre marked line and kept his convenient leg on circle 'A' as shown in illustration 12. On signal 'go' he tapped the circles 'A' to 'B', 'B' to 'A' and
ILLUSTRATION 11

Tapping by Hand
Figure 9. Marking of Tapping by Leg
ILLUSTRATION 12

Tapping by Leg

Instructions: Tapping both the circles was to be counted as one. No taps on the circle, score was not to be counted. Number of completed scores in five seconds was recorded. Great stood near point 'B' to count the scores.

Objective: To determine if the scale could be caught in the hand of the individual.

General: A scale was held in either hand on the thumb and other fingers. The thumb was kept near the scale width. The tester dropped the scale any distance from point 'A'. If the tester dropped the scale as it was caught, he would say 'yes'. After he said 'yes' the scale will be dropped at a moment. He was to concentrate on the scale as it enables him to catch it as soon as it is dropped.

Note: As many trials as possible were given, till the subject could catch the scale twice (almost in the same position). The difference in marking, in level with the outer edge of the thumb.
continued the same for five seconds, as fast as possible.

**Instructions:** Tapping both the circles was to be counted as one. If one didn't tap on the circle, score was not to be counted.

**Scoring:** Number of completed scores in five seconds was recorded. A scorer stood near point 'B' to count the scores.

### 27. Reaction Speed Test:

**Objective:** To measure the reaction speed of an individual.

**Equipment:** A Table and a foot scale.

**Procedure:** The subject was asked to place his either hand on the edge of the table. He formed 'U' shape with thumb and other fingers. There was a gap of at least a foot scale width. The tester held a 30 centimetre scale with '0' of the scale on the outer edge of the thumb as shown in illustration 13. On signal 'ready' the subject responded with 'yes'. Then the tester dropped the scale any moment he wished. The subject caught the scale as soon as he could.

**Instructions:** When the subject is ready to react, then only he was to say 'yes'. After he said 'yes' the scale will be dropped at any moment. He was to concentrate on the scale as it enables him to catch it as soon as it is dropped.

**Scoring:** As many trials as possible were given, till the subject held the scale twice (almost in the same position). The difference in marking, in level with the outer edge of the thumb
ILLUSTRATION 13

Reaction Speed Test
was recorded in centimetres and rounded off to the nearest centimetre.

Prediction Factor: Explosive Strength

28. Standing Broad Jump:

Objective: To measure the explosive strength of the body. (The test was modified in scoring procedure).

Marking: A metre line was marked in an outdoor or indoor area.

Equipments: A measuring tape.

Procedure: The subject stood behind the marked line with his feet slightly apart and parallel. He took a crouch position by bending his knees and swinging his arms backwards. He jumped outward as far as he could at a stretch with one maximum effort along with forward arms swing outward and landed in front.

Instructions: Initial movement of the toes was not to be allowed. Leaning backward after a jump was not to be permitted. If the jump was not executed correctly, another chance was to be given.

Scoring: Nearest heal mark right angle to the starting line was considered. Two trials were given. The best of two trials was recorded in metres. Part of the meter was rounded off to the nearest five centimetres.

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29. Vertical Jump:

Objective: To measure the explosive strength of leg muscles. (The test was modified in marking and scoring).

Markings: Parallel lines of two centimetres drawn on white sheets was pasted on the wall above 160 centimetres. The markings ranged from 160 centimetres to 280 centimetres. Bold arabic numerals were written on both edges of the papers at every two centimetres and in the centre of pages at every 10 centimetres interval.

Equipment: White sheets, sketch pens, two different coloured powder and a measuring tape.

Procedure: (a) The subject took coloured marking powder by the tip of the middle finger of his convenient hand and stood in front of the wall markings. He touched both the toes to the wall and then extended the hand over the wall markings and tried to reach as high as possible without raising his heals and marked the standing reach height as shown in illustration 14. This height was noted. (b) Subject stood on one side with his finger having marking powder towards the wall markings; he jumped as high as possible and marked the height of his jump.

Instructions: Jumping twice or 'Crow hop' was not to be permitted. He was to be allowed to crouch and swing his arms before he took

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8 Ibid., pp. 201-202.
ILLUSTRATION 14

Vertical Jump - Standing Reach
a jump. He was not to touch the wall other than with the marking hand.

Scoring: The number of centimetres between the standing reach and jumped mark measured to the nearest centimetre was to be recorded. Two trials were to be given. The best of two trials were to be recorded.

30. Sideward Jump:

Objective: To measure the explosive strength of leg muscles.

Markings: A rope of two metres in length and one centimetre in thickness was tied firmly to the legs of two wooden chairs/stools, which were placed parallel to each other at a rope's length. The rope was tied 10" above and parallel to the ground as shown in the figure 10.

Equipments: Two stools/chairs, 2 metres rope and a stop-watch.

Procedure: The subject stood sideward with his feet parallel near the rope. On signal 'go' he jumped over the rope to the other side of the rope on both legs and returned back to initial position with a jump. This sideward jump is shown in illustration 15. This process of sideward jumps was repeated by the subject for 10 seconds.

Instructions: The jump was always to be on his toes, he was to jump on both legs. He was not to touch the rope while performing the sideward jumps.
Figure 10. Marking of Sideward Jump
ILLUSTRATION 15

Sideward Jump
scoring: Jumping both sides once was counted as one cycle. Total number of cycles completed in 10 seconds was recorded. The tester was assisted by a scorer to count the cycles.

31. **Medicineball Put**\(^9\) (5 kg):

**Objective:** To measure the arm and shoulder girdle explosive strength.

**Markings:** A one metre line marked on an outdoor area.

**Equipment:** One measuring tape.

**Procedure:** The subject stood behind the marked line. He then put the ball in front as far as he could in one maximum effort.

**Instructions:** He was to put the ball, and not throw it. He was to put the ball only in standing position. He was to be permitted to take a jerk at the time of release to gain a maximum strength, but he was not to step on or over the line while doing so.

**Scoring:** Incorrect puts were not counted. Chance was given till the correct put. The best of two trials was considered. Nearest ball marking perpendicular to the marked line was recorded in metres. Fraction of a metre was rounded off to the nearest five centimetres.

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32. Sit-Ups (Bent Knee - 15 Seconds):

Objective: To measure the explosive strength of abdomen muscles.

Equipments: A mat on the floor, a yardstick and a stop-watch.

Procedure and Scoring: Same as Sit-Ups (Bent-Knee). But here the subject did the sit-ups for 15 seconds. Total number of completed correct sit-ups was recorded.

Administration of Test Variables

The collection of data was delimited to the district of Dakshina Kannada in Karnataka State. Initially three urban and three rural taluks (out of eight taluks) of the district were identified. Eleven high schools of six taluks having good sports reputations/appraisal were identified for the purpose of the first phase of data collection. Nine of the eleven high schools have been fairing well in taluk, district and some times even at state level sports or games competitions. To assure the normal distribution of data, three high schools with not much of sports records have also been considered for the study.

Selected 32 test items were administered to a representative sample of 180 high school boys of the eleven identified institutions. School records had been checked to confirm the representation of respective pupils in taluk/district/state level competition in any of the sports or games competitions. Out of 180 high school boys selected four had participated at Jr. State
level, 62 represented their school at district level and 114 represented their school at taluk level competitions in different sports disciplines.

The Investigator visited personally the head of the institutions required for his field survey. The importance and purpose of the research project was explained to them in detail and their prior permission was sought to carry out the work. Dates for the collection of data were fixed well in advance in consultation with respective physical education teachers of eleven high schools and their whole hearted co-operation was assured to the researcher. Assistance from qualified and experienced coaches/physical directors of Mangalore University area was taken during the collection of data. A score sheet of 29 test items along with age, weight, height and other required information was prepared to ease the process of data collection.

**Motivational Measures:**

The following motivational measures had been taken to ensure the best performance from the subjects.

1. A positive, competitive atmosphere was created with an encouraging talk by the investigator and also by the concerned physical education teacher of the high school.
2. Researcher assured the students of providing light refreshments, on the completion of each session of test administration. They were given refreshments as assured.

3. Students were asked to encourage their classmates, while performing at every moment of the test. They were informed to encourage either with claps or by shouting positively.

4. Previous highest performance of a test (height reached, distance covered or thrown, numbers completed etc. as the case may be) was announced before test administration and students were encouraged to do further better performance (For first school pilot study scores was told).

5. Greater individual attention and appreciation by the investigator was given to the better performer of a group. This indirectly encouraged other students to perform well.

6. Incentives for the ten best performers had been announced before the commencement of test administration at each school. (After completion of 180 samples, ten best performers were assessed by composite scores and as an incentive, a hero pen was given to them through their respective head of the institutions)

Data Collection for the First Phase of Study:

The period selected for data collection was August 1993 to October 1993. These are the three months during which most of the taluk level competitions would be conducted and completed. Hence,
most of the sports boys, in this season, were anticipated to be physically fit because of their active participation in sports/games competitions. Three days of two sessions each was fixed to collect the data of a high school, and where a greater number of students were available the duration for the process of data collection was extended by a day.

Significance of the study and need for active participation by the students had been explained by the researcher to the students during the first session of the first day. Age, weight, height and other required information was collected in the same session. Other 29 test variables were equally distributed for the remaining five sessions, by considering various factors that affect the performance of test items. Factors like muscular involvement, mode of administration, students' limitations, degree of difficulty of a test, fatigue factor etc. were considered to decide the order of the administration of tests. Sufficient rest between the tests, between the trials and between the sessions was given.

Initially students were provided an oral explanation regarding the tests followed by a demonstration by the tester. Boys were allowed to practice well before their active participation in the test. Only after the full acquaintance of students with the test, the test was administered. A specimen copy of the score sheet and data of 180 samples are provided in annexures A and B.
Objectivity and Reliability of Test Items:

Objectivity and reliability of the 32 selected test variables were obtained during January-march 1992 and November-December 1993. Small samples (ranging from 10 to 25 numbers) of students from four different high schools were considered for the administration of tests. Boys were given sufficient time to practice and to familiarize themselves with the test. Three to five trials of tests were given, depending upon the intensity of the test. For the tests which demand muscular endurance, only one trial was taken.

Objectivity of the tests was obtained by administering the test by two testers on the same sample, same day and at two different sessions. Sufficient rest was given between the two sessions. Only Sit-Ups (Bent Knee-Limit) was conducted by two testers on two different days.

Reliability of the test items was obtained by the test-retest method. The tests were administered by a tester on two different days and on the same sample. For tests which require minimum physical efforts (Tapping by Hand, Tapping by Leg, Reaction Speed test and Sideward Jump), tests were re-administered the same day.

The data was subjected to statistical computations in IBM PCAT Computer by using statistical package for social sciences (SPSS). A physical fitness test battery was constructed on the basis of the findings of the statistical analysis. The test battery so constructed, included six test variables.
The Second Phase of Study

standardisation of Physical Fitness Test of High School Boys

Initially, the constructed physical fitness test with details of test administrations (as mentioned early in this chapter) and a score sheet was prepared. These details were given to four physical education teachers of nearby high schools for pre-testing. The results were found satisfactory. The details of test administrations were also corroborated with required explanations in the local language viz., Kannada.

A permission letter from the Deputy Director of Public Instructions, addressed to the Head of the Institutions, was obtained for authenticity. In addition a personal request letter to the concerned physical education teachers of schools was prepared in the regional language. A copy of the letters in their translated form (viz., English) and a score sheet are given in annexures C, D & E.

The details of test administration along with two covering letters mentioned above and score sheets were mailed to 300 (out of 334) high schools of Dakshina Kannada District. The concerned physical education teachers were requested to administer the constructed physical fitness test to their respective high school boys of the age group of 13 to 15 years. Minimum sample requested from a school was 30 numbers (Ten students from each age group) A month's time was given to respond back.
As an outcome of the interest and enthusiasm shown by the physical education teachers of 66 high schools, the researcher received quite a good number of samples. These physical education teachers, took personal interest and administered the physical fitness test on 2636 high school boys in all.

Among 234 left out institutions, 30 high schools were again selected by random sampling and also by considering geographical distribution of the schools. The investigator personally visited these 30 identified schools for data collection. The minimum number collected from a school was 45, and wherever student strength was greater, 15 per cent of the total strength of a school was considered. In total, the researcher administered the constructed physical fitness test on 1905 high school boys of the age group of 13 to 15 years. The data of the first phase of study (N=125) was also included for standardising the test.

In all, the constructed physical fitness test was administered to a fairly large sample of N=4666 high school boys, (13 to 15 years age group) belonging to 96 different high schools of Dakshina Kannada District from eight different taluks [raw scores and list of high schools (taluk-wise) are given in annexures F and G ]

Raw scores were converted into standard scores, represented by T-scores. T-scale norms have been developed for boys of the age group of 13, 14 and 15 years.
Analysis of Data

The analysis of data was done, by using Product Movement Correlations, Multiple Correlations, Factor Analysis and Multiple Regression Analysis.