CHAPTER 3

METHODOLOGY
CHAPTER III

METHODOLOGY

The purpose of the study was to find out whether there would be any significant improvement on selected variables as a result of floor aerobics, step aerobics and aqua aerobics exercise. In this chapter, selection of subjects, experimental variables, tester reliability, instrumental reliability, orientation of the subjects, test administration, and statistical techniques were discussed.

3.1 SELECTION OF SUBJECTS

120 students studying in Teacher Training Institutes in Coimbatore, volunteered to be the subjects of this research were randomly selected. The selected subjects were of age group of 18 to 22 years. The subjects were randomly divided into four groups of 30 subjects in each group. Group one acted as experimental group I and group two acted as experimental group II, group three acted experimental group III and group IV acted as control group.

3.2 SELECTION OF VARIABLES

The research scholar reviewed the various scientific literatures pertaining to the floor aerobics, step aerobics and aqua aerobics on selected physical fitness components, physiological and psychological variables from books, journals, periodicals, magazines and research papers. Taking into consideration of feasibility, criteria, availability of instruments and the relevance of the variable
of the present study, the following dependent and independent variables were selected.

### 3.2.1 Dependent Variables

**Physical Fitness Variables**

1. Endurance
2. Muscular Strength
3. Speed

**Physiological Variables**

1. VO$_2$ max
2. Vital Capacity
3. Anaerobic power

**Psychological Variables**

1. Intelligence Quotient
2. Mental Health
3. Cognitive Style

### 3.2.2 Independent Variables

1. Floor aerobics
2. Step aerobics
2. Aqua aerobics
3.3 EXPERIMENTAL DESIGN

Pre test and post test randomized group design was applied to this research. The subjects, numbering 120, selected randomly were assigned into four groups. Each group consists of thirty subjects. All the subjects were measured of the selected physical variables: endurance, muscular strength and speed, physiological variables: VO₂ max, vital capacity and anaerobic power and psychological variables: intelligence quotient, mental health and cognitive style. This initial test scores formed as pre test scores of the subjects.

Experimental Group I was assigned to undergo floor aerobic exercises, experimental group II was assigned to undergo step aerobic exercises, experimental group III was assigned to undergo aqua aerobic exercises and the control group was not given any treatment. The experimental period was for 12 weeks. After the experimental treatment, all the subjects were measured of the selected physical, physiological and psychological variables. This final test scores formed as post test scores of the subjects. The pre test and post test scores were subjected to statistical analysis using Analysis of Covariance (ANCOVA) to find out the significance among the mean differences.

3.4 PILOT STUDY

The pilot study was conducted before analyzing of training programme to ensure the suitability, frequencies, and duration of exercise. Further it helps to know the subjects capacity to know the satisfactory effects and know the
difficulty of conducting training programme and to set a clear understanding about the duration of time, which is required for conducting the test.

3.5 CRITERION MEASURES

By referring the literature and consultation with professional experts the following variables were selected as the criterion measures in this study for testing the hypothesis.

1. Cardiovascular Endurance was measured through Physical Efficiency Index followed by Harvard Step Test. The test was developed by Brouha et al. (1943) in the Harvard Fatigue Laboratories and used in numerous researches with validity of correlation coefficient of 0.6 to 0.8. The formula used for calculating PEI is as follows:

\[
\text{PEI} = \frac{\text{Duration of Exercise in Seconds} \times 100'}{2 \times \text{Sum of pulse counts in recovery}}
\]

2. Muscular Strength was measured through One Repetition Maximum (1RM) test. The following formula as prescribed by Brzycki, (1998) was used to calculated 1 RM. The validity correlation coefficient ranges from 0.5 to 0.8.

\[
1 \text{ RM} = w/ [1.0278 - (0.0278 x r)]
\]

where \( w \) = amount of weight used and \( r \) = number of repetitions performed

3. Speed was measured through 50 M run. The validity correlation coefficient was found to be high in numerous research and it varied from 0.7 to 0.8.
4. To measure VO₂ max Cooper Test was used. The validity correlation coefficient was found to be from 0.5 to 0.7. The formula suggested by Cooper is:

\[
VO₂ \text{ max} = \frac{d_{12} - 505}{45}
\]

where \(d_{12}\) is the distance (in meters) covered by the subject in 12 minutes run / walk test.

5. Vital capacity was measured through Spirometer, which has high validity.

6. Margaria – Kulamen Power Test To Measure Anaerobic Power

7. Intelligence Quotient was measured through the Wechsler Adult Intelligence Scale (WAIS).

8. Mental Health was measured through Psychological Mental Health Scale authored by Peter Becker,(1989).

9. Cognitive Style was measured through Cognitive Style Inventory developed by Dr. Praveen Kumar Jha.

3.6 RELIABILITY OF THE DATA

The reliability of the data was ensured by establishing the instrument reliability, tester reliability of the tests and subject’s reliability.
3.6.1 Reliability of Instruments

The research scholar used the following instruments for measuring various tests: stop watch, measuring tape, Spirometer were used to find out the reliability of the instruments. Further, those instruments have been calibrated in slandered units, each of the variables were recorded. All the instruments were in good working condition. Their calibration were tested and found to be accurate enough to serve the purpose of the study.

3.6.2 Testers Reliability

To ensure that the investigator and other associated were well versed with the technique of conducting the test. The investigator had a number of practice session in testing procedure under the guidance of the expert. The reliability coefficient was established by test, re-test method and the correlation were obtained by interclass correlation.
Table I

INTRA-CLASS COREELATION COEFFICIENTS OF TEST RETEST SCORES

<table>
<thead>
<tr>
<th>S.No</th>
<th>Test</th>
<th>Coefficient of Correlation</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Cardiovascular Endurance</td>
<td>0.78*</td>
</tr>
<tr>
<td>2</td>
<td>Muscular Strength</td>
<td>0.77*</td>
</tr>
<tr>
<td>3</td>
<td>Speed</td>
<td>0.78*</td>
</tr>
<tr>
<td>4</td>
<td>VO₂ max</td>
<td>0.77*</td>
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<tr>
<td>5</td>
<td>Vital Capacity</td>
<td>0.76*</td>
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<tr>
<td>6</td>
<td>Anaerobic Power</td>
<td>0.75*</td>
</tr>
</tbody>
</table>

* Significant at 0.01 level.

As for the psychological variables tested, the investigator administered standard questionnaire to measure intelligence quotient, mental health and cognitive style. The correlation coefficient determined by the authors for its reliability and validity were enough to serve the purpose of the study.
3.6.3 Subject Reliability

The intra-class correlation value of the above test and retest also indicated subject reliability as the same subjects were used under similar conditions by the same tester.

Prior to the test administration the exercise and the test procedure were explained in detail to subjects to ensure proper understanding and secure effective cooperation so as to derive reliable data from the tests. Demonstration was done before the students prior to the actual collection of data. The training programme was under the personal supervision of the research scholar.

3.7 COLLECTION OF DATA

The purpose of the study was to estimate the effects of floor aerobics step aerobics and water aerobics on the selected physical, physiological and psychological variables among teacher training men students. For this purpose, the research scholar collected data from the selected subjects divided into four homogeneous groups. Among the four groups, the control group was strictly under control, without undergoing any special activity. The experimental groups were subjected to the experimental treatments.

The experimental treatments were given for 40 minutes in floor aerobics, step aerobics and aqua aerobics for twelve weeks, five days a week, except Saturdays and Sundays.
The experimental groups were well acquainted with their allotted techniques and did only the experimental variables given to them during the experimental period under the personal supervision of the research scholar. Data on pre test scores were collected prior to the experiment post test scores after the experimental period of twelve weeks from all the four groups.

3.8 TRAINING PROCEDURE

3.8.1 Floor Aerobics Training

The experimental group 1 performed the aerobic exercises after proper warming up.

I. Marching on the Spot

Starting Position

The subject stood with both feet at shoulder width distance and the arms were bent on either side of the body in a relaxed position.

Marching on the spot was performed by the subject raising the legs alternatively with the slight flexion at the knees, along with alternate arm movements.

On the spot marching was performed for 32 counts with alternate arm movements.

II. Touch Out

1. The left leg was stretched two feet to the left side and touched the ground, simultaneously both the arms were stretched at shoulder level.
2. The left leg was brought back to the starting position

3. Counts 3 and 4 were repetition of 1 and 2 with right leg and arms.

**Number of Sets**

Eight sets were performed continuously for a total of 32 counts.

**III. Side to Side**

1. The left leg was placed one step to the left and simultaneously both the hands were placed on the hip.

2. With the side ward movement, the right leg was placed near the left leg.

3. The right leg was brought back to the starting position

4. The left leg was brought back to the starting position.

5. Counts 5 to 8 were repetitions of 1 to 4 on the right side.

**Number of Sets**

Four sets were performed continuously on left and right side alternatively for a total of 32 counts.

**IV. Double Side to Side**

1. The left leg was placed one step to the left and simultaneously both the hands were placed on the hip.

2. With the sideward movement the right leg was placed near the left leg simultaneously the hands were brought back to the position.
3. Count 1 was repeated further towards the left side.

4. Count 2 was repeated.

5. Counts 5 to 8 were repetitions of 1 to 4 towards the right side to return to the starting position.

The same procedure was followed for the double side to side starting with the right leg for counts 9 to 16.

**Number of Sets**

Two sets were performed continuously on left and right side alternatively for a total of 32 counts.

**V. Grapevine**

1. The left leg was placed one step to the left and simultaneously both the hands were placed on the hip.

2. The right leg was placed behind the left leg with the heels raised.

3. The right leg was brought back to the starting position

4. The left leg was brought back to the starting position

5. The same procedure was followed on the right side for counts 5 to 8.

**Number of Sets**

Four sets were performed continuously for a total of 32 counts.
VI. Cross over Step

1. Raised the left heel up and swung the right arm forwards

2. The same step was repeated with right leg and left arm

3. Stepped side wards with a cross over step with the right leg simultaneously the right arm was swung along with right leg by twisting the trunk downwards towards left side.

4. The subject returned to the starting position

Counts 5 to 8 were repetitions of 1 to 4 with left leg and left arm

Number of Sets

Four sets were performed continuously on left and right side alternatively for a total of 32 counts.

VII. Jump on the Spot

1. The subject jumped slightly upwards simultaneously both arms were stretched forward and upward up to either side of the head.

2. The subject performed one more additional jump

3. The legs were brought back to the starting position simultaneously with a downward movement of the arms up to the shoulder level.

4. The arms were brought back to the starting position

Number of Sets

Eight sets were performed continuously for a total of 32 counts.
VIII. Knee Curl

1. The left leg was placed one step to the left side and simultaneously both the hands were placed on the hip.

2. The right leg was lifted diagonally towards left side with the knee flexed.

3. The right leg was brought back to the starting position

4. The left leg and arms were brought back to the starting position.

5. The above steps were repeated on the right side for counts 6 to 8.

Number of Sets

Four sets were repeated continuously for a total of 32 counts.

IX. Front Kick

1. With a jump the left thigh was raised to hip level and simultaneously both the hands were placed on the hip.

2. After landing again with a jump the left leg was kicked forwards.

3. After landing again with a jump the left leg was brought back to the count 1 position.

4. The left leg and arms were brought back to the starting position

5. Counts 5 to 8 were repetitions of 1 to 4 on the right leg.
**Number of Sets**

Four sets were repeated continuously for a total of 32 counts.

**X. Knee and Arm Lift**

1. The left foot was placed one step to the front and simultaneously the left arm flexed at elbows with clenched hand was raised side wards at right angle to the shoulder level. The right hand was placed on the hip.

2. The right knee was lifted forward at right angle to the hip and flexed left arm was moved forward from the sideward position

3. The right foot and left arm were brought back to count 1 position

4. The left foot and arms were brought back to the starting position.

**Number of Sets**

Four sets were repeated continuously for a total of 32 counts.

**3.8.2 STEP AEROBICS TRAINING**

The experimental group II performed the step aerobics exercises after proper warm-up.

**I. ‘V’ Step**

1. The subject placed the left foot forward and diagonally out to the left side at 45 degree angle to mount on the stepper and simultaneously placed the hands on hip.
2. The same step was performed with the right leg to the right side so that both the legs were on top of the stepper.

3. The left foot was brought back to the starting position.

4. The right foot and hands were brought back to the starting position.

Counts 5 to 8 were repetitions of counts 1 to 4 with right foot as the lead foot.

**Number of Sets**

Four sets were performed continuously on both left and right side for a total of 32 counts.

**II. Leg Curl**

1. The left foot was placed diagonally forward at 45 degree angle to mount on the stepper and simultaneously both the hands were placed on the hip.

2. The right leg was swung diagonally forward to the left side with the knee flexed.

3. The right leg was brought back to the starting position.

4. The left leg and arms were brought back to the starting position.

Counts 5 to 8 were repetitions of counts 1 to 4 with right leg as the lead leg.

Number of Sets: Four sets were repeated continuously on both left and right side alternatively for a total of 32 counts.
III. Toe Tap

1. The left foot was brought forward and the toes were tapped on the stepper.

2. The toes were tapped again and the foot was placed in an outward angle at about 45 degree while mounting on the stepper.

3. The right foot was placed across the stepper.

4. With a pivot turn of the right foot the left foot was brought near the right foot.

Counts 5 to 8 repetitions of counts 1 to 4 continued in the reverse direction starting with right foot as lead foot to reach the starting position.

Number of Sets:

Four sets were repeated continuously left and right side alternatively for a total of 32 counts.

IV. Trunk Twist with Extended Arms

1. The left foot was placed forward to mount on the stepper.

2. Right foot was placed forward to mount on the stepper.

3. Both the arms were extended sideways at shoulder height.

4. The trunk was twisted to the left side about 90 degree.

5. Returned to count 3 position.

6. Returned to count 2 position.
7. The right foot was brought to the starting position.

8. The left foot was brought to the starting position.

Counts 9 to 16 were repetition of counts 1 to 8 with the right foot as lead foot.

**Number of Sets**

Two sets were performed continuously on left and right side alternatively for a total of 32 counts.

V. Front Kick

1. The left foot was placed forward to mount on the stepper.

2. The right knee was flexed and raised to the hip level and kicked forward.

3. The right leg was brought back to the starting position.

4. The left leg was brought down to the starting position.

Counts 5 to 8 were repetitions of counts 1 to 4 with right foot as the lead foot.

**Number of sets**

Four sets were performed continuously on both left and right side alternatively for a total of 32 counts.
VI. Slice

1. The left foot was placed forward to mount on the stepper and simultaneously arms were raised upward above the head, palms facing forward.

2. Right foot was placed forward to mount on the stepper and simultaneously the arms pulled downwards with clenching the hands, and fists to the shoulder level.

3. Left arm was extended downwards along the side of the leg and simultaneously the right arm was raised upward straight above the head.

4. Pulled both fists back to the shoulder.

5. Right arm was extended downwards along the side of the leg and simultaneously the left arm was extended straight above the head.


7. Returned to count 1 position.

8. Returned to the starting position.

Number of Sets

Four sets were performed on left and right side alternatively for a total of 32 counts.
VII. 90 Degree Turn with Single Arm Extension (or) Stretch

1. The left foot was brought diagonally forward to the left at 45 degree angle to mount on the stepper, and simultaneously right elbow was fixed at the side of the trunk with clenched hand, and flexed the elbow.

2. The right foot was swung diagonally forward to the left and straddle down across the stepper, and simultaneously extended the right arm sideward at shoulder height.

3. A left turn was made by the right foot and simultaneously flexed the elbow and the left leg was brought close to the right leg.

4. The right arm was brought back to the position

Counts 5 to 8 were marching on the spot, with alternate leg and arm movements.

Counts 9 to 16 were repetitions of 1 to 8 continued in the reverse direction with the right foot as lead foot to return to starting position.

Number of Sets

Two sets were performed continuously on left and right side for a total of 32 counts.

VIII. Side Kick

1. The left foot was placed forward to mount on the stepper.

2. The right leg was raised to hip level and kicked side wards.
3. The right leg was brought back to the starting position.

4. The left leg was brought back to the starting position.

Counts 5 to 8 were repetitions of counts 1 to 4 with right foot as the lead foot.

**Number of Sets**

Four sets were repeated continuously on both left and right side for a total of 32 counts.

**IX. ‘V’ Step with Flexed Knees**

1. The left foot was brought forward and placed diagonally on the stepper at 45 degrees angle.

2. The right foot was taken diagonally out forward at 45 degree angle to mount to form a ‘v’ step and hands were placed on the thigh.

3. With trunk kept erect it was lowered below the hip level.

4. Simultaneously the left shoulder was bent inward and forward towards the medial axis of the body.

For counts 5 and 6 the trunk was raised and simultaneously counts 3 and 4 were repeated on the right side.

7. The trunk was raised to the standing position and the right foot was brought back to the starting position.

8. The left foot and arms were brought back to the starting position.
Number of Sets

Four sets were performed continuously on left and right side alternatively for a total of 32 counts.

X. Straddle Down

1. The left leg was brought diagonally forward to the left at 45 degrees to mount on the stepper, simultaneously hands were placed on the hip.

2. The right leg swung forward to the left at 45 degree angle and the knee was flexed.

3. The right leg was straddle down across the stepper.

4. The left leg was straddle down on the starting side of the stepper.

5. A right turn was made by the right foot towards left, with a backward movement the left foot was placed on the stepper.

6. Repeated the movements of count 2.

7. Returned back to the count 5 position.

8. The left foot was brought closer to the right leg.

Counts 9 to 16 were repetitions of counts 1 to 8 continued in reverse direction to return back to the starting position.

Number of Sets : Two sets were performed continuously on left and right side for a total of 32 counts.
3.8.3 AQUA AEROBICS TRAINING

The experimental group III intended to experiment with aqua aerobics underwent the following aqua aerobic exercises after proper warming up.

1) Walking

The subject was asked to walk on the spot in waist high water. Be sure to touch the floor with whole foot, from heel to toe. Lift the knees up high, rather than forwards. Lift the arms up to the sides to keep balanced.

2) Jogging and Sprinting

The subject was asked to jog on the spot in chest high water. Push off with toes, landing on the balls of the feet. Use the same arm action as in normal jogging, keeping fingers straight to cut the water. Keep lifting knees high.

Pump the arms and legs as fast as can to sprint. Good technique is keeping the head high and core tight.

3) Jumping Jacks

The subject was asked to stand with feet together and arms by the side in chest high water. Jump up, spread feet apart and lift arms to shoulder height. Land on balls of the feet. Then jump again, bring feet back together and arms back down. That's one repetition.
4) Cross Country Skiing

The subject was asked to stand in chest high water with the right leg forward, left leg back and toes facing forward. Left arm straight out in front, right arm bent by the side. As the subject move her right leg back and left leg forward, punch the right arm ahead and bend her left arm back. Continue this action in a smooth movement.

5) High Knee Walk

In this the athlete was asked to lift his knee upto hip level where in the thigh would be horizontal to the floor and the other leg would be placed on the ground. The arms bent at 90 degree at the elbow. The body slight leaned forward in the water.

6) Leg Back Kick Walk

The athlete walked forward slowly in water, kicking up the heels to the rear and attempting to hit the buttocks. The driving arms were bent at 90 degree at the elbow. The body slightly leaned forward in water.

7) High Knee Run

The runner slowly moved forward in water keeping the upper body slightly leaned forward. Looking ahead of the pool emphasized the knee being lifted to the hip level, with the arms driving forward and backward.
8) **Forward Lunge Walk**

The athlete moved forward in water with big steps, where both legs were stretched out. (Back leg was extended fully and the forward leg bending at 90 degree at the knee). Keeping the upper body straight with wider base of leg placement in order to maintain balance in water.

9) **Squat Walk Forward**

The athlete went down to the squat position leaned forward, the resistance of the water keeping the knees at 90 degree and line to the ankle. The athlete stepped forward to squat position and move on for 10 meters.

10) **Squat Walk Sideward (Both Side)**

The athlete stepped side ward to squat position .kept the upper body straight and knees bend at 90 degree .And moves in sideward direction in the water.

### 3.8.4 TRAINING SCHEDULE

Each training procedure was started light warm up and ended with cool down. The following schedule was followed.

**Warming Up Segment**

A ten minutes warming up session consisting of 200 meters jogging balanced combination of static stretches as smoothly controlled rhythmic calisthenics and limbering exercises were performed by the subjects prior to the training sessions.
Training period 12 weeks
Weekly 5 days
Duration 40 minutes/day
Warm up 10 minutes
Demonstrating 5 minutes
Conditioning 15 minutes
Warm down 10 minutes

**Cool Down Segment**

The aerobic sessions concluded with continued light aerobic activities such as walking, standing leg kicks and static stretches to prevent pooling of blood in the lower extremities immediately after the endurance phase and lower the heart rate gradually towards normal to promote faster removal of metabolic waste products from the muscles. Caution was taken to avoid bent-over stretches for long periods to avoid dizziness.

**3.9 TEST ADMINISTRATION OF PHYSICAL FITNESS COMPONENTS**

**3.9.1 Endurance**

**Purpose**

To measure the cardio respiratory endurance through Physical Efficiency Index.
**Equipments**

A stable bench 20 inches high and a stop watch.

**Procedure**

1. The subject step up and down 30 times a minute on a bench 20 inches high. Each time the subject should step all the way up on the bench with the body erect. The stepping process is performed in four counts, as follows: 1. one foot is placed on bench, 2. other foot is placed on the bench; 3. one foot is placed on the floor; 4. the other foot is placed on floor. The tester may lead off with the same foot each time or any change feet as he desires, so long as the four count step is maintained. The steps were counted the cadence as ‘up, up, down, down’.

2. The stepping exercise continues for exactly five minutes. unless the subject is forced to stop sooner due to exhaustion. In either case the duration of the exercise in seconds is recorded; the maximum number of seconds is 30 for the full five minute period.

3. Immediately after completing the exercise, the subject sits on a chair. The pulse is counted 1 – 1½, 2 – 2½ and 3 – 3½ minutes after the stepping ceases.
Scoring

A physical efficiency index (PEI) is computed utilizing the following formula:

\[
PEI = \frac{\text{Duration of Exercise in Seconds} \times 100'}{2 \times \text{Sum of pulse counts in recovery}}
\]

3.9.2 One Repetition Maximum (1 RM)

Purpose

To measure the muscular strength of the subjects.

Equipment

Barbells with weights

Procedure

The subject was asked to perform weight lifting with 30 Kgs weight in the ‘snatch’ method. In the snatch the subject started the initial drive which comes from the hips, gluteal, and quadriceps muscles. The bar proceeded upward and the torso stayed roughly at the same angle when the lifter set up. The lifter then extended their body when the barbell reached his pelvis. This extension created enough force that propelled the barbell upwards while the lifter dropped underneath to catch the barbell. Then the lifter will recover and stand up with the barbell. This would be repeated as many times as the subject could.
Scoring

1 RM was determined through Brzycki Formula (Brzycki, 1998) as detailed below:

\[ 1 \text{ RM} = \frac{w}{1.0278 - (0.0278 \times r)} \]

where ‘w’ is the weight and ‘r’ is the number of repetitions.

3.9.3 Speed (50 Meters Run)

Purpose:

To measure speed.

Equipments

An area on a track, football field or play ground with a starting line a 50 yard dash, and a finish line. Stop watches or spilt second timers.

Procedure

The subject took a position behind the starting line. The starter used the command, “ready” and “Go”. The latter was accompanied by a downward sweep of the arm as a signal to the timer. The subject ran across the finish line. One trial was permitted.

Scoring

The score was the elapsed time to the nearest one tenth of a second between the starting signal and the instant the subject crossed the finish line.
3.9.4. Test Administration of Physiological Variables

3.9.4 Cooper’s 12 Minutes Run or Walk Test

Purpose

To measure the VO$_2$ max (cardio respiratory endurance)

Equipment

Whistle, stopwatch, 400 meters track.

Description

Subjects assemble behind the starting line at the starting signal, they, run or walk as far as possible with in the 12 minutes time limit. An experienced pacer should accompany performers around the running area during the actual test. At the signal ‘to stop ‘performers should remain where they finished long enough for test administrators to record the distance covered. Ample time should be given for stretching and warm-up as well as cool down.

Scoring

The distance in meters covered in 12 minutes

The VO$_2$ max in ml/min/kg was calculated based on the formulae suggested by Cooper (1960) was:

$$VO_2 \text{ max} = \frac{d_{12} - 505}{45}$$

Where, $d_{12}$ is the distance (in meters) covered in 12 minutes.
3.9.5 VITAL CAPACITY

Purpose

The purpose of this test was to find out the maximum quantity of air that can be expired after a full inspiration.

Equipment

Spirometer, mouth pieces and nose clips.

Procedure

Vital capacity was measured by Spirometer in liters. The Spiro meter was equipped with a good length of rubber hose. The Spiro meter placed at a height where by all the subject can stand erect at the beginning of the test. The mouth piece was disinfected by an antiseptic solution after use by each subject.

The subjects were asked to take a deep breath for test: There after the fullest possible inhalation, the subject exhaled slowly and steadily bending forward over the hose till the air within his control was expelled.

Care was taken to prevent air from escaping either through nose or around the edges of mouth piece and was also ensured that a second breath was not taken by the subject during the test. Incase of doubt the test was repeated. Care was taken to lower the drum without spilling the water, each time after use.
Scoring

The score was taken from the dial of the Spiro meter which was recorded in \(1/100^{th}\) of a liter.

3.9.6 Margaria – Kulamen Power Test to Measure Anaerobic Power

Purpose

To measure the immediate anaerobic power output.

Procedure

The subjects began at point A and runs as rapidly as possible up a flight of stairs taking three steps at a time. The time to cover the distance between stair 3 and stair 9 was recorded to the nearest one hundredth of a second.

Scoring

Power output was the product of the subject’s weight (F) and vertical distance (D) divided by the time (T) which can be represented by the following formulae (McArdle et.al. 1996):

\[
P = \frac{F \times D}{T}
\]

TEST ADMINISTRATION OF PSYCHOLOGICAL VARIABLES

3.9.7 Intelligence Quotient

Purpose

To measure intelligence quotient of the subjects
The Wechsler Adults Intelligence Scale (WAIS), developed by David Wechsler, is an intelligence test for adults.

Description of the Tool Used

The Wechsler Adults Intelligence Scale is a battery of tests that evaluates intellectual abilities. This consists of two scales, the Verbal Scale and the Performance Scale. Each of these scales has several subtests.

The Verbal Scale measures language expression, comprehension, listening, and the ability to apply these skills to solving problems. The examiner gives the questions orally, and the subject gives a spoken response. The Performance Scale assesses nonverbal problem solving, perceptual organisation, speed, and visual-motor proficiency. Included are tasks like puzzles, analysis of pictures, imitating designs with blocks, and copying.

Test scores change over time due to chance, error, and many other factors. A Percentile rank expresses the relative position of a score. For example, a percentile rank of 98 means that the subject has scored as well as or better than 98% of students of the same age on that subtest. The confidence interval indicates the probable range of scores which can be expected when this individual is retested. Subtest scaled scores (listed below) range from 1 to 19.
<table>
<thead>
<tr>
<th>Verbal Subtests</th>
<th>Scaled Score</th>
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<th>Performance Subtests</th>
<th>Scaled Score</th>
<th>%ile Rank</th>
<th>Description</th>
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<tbody>
<tr>
<td>Picture Completion</td>
<td></td>
<td></td>
<td>Alertness to essential detail</td>
</tr>
<tr>
<td>Coding</td>
<td></td>
<td></td>
<td>Visual motor co-ordination, speed, concentration</td>
</tr>
<tr>
<td>Picture Arrangement</td>
<td></td>
<td></td>
<td>Sequential, logical thinking</td>
</tr>
<tr>
<td>Block Design</td>
<td></td>
<td></td>
<td>Spatial, abstract visual problem solving</td>
</tr>
<tr>
<td>Object Assembly</td>
<td></td>
<td></td>
<td>Visual analysis, construction of objects</td>
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<tr>
<td>Symbol Search</td>
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<td></td>
<td>Speed of processing novel information</td>
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<tr>
<td>Mazes</td>
<td></td>
<td></td>
<td>Fine motor co-ordination, planning, following directions</td>
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</tbody>
</table>
Wechsler IQ tests include the subtests below:

**Verbal scales**

**Information:** Similar to "Trivial Pursuit," this subtest measures fund of factual information. It is strongly influenced by culture. An Indian education and intact long-term memory will contribute to a higher score. Sample question (not really on the tests): "What is the capital of France?"

**Comprehension:** This subtest measures understanding of social conventions and common sense. It is also culturally loaded. Sample question: "What is the thing to do if you find an injured person laying on the sidewalk?"

**Digit Span:** Requires the repetition of number strings forward and backwards. Measures concentration, attention, and immediate memory. Lower scores are obtained by persons with an attention deficit or anxiety.

**Similarities:** This subtest measures verbal abstract reasoning and conceptualization abilities. The individual is asked how two things are alike. Sample question: "How are a snake and an alligator alike?"

**Vocabulary:** This test measures receptive and expressive vocabulary. It is the best overall measure of general intelligence (assuming the test-taker's native language is English). Sample question: "What is the meaning of the word 'articulate'?"
Arithmetic: Consists of mathematical word problems which are performed mentally. Measures attention, concentration, and numeric reasoning. Sample question: "John bought three books for five rupees each, and paid ten percent sales tax. How much did he pay all together?"

Performance Scales:

Object Assembly: Consists of jigsaw puzzles. Measures visual-spatial abilities and ability to see how parts make up a whole.

Block Design: One of the strongest measures of nonverbal intelligence and reasoning. Consists of colored blocks which are put together to make designs.

Digit Symbol / Coding / Animal House: Symbols are matched with numbers or shapes according to a key. Measures visual-motor speed and short-term visual memory.

Picture Arrangement: Requires that pictures be arranged in order to tell a story. Measures nonverbal understanding of social interaction and ability to reason sequentially.

Picture Concepts: Requires matching pictures which belong together based on common characteristics. Measures non-verbal concept formation and reasoning; a non-verbal counterpart of Similarities.
**Picture Completion:** Requires recognition of the missing part in pictures. Measures visual perception, long-term visual memory, and the ability to differentiate essential from inessential details.

**Matrix Reasoning:** Modeled after Raven's Progressive Matrices. This is an untimed test which measures abstract nonverbal reasoning ability. It consists of a sequence or group of designs, and the individual is required to fill in a missing design from a number of choices.

**Scoring**

Following the above principles of thirteen sub tests divided into two broad classifications, namely, verbal scales and performance scales, the investigator graded the subjects for 50 marks for verbal scales and 50 marks for performance scales. The performance of the subject or the marks scored by the subject was in verbal scales and the performance scales put together for a total score of 100 was taken as the scores of the performance of the subjects intelligence quotient.

**3.9.8 Mental Health**

The mental health scale was selected from Trier Personality Inventory (TPI) developed by Peter Becker (1989), to assess the subject’s mental health consisting of 20 statements. Each item has four answers namely, ‘always’, ‘often’, ‘sometimes’ and ‘never’. 
Method of Scoring

Totally this inventory consisted of 20 statements and each statement was responded to items of ‘always’, ‘often’, ‘sometimes’, and ‘never’ answers. First 20 items were coded uniformly according to the following coding key. The answers categories as follows

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<thead>
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<tbody>
<tr>
<td>Always</td>
<td>4</td>
</tr>
<tr>
<td>Often</td>
<td>3</td>
</tr>
<tr>
<td>Sometimes</td>
<td>2</td>
</tr>
<tr>
<td>Never</td>
<td>1</td>
</tr>
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</table>

The twenty items were divided into two categories such as items which indicate minus sign behind the number (straight coding direction).

The minus sign behind the number of an item indicates the reversal of the coding – direction. Further, the first value of items subtracted from ‘5’ as it was mentioned in the analysis sheet in the case of minus sign behind the number if a subject answers item ‘20’ with ‘often’, this answer at first gets the score ‘3’. But since the corresponding field on the analysis sheet should be ‘5’ the first value must be subtracted from ‘5’ (5-3 =2). So that the final score is 2 and in case of an item which is not having minus sign behind the item indicated straight coding direction as ‘4’, ‘3’, ‘2’. Thus, ‘often’ this answer gets a score of ‘3’, so the final score is also ‘3’.

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The item that indicate straight coding direction are 1, 2, 3, 4, 5, 8, 9, 10, 12, 14, 17, 18. The items which indicates minus sign behind number of 6, 7, 11, 13, 15, 16 and 20. The minimum score is 20 and the maximum is 80. The higher score indicates more presented of mental health and the lower the score ‘20’ indicate less presence of mental health of the subjects. (Peter Becker, 1989)

3.9.9 Cognitive Style

Description of the Questionnaire

To analyse the cognitive style of state level football, volleyball and handball players, the subjects selected were administered of the Cognitive Style Inventory questionnaire developed by Praveen Kumar (2001). The questionnaire consists of 40 statements with responses of five point-Likert format. The five response categories are: Strongly disagree, disagree, undecided, agree and strongly agree. For each statement, the respondent has to refer to the above scale and decide which number corresponds to his level of agreement with the statement and write that number in the blank space provided on the left of each statement.

Scoring

The responses are scored by adding all the response numbers as indicated in left of each item which yield a systematic score and an intuitive score. These scores are interpreted for comparison between the groups selected for this study.
3.10 STATISTICAL TECHNIQUES USED FOR ANALYSIS

Analysis of covariance (ANCOVA) statistical technique was used to find out the adjusted mean difference among the variables. Scheffe’s post hoc test was used to find out the paired adjusted mean difference when the study was significant.