Chapter - III

METHODOLOGY

This chapter deals with the procedure followed in the selection of the subjects, selection of variables, selection of tests, instrument reliability, reliability of the data, pilot study, orientation to the subjects, training programme, collection of data, test administration, experimental design and statistical procedures.

3.1 Selection of subjects

The purpose of the study was to find out the effect of physical education programme and handball drills on selected health related fitness and physiological variables among high school handball players. To achieve the purpose of the study 255 students given their willingness to act as subjects, out of whom 60 male subjects were selected at random from government high school, Dindigul, Tamilnadu, India. The age of the participants ranged between 12 and 15 years. The selected subjects were randomly divided into three groups namely physical education group, handball drill group and control group with twenty subjects (n=20) in each group. Experimental groups underwent physical training and the control group did not undergone any training programme apart from their regular curricular activity. All subjects were informed about the nature of the study and their consent was obtained to co-operate till the end of the experiment and testing period. The subjects were free to
withdraw their consent in case they felt any discomfort during the period of their participation, but there were no dropouts. A qualified physician examined the subjects medically and declared them fit for the study.

**3.2 Selection of variables**

The investigator had gone through the relevant literature in the area of physical education programme, handball drill and their various aspects in association with the guide and other experts in this area. The variables were selected after considering the feasibility and availability of proper techniques and instruments. In this experimental study, two experimental groups and one control group were employed to assess the difference.

**3.3 Justification of variables selection**

**3.3.1 Independent Variable**

There are many methods prevailing to develop health related fitness and physiological variables, the role of physical education programme and handball drill is an undisputed one. Previously many researchers have carried out in the effect of different training programmes, training like resistance, endurance and yogic. The review of related literature presented that there is further scope for research in India as well overseas in the area of training through their effect of physical education programme and handball drill on physical and physiological variables.
In this context the researcher made an attempt to find-out the effect of physical education programme and handball drills on selected health related fitness and physiological variables as given below.

**Physical education programme such as.**

1. Free hand exercises.
2. Light apparatus exercise (Dumbbells, warns, lazime and hoops)
3. Minor games (Relay games, Ball relay games and tag games )
4. Aerobic dance.

**Handball Drill such as.**

1. Chest pass
2. Overhead pass
3. Bounce pass
4. Wrist pass
5. Two men pass
6. Long pass
7. Run with ball passing relay
8. Jump and shoot
9. High dribble
10. Low dribble

Hence, the coaches and athletes who have advantage of different means and methods of training always change from one method of training. Each method of physical education programme and handball drill was scientifically designed to achieve specific training goals. Thus physical education programme and handball drill on selected health related fitness and physiological variables were considered as experimental variables in the present study.
3.3.2 Dependent Variables

The following health related fitness and physiological, variables namely

**HEALTH RELATED PHYSICAL FITNESS COMPONENTS**

1. Muscular strength,
2. Muscular endurance
3. Flexibility
4. Cardio respiratory endurance
5. Body composition

**PHYSIOLOGICAL VARIABLES**

1. Resting pulse rate,
2. Breath holding time,
3. Systolic blood pressure
4. Diastolic blood pressure
5. Vital capacity

were selected as dependent variables. In modern sports to meet the increasing competition demands, more training intensity is required. Sports and exercise science investigators often evaluate how different training regimes affect health related fitness and physiological variables, such as muscular strength, muscular endurance, flexibility, cardiovascular endurance, resting pulse rate, breath holding time, blood pressure and vital capacity.

The first step towards an enhancement of health related fitness and physiological quality at any age is to establish a systematic, productive, safe, and enjoyable conditioning programme that addresses the following factors: muscular strength, muscular endurance, flexibility, cardio respiratory endurance, body composition, breath holding time, systolic and systolic blood pressure,
resting pulse rate and vital capacity. So the researcher justifies the selection of dependent variables were presented as follows.

3.3.3 Muscular Strength

Muscular strength is the greatest amount of force a muscle or muscle group can exert in a single effort. Reliable and valid evaluation of hand strength is of importance in determining the effects of different procedures. It is widely accepted that, maximum strength measurements provide an objective index of the functional integrity of the upper extremity Balogun (1991). Crosby et al., (1994) investigated normative values of hand strength and claimed that the population as a whole demonstrated significant differences between the dominant and nondominant.

3.3.4 Muscular Endurance

Muscular endurance is the ability of a muscle or muscle group to do repeated contractions against a less-than-maximum resistance for a given time. On today’s playfield in addition to cardio respiratory fitness, athletes need a high level of muscular endurance and strength. Muscular fitness has two components: muscular strength and muscular endurance.

Although muscular endurance and strength are separate fitness components, they are closely related. Progressively working against resistance will produce gains in both of these components Hoff et.al. (2002).
3.3.5 Flexibility

Flexibility is an important component of your fitness program. Many activity-related injuries have their root in lack of flexibility. Think of your muscles as rubber bands. When they are cold they are rigid and brittle. When warm they stretch and retract more easily. Conducting a good warm-up prior to exercising and a good cool-down upon completion will help prevent injury and reduce muscle soreness. No matter what your current fitness level, you should always begin your exercise sessions with a warm-up, when your muscles are their warmest is the best time to improve your flexibility. Do not limit flexibility exercises to warm-up and cool-down only. Take the time to dedicate sessions to flexibility. Hence, the researcher select this (flexibility) as criterion variable for assess the ability of the students after the training regimen (Pope and Herbert (1998)).

3.3.6 Cardio Respiratory Endurance

Cardio respiratory fitness, sometimes called cardio respiratory endurance, aerobic fitness, or aerobic capacity, is one of the five basic components of physical fitness (Baechle and Earle, 2000). Cardio respiratory fitness is a condition in which the body’s cardiovascular (circulatory) and respiratory systems function together, especially during exercise or work, to ensure that adequate oxygen is supplied to the working muscles to produce energy. Cardio respiratory fitness is needed for prolonged, rhythmic use of the body’s large muscle groups. A high level of Cardio respiratory fitness permits continuous physical
activity without a decline in performance and allows for rapid recovery following fatiguing physical activity.

Activities such as running, road marching, bicycling, swimming, cross-country skiing, rowing, stair climbing, and jumping rope place an extra demand on the cardiovascular and respiratory systems. During exercise, these systems attempt to supply oxygen to the working muscles. Most of this oxygen is used to produce energy for muscular contraction. Any activity that continuously uses large muscle groups for 20 minutes or longer taxes these systems. Because of this, a wide variety of training methods is used to improve cardio respiratory endurance (Bompa 1999). The above factor’s were directly influence on the health aspect further most the physiological system so that the researcher has taken-up this criterion variable as appropriate for his study.

3.3.7 Body Composition

Body composition, which refers to the body’s relative amounts of fat and lean body mass (organs, bones, muscles), is one of the five components of physical fitness. Good body composition is best gained through proper diet and exercise. Examples of poor body composition are underdeveloped musculature or excessive body fat (Johnston et.al. 1997).

Body composition is influenced by age, diet, fitness level, and genetic factors. In such cases, the lean body mass accounts for a large share of their total body composition, while only a small percentage of the total body mass is composed of fat. Athletes who do not meet the
weight standards for their height and/or athletes whose appearance suggests that they have excessive fat are to be evaluated using the circumference (girth measurement) method described (Orchard et al., 1997). Hence, the researcher mind about the growing modern life style, such health fitness variable were selected for this study.

3.3.8 Breath Holding Time

The body is still using more oxygen than normal after exercise, so that the system needs to breath more. The human body can’t hold your breath as long since your body is trying to get more oxygen. After exercise, the body’s demand for oxygen is still above the normal level. Exercise physiologists call this excess post-oxygen consumption Tyler, et al., (2001). In the initial stage, this is because your body is still working hard to regulate temperature, may still be sweating, is consuming energy "reloading" the energy systems, and is trying to get the body back to homeostasis. After this initial phase, you require less oxygen, but oxygen consumption can still be higher than normal for up to about an hour afterwards as your body processes lactic acid accumulation (Hoff et.al. 2002). Hence, the researcher select this as criterion variable for assess the ability of the students after the training routine.

3.3.9 Blood Pressure

Taking part in sport can involve a reduction of the blood pressure; only if this sport is practiced in a regular way (at least once
per week) without any competition. Indeed, during the effort the blood pressure rises in a moderate way for moderate efforts, but the blood pressure can reach very high values if the effort is extreme (Bompa (1999). In addition to its beneficial effect on the blood pressure, the regular practice of a sport involves a reduction of cholesterol, of the fatty mass to the benefit of the thin mass. Moreover, it exerts an anti-stress effect and makes blood more fluid. Thus, taking part in sport helps fight against the arteriosclerosis disease, responsible for the appearance of cholesterol plates in the arteries (the benefit is proportional to the intensity of the effort) (Hoff et.al. 2002). Hence, the researcher selected the blood pressure as criterion variable for changes due to the training, because of the BP is directly influence the respiratory as well as circulatory system of the human body.

### 3.3.10 Vital Capacity

The maximal volume of air forcefully expelled from the lungs after a maximal inspiration. It is a measure of the maximum amount of air the lungs can breathe in or out. A person whose vital capacity is less than 75 per cent of the expected value, is generally advised to consult a doctor for further testing before exercising vigorously. The maximum volume of air forcefully expired after maximal inspiration. The value decreases slightly during exercise (Hoff et.al. 2002). A measurement of the amount of air that can be expelled at the normal rate of exhalation after a maximum inspiration, representing the greatest possible breathing capacity (Orchard et al., (1997). Hence,
the researcher selected vital capacity to assess the lung capacity of the subjects.

**Table I shows the selected dependent variables for this study**

<table>
<thead>
<tr>
<th>S1.NO</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Health related Fitness components</strong></td>
</tr>
<tr>
<td>1.</td>
<td>Muscular strength</td>
</tr>
<tr>
<td>2.</td>
<td>Muscular endurance</td>
</tr>
<tr>
<td>3.</td>
<td>Cardio Respiratory Endurance</td>
</tr>
<tr>
<td>4.</td>
<td>Flexibility</td>
</tr>
<tr>
<td>5.</td>
<td>Body Composition</td>
</tr>
<tr>
<td></td>
<td><strong>Physiological variables</strong></td>
</tr>
<tr>
<td>1.</td>
<td>Breathe Holding Time</td>
</tr>
<tr>
<td>2.</td>
<td>Systolic Blood Pressure</td>
</tr>
<tr>
<td>3.</td>
<td>Diastolic Blood Pressure</td>
</tr>
<tr>
<td>4.</td>
<td>Resting Pulse Rate</td>
</tr>
<tr>
<td>5.</td>
<td>Vital Capacity</td>
</tr>
</tbody>
</table>
3.4 Selection of tests

After reviewing the available literature, the following standardized tests were selected and used to collect the relevant data on the selected dependent variables and they are presented in table II.

Table II
LIST OF CRITERION VARIABLES AND THEIR RESPECTIVE TESTS

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Variable</th>
<th>Equipment/Test</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>HEALTH RELATED FITNESS VARIABLES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Muscular Strength</td>
<td>pull ups</td>
<td>Numbers</td>
</tr>
<tr>
<td>2</td>
<td>Muscular Endurance</td>
<td>bend knee sit-ups</td>
<td>Numbers</td>
</tr>
<tr>
<td>3</td>
<td>Cardio Respiratory Endurance</td>
<td>1.5 mile run and walk</td>
<td>In Seconds</td>
</tr>
<tr>
<td>4</td>
<td>Flexibility</td>
<td>sit and reach</td>
<td>Centimeters</td>
</tr>
<tr>
<td>5</td>
<td>Body Composition</td>
<td>skin fold caliber</td>
<td>Percentage (%)</td>
</tr>
<tr>
<td></td>
<td><strong>PHYSIOLOGICAL VARIABLES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Breath Holding Time</td>
<td>Hold the Breath</td>
<td>In Seconds</td>
</tr>
<tr>
<td>2</td>
<td>Systolic Blood Pressure</td>
<td>Sphygmomanometer</td>
<td>mmHg</td>
</tr>
<tr>
<td>3</td>
<td>Diastolic Blood Pressure</td>
<td>Sphygmomanometer</td>
<td>mmHg</td>
</tr>
<tr>
<td>4</td>
<td>Resting Pulse Rate</td>
<td>Radial Pulse Rate for Minute</td>
<td>Numbers</td>
</tr>
<tr>
<td>5</td>
<td>Vital Capacity</td>
<td>Spirometer</td>
<td>Liters</td>
</tr>
</tbody>
</table>
3.5 Instrument reliability

Instruments like skin-fold caliber, stop watch, measuring tape, sit and reach box, sphygmomanometer and spirometer which were purchased in reputed company and were used. They were reliable and manufactured by standard companies. Instrument reliability was also established by test re-test method.

3.6 Tester’s Competency

The investigator learned the procedures and methods to handle and operate the instruments to administer test item. The services of qualified assistance were made use, while taking the measurements. Three sessions were spent to familiarize the testing procedures.

3.7 Reliability of the data

Before commencement of the pilot study, the reliability of the data was established by using 10 participants at random. To ensure reliability, test and re-test method was executed. In between the test and retest, one-day rest was given to all the participants. The same testing personnel by using the same equipments under identical conditions tested all the variables selected in the present investigation for the same participants. The intra class correlation was used to find out the reliability of the data and the results were presented in table III.
Table III

INTRA CLASS CORRELATION CO-EFFICIENT VALUES OF SELECTED CRITERION VARIABLES

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Variable</th>
<th>‘R’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEALTH RELATED FITNESS VARIABLES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Muscular Strength</td>
<td>0.91*</td>
</tr>
<tr>
<td>2</td>
<td>Muscular Endurance</td>
<td>0.89*</td>
</tr>
<tr>
<td>3</td>
<td>Cardio Respiratory Endurance</td>
<td>0.90*</td>
</tr>
<tr>
<td>4</td>
<td>Flexibility</td>
<td>0.91</td>
</tr>
<tr>
<td>5</td>
<td>Body Composition</td>
<td>0.88*</td>
</tr>
<tr>
<td>PHYSIOLOGICAL VARIABLES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Breathe Holding Time</td>
<td>0.89*</td>
</tr>
<tr>
<td>2</td>
<td>Systolic Blood Pressure</td>
<td>0.87*</td>
</tr>
<tr>
<td>3</td>
<td>Diastolic Blood Pressure</td>
<td>0.88*</td>
</tr>
<tr>
<td>4</td>
<td>Resting Pulse Rate</td>
<td>0.86*</td>
</tr>
<tr>
<td>5</td>
<td>Vital Capacity</td>
<td>0.91*</td>
</tr>
</tbody>
</table>

* Significant at .01 level of confidence.

(The table value required for significance at .01 level of confidence was 0.765).

3.8 Orientation to the participants

The investigator explained the purpose of the training programme to the subjects. Before the commencement of the training programme, the physical training was taught to experimental group. For that four one-hour sessions were spent on alternate days to practice the techniques. This helped them to perform the training exercises perfectly by avoiding injuries.
3.9 Pilot study

A pilot study was conducted to assess the initial muscular strength, muscular endurance, flexibility, cardio respiratory endurance, body composition, breath holding time, resting pulse rate, blood pressure and vital capacity of the subjects in order to fix the load. To achieve this purpose twenty boys were selected from government high school, Dindigul, Tamilnadu, India, were randomly selected and divided into two groups of ten subjects in each group subjects. The subjects were given different kinds of physical education programme and handball drill under the supervision of researcher. During the pilot study the subjects underwent physical education programme and handball drill, only limited exercises were located and selected to design the training programme. The initial loads of the subjects were fixed according to the pilot study and the load for experimental groups was more or less similar. While constructing the training programme, the individual differences were not taken into consideration.
3.10 Training programme

During the training period, the experimental group underwent their respective training programmes four days per week on alternate days for fifteen weeks. The training session includes, warming up and warm down period. Every session the workout lasted for 45 to 60 minutes approximately. The training programs carried out in the playground and athletic track. The subjects underwent their respective training programs as per the schedules under the supervision of the investigator. Each training session was conducted only in the evening time (5.00 to 6.00 pm). During experimental period control group did not participate in any of the special training.
2.11 Administration of the tests

MUSCULAR STRENGTH

(Pull Up’s)

Purpose

This test measures upper body muscle strength.

Equipment required

Horizontal overhead bar, at an adequate height so that the participants can hang from with arms fully extended and feet not touching the floor.

Procedure

Grasp the overhead bar using overhand grip (palms facing away from body), with the arms fully extended. The subject then raises the body until the chin clears the top of the bar, then lowers again to a position with the arms fully extended. The pull-ups should be done in a smooth motion. Jerky motion, swinging the body, and kicking or bending the legs is not permitted. As many full pull-ups as possible are performed (Davis et al, 2000).

Scoring

The total number of correctly completed pull-ups is recorded.
MUSCULAR ENDURANCE

(Bent knee sit-ups)

Purpose

To assess abdominal strength and muscular endurance.

Equipments

A mat and a stopwatch.

Procedure

The subjects were asked to take a supine lying position on the mat, knees bent to an angle less than 90 degrees, and hands clasped behind neck. The ankles were held firmly on the ground by a partner. To perform the sit-ups, the subjects lifted his trunk, head and elbows forward in curt-up motion elbows touching the knees and then lowered his trunk touching the done continuously without pause for one minute. Number of correctly executed sit-ups was recorded as his performance.

To facilitate counting and recording the subjects were paired one subjects performed the exercise. While his partner counted. After the score was recorded, the subject inter changed their positions, i.e., the partner become the performer and vice versa.
**Scoring**

Recorded the number of correctly executed sit-ups performed with in one minute.

**FLEXIBILITY**

*(Sit and Reach Test)*

**Purpose**

To measure the flexibility of the subjects.

**Equipment**

The equipment for this test consists of a platform, scale, two gymnasium (Stall bar) benches. The scale is drawn on a piece of plywood 24 by 8 inches. The centre line is marked 0, inches lines on either side are marked 1, 2, 3 and so on to 12 and those on the other side – 1, -2, -3 and so on up to –12.

The support for the scale is in the form up and elongated sign made of 11 inch – wide boards resting on their edges. These are referred to as the cross-board and stem board, foot prints are outlines on the surface of the cross-board. One on either side of the upper edges of the support in such a way that when the subject is selected on the floor with the feet against the foot prints, the zero-line concedes with the near surface of the cross board towards the subject.
Two benches are placed side by side their sides, about 12 inches apart, with their legs against a wall. The scale is placed between the benches with the cross-board placed against them.

**Procedure**

In taking the test, the subject sits on the rubber matting with shoes removed, legs separated enough to stable the stem board. The feet are placed on the foot prints and pressed firmly against the cross board. The arms are extended forward with the hands placed palms down on the upper surface of the scale in this position, the subject moves up and down forward four time and holds the position of maximum reach on the fourth count. The knees must remain straight. If the hands reach unevenly, the hand reaching the shorter distance determines the score. The score is recorded to the nearest half inch.
CARDIO RESPIRATORY ENDURANCE

(1.5 Mile Run / Walk Test)

Purpose

To measure the cardio respiratory endurance of the subject.

Equipment

Stop watch, measuring tape, score card, pencils and 400 meters track

Procedure

The group was divided into three for testing purpose. Each student’s works with a partner, while one student is running the other checks the laps. The partner is instructed to count the laps which are run within the allotted laps. When the last lap have elapsed the instructor to give the signal to the runners. The observing partner gives the runner~ the number of completed laps he has run.

Scoring

The scoring in the amount of time elapsed between the starter’s signal and the subject crosses the finishing line. Record time is second to be nearest tenth of seconds
BODY COMPOSITION

(Skin Fold Caliber)

Purpose

The purpose of the test was to determine the percent body fat.

Equipment

Skin fold caliper, scoring sheet.

Procedure

Measurements were taken on the right side of the body with the subject standing. As the investigator has taken school boys as subjects, the sites selected for the skin folds are chest, abdomen and thigh (Siri Equation) cited by Jackson and Pollock, (1978) . The measurement of the skin fold at the chest was taken from a diagonal fold halfway between the shoulder crease and nipple. The abdomen was taken from a vertical fold about one inch to the right of the umbilicus. The thigh was taken from a vertical fold on the front of the thigh, midway between the knee and hip. Each side was measured by grasping a double thickness of skin firmly with the thumb and forefinger, pulling the fold slightly away the muscular tissue. The caliper was held perpendicular to the fold the measurement were taken one-half inch below the finger hold.

Scoring

The readings on each site was recorded as the score.
BREATH HOLDING TIME

(Hold Breath)

Purpose

The objective was to measure the ability of the subjects to hold the breath for longer time.

Equipments

A stopwatch with calibration of 1/10 seconds, a score sheet and a pencil were used to administer the test.

Procedure

The subject stood erect and inhaled deeply after which he held his breath for a length of time possible to him. The index finger of the respondent served as an indicator for the investigator to know the start and end of the recording time. The thumb and center finger were used to hold the nose to avoid letting the air through nostrils. The subjects were requested not to let the air out by opening the mouth while recording the breath holding time.

Scoring

The time the subject held the breath was recorded through stop watch to the nearest 1/10\textsuperscript{th} of a second.
RESTING PULSE RATE

(Radial Pulse rate)

Purpose

The objective was to record the resting heart beats of each subject per minute.

Equipment

Heart rate monitor (or) bio monitor was used to measure the resting heart rate.

Procedure

The resting heart rate of the subjects was monitored through the heart rate using the method of finger plythermography with the help of an opto-electronic transducer on finger.

Resting heart rate of each subject was recorded in the morning time between 6.00 A.M to 6.30 A.M. fifteen minutes before taking the heart rate, the subject was asked to sit and rest himself comfortably on chair. The investigator fixed on opto sensor unit to the thumb of the subjects using velcrostraps. It was fixed in such a way that the light on the opto sensor unit was the distal end of the fingertip and the L.D.R was near to the fingertip. The velcrostrap on the L.D.R side was fastened firmly while, the strap on the lamp side was loosely fastened.
The PCG/pulse ON-OFF switch of the bio monitor was kept in the pulse position. Then the heart rate monitor was switched on by pressing the pulse push button switch. After about 30 seconds, the put L.E.D indicator flashed and beeps occurred rhythmically with respect to the subjects pulse. The heart rate per minute was indicated in the digital meter.

**Scoring**

After a minute, scores in the digital meter representing the resting pulse rate of the subject was recorded.

**BLOOD PRESSURE (SYSTOLIC AND DIASTOLIC)**

*(Sphygomanometer)*

**Purpose :**

The purpose of this test was to measure the systolic and diastolic blood pressure at rest.

**Equipments :**

Sphygmanometer, stop watch

**Procedure :**

The procedure followed to record the blood pressures was as prescribed by Clarke (1976). Each subject was made to rest on two beds for 10 to 12 minute in a comfortable position. So that the circulatory system had enough time to become normal. The blood pressure for all the subjects were taken in morning, while taking blood
pressure, subjects right arm was completely made par to make certain that clothing did not press the blood vessels. The sphygmomanometer was kept of the level of the heart to avoid any gravitational influences; the blood pressure was taken while the subject was in a sitting position with his forearm supported on a table.

The cuff was wrapped around the arm evenly with the lower edge approximately one inch above the ant cubical space (the depression in the anterior region of the elbow) connects the tube from the mercury manometer to the cuff. Tighten the screw of the rubber bulb (hand pump). The stethoscope receiver was place firmly over the artery in the ante cubical space. It was made sure that stethoscope was free from contact with the cuff. The cuff was inflated until the artery fully collapses to the extent that no pulse beat could be heard. Pressure was then slowly released by realized the knob slowly as the investigator watched the gauge.

**Scoring**

When the heart beat was not audible air was released by opening the air value of the rubber tube and the systolic stroke the heart sent to spurt into artery and at the peak of the systolic stroke the first heart beat become audiable at which instant the read in millimeter of measuring (mmhg) was recorded with the gradual release of air, the heart beat become muffled and then disappeared. This indicated blood pressure at the diastolic stage and the reading was noted in mm Hg.
VITAL CAPACITY

(Wet Spirometer)

Purpose

To measure lung volume.

Equipments

Wet spirometer, mouth pieces, nose clip, pencil and score sheet were used.

Description

Vital capacity was measured by means of wet spirometer. The spirometer consisted of six litre container, filled with water upto one inch from the top and was counter balanced by a chain, which passed over free running pulley. The spirometer was placed at a height that allowed that subjects to stand erect. Before the test each subject was asked to take fullest possible inhalation and then slowly and forcefully expelled all the possible air in the rubber hose through the mouth pieces. Care was taken to prevent air from escaping through the nose by using nose clips. The point of the indicator at the top of the drum indicated the volume of air expelled in cubic centimeter. It was ensured that a second breath was not taken by the subject during the test. Care was taken to lower the drum without spilling the water each time after use.

Scoring

Only one trial was given to each subject and the measurement was recorded to the nearest cubic centimeter.
3.12 Experimental design and statistical procedures

The random group design was used as experimental design in which sixty boy’s subjects were divided into three groups. Each group consists of twenty subjects. Group I underwent physical education programme, group II underwent handball drill for four days per week for fifteen weeks of training period and group III acted as control, did not participate any special training programme apart from their regular curricular activities. The data were collected for both the groups on selected criterion variables such as muscular strength, muscular endurance, flexibility, cardio respiratory endurance, body composition, breath holding time, systolic and systolic blood pressure, resting pulse rate and vital capacity by using the standardized test. The data were collected, two days prior to and two days after the training programme on selected variables as pre and post tests. They were statistically analysed by using the analysis of covariance (ANCOVA) to determine the differences, if any, among the groups on selected dependent variables separately. Since, the obtained ‘F’ ratio for the adjusted post test was found to be significant, the Scheffe’s test was applied as post hoc test to find out paired mean differences, if any. The level of confidence was fixed at .05 to test the significance, which was considered as an appropriate.