CHAPTER III

Materials and Methods
CHAPTER-III

METHODS AND MATERIALS

The Procedure adopted for the selection of subjects, Pilot Study, Criterion Measure, Reliability of Test, Test Administration, Treatment Procedure, Training Schedule, Experimental Design and the Statistical Techniques employed for analysing the data have been described in this chapter.

SELECTION OF SUBJECTS

From the list of one hundred and fifty girls students studying in the eighth standard of the Chidambaram Chettiar Higher Secondary School for Girls, Kottaiyur, twenty students who were likely to be selected for the various school teams and thus would not be available for this project, were eliminated. The rest of the students were listed alphabetically. From the list so prepared, ninety subjects were selected at random using the table of random numbers. It was ensured by examining the records of the subjects kept in the school that they were medically fit to go through the experimental requirements of this project.
The requirements of the project were explained to all the subjects in the presence of the school teachers and they agreed to undergo the testing and training programmes. Through orientation the rigid requirements of the experimental procedures, testing as well as exercise schedules were explained to them so that there was no ambiguity of what effort was required on their part. It was heartening to note that the subjects took it as a challenge and were very enthusiastic to take part in this project. According to the school records the average age of the selected subjects was between 12 and 16 years.

Totally ninety students were selected randomly and their Muscular Performance, Cardiovascular Efficiency and Body Fat Percentage were tested by using the Muscular Performance tests, the Harvard Step test and skinfold measurements respectively. They were divided randomly into three groups. Two of them were considered as Intensive Interval Training group and Extensive Interval Training group and the other was treated as control group. All the subjects had routine activities except the subjects of the experimental groups who were progressively introduced to the additional practice of the Intensive and Extensive Interval Training.
The practice session was conducted for thirty minutes on all days except Sundays for a period of ten weeks. Following the practice in Interval Training, Muscular Performance, Cardiovascular Efficiency and Skinfolds were measured and recorded in second, fourth, sixth, eighth and tenth weeks.

PILOT STUDY

A Pilot Study was conducted to ensure whether the intensity and repetitions of the Intensive and Extensive Interval Training Programmes were within the limits of the Subjects' capacity to produce the desired effect.

The Intensity for the Interval Training was decided by the Maximal Heart Rate Reserve Method. The method consisted of calculating the working heart rate and target heart rate. The working heart rate was the difference between the maximal heart rate and resting heart rate. The target heart rate was determined as the percentage of working heart rate plus resting heart rate.

The number of repetitions assigned to each subject were tested and it was found that they were within the reach of the individuals.
CRITERION MEASURES

By glancing the literature, and in consultation with professional experts, the following variables were selected as the criterion measures in this study.

1. Muscular Performance

It is the ability of the body to perform motor skills involving muscular power, muscular strength, muscular endurance, speed, agility and cardiovascular endurance in an efficient manner.

AAHPER\(^1\) Youth Fitness was selected as the Criterion measure of Muscular Performance in this study for several reasons. It is widely accepted as a reasonably valid and reliable measure of Physical Fitness, mainly Muscular Performance. The test items of AAHPER Youth Fitness are explained below.

(a) Flexed Arm Hang

Flexed Arm Hang is a measure of arm and shoulder girdle strength. The length of time the subject held the hanging position was recorded in seconds as the score.

(b) Sit-ups

Sit-ups is a measure of abdominal strength and endurance. The number of times the subject correctly executed sit-ups in supine lying with bent knee position in 60 seconds was recorded as the score.

(c) Shuttle Run

Shuttle Run is a measure of Speed and agility. The time taken to cover two laps (4x10 Yards) was recorded to the nearest tenth of a second.

(d) Standing Broad Jump

It is a measure of muscular explosiveness and leg strength. The distance was measured to the nearest centimetre from the take-off line to the heel or other part of the body that touched the floor nearest to the take-off line.

(e) 50 Yards Dash

It is Purely a measure of speed. The elapsed time from the starting signal till the runner crossed the finish line was measured to the nearest one tenth of a second as the score.
(f) 600 Yards Run/walk

It is a measure of Cardiovascular Endurance. The elapsed time from the starting signal until the runner completed the 600 yards run/walk was measured in minutes and seconds as the score.

2. Cardiovascular Efficiency

Harvard Step Test was used to test the Cardiovascular Efficiency of the subjects. The subject stepped up and down on a 18 inch bench, 24 steps per minute for a period of 3 minutes. The pulse was taken from 1 to 1½ minutes. The score was calculated by using the Cardiovascular Efficiency Score formula.²

\[
C E S = \frac{\text{Duration of Exercise in seconds} \times 100}{5.6 \times \text{Pulse Count}}
\]

3. Sum of Skinfold fat

Sum of skin fold fat test measures the level of fatness in the body of the subjects. Subcutaneous fat was measured by the sum of skinfold measurements taken at biceps,

triceps, subscapular and suprailiac regions. The subcutaneous adipose tissue at the sites of biceps, triceps, subscapular and suprailiac was lifted with the fingers to form a skinfold. The skinfold consisted of a double layer of subcutaneous fat and skin, the thickness of which were measured with Harpenden skinfold caliper and each reading was recorded to the nearest millimetre.

RELIABILITY OF DATA

The reliability of data was ensured by establishing the instrument reliability, tester competency and reliability of the tests.

INSTRUMENT RELIABILITY

The stopwatch, measuring tape and skinfold caliper used in this study were obtained from reputed suppliers of standard equipment. All the instruments used were good and therefore, their calibrations were accepted as accurate enough for the purpose of the study.

THE RELIABILITY OF THE TEST

Reliability may be explained as the consistency of the test in measuring a phenomenon. There were many methods found in the literature to ascertain the reliability of a test. The best one suited for a test that measured motor performances was test-retest method.
As pointed out by Scott and French, the ideal method of ascertaining the reliability of the test was to administer it in identical form on successive days and to correlate the results. If the test was measuring consistently, it should yield a very high coefficient in the range of 0.90.

The repeated measurement of individuals on the same test, as is done to determine reliability, is a univariate, not a bivariate, situation - it is the distribution of a single variable. It makes sense, then, to use a univariate statistic, like the intraclass correlation coefficient. The intraclass correlation coefficients obtained for test-retest data are presented in Table I.

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### TABLE I

**INTRACLASS CORRELATION FOR ESTABLISHING TEST-RETEST RELIABILITY**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reliability Coefficient $R_{xx}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MUSCULAR PERFORMANCE</td>
<td></td>
</tr>
<tr>
<td>a) Flexed Arm Hang</td>
<td>.98</td>
</tr>
<tr>
<td>b) Sit Ups</td>
<td>.95</td>
</tr>
<tr>
<td>c) Shuttle Run</td>
<td>.97</td>
</tr>
<tr>
<td>d) Standing Broad Jump</td>
<td>.98</td>
</tr>
<tr>
<td>e) 50 yards dash</td>
<td>.96</td>
</tr>
<tr>
<td>f) 600 yards Run / Walk</td>
<td>.95</td>
</tr>
<tr>
<td>2. CARDIO-VASCULAR EFFICIENCY</td>
<td>.98</td>
</tr>
<tr>
<td>3. BODY COMPOSITION</td>
<td>.97</td>
</tr>
</tbody>
</table>

**MUSCULAR PERFORMANCE TEST**

**Administration of test items**

In administering the tests the flexed arm hang for girls, sit up, shuttle run and standing Broad Jump were all given in one period; the 50 yard dash, and 600 yard run/walk was given in a second period; pupils were given reasonable warm-up time prior to the testing.
PLATE - I

MUSCULAR PERFORMANCE TESTS

FLEXED ARM HANG

SIT-UPS

SHUTTLE RUN

STANDING BROAD JUMP
Flexed arm hang (AAHPER YOUTH FITNESS TEST 1976)

Equipment and Facilities:-

A horizontal bar with 1½ inches in diameter and a stop watches were used.

Description:-

The height of the bar was adjusted so it was approximately equal to the pupil's standing height. The pupil used an overhand grasp, with the assistance of two spotters, one in front and one in back of pupil. The pupil raised her body off the floor to a position where the chin was above the bar, the elbows were flexed, and the chest was close to the bar. The pupil held this position as long as possible.

Rules:-

1. The stop watch was started as soon as the subject took the hanging position.

2. The watch was stopped when (a) pupil's chin touched the bar (b) pupil's head tilted backwards to keep chin above the bar, (c) pupil's chin fell below the level of the bar.
Scoring:

The length of time the subject held the hanging position was recorded to the nearest second.

Sit-ups (AAHPER Youth Fitness Test 1976)

Description:

The student assumed the starting position lying on the back with knees bent, feet on the floor, and heels not more than 12 inches from the buttocks. The angle at the knees should be less than 90 degrees. The hands were clasped in back of the neck, with fingers interwined, and the elbows were touching the test surface. A partner held the feet. On the signal Ready, Go! the student curled up to a sitting position, touching elbows to knees. This represented one sit-up. The student then curled down to the starting position with elbows touching the surface and continued executing as many sit-ups as possible in 60 seconds. At the signal stop, the test ended.

Rules:

1. The fingers must remain in contact behind the neck throughout the exercise.

2. The knees must be on the floor during the sit-up but may be slightly bent when touching the elbow to knee.
3. The back should be rounded and the head and elbows brought forward when sitting up as "curl up".

4. When returning to starting position, elbows must be flat on the mat before sitting up again.

Scoring:-

One point was given for each complete movement of touching elbow or knee. No score was counted if the finger tips did not maintain contact behind the head, or if knees were bent when the pupil lied on her back or when she began to sit up, or if the pupil pushed up off the floor from an elbow. The maximum limit in terms of number of sit ups was 50 sit ups for girls, 100 sit-ups for boys.

Shuttle Run (AAHPER Youth Fitness Test 1976)

Equipment and Facilities:-

Two blocks of wood 2 inches x 2 inches x 4 inches and stop watch and Volleyball court. Pupil should wear canvas shoes or run barefooted.

Description:-

Two parallel lines were marked on the floor 30 feet apart. The width of a regulation volleyball court served as a suitable area. Blocks of wood were placed behind one of the lines. The pupils started from behind the other line.
On the signal "Ready"? "Go", the pupil ran to the blocks, picked one up, rushed back to the starting line, and placed the block behind the line; she then ran back and picked up the second block, which she carried back across the starting line. To eliminate the necessity of returning the blocks after each race, the races were started alternately, first from behind one line and then from behind the other.

Rules:-

Two trials with 10 minutes rest in between were allowed.

Scoring:-

The time of the better of the two trials was recorded to the nearest tenth of a second.

Standing Broad Jump (AAHPER Youth Fitness Test 1976)

Equipment and Facilities:-

Out door jumping pit and tape measure.

Description:-

Pupil stood with the feet several inches apart and the toes just behind the take-off line. Preparatory to jumping, the pupil swung the arms backward and bent the knees. The jump was accomplished by simultaneously extending the knees and swinging forward the arms.
Rules:-
1. Three trials were allowed.
2. The distance from the take-off line to the heel or other part of the body that touched the floor nearest the take-off line was measured.

Scoring:-
The best of the three trials was recorded in feet and inches. Fractions thereof were rounded to the nearest inch.

50 Yard Dash (AAHPER Youth Fitness Test 1976)

Equipment and Facilities:-
Track and Two stop watches or one with a split second timer.

Description:-
It was thought preferable to administer this test to two pupils at a time. Both were asked to take positions behind the starting line. The starter used the commands. "Are you ready?" and "Go". The latter was accompanied by a downward sweep of the starter's arm to give a visual signal to the timer, who stood at the finish line.

Rules:-
The score was the amount of time between the starter's signal and the instant the pupil crossed the finish line.
Scoring:

Scoring was recorded in seconds. Fractions thereof were rounded to the nearest tenth of a second.

600 Yard Run – Walk (AAHPER Youth Fitness Test 1976)

Equipment and Facilities:
Track and stopwatch

Description:
Pupil used a standing start. At the signal "Ready?" "Go" the pupil started running the 600 yard distance. The running was interspersed with walking. It was possible to have a dozen pupils run at one time by having the pupils pair off before the start of the event. Then each pupil listened for the command and remembered his partner's time as the latter crossed the finish.

Rules:
Walking was permitted, but the object was to cover the distance in the shortest possible time.

Scoring:
The time taken to cover 600 Yards was recorded in minutes and seconds.
The collected raw scores were converted into age based percentile scores by using the AAHPER youth fitness norms.5

HARVARD STEP TEST

Equipment:—
1. Bench with a height of eighteen inches.
2. Stop watch
3. Metronome

Rules followed:—

To get correct reading, certain precautionary steps had to be taken. The following points were explained to the subjects before they were asked to do the test.

1. They should maintain the rhythm, that was according to the count, along with cadence namely up, two, three, four, with which they had to perform the test.

2. When the third count was given, they must bring down the same leg, which they used first when the command up was given.

PLATE - II

HARVARD STEP TEST
3. They must stand erect when they were on the bench.

4. The subjects were expected to perform the test for not more than three minutes.

5. Uniformity of the body movement must be kept throughout the test.

Test Administration

The subjects went up and down on the eighteen inch bench at the rate of twenty four steps per minute for three minutes when the commands up, two, three, four were given. The cadence of ninety six counts per minute was maintained by watching the metronome. The time was counted from the beginning of the exercise to exactly three minutes when the exercise was stopped.

At the end of the three minutes exercise the subject sat down immediately and remained quiet. Exactly one minute after cessation of exercise, the subject’s pulse count was taken from one to one and half minutes immediately after the exercise. If a subject became over fatigued before the elapse of three minutes, she was stopped and the duration of exercise to that point was noted.

The test was conducted in short form. The readings thus obtained were put to statistical analysis to find out the cardiovascular efficiency.
Scoring:

The score was calculated from the duration of the exercise in seconds and the pulse count taken from one minute to one minute thirty seconds using the formula

\[
C.E.\text{Score} = \frac{\text{Duration of Exercise in seconds} \times 100}{5.6 \times \text{Pulse count}}
\]

If the student did not continue to exercise for the prescribed time, the duration of exercise to that point was noted. When she stopped exercising, the formula was applied.

SKINFOLD TESTS AND THEIR TRANSFORMATION INTO BODY FAT PERCENTAGE

Pinchings of tissues known as skinfold, which includes a double layer of skin plus subcutaneous fat to obtain a rough estimate of the leanness or fatness of a subject, is an old clinical procedure. It is necessary that the pressure exerted on the skinfold should be 100 gm/mm and should not vary with opening of the caliper. The following skinfolds were accepted in International level.
PLATE - III

SITES OF SKINFOLD MEASUREMENTS

1. BICEPS  3. SUBSCAPULARIS
2. TRICEPS  4. SUPRA-ILIAC

THE STRAIGHT LINE INDICATES THE LONGITUDINAL AXES OF THE SKINFOLDS
Biceps Skinfold

With the subject standing erect, with arm hanging loosely, a fold was picked up on the anterior of the mid part of biceps and the skinfold thickness was taken. The position of the fold was vertical. Reading to the nearest half millimetre was recorded.

Triceps skinfold

The skinfold thickness was taken over the triceps muscle at a point half way between the acromion process and the tip of the olecranon process. The point was located with fore arm flexed to 90 degrees, and while taking the measurement the arm was kept hanging free. The fold was lifted parallel to the long exist of the arm. Reading to the nearest half millimetre was recorded.

Subscapular Region Skinfold

The skinfold thickness was taken at the top of tip of the scapular (inferior angle) with the subject in a relaxed standing position. The fold was lifted at the diagonal plane at about 45 degree from vertical and horizontal planes. Reading to the nearest millimetre was recorded.
Suprailliac Region Skinfold

The skinfold thickness was taken three to five centimeters above and anterior suprailliac spine on diagonal line going downward and inward. Reading nearest to the half millimetre was recorded.

Four skinfolds were used for estimating body density using Durnin and Rahaman formula. 6

After Estimating Body density, body fat percentage was calculated by using Durnin and Rahaman formula. 7

Treatment Procedure

First day Extensive Interval Training Group was involved in 100 Metres run with the running time of twenty to seventeen seconds. At the same time Intensive Interval Training group was involved in Intensive type of interval training so that the running time was seventeen to fourteen seconds per repetition. The repetitions and pause were given


7 Ibid.
in the training schedule. According to the training schedule, the Intensive group and extensive group were trained up to ten weeks. At the end of the second, fourth, sixth, eighth and tenth weeks of training the effect was noted for experimental groups and tenth week for control group. The obtained data were analysed by statistical method.

TRAINING SCHEDULE

Maximal Heart Rate method of detraining the intensity of Interval training was employed for the experimentation. The Extensive Interval Training was based on 60 to 80 percent of intensity. But the Intensive Interval training was based on 80 to 90 percent intensity. The running distance was classified as 100 metres, 200 metres, 300 metres and 400 metres. The running distance was varied everyday, first day 100 metres training, second day 200 metres training, third day 300 metres training, fourth day 400 metres training, fifth day again 100 metres training and so on. The training was based on the interval method. The training schedule employed for an individual is presented below. This method was followed for all the subjects to determine the intensity of Intensive and Extensive interval training.
### TABLE II

**INTENSIVE INTERVAL TRAINING WEEK SCHEDULE FOR AN INDIVIDUAL**

<table>
<thead>
<tr>
<th>Days</th>
<th>Distance (Metres)</th>
<th>Running time (secs)</th>
<th>Pulse (rate/minute) 80%-90% Intensity</th>
<th>Repetitions</th>
<th>Pause minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Day</td>
<td>100 mts</td>
<td>17 - 14</td>
<td>180 - 192</td>
<td>6 - 8</td>
<td>4 - 5</td>
</tr>
<tr>
<td>II Day</td>
<td>200 mts</td>
<td>38 - 36</td>
<td>---</td>
<td>6 - 8</td>
<td>--</td>
</tr>
<tr>
<td>III Day</td>
<td>300 mts</td>
<td>54 - 52</td>
<td>---</td>
<td>4 - 6</td>
<td>--</td>
</tr>
<tr>
<td>IV Day</td>
<td>400 mts</td>
<td>95 - 75</td>
<td>---</td>
<td>4 - 5</td>
<td>--</td>
</tr>
<tr>
<td>V Day</td>
<td>100 mts</td>
<td>17 - 14</td>
<td>---</td>
<td>6 - 8</td>
<td>--</td>
</tr>
</tbody>
</table>

### TABLE III

**EXTENSIVE INTERVAL TRAINING WEEK SCHEDULE FOR AN INDIVIDUAL**

<table>
<thead>
<tr>
<th>Days</th>
<th>Distance (Metres)</th>
<th>Running time (secs)</th>
<th>Pulse (rate/minute) 60%-80% Intensity</th>
<th>Repetitions</th>
<th>Pause minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Day</td>
<td>100 mts</td>
<td>20 - 17</td>
<td>155 - 180</td>
<td>10 - 12</td>
<td>2 - 3</td>
</tr>
<tr>
<td>II Day</td>
<td>200 mts</td>
<td>42 - 38</td>
<td>---</td>
<td>9 - 10</td>
<td>--</td>
</tr>
<tr>
<td>III Day</td>
<td>300 mts</td>
<td>60 - 54</td>
<td>---</td>
<td>6 - 8</td>
<td>--</td>
</tr>
<tr>
<td>IV Day</td>
<td>400 mts</td>
<td>100 - 80</td>
<td>---</td>
<td>5 - 7</td>
<td>--</td>
</tr>
<tr>
<td>V Day</td>
<td>100 mts</td>
<td>20 - 17</td>
<td>---</td>
<td>10 - 12</td>
<td>--</td>
</tr>
</tbody>
</table>
EXPERIMENTAL DESIGN

A completely randomized group design of three groups of equal numbers was adopted for this study. Treatments were also assigned to the three groups at random. Scores in each Criterion measure were taken before alternate weeks up to ten weeks of experimental period.

STATISTICAL ANALYSIS

The following statistical procedures were observed to estimate the effects of Intensive and Extensive Interval training on Muscular performance, cardiovascular efficiency and Body composition in varied periods.

Repeated Measures of Analysis of Variance was employed in the study to measure the same dependent variable in varied weeks. The paired mean differences of varied weeks were tested with Confidence Interval Value of Tuckey's Honestly Significant Difference test.\(^8\)

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Analysis of Covariance\(^9\) was applied to determine whether the intensive and extensive interval training produced significantly different improvements in selected variables namely muscular performance, cardiovascular efficiency and percentage of body fat after 10 weeks of training. Since the initial means were not matched, comparisons between actual means were not justified. Therefore, before valid comparisons could be made, all means were adjusted by regression to a common initial mean. The adjusted mean equalled the actual mean minus the product of the regression coefficient \((\Sigma XY/\Sigma X^2)\) and the difference between the initial group mean and initial common mean of all groups.

The significance of difference of pairs of adjusted final group means was tested for significance by applying Scheffe's post hoc test.\(^{10}\)

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10 Ibid., p.39.