Chapter III

PROCEDURE

In this chapter, the selection of subjects, selection of variables, criterion measures, administration of test, collection of data, reliability of data, administration of training programme, training schedule, design of the study, statistical procedure and level of significance employed for analyzing the data have been described.

Selection of Subjects

Ninety school girls of 9th and 10th grade of Khirpai Dr. S.K.B.M. Girls High School, Dist.- Paschim Madinipur, West Bengal were selected as subjects for this study. Average age of the subjects was 14 years ranging from 13 years to 15 years of age. It was ensured from the health examination that all the subjects were medically fit for going through the experimental treatment of the study.

Ninety subjects were further sub-divided randomly into three equal groups consisting of 30 subjects in each group. Two experimental designs,
i.e., circuit training and aerobic fitness programmes were randomly assigned to the two groups, named by experimental groups (aerobic fitness group, circuit training group), while the remaining group was studied as control group.

The importance of procedure and the significance of the study were explained to the subjects in brief and they were asked to act as the subjects from their hearts. Different types of incentives were announced to motivate and encourage them to continue training programme and to give the tests up to the best of their capacity.

**Selection of Variables**

The selection of physical fitness test, anthropometric and physiological variables were done by using the following criteria:

1. Through review of all the available scientific literature pertaining to the physical fitness, anthropometric and physiological variables which seem to be related and likely to contribute to better athletic performance.
2. Series of discussions were held with the experts and advisors of the scholar regarding the effectiveness of the chosen variables to the athletic performance.

3. Feasibility in terms of availability of instruments and measuring techniques and acceptability of the test items were discussed with the experts and supervisors.

Based on the above mentioned criteria, the following physical fitness test, anthropometric and physiological variables were selected.

**Physical Fitness Test**

I. AAHPER Youth Fitness Test

**Anthropometric Variables**

i) Weight

ii) Standing Height

iii) Calf Girth

iv) Thigh Girth

v) Hip Girth

vi) Chest Girth
vii) Upper Arm Girth

viii) Skinfold Measurements
   a. Biceps Skinfold Measurement
   b. Triceps Skinfold Measurement
   c. Supra iliac Skinfold Measurement
   d. Sub scapular Skinfold Measurement

**Physiological Variables**

i) Resting Heart Rate

ii) Working Heart Rate

iii) Resting Systolic Blood Pressure

iv) Resting Diastolic Blood Pressure

**Criterion Measures**

**Physical Fitness**

The composite scores of individual items of AAHPER Youth Fitness Test battery were recorded in number.
Anthropometric Variables

1. Weight of the subjects was measured by a standing laboratory anthropometric weighing machine and it was recorded correct to one fourth (1/4) of a kilogram.

2. Standing height was recorded correct to the nearest half centimeter with the help of wall scale.

3. Calf girth was recorded correct to the nearest half centimeter with the help of flexible steel tape.

4. Thigh girth was recorded correct to the nearest half centimeter with the help of flexible steel tape.

5. Hip girth was recorded correct to the nearest half centimeter with the help of flexible steel tape.

6. Chest girth was recorded correct to the nearest half centimeter with the help of flexible steel tape.

7. Upper arm girth was recorded correct to the nearest half centimeter with the help of flexible steel tape.

8. Biceps skinfold was measured by skinfold caliper, which was recorded correct to the nearest one tenth of a millimeter.
9. Triceps skinfold was measured by skinfold caliper, which was recorded correct to the nearest one tenth of a millimeter.

10. Supra iliac skinfold was measured by skinfold caliper, which was recorded correct to the nearest one tenth of a millimeter.

11. Sub-scapular skinfold was measured by skinfold caliper, which was recorded correct to the nearest one tenth of a millimeter.

**Physiological Variables**

1. Resting heart rate in terms of number of heart beats recorded per minute during resting condition at the radial artery.

2. Working heart rate was measured using the Harvard steptest method (Long form) to collect the data on working heart rate of each subject. The score was expressed in terms of number of beats per minute.

3. Resting systolic blood pressure was measured by sphygmomanometer recorded in mm/Hg.

4. Resting diastolic blood pressure was measured by sphygmomanometer recorded in mm/Hg.
Administration of Tests

The tests were administered to the subjects at Khirpai Dr. S.K.B.M. Girls High School, Dist. - Paschim Madinipur of West Bengal. The research scholar took the help of some experienced physical education teachers, athletic coaches and some scholars. Assistance of them was well-oriented by the research scholar herself and the supervisor of the thesis a few days before the tests were administered.

Prior to the actual administration of the tests, all the subjects were introduced to the tests and the necessary number of practice trails were provided to each subject to make them familiar to the actual conduct of the test.

In order to motivate the subjects to put their best performance the significance of the study was clearly explained to them and the tests were administered before and after the experimental treatment.

All the tests were administered in the morning from 6.30 a.m. to 10.30 a.m. at the school ground.
Collection of Data

Physical Fitness

AAHPER Youth Fitness Test was administered to the subjects, strictly in accordance to the instructions given in the manual.¹

Anthropometric Variables

Weight.

The weight of the subjects was measured with a lever type laboratory anthropometric weighing machine. The subject wearing short and vest only, stood at the centre of the weighing machine. The weight was read and recorded correct to a quarter of a kilogram.

Standing Height.

The standing height was taken with the subject standing erect without shoes, against a marked scale on a wall touching the heels, buttocks and backs. The subject was instructed to keep the heels together, head level without tilt and to take and hold a full breath while the measurement was taken. A stiff hard board was held horizontally on his head, slightly pressing his head and touching the scale marked on the

wall. The subject was asked to step out and the reading indicated by the hard board was read on the scale. Height was recorded correct to the nearest half centimeter.²

**Calf Girth.**

Calf girth was taken with the flexible steel tape at the maximum circumference of the calf in a plane at right angle to its long axis. The leg was held dangling over a table top, so the tape measure was in a horizontal plane. In this position, the calf muscle is quite relaxed. Calf girth was recorded correct to the nearest half centimeter.³

**Thigh Girth.**

Thigh girth was measured with a flexible steel tape placed around the thigh horizontally with its top edge just under the fold of the buttocks. The subject stood with his weight equally distributed on both feet. Thigh girth was recorded correct to the nearest half centimeter.⁴

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⁴ Ibid., P. 26.
Hip Girth

The subject stood with his heels together in relaxed condition. Hip Girth was taken with a flexible steel tape at the maximum circumference of the buttocks in a plane at right angle with its long axis, so the tape measure was in a horizontal plane. Hip Girth was recorded correct to the nearest half centimeter.\(^5\)

Chest Girth.

For this test, the subject was in a normal standing position; a flexible steel tape was brought around his chest at the level of the nipples. The score recorded was the average of the girth measurements taken on full inhalation and full exhalation.\(^6\)

Upper Arm Girth

For this test, the girth of the left flexed tensed upper arm was taken. The subject sat in a chair, feet flat on the floor. The arm was flexed at the shoulder to about 90 degrees and the forearm in supine position was flexed at the elbow; the muscles of the upper arm were contracted to form

\(^5\) Ibid.

as “Large a muscle” as possible. The girth was measured around the most prominent part of the upper arm. 7

**Skinfold Measurements**

**Biceps Skinfold**

The skinfold was taken midway on front of upper arm over biceps, lifted parallel with the long axis of the arm. 8

**Triceps Skinfold**

The skinfold was taken on the back of the arm midway between the acromion process and the olecranon process. The skinfold is taken parallel to the long axis of the arm. 9

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Super iliac Skinfold

The skinfold was taken just above the crest of the ilium at the midaxillary line. The fold is lifted diagonally, following the natural line of the iliac crest.\(^{10}\)

Sub scapular Skinfold

The skinfold was taken at the tip of the scapula (inferior angle) with the subject in a relaxed standing position. The fold is lifted in the diagonal plane at about 45 degrees from the vertical and horizontal planes.\(^{11}\)

Physiological Variables

Resting Heart Rate

The data was collected while the subjects were in bed at dawn. The heart rate was counted by palpitating at the carotid artery in pre-abortive condition. The score was expressed in terms of beats per minute.\(^{12}\)

\(^{10}\) Ibid., P. 180.

\(^{11}\) Clarke, Application of Measurement to Health and Physical Education, p. 83.

\(^{12}\) Larry G. Shaver, Essentials of Exercise Physiology (Delhi: Surjeet Publication, 1982), p. 84.
Working Heart Rate

The working heart rate denotes such rapid rates of heart per unit time (minute) as the result of specified intensity and duration of work load.¹³

Resting Blood Pressure (Systolic, Diastolic)

After the completion of recording heart rate at bed at dawn the blood pressure was recorded in the same sitting. The objective of this test was to measure the systolic and diastolic blood pressure at rest.

Equipment and necessities for recording the blood pressure required sphygmomanometer, a stethoscope and a bed were used.

The blood pressure was checked at dawn. Each subject was made to lie down at bed in a relaxed and placid mood for about 15 minutes so that his circulatory system got enough time to come back to normal.

The cuff of the sphygmomanometer was wrapped around the left upper arm of the subject just above the elbow. The cuff was then fixed to the pump and the manometer (while taking blood pressure the left arm was fully bared to make sure that obstruction did not constrict the blood

¹³ Ibid., P. 82.
vessels. The pressure measured was taken with the subject in a lying down position. Here fore-arm was laid relaxed on the bed.). The stethoscope receiver was placed over the artery in anticubital space. The cuff was inflated until the artery was fully pressed to the extent that no pulse beat could be heard.

While the investigator watched the dial the pressure was then slowly released. When the first sound of the pulse became audible the reading in millimeters of mercury (mm/mg.) instant was recorded as the systolic blood pressure.

The pressure was further released gradually, as the sound of the pulse changed in intensity and quality. The index of diastolic pressure was noted in mm/mg, when the heart sound completely ceased.¹⁴

**Reliability of Data**

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

**Tester Competency**

To ensure that the investigator was well-versed with the techniques of conducting the tests and taking the measurements, the investigator had a number of practice sessions in testing procedure under the guidance of the expert. All possible assistance of the Lecturess in physical education, medical officer and athletic coaches who were also well acquainted with the tests and measurements were received.

Tester reliability in conducting tests on physical fitness, anthropometrical and physiological variables was established by test-retest process. Thereby consistencies of results were obtained by the scholar and the scores obtained by an expert on randomly selected sample of 30 subjects. The co-efficients are presented in Table 1, 2 and 3.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>AAHPER Youth Fitness Test</th>
<th>Co-efficient of correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flex Arm Hang</td>
<td>0.9460</td>
</tr>
<tr>
<td>2</td>
<td>Bent Knee Sit up</td>
<td>0.9094</td>
</tr>
<tr>
<td>3</td>
<td>Standing Broad Jump</td>
<td>0.9579</td>
</tr>
<tr>
<td>4</td>
<td>Shuttle Run</td>
<td>0.9198</td>
</tr>
<tr>
<td>5</td>
<td>50 Yard dash</td>
<td>0.9287</td>
</tr>
<tr>
<td>6</td>
<td>600 Yard Run Walk</td>
<td>0.9094</td>
</tr>
</tbody>
</table>
TABLE 2  
CO-EFFICIENT OF CORRELATION FOR TESTER RELIABILITY IN ANTHROPOMETRIC VARIABLES

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Anthropometric Variables</th>
<th>Co-efficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weight</td>
<td>0.9956</td>
</tr>
<tr>
<td>2</td>
<td>Standing Height</td>
<td>0.9985</td>
</tr>
<tr>
<td>3</td>
<td>Calf Girth</td>
<td>0.9918</td>
</tr>
<tr>
<td>4</td>
<td>Thigh Girth</td>
<td>0.9922</td>
</tr>
<tr>
<td>5</td>
<td>Hip Girth</td>
<td>0.9917</td>
</tr>
<tr>
<td>6</td>
<td>Chest Girth</td>
<td>0.9916</td>
</tr>
<tr>
<td>7</td>
<td>Upper Arm Girth</td>
<td>0.9820</td>
</tr>
<tr>
<td>8</td>
<td>Skinfold Measurements</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Biceps Skinfold</td>
<td>0.9951</td>
</tr>
<tr>
<td>b.</td>
<td>Triceps Skinfold</td>
<td>0.9752</td>
</tr>
<tr>
<td>c.</td>
<td>Supra Iliac Skinfold</td>
<td>0.9634</td>
</tr>
<tr>
<td>d.</td>
<td>Sub-Scapular Skinfold</td>
<td>0.9830</td>
</tr>
</tbody>
</table>
TABLE 3
CO-EFFICIENT OF CORRELATION FOR TESTER RELIABILITY IN PHYSIOLOGICAL VARIABLES

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Physiological Variables</th>
<th>Co-efficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Resting Heart Rate</td>
<td>0.9951</td>
</tr>
<tr>
<td>2</td>
<td>Working Heart Rate</td>
<td>0.9953</td>
</tr>
<tr>
<td>3</td>
<td>Resting Systolic Blood Pressure</td>
<td>0.9864</td>
</tr>
<tr>
<td>4</td>
<td>Resting Diastolic Blood Pressure</td>
<td>0.9873</td>
</tr>
</tbody>
</table>

Subject Reliability

AAHPER Youth Fitness Test was conducted on two consecutive days. In the case of 20 percent of subjects, who were selected at random, so that test-retest co-efficient of correlation might be computed to establish reliability of the data. The obtained r’s are given in Table 4.
Anthropometric variables namely Weight, Standing height, calf girth, thigh girth, hip girth, chest girth, upper arm girth, biceps skinfold, triceps skinfold, supra iliac skinfold, sub scapular skinfold were measured three times at the beginning of the experiment. The co-efficient of correlation of the scores made in the first and second measurements of each of the above variables were taken as the measures of reliability. The
obtained r’s are given in Table 5. All the obtained r’s are almost 1, thus indicating high reliability.

### TABLE 5
**TEST-RETEST RELIABILITY CO-EFFICIENT OF SUBJECTS IN ANTHROPOMETRIC CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Anthropometric Variables</th>
<th>Co-efficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weight</td>
<td>0.9752</td>
</tr>
<tr>
<td>2</td>
<td>Standing Height</td>
<td>0.9945</td>
</tr>
<tr>
<td>3</td>
<td>Calf Girth</td>
<td>0.9956</td>
</tr>
<tr>
<td>4</td>
<td>Thigh Girth</td>
<td>0.9948</td>
</tr>
<tr>
<td>5</td>
<td>Hip Girth</td>
<td>0.9952</td>
</tr>
<tr>
<td>6</td>
<td>Chest Girth</td>
<td>0.9962</td>
</tr>
<tr>
<td>7</td>
<td>Upper Arm Girth</td>
<td>0.9882</td>
</tr>
<tr>
<td>8</td>
<td>Skinfold Measurements</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Biceps Skinfold</td>
<td>0.9741</td>
</tr>
<tr>
<td>b.</td>
<td>Triceps Skinfold</td>
<td>0.9628</td>
</tr>
<tr>
<td>c.</td>
<td>Supra Iliac Skinfold</td>
<td>0.9867</td>
</tr>
<tr>
<td>d.</td>
<td>Sub-Scapular Skinfold</td>
<td>0.9820</td>
</tr>
</tbody>
</table>
Physiological test was conducted on two consecutive days, in the case of 20 percent of subjects, who were selected at random, so that test-retest co-efficient of correlation might be computed to establish reliability of the data. The obtained r’s are given in Table 6.

### TABLE 6
**TEST-RETEST RELIABILITY CO-EFFICIENT OF SUBJECTS IN PHYSIOLOGICAL VARIABLES**

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Physiological Variables</th>
<th>Co-efficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Resting Heart Rate</td>
<td>0.9781</td>
</tr>
<tr>
<td>2</td>
<td>Working Heart Rate</td>
<td>0.9872</td>
</tr>
<tr>
<td>3</td>
<td>Resting Systolic Blood Pressure</td>
<td>0.9838</td>
</tr>
<tr>
<td>4</td>
<td>Resting Diastolic Blood Pressure</td>
<td>0.9730</td>
</tr>
</tbody>
</table>

**Instrument Reliability**

The steel tape used for anthropometric measurements namely standing height, calf girth, thigh girth, hip girth, chest girth, upper arm
girth and to measure the performance of the subjects in Standing Broad Jump was non-elastic and flexible, which was calibrated and approved for use by the Physiology Laboratory N. B. S. M. Bishnupur, Dist. Bankura under Burdwan University.

The stop watches used for measuring performance of subjects in 50 yard dash, 600 yard run and shuttle run test were all calibrated and approved for use by the Physiology Laboratory N. B. S. M. Bishnupur, Dist. Bankura under Burdwan University Swiss made and supplied by Krishna Watch Co., Bombay.

The skinfold caliper used for measuring skinfold of the Subjects were calibrated and approved for use by the Physiology Laboratory N. B. S. M. Bishnupur, Dist. Bankura under Burdwan University, supplied by Herpenden Caliper (made in Japan). The manufacturers also ensured the reliability of the instrument.

The sphygmomanometer was used for testing blood pressure. It was calibrated and approved for use by the Physiology Laboratory N. B. S. M. Bishnupur, Dist. Bankura under Burdwan University.
Weighing machine was used for testing weight. It was calibrated and approved for use by the Physiology Laboratory of Nikhil Banga Sikshan Mahavidyalaya at Bishnupur, Dist. Bankura (West Bengal).

**Administration of Training Programme**

A ten weeks circuit training and aerobic fitness programmes for three days in a week, i.e., on Monday, Wednesday and Friday was undertaken in this study.

During the experimental period, specific training schedules prepared by the investigators was applied to the experimental groups (circuit training and aerobic fitness group) and the training programme was personally supervised by the investigator with the help of three respective experts and three assistants who were previously trained and instructed. The training programmes of two different groups, i.e., circuit training group and aerobic fitness group, was checked by the research scholar of and on. The control group girls were asked to continue their regular as usual programme.
Circuit Training Programme

A circuit training programme consisting of eight stations centering upon the components of physical fitness namely, speed, endurance, strength, co-ordination, power, agility and flexibility, which were adopted in the following manner.

Station 1 – Reaction time activity
Station 2 – 50 mts Sprint
Station 3 – Shuttle Races
Station 4 – Sit ups
Station 5 – Push ups
Station 6 – Squat Jump
Station 7 – Stretching Exercise (arching, leg split, side lunging)
Station 8 – Medium pace run with long stride

30 second work with optimum intensity in each station was followed by 30 second active rest in the form of walking or jogging for reporting to the next stations of the circuit, which was followed till the completion of all activities specified in eight stations.

Prior to the commencement of circuit training programme, warm-up programme for 5 minutes duration was exercised.
At the initial stage of training the eight exercises of the circuit was exercised only once for 7 minutes and 30 seconds for first two weeks as per following training schedule.

Later on each after two weeks one more repetition/set of same duration was enhanced. Each in between the repetition/set 5 minutes active rest in the form of relaxation activities were provided and thereby in the last two weeks i.e., 9th and 10th weeks five repetition, 20 minutes active rest, 37 minutes and 30 second duration of circuit training programme was exercised.

**Aerobic Fitness Programme**

Aerobic fitness programme consisting of eight different types of dancing items along with music centering upon reaction time, speed of movement, agility, strength, endurance and flexibility, power and coordination exercises were adopted.

Each dancing item was exercised for 30 second with optimum intensity along with music which was followed by 30 sec. active rest in the form of jogging programme with music before commencement of next
dancing item and the same method was adopted till the completion of all the eight selected dancing items under aerobic fitness programme.

Prior to the commencement of aerobic fitness programme, warm up programme for 5 minutes duration was exercised as per following training schedule.

At the initial stage of training the eight dancing items for the duration of 7 minutes and 30 seconds, under aerobic fitness programme for first two weeks was exercised.

Later on after two weeks, one more repetition/set of same duration was enhanced. Each in between the repetition/sets, 5 minutes active rest in the form of relaxation activities were provided and thereby in the last two weeks, i.e., 9th and 10th weeks, five repetitions of 20 minutes active rest and 37 minutes and 30 seconds duration of aerobic fitness programme was exercised.
<table>
<thead>
<tr>
<th>Weeks</th>
<th>Duration of Warm-up</th>
<th>Circuit Training Repetition (No. of Sets)</th>
<th>Duration of Active Rest in Between Sets</th>
<th>Total Duration of Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2 weeks</td>
<td>5 min.</td>
<td>1</td>
<td>--</td>
<td>12 min. 30 sec</td>
</tr>
<tr>
<td>3-4 weeks</td>
<td>5 min.</td>
<td>2</td>
<td>5 min.</td>
<td>25 min.</td>
</tr>
<tr>
<td>5-6 weeks</td>
<td>5 min.</td>
<td>3</td>
<td>10 min.</td>
<td>37 min. 30 sec</td>
</tr>
<tr>
<td>7-8 weeks</td>
<td>5 min.</td>
<td>4</td>
<td>15 min.</td>
<td>50 min.</td>
</tr>
<tr>
<td>9-10 weeks</td>
<td>5 min.</td>
<td>5</td>
<td>20 min.</td>
<td>62 min. 30 sec</td>
</tr>
</tbody>
</table>
Aerobic Fitness Programme

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Duration of Warm-up</th>
<th>Repetition (No. of Sets)</th>
<th>Duration of Active Rest Between Sets</th>
<th>Total Duration of Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2 weeks</td>
<td>5 min.</td>
<td>1</td>
<td>7 min. 30 sec.</td>
<td>12 min. 30 sec</td>
</tr>
<tr>
<td>3-4 weeks</td>
<td>5 min.</td>
<td>2</td>
<td>15 min.</td>
<td>25 min.</td>
</tr>
<tr>
<td>5-6 weeks</td>
<td>5 min.</td>
<td>3</td>
<td>22 min. 30 sec.</td>
<td>37 min. 30 sec</td>
</tr>
<tr>
<td>7-8 weeks</td>
<td>5 min.</td>
<td>4</td>
<td>30 min.</td>
<td>50 min.</td>
</tr>
<tr>
<td>9-10 weeks</td>
<td>5 min.</td>
<td>5</td>
<td>37 min. 30 sec.</td>
<td>62 min. 30 sec</td>
</tr>
</tbody>
</table>

Design of the Study

To compare the effect of circuit training and aerobic fitness programme on physical fitness ability, anthropometric variables, namely Weight, Standing height, calf girth, thigh girth, hip girth, chest girth,
upper arm girth, biceps skinfold, triceps skinfold, supra iliac skinfold, subscapular skinfold measurement and physiological variables namely resting heart rate, working heart rate, resting systolic blood pressure and resting diastolic blood pressure of secondary school girls, the random group design was adopted.

**Statistical Procedure**

1. To establish the reliability of the data the Pearson’s product moment correlation method was used.

2. In order to investigate the comparative effect of each training method on physical fitness, Anthropometric and Physiological Variables of the secondary school girl, the analysis of co-variance statistics was used.

3. In case of significant difference by analysis of co-variance is noticed, the post-hoc test was used, in order to investigate the existence of significant difference, if any, between the paired adjusted final means.
Level of Significance

For testing the mean difference among the subjects belonging to the experimental and control group in physical fitness, Anthropometric and Physiological Variables, the level of significance was set at 0.05 level of confidence.