PROCEDURE
CHAPTER III

PROCEDURE

In this chapter, the selection of the subjects, selection of the tests, reliability of the instrument, reliability of the data, competence of tester, orientation of the subjects, test administration, training programme, experimental design, collection of data, and statistical procedure have been explained.

3.1 SELECTION OF SUBJECTS

Thousand two hundred women students studying in Nirmala college for Women and Bishop Appaswamy College of Arts and Science, Coimbatore, Tamilnadu were screened using Body mass index (BMI) expressed as weight / square of height. BMI is commonly used to classify obesity (BMI greater than or equal to 30). Out of the thousand two hundred women students ninety two were found to be obesed (BMI; 32.4±1.5 kg/ m²). Among the ninety-two, sixty sedentary moderately obese women were randomly selected for the purpose of this study.

3.2 EXPERIMENTAL DESIGN

The study was formulated as a pre and post test random group design, in which sixty obese women were randomly assigned into four groups each consisting of 15 subjects. Group I underwent 30 minutes continuous long bout cardio-aerobic circuit training programme (1 x 30), Group II underwent three 10 minutes multiple short bout cardio-aerobic circuit training
programme (3 x 10 = 30), Group III underwent three 10 minute short bout cardio-aerobic circuit training with resistance exercises programme (3 x 10) and, Group IV control group did not undergo any above mentioned special training programme. After assigning the subjects to treatment and control groups, they were tested on selected criterion variables. It was considered as pre-test. After assessing the pre-test performance on criterion variables, the subjects were treated with their respective training program for five days a week for about twelve weeks. After twelve weeks of their training program, again the subjects were tested on selected criterion variables as such in the pre-test.

3.3 SELECTION OF CRITERION VARIABLES

The present study mainly concerns with obesity. Obesity is closely associated with individual health and also served as a functional determinant of health aspects. As far as individual health is concerned, physical and physiological aspects have to be considered as the major factors since these are having the functional association with one another. Obesity refers the excess body fat. The excess body fat stored in the abdominal and the thoracic region disturbs the stability and mobility in addition to cardio pulmonary system. Resultant of these, obese person easily acquire the aged and other deadly diseases. Earlier studies clearly describe its nature, also accorded by the professional experts. With these causes and effect, to visualize the status of physical and physiological characteristics of obese women and its effect to newly designed treatments using varied bouts along with resistance exercises, the variables underlie the health fitness, body composition indices and
physiological variables which are highly related to the obese were chosen as the criterion variables.

**Health Fitness components**

1. Muscular Strength and Endurance
2. Flexibility
3. Cardiovascular Endurance

**Body Composition Indices**

1. Percent Body Fat
2. Lean Body Mass
3. Body Weight
4. Waist Circumference

**Physiological Variables**

1. Maximum Oxygen Consumption
2. Resting Heart Rate
3. Resting Systolic Blood Pressure
4. Resting Diastolic Blood Pressure

**3.4 CRITERION MEASURES**

Having the experts’ consultation in the field of physical education and sports sciences and scanning various literatures related to obesity and health,
the investigator has selected the following test items as criterion measures. The chosen tests are highly standardized, appropriate and ideal for the selected variables and briefly explained here.

**Modified Sit-Ups**

Modified sit-ups is a measure of abdominal muscular strength and endurance. The number of correctly executed sit-ups performed in 60 seconds was recorded as the score.

**Sit and Reach**

Sit and reach is a measure of flexibility (extensibility) of the low back and posterior thigh muscles. The stretched arms are moved to touch the toes in long sitting position. The extent of movement was recorded to the nearest centimeter as the score.

**1.5 Mile Run and Walk test**

1.5 Mile run is a measure of cardiovascular endurance. The time taken by the subject to run a distance of 1.5 mile as fast as possible was recorded to the nearest seconds as the score.

**Percent Body Fat**

To obtain the amount of percent body fat, skinfold caliper was used. Measurements were recorded to the nearest millimeter at three sites of the body namely Triceps, Supra iliac and Abdomen (Werner et al. 1990).
Lean Body Mass

Lean body mass was calculated by subtracting weight of the fat from the weight of the body

Body Weight

Body weight was measured on weighing machine and recorded to the nearest one tenth of a kilograms

Waist Circumference

The waist circumference was measured at the natural waist (small waist) with no elastic tape and recorded to the nearest millimeter.

Maximum Oxygen Consumption

The Queen’s College step test was used to predict the Maximum Oxygen consumption uptake. The measurement was recorded in ml/ kg/min

Heart Rate

Heart rate is the rate of beats of heart per minute. Heart rate was measured by using stethoscope and recorded as the number of beats per minute.

Blood Pressure

Blood pressure is the force that blood exerts against the walls of the blood vessels or heart. Measurements of both Systolic and Diastolic blood
pressures were taken by using sphygmomanometer and recorded to the nearest mm of Hg.

3.5 RELIABILITY OF DATA

The reliability of data was measured by ensuring instrument reliability, testers competency and subject reliability.

3.5.1 Instrument Reliability

With respect to the instruments used in measuring various variables, certificate of accuracy was obtained from appropriate instrument testing agency; and also by recalibrating the scale using known amounts of variables wherever required.

3.5.2 Tester’s Reliability

The assistance of six specially trained physical education teachers was sought on administration of various test items. They were oriented about the procedures of measuring and recording the scores in each variable. All the assistants were asked to measure on a few subjects and coefficient of intercorrelation of scores recorded by them was taken. The final measuring programme was conducted only on getting high coefficient of correlation.

3.5.3 Subject Reliability

The subject reliability was established by test and retest coefficient of correlation for the scores in each of the criterion measures. Re-testing was done within a period of a week of initial tests in each of the criterion measures,
to get data for calculating test and re-test coefficient of correlation for reliability of the subject.

**TABLE 3.1**

**RELIABILITY COEFFICIENT OF TEST RETEST SCORES OF PHYSICAL FITNESS COMPONENTS, BODY COMPOSITION INDICES AND SELECTED PHYSIOLOGICAL VARIABLES**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Criterion Variables</th>
<th>‘r’ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Modified Sit ups</td>
<td>0.90</td>
</tr>
<tr>
<td>2</td>
<td>Modified Sit and Reach</td>
<td>0.92</td>
</tr>
<tr>
<td>3</td>
<td>1.5 Mile Run</td>
<td>0.89</td>
</tr>
<tr>
<td>4</td>
<td>Skin fold caliper</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Triceps</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>b. Suprailiac</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>c. Abdominal</td>
<td>0.87</td>
</tr>
<tr>
<td>5</td>
<td>Body Weight</td>
<td>0.92</td>
</tr>
<tr>
<td>6</td>
<td>Waist Circumference</td>
<td>0.93</td>
</tr>
<tr>
<td>7</td>
<td>Three Minutes Step Test</td>
<td>0.88</td>
</tr>
<tr>
<td>8</td>
<td>Resting Heart Rate</td>
<td>0.89</td>
</tr>
<tr>
<td>9</td>
<td>Resting Systolic Blood Pressure</td>
<td>0.90</td>
</tr>
<tr>
<td>10</td>
<td>Resting Diastolic Blood Pressure</td>
<td>0.90</td>
</tr>
</tbody>
</table>
3.6 ORIENTATION OF THE SUBJECTS

The researcher explained the purpose of the study to the subjects clearly. Instructions in connection with the testing procedure while measuring the selected variables were also explained to the subjects. Three sessions were spent to familiarize the subject with the technique involved in various tests used to collect the data.

3.7 PILOT STUDY

The present study was mainly concerned with effects of various modes of physical training on health fitness components; body composition indices and selected physiological variables of obese subjects pertain to college women. The various modes of physical training used in the present study were cardio aerobic training with continuous nature, with intermittent nature and with combination of resistance exercises and intermittent nature. Earlier studies in this case mostly underlie the generalized physical training with continuous and intermittent nature. But the present study is mainly conceived with the two factors that are type of training and mode of application. Hence the investigator has to determine the intensity, frequency, specificity, recovery and type of cardio aerobic exercises and resistance exercise in order to easily accommodate the subjects into the treatments used in the present study. For this purpose the investigator has conducted the pilot study. For this, as subjects of 30 obese pertain to college women were selected. They were inclined to treatments specifically designed for the present study of continuous long bout cardio aerobic circuit training, multiple short bouts cardio aerobic circuit training, and multiple short bouts cardio aerobic circuit training with
resistance exercises. The heart rate reserve method was used to determine the training intensity. The heart rate reserve method was made popular by Karvonen. The intensity (training heart rate) was determined as follows. First maximum heart rate was estimated by the following formula. \( HR_{max} = 220 - \text{age} \). Resting HR (Heart Rate) was subtracted from maximal HR to obtain the HR reserve. From the reserve heart rate 50% to 60% was taken as the intensity. This value was added to the resting heart rate to obtain the target heart rate (THR) i.e. the target heart rate (THR) was determined as a percentage (50% to 60%) of the HRR plus the HR rest.

3.8 TEST ADMINISTRATION

The Modified Sit - Ups

Purpose

The test aims to measure the abdominal muscular strength and endurance.

Procedure

The subjects were asked to lie in supine with knees flexed and feet flat on the floor with the heels 12 and 18 inches from the buttocks. The angle of the knee was kept at 90 degrees. The arms were crossed over the chest with the hands on opposite shoulders. A partner held the feet securely. The subjects then curls up to a sitting position and touched the elbows to the thighs and returned to starting the until their mid back contacted to the floor.
Scoring

One point was scored for each correct sit up. The score was the maximum number of sit-ups completed in 60 seconds.

Sit and Reach Test

Purpose

The sit and reach test was designed to evaluate the flexibility of low back and posterior thigh.

Procedure

The subjects were asked to remove their shoes. They were asked to sit on a mat with their legs extended. Their feet rested against the base of the box on which a yard stick was mounted with the 23 centimeter on the near side of the box. After the general warm up that included stretching of lower back and posterior thighs, slowly reached forward with both hands as far as possible and held the position momentarily. The distance reduced on the yardstick by their fingertips was recorded as the test score.

Scoring

The distance reduced on the yardstick by their fingertips on the four trials was reached as the score to the nearest centimeter.
1.5 Mile Run and Walk Test

**Purpose**

To measure the cardio vascular endurance of the subject.

**Equipment**

Stop Watch, Measuring Tape, Score Card, Pencils

**Procedure**

For this test, the subjects were divided into five groups. Each subject worked with an assigned tester. The testers were instructed to count the laps, which are run within the allotted distance. When the last laps had elapsed the instructor gave the signal to the runners. The observing partner informed the runners the number of completed laps then and then.

**Scoring**

The scoring was the amount of time elapsed between the starters signal and the subject crosses the finishing line and the time was recorded to the nearest tenth of a second.

**Body Composition**

*Skin Fold Fat*

Pinching of tissues known is as skin fold, which included 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. The validity of the skin fold as
a measure of subcutaneous fat is satisfactory. The skinfold in the present investigation were measured with Harpenden skinfold caliper. All the skinfold measurements were taken on the left side of the body as recommended by McColy.

The skinfold taken in the vertical plane, was grasped between the thumb and forefingers with span of the grasp determined by the thickness of the fold. The size of the skinfold held was great enough to include two thickness of skin and the adhering subcutaneous fat. Care was taken to avoid unnecessary compression of the skinfold while measurements were being made. An attempt was made to apply the caliper jaws in such a way that the critical pressure on the skinfold was exerted by the contact surfaces of the instrument and not by the operator's fingers. The skinfold was held up about 1 to 1.5 cm from the side where the fold was to be measured. Each skinfold was measured two times and the average reading recorded to the nearest millimeters. These three skinfold were also used for estimating body density (Women) using the Jackson and Pollock, and ward equation

$$\text{Density} = 1.089733 - 0.0009245(X_1) + 0.0000025(X_1^2) - 0.0000979(X_2)$$

When $X_1 = \text{Sum of Triceps, Suprailiac, and abdominal skinfolds, and } X_2 = \text{age in years.}$

The body density value obtained is used in the Siri equation to calculate % body fat
**Siri Equation**

\[
\text{Percent Body Fat} = [(4.95 / D) - 450]
\]

**Triceps**

Triceps skin fold measurement was taken with the help of skin fold caliper at the mid way of landmarks acromion and radial on the posterior side of the upper arm. A vertical skin fold was lifted at this site with thumb and forefinger and the caliper was applied one centimeter below the finger and the grip of the caliper was slowly released so that a full tension of the caliper was applied on the lifted skin fold.

**Suprailiac**

A vertical skin fold was lifted with the thumb and the forefinger just superior to the iliac crest at the mid auxiliary line. A skin fold was lifted at this site with thumb and forefinger and the caliper was applied one centimeter below the finger and the grip of the caliper was slowly released so that the full tension of the caliper was applied on the lifted skin fold.

**Abdominal Skinfold**

The site is located 4 cm laterally to right of the umbilicus and was taken vertically.

**Scoring**

Each site was measured three times and the average of the two reading was recorded as the final score.
Body Weight

Purpose

The purpose of the test was to measure the body weight.

Equipment

Weighing machine and score sheet.

Procedure

The body weight of each subject was taken on a portable weighing machine. Before taking the measurements, care was taken to see that the pointer of weighing machine stood at zero when there was no weight on it. The measurement of body weight was recorded to nearest one tenth a kilogram.

Scoring

The body weight was recorded with nearest one tenth of kilogram and recorded as score.

Waist Circumference

Purpose

To measure the waist circumference

Equipment

Non elastic Measuring Tape
Procedure

The subjects were asked to stand with their feet together and their arms at the sides. The measurement was taken with a no elastic measuring tape at the natural waist (smallest waist circumference). If there is non natural waist, the measurement was made at the level of the Umbilicus. The measurement was done at the end of a normal inspiration.

Scoring

The score was recorded to the nearest centimeter at the natural waist.

The Queen’s College Step Test

Purpose

To determine Maximum Oxygen Consumption.

Equipment

Stepping bench (41cm high), Stop watch and Metronome.

Procedure

The test was conducted with a 41cm height bench. To establish step cadence the metronome was set at 28beats/min. The subjects were allowed to practice a brief period of 5 to 10sec the step rhythm to adjust to the cadence of the metronome. The sequence was left up/right up/left down/right down- each element to a single metronome beat. The subjects performed the step-ups for exactly for 3 minutes. At the end of the 3 minutes, exercise period the subjects remained standing for 5 seconds. Then the pulse was counted at the carotid
artery for a 15 sec. This was multiplied by four to give the heart rate score in beats/minutes (bpm). The maximum oxygen consumption in ml/kg/min was calculated according to following equation.

\[
\text{Maximum oxygen uptake} = 65.81 - (0.1847 \times \text{recovery heart rate in beats per minute (bpm)}
\]

**Resting Heart Rate**

*Purpose*

To record the resting heart beats of each subject per minute.

*Equipment*

Stethoscope.

*Procedure*

To determine the resting heart rate, the subject was asked to lie down on the table comfortably. The chest piece of the stethoscope was applied on the 5th left intercostals space of the body. The heart rate was recorded by hearing the sounds lub-dub which was taken as one beat. It was expressed as beats per minute.

*Scoring*

The number of beats per minute was recorded as the resting heart rate.
**Blood Pressure**

*Purpose*

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

*Equipments*

Sphygmomanometer, stethoscope and a comfortable chair.

*Procedure*

The subject was asked to sit on a chair comfortably. While taking blood pressure, the subject’s right arm was completely made bare to make certain that clothing does not press the blood vessels. The instrument was kept at the level of heart. The blood pressure measurement was taken with the subject in the sitting position; the forearm was kept straight and relaxed position. The cuff was wrapped round the arm evenly with the lower edge approximately one inch above the anticubital space. The stethoscope receiver was placed firmly over the brachial artery in anticubital space. The cuff was inflated until the artery collapsed fully to the extent that no pulse beat was heard.

*Measurement*

When no pulse beat was heard, the pressure was slowly released till the first sound of the pulse was heard. This was the systolic blood pressure. When
the pressure was further released gradually, the total stoppage of the sound of
pulse was identified y. This recording was the diastolic blood pressure.

Scoring

Both the recordings were in millimeters of mercury (mm of Hg). Arthur

3.9 TRAINING PROGRAMME

The procedure adopted in the training programme for the present study
is described in the following aspects.

1. During the training period, Group I underwent one 30 minutes
continuous long bout cardio-aerobic circuit training programme per
day (1 x 30=30), Group II underwent a three 10 minutes multiple-
short bouts cardio-aerobic circuit training programme per day (3 x
10=30) and Group III underwent three ten minutes short bouts of
cardiac-aerobic circuit training programme per day (3 x 10)-30). The
exercising subjects of all the three training groups participated in
cardio-aerobic circuit training programme at 50-60% of heart rate
reserve five days per week for twelve weeks. Group IV acted as
control that did not participated in any special training programme.

2. The cardio-aerobic circuit training programme was constructed
based on the results of the pilot study.

3. The training programme was carried out at Nirmala College for
women, Coimbatore. The subjects underwent their respective
training programme as per the schedules under the supervision of the investigator. Each day the training session was conducted only in the morning time. In every day training session the work out lasted for 30 minutes. Prior to every training session all the 3 groups had 10 minutes warm up exercise involving jogging, mobility exercise and stretching. All the subjects involved in the training programmes were questioned about their status throughout the training period. None of them reported any injury. However muscle soreness and fatigue were reported in the early weeks which subsided later.

4. Cardio – aerobic exercise can help to change the portion of the body weight that is made up of fat. The best type of exercise for decreasing the body fat is low to moderate intensity cardio-aerobic exercise. In order to add some variety in the exercise programme without really increasing exercise intensity three different levels of alternative exercises (calisthenics) that can add interest and increase their enjoyment were prepared. The subjects practiced level I for 1st, 2nd, 3rd, and 4th weeks, level II for 5th, 6th, 7th and 8th weeks and level III for 9th, 10th, 11th, and 12th weeks.

5. Body responds best to an exercise programme if it gets rest period. So it is best to give two day of rest in a week. Therefore the exercise programme was done 5 days per week.

6. The subjects were instructed not to begin the next exercise until they can complete the 30-second period of exercise. The exercise
programme was individualized instead of group. Therefore the subjects were instructed to continue with the week cardio-aerobic circuit programme with low-to moderate intensity of their own capacity.

3.9.1 CONTINUOUS LONG BOUT CARDIO-AEROBIC CIRCUIT TRAINING (CLBCACT) PROTOCOL – Group -I

The following schedule was followed for Group I (one 30 minutes continuous long bout cardio-aerobic circuit training).

The subject in the CLBCACT group were trained for 5 days per week. The subjects performed the following circuit comprising 30 second work period at 50- 60% of max heart rate with 30 seconds of Jogging between each station to increase the aerobic content. This workout was done three times a day during morning, noon and evening. Thus the session lasted for 30 minutes. The cardio aerobic exercises used in the continuous long bout cardio-aerobic circuit training are described below:
TABLE 3.2

TRAINING PROGRAMME FOR CONTINUOUS LONG BOUT CARDIO AEROBIC CIRCUIT TRAINING (CLBCACT) GROUP - I AND MULTIPLE SHORT BOUT CARDIO AEROBIC CIRCUIT TRAINING (MSBCACT) GROUP - II

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Level - 1</th>
<th>Level - 2</th>
<th>Level - 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Skipping</td>
<td>Side Skipping</td>
<td>Rope Jumping</td>
</tr>
<tr>
<td>2</td>
<td>Step up</td>
<td>Lateral Step up</td>
<td>Depth Jump</td>
</tr>
<tr>
<td>3</td>
<td>Shuttle Run</td>
<td>Sideward Shuttle Run</td>
<td>Bound Jump</td>
</tr>
<tr>
<td>4</td>
<td>Alternate Leg Thrust</td>
<td>Squat Thrust</td>
<td>Burpees</td>
</tr>
<tr>
<td>5</td>
<td>Heel and Toe Walking</td>
<td>Side to Side Jumping</td>
<td>Bunney Hop Shuttle Run</td>
</tr>
<tr>
<td>6</td>
<td>Curl up</td>
<td>Reverse Curl</td>
<td>Trunk Lift</td>
</tr>
<tr>
<td>7</td>
<td>Hexagon Drill</td>
<td>Hexagon Run</td>
<td>Hexagon Jumping</td>
</tr>
<tr>
<td>8</td>
<td>Flexed Arm Support</td>
<td>Bent Knee Push Ups</td>
<td>90° Push Ups</td>
</tr>
<tr>
<td>9</td>
<td>Four Count Jumping Jack</td>
<td>Two Count jumping Jack</td>
<td>Back Kicks</td>
</tr>
<tr>
<td>10</td>
<td>Sitting Tucks (Alternate leg)</td>
<td>Sitting Tucks (Both legs)</td>
<td>Jump and Reach</td>
</tr>
</tbody>
</table>
### TABLE 3.3

**TRAINING PROGRAMME FOR MULTIPLE SHORT BOUT CARDIO AEROBIC CIRCUIT TRAINING WITH RESISTANCE EXERCISES**  
*(MSBCACTRE) GROUP – III)*

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Level – 1</th>
<th>Level – 2</th>
<th>Level – 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Skipping</td>
<td>Side Skipping with Big arm Sing</td>
<td>Rope Jumping</td>
</tr>
<tr>
<td>2</td>
<td>Shuttle Run</td>
<td>Sideward Shuttle Run</td>
<td>Bound</td>
</tr>
<tr>
<td>3</td>
<td>Heel and Toe Walk</td>
<td>Side to Side Jump</td>
<td>Side to Side Jump</td>
</tr>
<tr>
<td>4</td>
<td>Hexagon Drill</td>
<td>Hexagon Hopping</td>
<td>Bunny Hop Shuttle</td>
</tr>
<tr>
<td>5</td>
<td>Four Count Jumping Jog</td>
<td>Two Count Jumping Jog</td>
<td>Four Count Jumping Jog</td>
</tr>
<tr>
<td>6</td>
<td>Half Squat</td>
<td>Lange</td>
<td>Step up with Dumbbles</td>
</tr>
<tr>
<td>7</td>
<td>Triceps Extension</td>
<td>Shoulder Press</td>
<td>Press Down</td>
</tr>
<tr>
<td>8</td>
<td>Biceps Curl</td>
<td>Upride Row</td>
<td>Bend Over Row</td>
</tr>
<tr>
<td>9</td>
<td>Heel Raise</td>
<td>Heel Raise with Toes together</td>
<td>Heel Raise with Heel together</td>
</tr>
<tr>
<td>10</td>
<td>Trunk Curl</td>
<td>Reverse Curl</td>
<td>Bench press</td>
</tr>
</tbody>
</table>
# TABLE 3.4

**SPECIFICITY FOR TRAINING PROGRAMME FOR CONTINUOUS LONG BOUT CARDIO AEROBIC CIRCUIT TRAINING (CLBCACT) GROUP – I, MULTIPLE SHORT BOUT CARDIO AEROBIC CIRCUIT TRAINING (MSBCACT) GROUP – II AND MULTIPLE SHORT BOUT CARDIO AEROBIC CIRCUIT TRAINING WITH RESISTANCE EXERCISE (MSBCACT) GROUP – III**

<table>
<thead>
<tr>
<th>Specificity</th>
<th>Continuous Long Bout Cardio Aerobic Circuit Training</th>
<th>Multiple Short Bout Cardio Aerobic Circuit Training</th>
<th>Multiple Short Bout Cardio Aerobic Circuit Training with Resistance Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Exercises</td>
<td>Cardio Aerobic</td>
<td>Cardio Aerobic</td>
<td>Cardio Aerobic with Resistance</td>
</tr>
<tr>
<td>Number of stations</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Number of Exercises in each circuit</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Intensity</td>
<td>50 to 60 % of Max.Heart Rate</td>
<td>50 to 60 % of Max.Heart Rate</td>
<td>50 to 60 % of Max.Heart Rate</td>
</tr>
<tr>
<td>Duration of each circuit</td>
<td>10 minutes</td>
<td>10 minutes</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Number of circuits</td>
<td>Three</td>
<td>One</td>
<td>One</td>
</tr>
<tr>
<td>Number of Session</td>
<td>One (Morning) (CLBCACT)</td>
<td>Three (Morniing, Noon and Evening) (MSBCACT)</td>
<td>Three (Morning, Noon and Evening) (MSBCACTRE)</td>
</tr>
<tr>
<td>Total Duration</td>
<td>30 minutes (CLBCACT)</td>
<td>30 minutes (3 X10) (MSBCACT)</td>
<td>30 minutes (3 X10) (MSBCACTRE)</td>
</tr>
</tbody>
</table>
LEVEL I

1. Skipping

Subjects were asked to lift the right leg with the knee bent to 90 degrees while lifting the left arm with the elbows also bent 90 degrees. As these two limbs come back, the exercise was repeated for the opposite limb with the same motion.

2. Step - Ups

Subjects were asked to stand in front of a bench about 40 centimeters. They were instructed to step up on to the bench straightening the knees fully and then down, in quick succession. On each set of the exercise, leading leg was alternated. The exercise was repeated for a period of 30 seconds.

3. Shuttle Run

The subjects were asked to run continually forward and back between two parallel lines. The distance between the two parallel lines was ten meters. They were instructed to run as fast as possible. This course was repeated for 30 seconds.

4. Alternate Leg Thrusts

In practicing alternate leg thrusts, subjects were asked to crouch on the floor with legs straight out behind them. They were asked to rest their weight of on their hands. One knee was bent up to their chest, kicking the leg straight out behind, while the other knee is bent up to their chest. The movement was repeated in quick successions for 30 seconds.
5. Heel and Toe Walking

Two lines were drawn approximately 5 meters apart and the subjects were asked to walk forward with their heels up to the end line and walk back with the toes, up to the starting line. This movement was repeated as many times as possible for 30 seconds.

6. Curl-Up

The subjects were instructed to lie on the floor with the knees bent and the arms crossed with hands on shoulders. Then they were asked to curl up until their shoulder blades leave the floor and then roll down to the starting position. The exercise was repeated for 30 seconds.

7. Hexagon Drill

The subjects were asked to stand in the centre of the hexagon with feet shoulder width apart. They were then asked to jump across one side of the hexagon and back to center, then proceeding around each side of the hexagon. This type of movement was repeated for 30 seconds.

8. Flexed - Arm Support

The subjects were instructed to lie on the floor. They were then asked to place the feet flat on the floor and hands outside the shoulders. The knees were lifted and raising the hips off the floor with the upper arm parallel to the floor or elbow flexed at 90 degrees. They were also instructed not to let the hip go past the shoulders. The 90 degree position was held as long as possible, up to 30 seconds.
9. Four Count Jumping Jack

The subjects were asked to stand in a position with feet together and hands at the sides. For count one, they jumped taking the legs sideward apart and hands raised sideward up to the shoulder level. For count two hands were raised over the head and clapped. For count three, they brought back their hands and legs to count one position and for count four, starting position was retained. This exercise was repeated for 30 seconds.

10. Sitting Tucks

The subjects sat on floor with feet raised and arms extended for balance in a ‘V’ sit position. They were then asked to alternately bend and extend legs without lifting back or the feet touching floor. This exercise was repeated for 30 seconds.

LEVEL II

1. Side Skipping with Big Arm Swing

This exercise looks like a jumping Jack. The subjects step to the side, swinging the arms up and over the head. As they pushed to bring the feet back together, the arms were brought back down and cross in front of the body. They kept performing this extended side step and arms swinging for a distance of 5 meters. This exercise was repeated for 30 seconds.

2. Lateral Step-Ups

The subjects were asked to stand in front of a bench about 40 centimeters height. They lateral step up onto the bench straightening their
knees laterally fully then step down in quick succession. This exercise was repeated by alternating the leading leg on each side for a period of 30 seconds.

3. Sideways Shuttle Run

Two lines were drawn approximately 5 meters apart and the subjects were asked to run side-ward from one to the other as many times as possible for a period of 30 seconds.

4. Squat Thrusts

The subjects were instructed to crouch on the floor with legs straight out behind. The body weight rested on their hands. Both knees were bent up to the chest then kicked back both knees together. The movement was repeated in quick succession for 30 seconds.

5. Side - to - Side Jumping

Two lines were drawn on the ground approximately 5 meters apart, and the subjects jumped sideways from one line to another while progressing forward. This movement was repeated as many times as possible for a period of 30 seconds.

6. Reverse Curl

The subjects were asked to lie on the floor. First the knees were bent, placing the feet flat on the floor, then placing arms at sides. The knees were lifted to the chest, raising the hips off the floor, without letting the knees go past the shoulders. Then they were then asked to return to the starting position. This movement was repeated for 30 seconds.
7. Hexagon Run

The subjects were asked to stand in the centre of the hexagon with feet shoulder width apart. Then they were instructed to run across one side of the hexagon and back to center, then proceeding around each side of the hexagon. This type of exercise was repeated for a period of 30 seconds.

8. Bent Push-Ups

The subjects were asked to lie on the floor, facing down with the hands under their shoulders. Their body was kept straight from the knees to the top of the head. Then they pushed up until the arms were straight and slowly lowered their chest to the floor. The exercise was repeated for 30 seconds.

9. Two Count Jumping Jack

The subjects were asked to stand in a position with feet together and hands at the sides. For count one, along with a jump, they were asked to take their legs sideward apart and hands raised upward over the head and clapped. For count number two, the subjects were to come back again to starting position. In such a way this exercise was repeated for 30 seconds.

10. Sitting Tucks

The subjects were asked to sit on floor with feet raised and arms extended for balance. Simultaneously, both legs were bent and extended without lifting back or feet touching the floor. This exercise was repeated for 30 seconds.
LEVEL III

1. Rope Jumping

In rope jumping, the subjects were asked to aim at spending as much time in the air as possible, using their arm to gain extra height. Then they were asked to alternate their leg upon landing, thrusting the leading leg upward. The subjects have begun with one leg forward, driving off the back leg and then started short skipping step. This exercise was repeated for 30 seconds.

2. Depth Jump

The subjects were instructed to stand on a box with toes close to the front edge. They stepped from the box and dropped to land on both feet. This was repeated for 30 seconds.

3. Bound

The exercise started by bounding forward with only one leg, but landing on the other. Immediately upon landing, the subjects bounded forward as far as they can with the other leg. It is similar to skipping, but maximum effort was put into each bound. This exercise was repeated for 30 seconds.

4. Burpees

The subjects crouched on the floor with their legs straight out behind with their weight on their hands. Then they were asked to jump upwards after bending their knees up to their chest and then springing down to kick their legs back again. This exercise was repeated for 30 seconds.
5. Bunny Hops Shuttle Run

The subjects started the Bunny hops with feet about shoulder width apart. They were asked to squat and bring both arms back into a full arm swing and forward as far as ahead they could. After landing, the entire motion was immediately repeated. The subjects then Bunny hops back and forth between the parallel lines, which was 5 meters apart as many times as possible within 30 seconds.

6. Trunk Lift

The subjects were asked to lie in supine position with hands clasped behind the neck. They pulled the shoulder blades together, raising the elbows off the floor. The subjects then raised the head and chest slowly off the floor by arching the upper back. Then they returned to the starting position and the movement was repeated for 30 seconds.

7. Hexagon hopping

The subjects were asked to stand in the centre of the hexagon with feet shoulder width apart. They then hopped across one side of the hexagon and back to center, then proceeding around each side of the hexagon with the same hop. This exercise was repeated for 30 seconds.

8.90° Push - Ups

The subjects were instructed to kneel down and to place their hands on ground in front of body, shoulder-width apart with a straight back. They were asked to move the feet back until they were on toes. Then they slowly bend
arms until parallel to ground, dropping chest 4-5 inches from ground and push up to starting position. This exercise was repeated as many times as possible for 30 seconds.

9. Butt Kicks

While doing butt kicks, the back should be straight with a slight forward body lean. The body lean was natural as the player assumed while running that the arms are legs higher up. The player was quick in bringing the heels to the buttocks, not in moving up in the field. The subjects ran with butt kicks continuously back and forth between two parallel lines five meters apart as fast as possible for 30 seconds.

10. Jump and Reach

The subjects jumped vertically up, to touch the mark on a wall. As soon as they touched the mark on the wall, they returned to the floor. This exercise was repeated for 30 seconds.

3.9.2 MULTIPLE SHORT BOUTS CARDIO- AEROBIC CIRCUIT TRAINING (MSBCACT (GROUP II))

The subjects in the MSBCACAT (Group II) trained for five days a week. This circuit comprised of 30 second work periods at 50 to 60 % of maximum heart rate with 30 seconds of jogging between each station to increase the aerobic content. This workout was done three times in a day. The MSBCACT differed from CLBCACT only in terms of duration and frequency not in the mode of exercises. The total duration of exercise of MSBCACT was
30 minutes as that of CLBCACT. This 30 minutes training was practiced intermittently in the morning, noon and evening. Hence the exercises used in continuous long bout cardio-aerobic circuit training programme were adapted for this group also.

3.9.3 MULTIPLE SHORT BOUTS CARDIO- AEROBIC CIRCUIT TRAINING WITH RESISTANCE EXERCISE (MSBCACTRE) (GROUP III)

The subjects in the MSBCACTRE (Group III) trained for five days a week. This training programme comprised with exercises of aerobic and resistance. The nature of the MSBCACTRE programme was similar to MSBCACT in duration and frequency (3 x 10 minutes). This group practiced five minutes cardio aerobic circuit training as in the case of MSBCACT followed by five minutes cardio aerobic circuit training with resistance exercises at 50 to 60% of maximum heart rate in a single set fashion. This training comprised of 30 second work rate with 30 seconds of Jogging between each station to increase the aerobic content.

LEVEL I

This group first practiced cardio aerobic circuit for a duration of 5 minutes. The exercises included in this cardio aerobic circuit were skipping, shuttle run, heel and toe walking, four count jumping jack and hexagon drill. The above exercises were already explained in the earlier training programmes of CLBCACT and MSBCACT. Hence only the resistance exercises were explained here.
1. Half Squat

The subjects were asked to stand erect with the weight balanced comfortably across the top of the shoulders. Using an overhand grip hands spread shoulder width a part, the weight was lowered by bending the knees to a 90 degree angle and return to the starting position by keeping the back straight. This exercise was repeated for 30 seconds.

2. Triceps Extension

The subjects were asked to sit erect and palms facing up bar resting behind neck on shoulder hands near center of the bar, feet shoulder width spread apart, tighten abdominal and back muscles. The bar was raised over head and return to original position. This exercise was repeated for 30 seconds.

3. Biceps Curl

The subjects were asked to grasp the bar shoulder width apart, using an under hand grip. The bar was brought to a position of rest against thighs, elbows fully extended and feet spread shoulder width apart. The bar was raised using only the arms up to the chest and returned to starting position. The bar was kept straight and returned to a position with the elbows fully extended. This exercise was repeated for 30 seconds.

4. Heel Raise

The subjects were asked to stand erect with palm facing forward, hands wider than shoulder width apart and bar resting behind neck on shoulders. The subjects were instructed to rest balls of feet on 2 inch block with heels apart.
Then they raised on toes quickly, holding for 1 second. This exercise was repeated for 30 seconds.

5. Trunk Curl

The subjects were asked to lie on mat with knees bent and holding a 5 pound barbell plate. They slowly curled their head and shoulders off the mat and pressed lower back into the mat. Slowly they returned to the starting position and the exercise was repeated for 30 seconds.

LEVEL II Group III

1. Forward Lunge

The subjects were asked to place a barbell behind the neck and support it with hands placed slightly wider than shoulder width apart. In a slow and controlled motion, they took a step forward, allowing the leading leg to drop so that it was nearly parallel with the ground. The lower part of the leg was kept nearly vertical and the back was maintained in upright posture. The stride with opposite leg toe turn to standing posture. The movement was repeated with other leg, remaining stationary or moving slowly in a straight line with alternating steps. The exercise was repeated for 30 seconds.

2. Shoulder Press

The subjects were asked to sit erect, bending their elbows, with palms facing forward at chest level, and hands spread shoulder width apart and feet spread. They also tightened the abdominal and back muscles. The bar was
moved to overhead position (arms straight) and then lowered to chest position. The exercise was repeated for 30 seconds.

3. Upright Row

The subjects were asked to stand erect with palms facing forwards to the body, hands wider then shoulder width apart the bar resting at the hip level. They pulled the bar upward up to the chest level with both hands by flexing the elbows, holding it for 1 second and then lowering it to the same position. The exercise was repeated for 30 seconds.

4. Heel Raise with Toes Together

The subjects were asked to stand erect with palms facing forward, hands wider than shoulder width apart bar resting behind neck on shoulders. They were then asked to rest their balls of feet on 2 inch block with toes together. They then raised on their toes quickly, holding for 1 second having the heels to floors. The exercise was repeated for 30 seconds.

5. Reverse Curl

The subjects were asked to lie on the floor. While bending their knees, they placed the feet flat on the floor and arms at sides. They then lifted the knees to the chest, raising the hips off the floor, without letting the knees go past the shoulders. Finally they returned to the starting position. This exercise was repeated for 30 seconds.
LEVEL III Group III

1. Step-Ups With Dumbbells

The subjects were asked to stand in front of a bench about centimeters high. They stepped up on to the bench with Dumbbells, straightening their knees fully then down in quick succession. On each set of the exercise the leading leg was alternated. The exercise was repeated for 30 seconds.

2. Power Clean

The subjects were asked to stand erect with palm facing forward, hands wider than shoulder width apart, with the bar resting at the hip level. The bar was raised with both hands simultaneously upward up to the chest level. The bar was touching the chest. The abdominal and back muscles were tightened. The bar was first moved to overhead position (arms straight), lowered to chest position and then to the hip position. The exercise was repeated for 30 seconds.

3. Bent-Over Row

The subjects were asked to stand erect with the bar, with hands wider than shoulder width apart. They then bent forward at the same time holding the bar in front of the body in a hanging position. The bar was pulled upward to the chest level with both hands by flexing the elbows, holding for 1 second and then lowering it to the same position. The exercise was repeated for 30 seconds.
4. Heel Raise with Heels Together

The subjects were instructed to stand erect with palms facing forward, hands wider than shoulder width apart and the bar resting behind neck on shoulders. They were then asked to rest their balls of feet on 2 inch block with heels together. Next they raised on toes quickly, holding for 1 second however heels to floor. The exercise was repeated for 30 seconds.

5. Bench Press

The subjects were asked to lie supine on bench with the knees bent and feet flat on floor in stride position; bar grasped at the shoulder level. The bar was raised over the head until arms were straight and returned to the starting position. The exercise was repeated for 30 seconds.
3.10 COLLECTION OF DATA

At the end of the treatment period, as post test, the subjects belong to the treatment groups namely continuous long bout cardio aerobic circuit training, multiple short bouts cardio aerobic circuit training and multiple short bouts cardio aerobic circuit training with resistance exercises and control group were tested on criterion variables of muscular strength and endurance, flexibility, cardio respiratory endurance (health fitness components), percent body fat, lean body mass, body weight, waist circumference (body composition indices) and resting heart rate, resting systolic blood pressure, resting diastolic blood pressure and maximum oxygen consumption as such in the pre-test of the same. The collected data were processed with appropriate statistical tool and the detailed procedure of the same is given below.

3.11 STATISTICAL ANALYSIS OF DATA

The present study pays attention mainly on testing the means of four treatment groups and secondarily deals with the increase of means in each group from baseline to post treatment for various measures. The statistical tool used for these are described here. Analysis of covariance was applied to determine whether the four programmes of training produced significantly different improvements in selected variables after 12 weeks of training. Since the initial means were not matched, comparisons between actual could not be made, all means were adjusted by regression to a common mean. The significance of difference of pairs of adjusted final group means was tested for significance by applying Scheffe’s post hoc test.
Further, the group mean gains recorded by the various groups during the experimental period of twelve weeks to the criterion measures were tested for significance by applying students test.