Chapter III

PROCEDURE

In this chapter the selection of subjects, experimental design, criterion measures, reliability of data, training programme, collection of data and statistical techniques for the analysis of data have been described.

Selection of Subjects

Eighty students (40 males and 40 females) studying in Certificate Course in Physical Education (1988-89) of Shaheed Kanshi Ram College (SKR College) of Physical Education, Bhago Majra, Kharar, Distt. Ropar, Panjab were selected as subjects for this investigation. These subjects were selected at random out of a total of 60 boys and 60 girls. The age of these subjects ranged from 16 to 19 years. Before the commencement of the scientific investigation, the researcher checked the health records of these students maintained by the college and also at his own level, with the help of a qualified doctor of a local private clinic, conducted a few medical tests to ensure that all the subjects were medically fit to undergo the type of training programmes they were subjected to. After scrutiny of the health records and medical report prepared
by a doctor after a general check-up, it was revealed that all the subjects had fairly well-developed physiques and were free from any chronic disease.

All the subjects were residents of the hostel in the college campus and had the same routine in terms of diet, physical activity programme and environment and thus there was no need to control these factors.

A meeting of all the selected subjects was held prior to the commencement of the experiment, in which the Principal and some of the faculty members of the college were present. The purpose of this investigation along with the various testing procedures and training programmes was explained to them in detail so that there was no ambiguity in their minds regarding the efforts required of them and the hard work they would have to put in. All the subjects were convinced and agreed to cooperate whole heartedly in the experiment, which was explained to them. The Principal and teachers also asked them to put in their best efforts in the interest of scientific investigation and to enhance their own performance and achievement standards. However, no special motivational techniques were used to enhance their performance.

**Experimental Design**

Random group design was adopted for this study. The 40 boys and 40 girls were divided randomly into two
equal groups of 20 subjects each i.e. in total four groups were made (two for males and two for females). Out of these four groups two experimental groups (one each for boys and girls) and two control groups were assigned at random. The boys' groups were called as EB (Experimental Group) and CB (Control Group boys) and the girls' EG (Experimental group) and CG (Control group girls). The control groups did not participate in the planned training programme; however, the subjects belonging to these groups kept participating in the required physical education classes of the college curriculum.

Criterion Measures

The criterion measures for testing the hypothesis were:

Cardio-Pulmonary Index (C.P. Index)

Following seven variables were incorporated in the formula prescribed for estimating Hyman's Cardio-Pulmonary Index.

\[
\text{C.P. Index} = \frac{VC + MBH + MEP + Age}{SP + DP + PR}
\]
1. Systolic Blood Pressure in mm Hg. (SP)
2. Diastolic Blood Pressure in mm Hg. (DP)
3. Pulse rate per minute. (DR)
4. Vital Capacity in 100 ml units. (VC)
5. Maximum Breath Holding time in seconds. (MBH)
6. Maximum Expiratory Pressure in mm Hg. (MEP)
7. Age in completed years. (Age)

Body Composition

Skinfold measurements were recorded in mm using skinfold caliper. The sites for the skinfold measurements were:

1. Biceps
2. Triceps
3. Subscapular region
4. Supra iliac region

Anaerobic Capacity

Anaerobic capacity of the subjects was measured by using the following tests:

1. Margaria Power test
2. 50 metre run
Reliability of Data

The reliability of data were ensured by establishing the instrument reliability, tester competency, reliability of tests and subjects' reliability.

Instrument Reliability

Electronic stop watches, Metronome, Weighing Machine, 18 inch high bench, Sphygmomanometer, Stethoscope and Spirometer used in this study were obtained from reputed suppliers of standard firms which cater to the needs of various research laboratories in India and abroad. All the instruments used, were available in the department of Physical Education, Punjab University, Chandigarh and the Department of Physical Education, Panjab Engineering College, Chandigarh. The calibration of these instruments was certified by the suppliers.

Tester Competency and Reliability of Test

To ensure that the investigator was well versed in the techniques of conducting the tests, the investigator had a number of practice sessions under the guidance of Dr. G.S. Sohi (Principal, SKR College of Physical Education) at Shaheed Kanshi Ram College of Physical Education, Bhago
Majra, Distt. Ropar, Panjab.

All the measurements were taken by the investigator with the assistance of faculty members of the college and some of the senior students of the college, who were also trained and acquainted with the tests and the testing procedures.

Tester competency was evaluated together with reliability of tests. Reliability of tests was established by test-retest method whereby consistency of results was obtained by product moment correlation. The data was collected from randomly selected ten subjects through test-retest. The test-retest scores for each variable were then correlated and the coefficients thus obtained have been presented in Table 1.

**TABLE 1**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Test</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Systolic Blood Pressure</td>
<td>.85</td>
</tr>
<tr>
<td>2</td>
<td>Diastolic Blood Pressure</td>
<td>.80</td>
</tr>
<tr>
<td>3</td>
<td>Pulse rate</td>
<td>.90</td>
</tr>
<tr>
<td>4</td>
<td>Vital Capacity</td>
<td>.87</td>
</tr>
<tr>
<td>5</td>
<td>Maximum Breath Holding Time</td>
<td>.93</td>
</tr>
<tr>
<td>6</td>
<td>Maximum Expiratory Pressure</td>
<td>.92</td>
</tr>
<tr>
<td>7</td>
<td>Skinfold measurements</td>
<td>.81</td>
</tr>
<tr>
<td>8</td>
<td>Margaria Power test</td>
<td>.91</td>
</tr>
<tr>
<td>9</td>
<td>50 metre Run</td>
<td>.88</td>
</tr>
</tbody>
</table>
It may be observed from Table 1 that the data pertaining to different tests were quite reliable and the table further indicated that the tester's reliability was significantly high (reliability coefficients ranging from .80 to .93), which ensured the competency of the investigator to administer the tests.

Subject Reliability

The test-retest coefficients of correlation also established the subject reliability, because the same subjects were used and under similar conditions by the same tester and no motivational techniques were used.

Training Programme

Similar training programme was administered to both the experimental groups, namely male group EB and female group EG, which mainly provided for three physiological qualities, namely strength, speed and cardio-respiratory endurance. This programme was planned and prepared by the investigator in consultation with experts in the field of exercise physiology and training methods. The training schedules/set of exercises, included in the programme after conducting pilot study to establish the progression of load and intensity, have been presented
in Tables 2, 3 and 4.

**TABLE 2**

**SCHEDULE IN STRENGTH TRAINING WITH WEIGHTS**

<table>
<thead>
<tr>
<th>Exercises</th>
<th>Week</th>
<th>Intensity (%)</th>
<th>Repetition (Nos.)</th>
<th>Recovery (Min.)</th>
<th>Sets (Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bench Press</td>
<td>1 and 2</td>
<td>70-80</td>
<td>3-5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Half squat</td>
<td>3 and 4</td>
<td>80-90</td>
<td>3-5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Trunk bending</td>
<td>5 and 6</td>
<td>70-80</td>
<td>3-5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Two arm</td>
<td>9 and 10</td>
<td>70-80</td>
<td>3-5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Curls</td>
<td>11 and 12</td>
<td>80-90</td>
<td>3-5</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

**TABLE 3**

**SCHEDULE IN SPEED TRAINING**

(Single Acceleration Runs)

<table>
<thead>
<tr>
<th>Week</th>
<th>Distance Run (Metres)</th>
<th>Repetitions (Numbers)</th>
<th>Recovery (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st and 2nd</td>
<td>60</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3rd and 4th</td>
<td>60</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>5th and 6th</td>
<td>70</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7th and 8th</td>
<td>70</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>9th and 10th</td>
<td>80</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>11th and 12th</td>
<td>80</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
TABLE 4
SCHEDULE IN ENDURANCE TRAINING

<table>
<thead>
<tr>
<th>Week</th>
<th>Continuous Run (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st and 2nd</td>
<td>15</td>
</tr>
<tr>
<td>3rd and 4th</td>
<td>15</td>
</tr>
<tr>
<td>5th and 6th</td>
<td>20</td>
</tr>
<tr>
<td>7th and 8th</td>
<td>20</td>
</tr>
<tr>
<td>9th and 10th</td>
<td>30</td>
</tr>
<tr>
<td>11th and 12th</td>
<td>30</td>
</tr>
</tbody>
</table>

The above training programme was administered to both the experimental groups with the help of the qualified teachers of Shaheed Kanshi Ram College of Physical Education, between 3 to 5 P.M. on each day of training. The training was imparted from middle of September to middle of December, 1988.

Before starting each day's training, both the experimental groups were given the necessary warming up which included jogging, running, stretching exercises and mobility exercises. Alongwith these during warming up, agility and flexibility exercises were also administered thrice a week.

Biweekly progression was executed in case of strength and speed training and monthly progression was
provided for endurance training.

**Collection of Data**

The necessary data were collected by administering the tests for measuring C.P. Index, body composition and anaerobic capacity following the standard procedures of test administration on the subjects selected for this study before the start of training, after four weeks, after eight weeks and after the experimental period of twelve weeks. All the tests were administered in the complex hall and play grounds of Shaheed Kansi Ram College of Physical Education, Bhago Majra, Distt. Ropar, Panjab.

Before the administration of tests, the subjects were given a chance to practice the prescribed tests, so that they became familiar with the tests and knew exactly what was to be done. The use of apparatus was explained to them prior to the administration of tests and demonstration of Margaria Power Test and Harward Step Test were given by the investigator himself. To ensure uniformity in the testing conditions, the subjects were tested between 3 P.M. to 5 P.M. by the same testers and competent assistants under the close supervision of the investigator.
Administration of Subjects

Cardio-Pulmonary Index

Following seven variables were incorporated in the formula prescribed for estimating Hyman's Cardio-pulmonary Index which measures efficiency of the cardio-pulmonary system.

i) Vital Capacity in 100 ml units.
ii) Maximum Breath Holding time in seconds.
iii) Maximum Expiratory Pressure in mm Hg.
iv) Actual age in years.
v) Systolic Blood Pressure in mm Hg.
vi) Diastolic Blood Pressure in mm Hg.
vii) Pulse rate per minute.

Vital Capacity

Vital capacity was measured with the help of a spirometer graduated in litres. The spirometer bell was immersed in the water filled in the spirometer drum. The pointer of the scale was set at zero mark in the beginning of the test and it was placed at such a height that all subjects could perform the test from standing erect position. The subject took deep breaths before starting
the test, and then after fullest inhalation, the subject placed the mouth piece attached to the hose connected to the drum of the spirometer in his/her mouth, taking care that no air escaped through the edges of the mouth piece. The subject exhaled with maximum effort while bending forward slightly until the maximum volume of the air could be expelled without taking a second breath. The subjects were instructed to take care that they blew out air only through the mouth and not by the nose even partially. To prevent the air from escaping through the nose, the use of a nose clip was made. The score of vital capacity for each subject was recorded in litres.

Maximum Breath Holding Time

The subject tested had the nose clip on and was asked to inhale through his mouth to the maximum capacity. As soon as the subject took a deep breath to the full capacity of his/her lungs and closed his/her lips the stop watch was started. As long as the subject was holding his/her breath his/her index finger was kept down. The tester kept his eyes on the subject's index finger and stopped the watch the moment the index finger was seen moving up. The time to the tenth of a second was recorded for each subject.
Maximum Expiratory Pressure

The bulb was removed from the sphygmomanometer and a mouth piece was fitted. The subject was asked to sit on the chair and inhale deeply and blow into the manometer as forcefully as possible; the highest pressure maintained for three seconds was recorded.

Age

It is based on actuarial table in which the age nearest to the candidate's past or next birth day is employed\textsuperscript{1}.

Blood Pressure

A dial type sphygmomanometer and a stethoscope were used for measuring the systolic and diastolic blood pressures. Before the measurements were taken, each subject was given enough time to relax in an easy chair. It was ensured that each subject was placed in a comfortable position. While taking blood pressure, the subject's left arm was completely bared to make sure that the clothing

\textsuperscript{1} Encyclopedia of Sports Sciences and Medicine, P.276.
did not constrict the blood vessels. The blood pressure measurement was taken with the subject in a sitting position, his fore-arm supported on the handle of the chair. The cuff was wrapped around the arm evenly, with lower edge approximately one inch above the antecubical space. The stethoscope receiver was placed gently over the artery in the antecubical space. It was made sure that stethoscope was free from contact with the cuff. The cuff was inflated until the artery was fully pressed to the extent that no pulse beat could be heard.

Pressure was then slowly released as the investigator watched the dial. When the first sound of the pulse became audible the reading in millimeters of mercury (mm Hg) 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 Hg when heart sound completely ceased.

Pulse Rate

The subject was asked to sit in the easy chair. Then the radial artery was palpated with the finger tips to take the total pulse rate per minute with the help of a stop watch.
Regardless of the formula employed, the measurement of cardio-respiratory functional capacity is a three phase procedure; the necessary data were obtained during a resting period, directly after the performance of measured physical activity and after a specified resting period.

Work performance in relation to cardio respiratory system was estimated by the Harvard step test procedure. When a given subject's weight in pounds was multiplied by the height climbed in feet, the calculated pounds of work was obtained. Approximately 5000 foot pounds of work was performed on Harvard Step Bench by each subject. The second or dynamic phase of the cardio-pulmonary exercise Tolerance test was performed directly after the subject has completed 5,000 foot pounds of work. The six variable parameters were promptly determined; the age factor of course, remained the same as in the C.P.Index adynamic phase.

The third phase or restoration phase of the C.P. Index exercise test was concerned with the time required to restore all the various parameters to the original pre exercise levels. The five minute resting period has been generally accepted for most of the tolerance tests; thus resting period, in this study was kept five minutes. After resting period all the seven parameters except age were
determined to calculate the C.P. Index (Restoration) scores\(^2\).

**Body Composition**

In order to determine the fat percentage, the skinfold measurements were recorded in millimeters with the help of the Lange Skinfold Callipers, at four different sites, and to obtain the percentage of body fat the total value of skinfold thickness at four sites was referred to the converting chart prepared by Durnin and Rehman\(^3\).

The skinfold measurements were taken as per procedure given below:

Lange Skinfold Callipers was employed for measuring skinfold thickness at specific sites. The skin at a specific site was held between the thumb and index finger and pulled out to form a fold so as to include two thicknesses of skin and subcutaneous fat in between them.

The calipers was applied about one centimeter from the spot pinched with thumb and finger and to a depth equal to the fold approximately. The measurement was recorded in millimeters. Three readings were taken and the average of

\(^2\)Encyclopedia of Sports Sciences and Medicine, P. 276.

three readings was recorded as the thickness of the skinfold at that site. To eliminate any error, the reading was made between three to four seconds, when essentially all compressions have taken place. If this precaution was not taken, the skinfold would gradually have decreased because of the tissue being squeezed out from the jaws of the calipers. The following were the sites for skinfold measurements:


**Biceps Skinfold**

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

**Triceps Skinfold**

The skinfold thickness was taken over the triceps muscle at a point half way between the tip of the shoulder (acromial process) and the tip of the elbow (olecranon process). The point was located with forearm flexed to 90 degrees, and while taking the measurement the arm was kept
hanging free. The fold was lifted parallel to the long axis of the arms; reading to the nearest half millimeter was recorded.

Subscapular Region Skinfold

The skinfold thickness was taken at the tip of the scapula (interior angle) with the subject in a relaxed standing position. The fold was lifted in the diagonal plane at about 45 degree from vertical and horizontal planes; reading to the nearest half millimeter was recorded.

Supra Iliac Region Skinfold

The skinfold thickness was taken three to five centimeters above anterior superior iliac spine on diagonal line going downward and inward; reading to the nearest half millimeter was recorded.

Anaerobic Capacity

The anaerobic capacity of the subjects was measured by means of Margaria Power Test and by 50 metre run.
Margaria Power Test

The subjects were assembled at the premises of SKR College of Physical Education, Bhago Majra. The steps of the gallery of the college building which were made use of in taking the Margaria Power Test, were shown to the subjects. As per the requirement of this particular test, the number of steps was more than 20, which enabled each subject to put forth maximal effort from the start to beyond the 12th step. The height of each step was 44 centimeter and the vertical distance 1.56 meter (Figure 1). The flight of stairs has been constructed in such a way that one side of it is open and it was numbered by the investigator from 1 to 12, which enabled the time keeper to start and stop the watch as the subject struck the fourth and twelfth steps respectively.

The subjects were explained the meaning and significance of anaerobic test and the rationale of the testing procedure. The test procedure was demonstrated with the help of senior students of the said college. The subjects were allowed to take a number of trials in the course of three days to give reliable performance avoiding learning effects of testing techniques. Each subject was started off from a starting line, six feet from the base of the first step and marked with white indicators. The subject was given clues 'ready and go' as in any standing sprint start. A stop watch (1/100) was started as the subject
MARGARIA KALAMEN
ANAEROBIC CAPACITY TEST

This test was employed to measure anaerobic capacity. Two parallel lines 30 metres apart from each other were marked on the college standard track and start and finish times were taken.
stepped on the fourth step and it was stopped when the same foot stepped on the twelfth step. The subject attempted to run through the flight of steps as fast as he/she could. However, as the subject hit the twelfth step, the stop watch was stopped. He/she was given oral signal to stop. Of course, he/she was instructed not to stop all of a sudden as in that case, the subject might slow down in coming to a stop. Each subject was given three trials. The average timing of three trials was used in calculations. On the day of the test the weight of the subject was recorded in the campus of the college. Anaerobic capacity was calculated by using the following formula:

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

Where,  
- \( P \) = power  
- \( F \) = weight  
- \( D \) = vertical distance  
- \( t \) = mean time taken to run

50 Metre Run

This test was also employed to measure the anaerobic capacity. Two parallel lines 50 metres apart from each other were marked on the college standard track. Two
subjects were tested at a time. They were asked to take standing start behind the starting line. The clapper was clapped after the caution "ready" was given to the subjects. The starter stood in such a position, so that the 'V' of the clapper (open before clap) was visible to the time keepers. As the 'V' closed, when the clap was executed, the time keepers at the finish line started their stop watches. The subjects sprinted as fast as possible across the finish line and the stop watches were stopped, as and when the concerned subject covered the distance.

The elapsed time, from the starting signal until the subject crossed the finish line was recorded to the nearest 1/10th of a second as a score.

Statistical Techniques

Analysis of variance (ANOVA) was applied in order to find out the differences, if any, on each of the chosen variables before start of training, after four weeks, after eight weeks and after the experimental treatment of twelve weeks. Analysis of covariance (ANCOVA) was carried out for all the groups with respect to the mean gains in each of the chosen variables, to find out the differential effects of similar training programme treatment in males and females. To find out the significance of difference between paired means and adjusted paired means, the Scheffe's post hoc test
was applied where F-ratio was found significant. For testing the hypothesis, .05 level of significance was chosen. All the statistical computations of this investigation were got done through VAX-8350 system of Computer Science & Applications Department of the Panjab University, Chandigarh.