Chapter III

PROCEDURE

In this chapter the selection of subjects, selection of variables, criterion measures, procedure for administering the test, selection of exercises, description of exercises, administration of training programme and statistical procedure employed for analysing the data are described.

Selection-of-Subjects

Sixty boys ranging from 14 to 16 years of age of Rabbani Bahai School, Gwalior were randomly chosen as subject for this study. As this school is situated at the outskirts of Gwalior city the students were the representative of lower middle class family, educationally as well as economically.

For classifying them into three experimental and one control group their height and weight were used as criterion. The height and weight of all the sixty subjects had been converted into standard scores and on the basis of sum of the standard scores the
subjects had been graded and then classified into three experimental and one control group. Group A which was the "Concentric only Group" and group B which was the "Eccentric only Group" had fifteen subjects each where as group c which was the "Combined (Concentric-eccentric) Group" had sixteen subjects. The Control Group i.e. group D had fourteen subjects but due to illness, one boy had withdrawn himself and there were thirteen subjects left in control group.

These boys were chosen as subjects for this study because all of them were the residents of the hostel and had a common routine and food.

They had shown interest, enthusiasm and cooperation for collection of data and training.

Selection-of-Variables

Keeping in mind the availability of instruments, tests and easyness to isolate the concentric and eccentric phase of a movement the following variables had been selected to find out the effectiveness of concentric, eccentric and combined (Concentric-eccentric) training on muscular strength, muscular hypertrophy and muscular power.
1. Static strength of arm and shoulder
2. Dynamic strength of arm and shoulder
3. Arm girth
4. Muscular power of arm and shoulder
5. Static strength of leg
6. Dynamic strength of leg
7. Thigh girth
8. Muscular power of leg.

**Criterion Measures**

The criterion measures chosen for testing the hypothesis were:

1. The resistance overcome to the nearest half of kilogram in a portable leg dynamometer for modified elbow flexion test.

2. The resistance overcome to the nearest half of kilogram in a 1-RM (Repetition maximum) bench press test.

3. The girth measured around the most prominent part of upper left arm using a steel tape in nearest half of centimeters.
4. The distance covered to the nearest of centimeter in a two hand medicine ball put.

5. The resistance overcome in nearest half of kilogram in a leg dynamometer for a leg lift test.

6. The resistance overcome in nearest half of kilogram in a 1-RM (Repetition maximum) full squat test.

7. The girth measured around the left thigh just under the fold of the buttocks using a steel tape in nearest half of centimeters.

8. The difference between standing reach and the maximum vertical jump reach recorded in nearest half of centimeters.

Procedure for Administering the Test

Elbow Flexion Test
(Static Strength of Arm and Shoulder)

The subject lied on a table in supine position, hips and knees flexed, feet resting on table. A portable leg dynamometer was fixed into the table at the side of the subject with the help of two nails. The regulation strap was fixed in forearm mid way in
wrist and elbow joint, keeping elbow in 115° flexion. The other end of the regulation strap was fixed in the hook of the dynamometer. For getting the exact 115° flexion of elbow the position of subject was adjusted on the table and the angle was measured by a simple goniometer. The subject was then instructed to flex his elbow keeping the forearm in mid prone position. During the execution of test it had been kept in mind that the shoulder and elbow were not raised from the table. The score recorded to the nearest half of kilogram on the dial.

1-RM Bench Press Test

(Dynamic Strength of Arm and Shoulder)

1-RM method was used to determine the dynamic strength of arm and shoulder. The subject layed on a bench keeping the feet on the floor. The hands were at the side and just above the chest. The weights in the form of barbell had been given in the hands of subjects with the help of two helpers. He was then instructed to lift the barbell in the upward direction at right angle until the arms reached in elbow extended position. By giving two or three trials the maximum weight was recorded to the nearest half of
kilogram which the subject was able to lift 1-RM (Repetition Maximum).

**Arm Girth**

The arm girth of the left flexed tensed upper arm was measured. The subject sat on a chair, feet flat on the floor. The arm was flexed at the shoulder to about 90° and the forearm in supine position was flexed at the elbow. The muscles of the upper arm were contracted to form a bulk as large as possible. The girth measured around the most prominent part of the upper arm using a flexible steel tape in nearest half of centimeter was recorded as the score.

**Two Hand Medicine Ball Put**

(Muscular Power of Arm and Shoulder)

From a sitting position in a straight back chair the subject had been given to hold a 2 kg medicine ball in both the hands against the chest and just under the chin. He was then instructed to push the ball upward and forward preferably at an angle of 45° for maximum distance. A small cotton strap was placed around the subject chest and was tauted to the rear by an assistant; in order to eliminate rocking action and use of other parts of the body during the
put. The distance of the best of three successive trials measured to the nearest of the centimeters was recorded as the score. The distance was measured from the forward edge of the chair to the nearest point of contact of the ball with the floor.

**Leg Lift**

*(Static Strength of Leg)*

The subject was instructed to hold the bar of the dynamometer at the junction of the thigh with a over hand grip after standing on the plateform. The subject then stood in knee bent; back erect, head up and eye straight ahead position. The hook of the dynamometer was then fixed with the chain of the bar and then the subject was instructed to straight his knee while pulling the bar. At the end of the lifting effort the score was recorded in nearest half of kilogram.

**1-RM Full Squat Test**

*(Dynamic Strength of Leg)*

1-RM method was used for determining the dynamic strength of leg. the subject sat on a full
squat position using two weight plates for raising the heels for balance. The weight in the form of barbells was then placed on his shoulder with the help of two helpers. He was instructed to support the barbells with the help of hands, neck and shoulders keeping his back straight. He was then instructed to stand up in the back straight position. By giving two or three trials the maximum weight was recorded to the nearest half of kilogram which the subject was able to lift 1-RM (Repetition Maximum).

Thigh Girth

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

Vertical Jump
(Muscular Power of Leg)

In this test the wall was marked in centimeters. The subject stood away from the wall for
avoiding any type of injuries or disturbances while executing the jump.

For getting the standing reach the subject was instructed to stand close to the wall and to extend both the hands as high as possible. The measurement was recorded on a paper. He was then instructed to execute three jumps from a crouched position making a marks each time on the wall. But he was not allowed to take help by swinging his hands. The highest mark was again recorded and the difference was recorded as score in nearest half of centimeter.

Selection-of-Exercise

The research scholar had gone through the available literature regarding the selection of exercises and isolating them concentrically and eccentrically. Based on the experts opinion and scholar own understanding about the muscle contraction during movements the following exercises had been selected for analysing the effects of concentric only, eccentric only and combined (concentric-eccentric) type of training on different strength variables.
1. Partner arm press
2. Medicine ball shoot
3. Floor push up (with support)
4. Partner leg press
5. Half lying press
6. Stair assending/descending (with partner)

Description of Exercise

Partner Arm Press

The concentric only group lied on the floor in bent knee position. He was then instructed to hold a bamboo lathi widely like a barbell in bench press. His partner from eccentric only group stood towards his head side about 3-4 feet from his head. The partner was instructed to incline himself keeping his knees on the floor and to hold the lathi in between the hands of the performer applying his body weight on the lathi down ward. The performer was then instructed to push-up using his posterior arm and chest muscles concentrically from a elbow flexed position. He continued the movement until the extention of the elbow in an upward direction. After the extention of
the elbow of performer the partner was instructed to release his body weight and the performer was instructed to come to the starting position. The same movement was continued for a number of repetition.

For an eccentric only group subject the elbow extended position was the starting position and the performer was instructed to flex his elbow slowly and in a controlled manner so that the body weight of partner (concentric only group subject) could be lowered using posterior arm and chest muscles eccentrically.

For a combined (concentric-eccentric) group both the movement was continued simultaneously.

**Medicine Ball Shoot**

The concentric only group subject and eccentric only group subject stood, keeping 2 feet distance facing each other. The concentric only group subject held a medicine ball by both the hands in an elbow extended position, keeping the ball nearer to the thigh. From this position he was instructed to lift the ball to the shoulder level keeping his elbow straight. He was then instructed to flex his elbow and bring the ball close to the face and then to throw
the ball with both hands like a basketball shoot, up in the air using his shoulder and arm muscles concentrically. The eccentric group subject was instructed to catch the ball up in the air and then to lower down the ball slowly close to his face. He was again instructed to extend his elbow straight at shoulder level and then to lower down the ball slowly close to his thighs keeping his elbow straight and then instructed to throw the ball slowly in a under arm manner to the concentric only group subject using his arm and shoulder muscles eccentrically. This cyclic movement was repeated for a number of times.

The combined (Concentric-eccentric) group was instructed to repeat both phase of movement individually and simultaneously.

**Floor Push-up**  
*(With Support)*

The concentric only group subject was instructed to take push-up position keeping his elbow in completely flexed position and palm on the floor at the side of the chest. The eccentric only group
subject stood in a spread leg position keeping his legs at the both sides of the concentric only group subject. A wide strap was tauted around the chest the concentric only group subject, which was held by eccentric only group subject by both the hands. The concentric only group subject was then instructed to push up using his posterior arm and chest muscles concentrically until the elbow reached in completely extended position. After this movement the concentric only group subject was brought down by the eccentric only group subject with the help of the wide strap and the same movement was performed a number of times.

For an eccentric only group exercise the subject were instructed to change their position i.e. the eccentric only group subject on the floor and concentric only group subject in a spread leg standing position. The eccentric only group subject was then instructed to take a push-up position keeping his elbow in a completely extended position and palm on the floor. He was then instructed to go down in a controlled manner using his posterior arm muscles eccentrically until the elbow reached in a completely
flexed position. He was then pulled up by the concentric only group subject with the help of the wide strap. The same movement was performed a number of times.

The combined group (concentric-eccentric) performed both phase of movement individually and simultaneously.

**Partner Leg Press**

The concentric only group subject lied on his back with knees tucked towards the chest. The eccentric only group subject was instructed to hold the legs, applying body weight on the soles of the concentric only group subject through his chest. From the knee flexed position the concentric only group subject was instructed to push away the eccentric only group subject using the anterior thigh muscle concentrically. After the full extension of the knee the eccentric only group subject was told to release the body weight and the concentric only group subject was instructed to come again in the bent knee tucked position for next repetition. The same movement was performed a number of times.
For the eccentric only group, the subject was instructed to start the movement from knee extended position. From this position he was instructed to flex the knee slowly and in controlled manner using the anterior thigh muscle eccentrically.

The combined (concentric-eccentric) group was instructed to perform both the phase of movement simultaneously.

**Half Lying Press**

The concentric only and eccentric only group subject was instructed to sit in half lying position keeping their elbow and forearm on the floor. Concentric only group subject was instructed to bend his legs from knee and hip where as eccentric only group subject was instructed to extend his legs and then both were instructed to fix their soles against each other. Now the concentric only group subject was instructed to press the sole of the eccentric only group subject where as eccentric only group subject was instructed to resist the press in such a manner so the movement of press could be slowed down by using his thighs muscles eccentrically. After the complete
extent of leg of the concentric only group subject both the group subject were instructed to come in the starting position again without applying any force and the same movement was repeated a number of times.

The combined (concentric-eccentric) group was instructed to apply press and resist from both the side simultaneously i.e. when one group subject had pressed the other group subject had resisted and vice-versa.

**Stair: Ascending/Descending**
* (with partner)

The concentric only group subject was instructed to lift the eccentric only group subject on his back holding both the legs of eccentric only group subject around his arms. Eccentric only group subject was also instructed to keep his body weight on the shoulder of concentric only group subject keeping his both hands infront of the concentric only group subject and head on one shoulder. Now concentric only group subject was instructed to ascend the stairs. After reaching the top of the stairs the eccentric only group subject was
instructed to lift the concentric only group subject and then he was instructed to descend the stairs in a slow manner by using the thigh muscles eccentrically.

The combined (concentric-eccentric) group subject was instructed to ascend and descend the stairs with their partner on their back simultaneously.

Administrating the Training Programme

The research scholar had selected and modified a few exercises for concentric only, eccentric only and combined (concentric-eccentric) group keeping in mind the contraction of muscles during the movement. The groups were divided on the basis of their height and weight and pairs for exercises were also made on the basis of their height and weight.

The training was given three days in a week for each experimental group. Concentric only and eccentric only group were given training on Mondays, Wednesdays and Fridays, whereas combined groups was given training on Tuesdays, Thursdays and Saturdays. The training was given in the evening session between 4.00 to 5.30 p.m.
For the first and second week all the exercises were done 10 repetition of 3 sets for two circuits through a circuit training training methods. after completion of first circuit 6 min rest was given to subjects where as 30 sec rest was considered sufficient between sets and between the two exercise.

5 repetition after every two weeks was increased for increasing the resistance of load. The repetition was increased a maximum of 30 for one set.

Measureme of experimental variables were taken at the begining and after an experimental period of ten weeks. This period commenced from the last week of July 1991 and concluded before the Puja vacation in the 2nd week of October 1991.

**Statistical Procedure**

In order to find the effectiveness of the three training programme viz. concentric only, eccentric only and combined training in all the test items after a training period of ten weeks, paired 't' test (one tailed) was applied between the pre test and post test means of each group.
To find out the comparative effect of different training programme on different variables, analysis of variance and covariance was applied. Analysis of covariance was applied because initial performance in the three experimental and one control group had not been equated. A post hoc 't' test was applied as an extension of analysis of covariance to compare the difference between the adjusted means of the groups.

For testing the hypothesis the level of significance was set at .05.