Chapter I

INTRODUCTION

"Muscles are meant to be used; give them extra work and they grow bigger and stronger."

This is the basic philosophy of weight training and it is certainly no new idea. Men have exercised with weights for almost two thousand years, mostly using crude dumbbells or sandbags. Now we have modern disc loading system, barbell and dumbbell and a scientific approach, but it is only comparatively recently that this system of physical training has become universally accepted. It is now recognized that a planned schedule of exercise using progressive load lead to greater strength for the athlete and a harmonious, fully developed physique for the body builders.

The ancient tradition of stone lifting evolved into the modern sport of weight lifting. It stands as established that weight plays an important role in bringing the fit and healthy people to a certain
requisite standard. As the sport developed it took on different shapes in different cultures. In Europe weight training was a form of entertainment from which the professional strongmen emerged.

The common method prevalent during those olden periods almost in all the sports was that weights were used upon hands. The other method comparatively less popularly used was the throwing of weights. They used to lift solid weights, but these were clumsy in their make. Iron globes were cast with iron and steal connecting bars while rest of the weights were cast as single globes or block with single projecting handles.

It was in the year 1903 when the first ever company was established to manufacture the weights. The Milo Barbell company was started by the first known instructor Mr. Alen Calvert. He brought out sound weights and also the Training Methods to the mass following.

A transformation in the clumsy and roughly moulded weights took place with the beginning of the 20th Century. By the 1920's and 30's it had become
evident that weight training was the best way to produce the greatest degree of muscular development in the shortest possible time.

Because of the ease of controlling resistance and the simplicity of taking measurements of results in terms of weights overcome in standard lifts, the use of barbells and weights has become a popular method of strength training.

It is also well established that strength training is a key to success for all sports and games. An adequate amount of strength is needed for all sports. Weight training is one of the best way to develop specific type of strength due to the fact that resistance can be manipulated at will.

Now modern weight equipments i.e. multigym and isokinetic machines are available for the development of specific strength for specific group of muscles.

-But the unique thing about training is that different programme do different things to the body. Some programme develops muscle strength, while other improves the way heart and circulatory system
function. One of the best way to train for increasing muscle strength is by lifting weights.

To increase the working ability of the heart and circulation, running and cycling are good exercises. Although training programme differs depending on which organs need to be conditioned. There is something common to all of them. They all increase physical performance by applying the same principle. This principle is called the over-load principle which holds that changes take place when work is gradually increased and conditioning improves. This is the principle followed to develop muscle size and strength.

Although muscle respond in different ways depending on what "turns them on". Only certain kinds of activity lead to the development and shaping of muscles. Exercises that makes the muscle contract with relatively high force are these kind of activities.

Weight training has its best effect when the exercise are done through the longest range of motion possible. This allows to stimulate the maximum
amount of muscle fibers. But it has another effect as well: when we fully contract one muscle, we are stretching its opposing muscles. Therefore weight training done correctly leads to an increase in flexibility also.

Studies have demonstrated improvements in strength and/or muscular endurance following resistance training. The classic work in this area was done by Delorme (1945) who mentioned that high resistance-low repetition exercise build powerful muscles whereas low resistance-high repetition exercise produce the quality of endurance, suggesting a functional and specific relationship between training stimulus, and response. This contention has been supported by the work of Berger (1962), Berger and Hardage (1947), Penman (1969) and Peterson and Others (1961).¹

The majority of studies which have assessed the bio-chemical adaptations to exercise have also

supported the original observation of Delorme (1945). The result has shown that low intensity-long duration training increase the activity of aerobic enzymes, whereas high intensity - short duration training increase the activity of anaerobic enzymes.\(^2\)

In 1933 Steinhaus received a number of studies that form the basis for the modern beliefs that increased size and strength of muscle resulting from overload training is caused by hypertrophy of latent muscle fibers, that there is accompanying increase vascularization of the exercised parts and that both these changes can be reversed through inactivity.

Measuring and evaluating muscle strength serves several useful purposes: to determine strength, endurance, and fatigue, difference between isometric, concentric, and eccentric muscle contraction and to reveal deficiencies in muscle function. Obtaining valid strength measurement is dependent upon the reliability of the testing instrument used and upon the subject providing maximum voluntary muscle contraction for the given

\(^2\text{Ibid.}\)
conditions. Testing instruments are simple spring scales, cable tensiometer and the more sophisticated Cybex II dynamometer, an isokinetic device that measures muscle force both isometrically and isotonically.

Maximum dynamic strength of large muscle group (shoulders, arms, and legs) may be determined without the use of sophisticated measuring device by performing one repetition maximum (1-RM) in one or more weight lifting movements. such as the bench press and squat. For assessing a combined level of muscular strength and endurance 5-8 RM are recommended and for muscular endurance only 12-15 RM.

One major limitation to measure isotonic strength through weight lifting exercise is that the subject must know the technique of the test lift and this requires a pre-training period prior to testing. Assessing dynamic strength is complicated function but it provides a useful evaluation of over all functional strength which isometric measurement does not. ³

Berger developed the use of 1-RM (the maximum load a person can raise only once) as a means for evaluating strength improvement. He later used the same principle for the purpose of classifying students in weight lifting classes on the basis of strength.  

The difficulty in isolating the eccentric (lengthening) phase of any movement must be under-scored once again, because most exercises encompass both shortening and lengthening in a single repetition. However, it is a valid concern to study such movement in order to gain insight into which part leads to the major training effect for isotonic contractions. Johnson et al. (1976) worked with arms and legs on one side of the body by concentric (shortening) contraction and the opposite side by eccentric (lengthening) means. Employing arm curl, arm presses and knee flexion and extension exercises. The concentric movements were performed against a resistance of 80 percent of 1-RM for 10 repetitions

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and the eccentric contraction employed six repetitions at 120 percent of the 1-RM training three times a week for six weeks. Both types of exercise resulted in significant strength gain, but neither was significantly more effective than the other. Since these results are in basic agreement with others (Laycoke and Marferiule 1971; Seliger et al., 1968). It signifies that both forms of the isotonic movements contribute an important part to strength development.\(^5\)

The research in the field of concentric and eccentric types of training are comparatively fewer than other types of strength training programme which had given an idea and motivation to the research scholar to study this field of strength training programme.

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It has also been seen that eccentric type of movements were neglected due to the effect of gravity in the eccentric phase of movements, whereas studies had shown that both the phases were beneficial for the development of strength.

Due to the above concept and after reviewing the literature in this field the research scholar had taken up this study.

**Statement of the Problem**

The purpose of this study was to analyse the effects of concentric only, eccentric only and combined (concentric - eccentric) types of training on muscular strength, muscular hypertrophy, and muscular power of 14 to 16 years old male subjects.

**Delimitations**

1. The study was delimited to 14 to 16 years old male subjects of Rabbani Bahai School, Gwalior.

2. The study was delimited to the study of arm and shoulder muscles and anterior thigh muscles.

3. The study was further delimited to a number of specific exercises which had been selected and
modified so that isolated concentric and eccentric types of training could be given to the subjects.

Limitations

1. As it was difficult to isolate the concentric and eccentric phase of any movement completely the mild effect of other phase of movement was considered the limitation of the study.

2. As there was no sophisticated equipment (cable tensiometer) available in the institute for measuring the static arm strength the use of portable leg dynamometer with some modification was another limitation of the study.

Hypothesis

Based on the research conducted by different researchers and the literature available in the field of physical education it was hypothesized that:

1. There would be a significant difference by the three methods of training namely concentric only, eccentric only and combined (Concentric-eccentric) on strength variables such as static strength of arm and
shoulder, dynamic strength of arm and shoulder, arm girth, muscular power of arm and shoulder, static strength of leg, dynamic strength of leg, thigh girth, and muscular power of leg.

2. No difference would be effected between three methods of training namely concentric only, eccentric only, and combined (Concentric-eccentric) on strength variables such as static strength of arm and shoulder, dynamic strength of arm and shoulder, arm girth, muscular power of arm and shoulder, static strength of leg, dynamic strength of leg, thigh girth, and muscular power of leg.

Definition and Explanation of the Terms

Concentric Contraction

When a muscle develops tension sufficient to overcome a resistance so that the muscle visibly shortens and move a body part in spite of a given resistance it is said to be in concentric contraction. 6

The first phase of isotonic movement is the concentric contraction characterized by a shortening of the overall muscle length.\textsuperscript{7}

Eccentric Contraction

When a given resistance overcome the muscle tension so that the muscle actually lengthens, the muscle is said to be in eccentric contraction.\textsuperscript{8}

The second phase of an isotonic activity is called eccentric and is defined as a muscular contraction performed during a lengthening movement.\textsuperscript{9}

Muscular Hypertrophy

Muscular hypertrophy is an increase in size of the muscle as a direct result of forceful muscle contraction.\textsuperscript{10}

\textsuperscript{7}Encyclopedia of Physical Education \textbf{Fitness and Sports}, p.\textbf{22}.

\textsuperscript{8}Rasch and Burke, \textit{Kinesiology and Applied Anatomy}, p.50.

\textsuperscript{9}Encyclopedia of Physical Education \textbf{Fitness and Sports}, p.22.

\textsuperscript{10}O'shea, \textit{Scientific Principles and Methods of Strength Fitness}, p.14.
Muscular Strength

Muscular strength is defined as the maximum tension a muscle can apply in a single contraction.\textsuperscript{11}

Muscular Power

Muscular power is the ability of the individual to release maximum force in the shortest period of time.\textsuperscript{12}

Significance of the Study

Many studies have already been taken to find out the comparative effect of isotonic and isometric types of training in the development of strength. The present study had the idea to find out the specific effect of concentric only, eccentric only and combination of concentric and eccentric (isotonic) types of training on muscular strength, muscular hypertrophy and muscular power.


\textsuperscript{12} Ibid. S.V. "Muscular Power".
1. The result may provide guide lines for preparing scientific schedule, for training sportsmen with particular reference to specific strength of different muscle group of the body for different activities.

2. Result may help the teachers of physical education and coaches to have adequate knowledge regarding the effectiveness of different types of dynamic muscular contraction involving varied exercise for developing strength.

3. The findings of the study may add to the existing knowledge in the area of training method for strength variables.