



ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 8.4
IJAR 2021; 7(6): 304-306
www.allresearchjournal.com
Received: 12-04-2021
Accepted: 15-05-2021

Dr. Amit Arjun Budhe
Principal, DBM College of
Physical Education, Gondia,
Maharashtra, India

An analytical study of effects of weight training and circuit weight training on selected strength and physiological variables

Dr. Amit Arjun Budhe

Abstract

The aim of the present study was to find out the effect of weight training and circuit weight training on strength and physiological variables among male players of various games and sports. For this purpose, forty five male players studying in various colleges around Nagpur, Maharashtra, were selected as subjects. The age of the subjects ranged from 18 to 23 years. They were divided into three equal groups, each group consisted of fifteen subjects, in which experimental Group - I underwent weight training, experimental Group - II underwent circuit weight training and Group - III acted as control who did not participate in any special activities apart from their regular activities. The training period for the present study was three days (alternative days) in a week for twelve weeks. Prior to and after the experimental period, the subjects were tested on back strength, strength endurance and resting pulse rate. Back strength was assessed by administering dynamometer in kilograms, strength endurance was assessed by administering sit-ups test in numbers per minute and resting pulse rate was assessed by counting the pulse at resting condition of the subject for one minute. The Analysis of Covariance (ANCOVA) was applied to find out any significant difference between the experimental groups and control group on selected criterion variables. Whenever the adjusted post-test mean was found to be significant, the Scheffé S was used as post-hoc test. The result of the study shows that the weight training and circuit weight training groups were increased the back strength, strength endurance and resting pulse rate significantly ($P > .05$). It was concluded from the results of the study that weight training and circuit weight training has brought positive changes in back strength, strength endurance and resting pulse rate as compared to the control groups. It was concluded that no significant difference was found between the weight training group and circuit weight training group on selected criterion variables.

Keywords: Weight training, weight circuit training, back strength, strength endurance, resting pulse rate, ANCOVA

Introduction

Strength or the ability to express force is one of the several basic physical characteristics that determine performance efficiency in different sports disciplines. Each event varies in the claims it makes on strength, and consequently in the interest of specificity, we should consider its relationship to other conditional abilities. Upon analysis of various sporting activities, it can be stated that all sportspersons require different types of strength in different quantities. This requirement depends on the actual resistance involved in the sport.

To produce a performance, an athlete has to overcome any of the following types of resistance.

- Body weight (Gravitation)
- Resistance of the opponent
- Weight of the instrument
- Resistance of air/water

Definition of strength

In the scientific literature several definitions have been used over the years. Steindler (1935) defined strength as the "maximum display of power". Atha (1981) has reported that this definition is not clear in its concept as it simply substitutes one unexplained term (power) for another (strength). According to Muller (1970), "strength is the maximum force that

Corresponding Author:
Dr. Amit Arjun Budhe
Principal, DBM College of
Physical Education, Gondia,
Maharashtra, India

can be exerted against an immovable resistance by a single contraction". This definition shows that all strength is a 'maximum isometric effort'. Many scientists have shown their disagreement to this definition and they pointed out that force production is important in muscular endurance and speed of movement. In addition to this, the measure of maximum force production is linked with maximum power production. The implications are that if force and strength are linked, then strength must be related in some manner to endurance, speed and power. Thus, a definition of strength being a maximal isometric contraction is not adequate enough to define strength under all conditions. Hence, strength should be considered as an ability. Thus strength can be defined as an ability to produce force. The latest and widely accepted definition of strength is:

"Strength is the ability of the neuromuscular system to produce force".

According to this definition, not only the muscular system, but also the nervous system is involved in force production. Because force is a vector quantity, strength will have a magnitude and direction. The magnitude of strength output can range from 0 to 100% and the muscles involved determine the direction of force application.

Strength as a bio-motor ability has many expressions. Since all motor tasks require force production, all athletes must concern themselves with developing their strength levels to the optimum. Weight training is a common type of strength training for developing the strength and size of the skeletal muscles. It uses the force of gravity (in the form of weighted bars, dumbbells or weight stacks) to oppose the force generated by muscle through concentric or eccentric contraction. The basic principles of strength training involve a manipulation of the number of repetitions (reps), sets, tempo, exercises and force to cause the desired changes in strength, endurance, size or shape by overloading a group of muscles. Weight training boosts VO_2 max, the maximum capacity of an individual's body to transport and use oxygen during incremental exercise, which reflects the physical fitness of the individual. Circuit training is a workout routine that combines cardiovascular fitness and resistance training. It was first proposed in the late 1950s as a method to develop general fitness. In planning a circuit training programme, exercises are chosen to fit the need of the individual. Circuit weight training (CWT) was developed in the 1950's to address the question of whether one program can increase muscular strength and endurance while working the aerobic system. In a circuit weight training session, heart rate average around 80% of max, but oxygen consumption only 40% of VO_2 max, which is the minimum level for aerobic fitness improvements. Back strength plays a vital role in the

daily activities of human being. It is an essential factor for including in almost all games and sports. Strength endurance is defined as the capacity of the whole organism to withstand under the long lasting experience of strength. The pulse of an individual, or the rate at which his heart beats, can facilitate a quick evaluation of the individuals health.

Methodology

Forty five male sports person around Nagpur, Maharashtra studying in various colleges were selected as subjects. The age of the subjects ranged from 18 to 23 (mean age = 21.0 ± 0.7 months) years.

Design

The selected subjects were divided into three equal groups, each group consisted of fifteen subjects, in which Group - I (n = 15) underwent weight training, Group - II (n = 15) underwent circuit weight training and Group - III (n = 15) acted as control, which did not participate in any special activities apart from their regular curricular activities. The training period for weight training group and circuit weight training group was three days (alternative days) per week for twelve weeks. The researcher consulted with the physical education professionals and coaches of various games and sports and selected the following variables as criterion variables: 1. Back strength, 2. Strength endurance and 3. Resting pulse rate. The back strength was assessed by using leg lift with dynamometer and it was recorded in kilograms, strength endurance was assessed by administering sit-ups test and it was recorded in numbers per minutes and resting pulse rate was assessed by using the wet spirometer and it was recorded in liters. For the purpose of collection of data the subjects were asked to report early morning, one day prior and one day after experimental period. Analysis of Covariance (ANCOVA) was applied to find out the significant difference if any, among the experimental groups and control group on selected criterion variables separately. In all the cases, .05 level of confidence was fixed to test the significance, which was considered appropriate. Whenever the 'F' ratio was a significant in adjusted post-test mean, the Scheffé S was applied as post-hoc test.

Results

The data collected on back strength, strength endurance and resting pulse rate among weight training group, circuit weight training group and control group were analysed and presented in Table - I.

Table 1: Analysis of covariance on selected criterion variables among experimental groups and control group

Variable name	Group name	Weight training group	Circuit weight training group	Control group	'F' ratio
	Pre-test Mean \pm S.D	58.60 \pm 5.816	58.33 \pm 6.17	56.4 \pm 6.127	0.593
Back strength (In Kgs.)	Post-test Mean \pm S.D.	62.13 \pm 5.693	61.33 \pm 5.92	55.40 \pm 4.595	6.871*
	Adj. Post-test Mean	61.454	60.874	56.539	22.285*
	Pre-test Mean \pm S.D	32.47 \pm 3.226	30.67 \pm 2.19	32.07 \pm 3.282	1.555
Strength endurance (No./min)	Post-test Mean \pm S.D.	35.27 \pm 3.081	34.13 \pm 2.20	31.20 \pm 3.052	8.381*
	Adj. Post-test Mean	34.680	34.987	30.933	31.22*
	Pre-test Mean \pm S.D	66.267 \pm 4.21	65.467 \pm 3.06	66.53 \pm 3.33	0.362
Resting pulse rate (No./min)	Post-test Mean \pm S.D.	64.867 \pm 4.22	63.933 \pm 3.03	66.87 \pm 3.39	2.618
	Adj. Post-test Mean	64.692	64.545	66.430	29.754*
	Mean				

*Significant 0.05 level of confidence. (The table values required for significance at .05 level of confidence with df 1 and 28 and 1 and 27 were 4.20 and 4.21 respectively).

Table 1 shows that pre and post-test means 'f ratio of weight training group, circuit weight training group and control group on back strength were 0.593, which was not significant ($p>0.05$) and 6.871, which was significant ($p<0.05$). The adjusted post-test mean 'f' ratio value of experimental groups and control group was 22.285, which was significant ($p<0.05$). The pre and post-test means 'f' ratio of weight training group, circuit weight training group and control group on strength endurances were 1.555, which

was not significant ($p>0.05$) and 8.381, which was significant ($p<0.05$). The adjusted post-test mean 'f' ratio value of experimental groups and control group was 31.22, which was significant ($p<0.05$). The pre and post-test means 'f' ratio of weight training group, circuit weight training group and control group on resting pulse rate was 0.362 and 14.25, which was not significant ($p>0.05$). The adjusted post-test mean 'f' ratio value of experimental groups and control group was 29.754, which was significant ($p>0.05$).

Table 2: Scheffe's test for the difference between the adjusted post-test mean on selected criterion variables

Adjusted post-test mean on back strength				
Weight training group	Circuit weight training group	Control group	Mean difference	Confidence interval at .05 level
61.454		56.539	4.915*	1.140067
61.454	60.874		0.58	1.140067
	60.874	56.539	4.335*	1.140067
Adjusted post-test mean on strength endurances				
34.680		30.933	3.747*	1.444971
34.680	34.987		0.307	1.444971
	34.987	30.933	4.054*	1.444971
Adjusted post-test mean on resting pulse rate				
64.692		66.430	1.738*	0.687657
64.692	64.545		0.147	0.687657
	64.545	66.430	1.885*	0.687657

*Significant at .05 level of confidence.

Table 2 shows that the Scheffe's Test for the difference between adjusted post-test mean in back strength of weight training group and control group (4.915) and circuit weight training group and control group (4.335), which were significant at .05 level of confidence. There was a significant difference in strength endurances between weight training group and control group (3.747) and circuit weight training group and control group (4.054) and also there was a significant difference on resting pulse rate between weight training group and control group (1.738) and circuit weight training group and control group (1.885) which was significant at 0.05 level of confidence after the respective training programme.

Conclusions

There was a significant improvement in back strength after the weight training period. There was a significant improvement in strength endurance due to weight training and circuit weight training. The decrease in resting pulse rate was significantly higher for weight training group and for circuit weight training group when compared with the control group. It was also found that there was no significant difference was found between the weight training group and circuit weight training group on selected criterion variables.

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