

**EFFECT OF RESISTANCE TRAINING ENDURANCE TRAINING AND COMBINED
TRAINING ON LEG STRENGTH BACK STRENGTH
AND TIDAL VOLUME**

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Abstract

The purpose of the study was to find out the effect of resistance training, endurance training and combined training on leg strength, back strength and tidal volume. Sixty male students aged between 17 and 22 years were selected for the study. They were divided into four equal groups, each group consisting of fifteen subjects in whom Group I underwent resistance training, group II underwent endurance training, group III underwent combined training three days per week for twelve weeks and group IV acted as control, which did not participate in any training. The subjects were tested on selected criterion variables such as leg strength, back strength and tidal volume at prior to and immediately after the training period. For testing the leg strength and back strength, the dynamometer was used and tidal volume was tested by using expirio-graph. The analysis of covariance (ANCOVA) was used to find out the significant difference if any, between the experimental groups and control group on selected criterion variables separately. Since there were four groups involved in the present study, the Scheffé *S* test was used as post-hoc test. The selected criterion variables such as leg strength, back strength and tidal volume were improved significantly for all the training

groups when compared with the control group and the leg and back strength were improved significantly for resistance training group and in tidal volume, the endurance training group was significantly improved.

Key Words: *Resistance training, endurance training, physical fitness, leg strength, back strength and tidal volume.*

INTRODUCTION

Sports includes all forms of competitive physical activity or games through casual or organized participation, aim to use, maintain or improve physical ability and skills while providing enjoyment to participants, and in some cases, entertainment for spectators. (Retrieved from <https://en.wikipedia.org/wiki/Sport> on 12-05-2017).

"Sports training is a planned and controlled process in which, for achieving a goal, changes in complex sports motor performance, ability to act and behavior are made through measures of content, methods and organization". (Martin, "What is Sports Training and Types of Training ?", Retrieved from [http://wiki.answers.com/Q/What is sports training and types of training](http://wiki.answers.com/Q/What_is_sports_training_and_types_of_training) on 21-02-2013.)

Sports training are a process of athletic improvement, which is conducted on the basis of scientific principles and which, through systematic development of mental and physical efficiency, capacity and motivation, enables the athletes to produce outstanding and record breaking athletic performances. (Dietrich Harre, 1982).

While planning the dynamics of training, consider these aspects, referred to as the variables of training according to the functional and psychological characteristics of a competition. Throughout the training phases preceding a competition, define which component to emphasize and achieve the planned performance objective (Vladimir M.Zatsiorsky, 1995).

Resistance training has two different meanings. A broader meaning that refers to any training that uses a resistance to the force of muscular contraction (better termed strength training), and elastic or hydraulic resistance, which refers to a specific type of resistance training that uses elastic or hydraulic tension to provide this resistance (www.wikipedia.org).

Resistance training - sometimes called weight training or strength training - is a “specialized method of conditioning designed to increase muscle strength, muscle endurance and muscle power,” according to the American Sports Medicine Institute (ASMI) (Edward G. Mcfarland, www.google.com).

Endurance is a term widely used in sport and can mean many different things to many different people. In sports it refers to an athlete’s ability to sustain prolonged exercise for minutes, hours, or even days. Endurance requires the circulatory and respiratory systems to supply energy to the working muscles in order to support sustained physical activity (www.busywomenfitness.com).

Leg strength plays a vital role in the daily activities of man. It is an essential factor for including in almost all games and sports. There is an old saying that an athlete will go only as long as his legs will carry him.

At rest, only about half a liter of air is drawn into the lungs with each breath; this is known as the tidal volume. It increases with exercise until it reaches the vital capacity. The total amount of air inhaled each minute (ventilation rate) depends on both the depth and frequency of breathing. At rest, about 12 breaths per minute are taken so that the total volume of air inhaled is about 6 liters. During very strenuous exercise, this can increase to more than 100 liters a minute. (Retrieved from https://en.wikipedia.org/wiki/Lung_volumes on 28-12-2015)

Methods

In this study it was aimed to find out the effect of resistance training, endurance training and combined training on leg strength, back strength and tidal volume. To achieve the purpose sixty male students from various colleges around Faridabad Town, Faridabad were selected as subjects at random from the total population of 160 students. They were divided into four equal groups of fifteen each and further divided as two experimental groups and one control group, in which the group I (n=15) underwent resistance training, group II (n = 15) underwent endurance training group III underwent combined training (n = 15) and group IV (n = 15) acted as control which did not participate in any special training apart from the regular curricula.

For every training programme there would be a change in various structure and systems in human body. So, the researchers consulted with the experts and then selected the following variables as criterion variables: 1. Leg strength, 2. Back strength and 3. Tidal Volume.

Analysis of the Data

Analysis of covariance was used to determine the differences, if any, among the adjusted post test means on selected criterion variables separately. Whenever the 'F' ratio for adjusted post test mean was found to be significant, the Scheffé S test was applied as post-hoc test. The level of significance was fixed at .05 level of confidence to test the 'F' ratio obtained by analysis of covariance.

Table – I

Analysis of Covariance and 'F' ratio for Leg Strength, Back Strength and Tidal Volume of Resistance Training Group, Endurance Training Group and Control Group

Variable Name	Group Name	Resistance Training Group	Endurance Training Group	Combined Training Group	Control Group	'F' Ratio
Leg Strength (in Kg)	Pre-test Mean±S.D.	71.20 ± 2.88	71.73 ± 2.22	71.80 ± 3.08	71.60 ± 3.29	0.13
	Post-test Mean±S.D.	76.27 ± 1.94	73.87 ± 2.50	74.47 ± 2.99	71.40 ± 3.278	8.17*
	Adj. Post-test Mean	76.583	73.743	74.288	74.288	38.97*
Back Strength (in Kg)	Pre-test Mean±S.D.	62.13 ± 1.80	61.47 ± 1.81	62.07 ± 1.58	61.87 ± 2.36	0.39
	Post-test Mean±S.D.	69.67 ± 1.80	65.07 ± 2.02	65.60 ± 1.84	61.87 ± 2.03	41.47*
	Adj. Post-test Mean	69.453	65.423	65.443	61.881	117.45*
Tidal Volume	Pre-test Mean±S.D.	0.462 ± 0.018	0.459 ± 0.017	0.455 ± 0.024	0.450 ± 0.031	0.724
	Post-test Mean±S.D.	0.503 ± 0.02	0.542 ± 0.017	0.515 ± 0.026	0.451 ± 0.032	34.49*

(in Liters)	Adj. Post-test Mean	0.498	0.540	0.5196	0.458	130.63*
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* Significant at .05 level of confidence. (The table value required for significance at .05 level of confidence with df 3 and 56 and 3 and 55 were 2.77 and 2.78 respectively).

Results - I

Table – I shows that there was a significant difference among resistance training group, endurance training group and control group on leg strength, back strength and tidal volume. Further to know which of the paired mean has significant improvement on selected criterion variables; the Scheffé *S* test was applied.

Table – II

Scheffé S Test for the Difference between the Adjusted Post-Test Mean of Leg Strength Back Strength and Tidal volume

Adjusted Post-test Mean Leg Strength					
Resistance Training Group	Endurance Training Group	Combined Training Group	Control Group	Mean Difference	Confidence Interval at 0.05 level
76.583	73.743			2.84*	1.395
76.583		74.288		2.295*	1.395
76.583			71.386	5.197*	1.395
	73.743	74.288		0.545	1.395
	73.743		71.386	2.357*	1.395
		74.288	71.386	2.902*	1.395
Adjusted Post-test Mean Back Strength					
Resistance Training Group	Endurance Training Group	Combined Training Group	Control Group	Mean Difference	Confidence Interval at 0.05 level
69.453	65.423			4.03*	1.164
69.453		65.443		4.01*	1.164
69.453			61.881	7.572*	1.164

	65.423	65.443		0.02	1.164
	65.423		61.881	3.542*	1.164
		65.443	61.881	3.562*	1.164
Adjusted Post-test Mean Tidal Volume					
Resistance Training Group	Endurance Training Group	Combined Training Group	Control Group	Mean Difference	Confidence Interval at 0.05 level
0.498	0.540			0.042*	0.013
0.498		0.516		0.018*	0.013
0.498			0.458	0.041*	0.013
	0.540	0.516		0.024*	0.013
	0.540		0.458	0.082*	0.013
		0.516	0.458	0.058*	0.013

* Significant at 0.05 level of confidence.

Result - II

Table – II shows that the Scheffé *S* Test for the difference between adjusted post-test mean of resistance training group and endurance training groups (2.84), resistance training group and combined training group (2.295), resistance training group and control group (5.197), endurance training group and control group (2.357) and combined training group and control group (2.902) which were significant at .05 level of confidence on leg strength after the training programme. But the adjusted post-test mean difference between endurance training group and combined training group on leg strength was 0.545, which was not significant at 0.05 level of confidence.

Table – II also shows that the Scheffé *S* Test for the difference between adjusted post-test mean difference in back strength of resistance training group and endurance training groups (4.03), resistance training group and combined training group (4.01), resistance training group and control group (7.572), endurance training group and control group (3.542) and combined training group and control group (3.562) which were

significant at .05 level of confidence on back strength after the training programme. But the adjusted post-test mean difference between endurance training group and combined training group on leg strength was 0.02, which was not significant at 0.05 level of confidence.

Table – II shows that the Scheffé *S* Test for the difference between adjusted post-test mean difference in tidal volume of resistance training group and endurance training groups (0.042), resistance training group and combined training group (0.018), resistance training group and control group (0.041), endurance training group and combined training group (0.024), endurance training group and control group (0.082) and combined training group and control group (0.058) which were significant at .05 level of confidence on back strength after the training programme. But the adjusted post-test mean difference between, which was not significant at 0.05 level of confidence.

Conclusions

1. The resistance training, endurance training and combined training groups have better improvement in leg strength after their respective training period. But resistance training group have better improvement in leg strength than the endurance training group and combined training group. There was no significant difference have occurred between endurance training group and combined training group on leg strength. This result is in line with findings of **K. Spanos et al**, (2007) and **W.J. Kraemer et al** (2001) who were found that there was a significant improvement in leg strength (1RM squat) after the resistance training. **Hennesay and Watson** (1994) have found that combined training (resistance and endurance training) have improved the strength significantly..

2. The present study shows that there was a significant improvement in back strength after the resistance training, endurance training and combined resistance and endurance training when compared with the control group. The resistance training group have significantly improved the leg strength than the endurance training group and combined training group. Moreover, the endurance training group and combined training group didn't show any significant difference on back strength.

3. Tidal volume was significantly improved for all the training groups, such as, resistance training group, endurance training group and combined training group when compared with the control group. But, there was a significant difference was occurred among all the training groups on tidal volume. **Sajwan (1986)** has found that there was a significant improvement in vital capacity after the endurance training. **D.C. McKenzie, S.L. McLuckie** and **D.R. Stirling (1994)** have also found that there was a significant improvement in forced vital capacity after the continuous warming up.

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