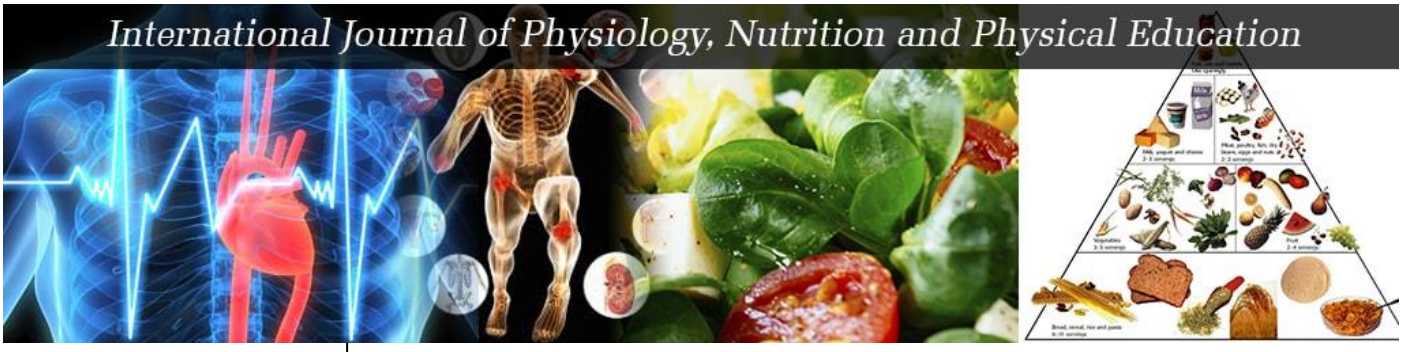

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Effect of resistance aerobic and concurrent training on muscular strength of untrained college students

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Abstract
The purpose of the study is to investigate the effect of resistance, aerobic and concurrent training on muscular strength of untrained college students. Sixty college men students from the Periyar University Constitution College of Arts and Sciences, were selected as subjects. The age, height and weight of the subjects ranged from 18 to 23 years, 162 to 175 centimeters and 56 to 70 kg respectively. The selected subjects were randomly assigned into four equal groups of 15 subjects each. Group I underwent resistance training, group II underwent aerobic training, group III underwent concurrent training and group IV acted as control. Prior to and after the training the subjects were tested on muscular strength using standard test and procedure. Analysis of covariance was used to determine the significantly difference existing between pre test and post test on muscular strength. The result of the study proved that the effect of resistance, aerobic and concurrent training significantly improved muscular strength of the untrained college men students.

Keywords: Resistance, aerobic and concurrent training

Introduction
Resistance training has two different meanings. A broader meaning that refers to any training that uses a resistance to the force of muscular contraction and elastic or hydraulic resistance, which refers to a specific type of strength training that uses elastic or hydraulic tension to provide this resistance. Resistance training is a form of strength training in which each effort is performed against a specific opposing force generated by resistance. Resistance exercise is used to develop the strength and size of skeletal muscles. Properly performed, resistance training can provide significant functional benefits and improvement in overall health and well-being. Resistance training has been shown to improve the lactate threshold Marcinik, *et al*. (1991) [5] resistance training can also improve a wide range of sports and sporting activities including throwing.

Aerobic training means constant moderate intensity work that uses up oxygen at a rate in which the cardio respiratory system can replenish oxygen in the working muscles. Examples of such activity are exercises like stationary bike riding or walking or jogging. It is a good activity for fat loss when done in the right amounts but highly catabolic if done in excess. The benefits of aerobic exercise are myriad. It include systemic changes such as reduced cholesterol and blood pressure, improved muscular endurance, reduced body fat, increased metabolism, to name a few. Aerobic activities strengthen the heart and lungs, making them more efficient and durable, improving quality and quantity of life. Exercise not only extends our life, but also gives us more energy to live it to the fullest. Aerobic exercise improves the strength of our bones, ligaments and tendons, allows our body to use fats and sugars more efficiently, burns lots of calories and plays an important role in reducing the onset and symptoms of aging and illness. Aerobic exercise reduces our risk of heart disease, vascular disease, and diabetes and can help those trying to quit smoking by relieving cravings and improving lung function.

Concurrent training means working on strength and aerobic training at the same time, whether be in the same session, alternative days, alternative sessions, etc. Countless numbers of recreational workout enthusiasts complete their strength and aerobic training workouts during the same training session, or within hours of one another.

Many people, athletes and non-athletes, take part in a combination of resistance and aerobic training. A number of studies have shown that performing these two types of training simultaneously can be detrimental to the gains that might be made in performing one type of training alone Bell, *et al*., (2000) [1].

Methodology

Subjects and variables

The purpose of the study is to investigate the effect of resistance, aerobic and concurrent training on muscular strength of untrained college students. Sixty college men students from the Periyar University Constitution College of Arts and Sciences, were selected as subjects. The age, height and weight of the subjects ranged from 18 to 23 years, 162 to 175 centimeters and 56 to 70 kg respectively. The selected subjects were randomly assigned into four equal groups of 15 subjects each. Group I underwent resistance training, group II underwent aerobic training, group III underwent concurrent training and group IV acted as control. Muscular strength was measured by the 1RM bench press test.

Training protocol

The training programmes were scheduled for one session a day; each session lasted between thirty to forty five minutes approximately including warming up and warming down. During the training period, the experimental groups underwent their respective training programme three days per week (alternative days) twelve sixteen weeks in addition to their curriculum. The group-I concentrated on resistance training, intensity fixed based on their 1RM, once in two weeks the load was increased with 5%. Group–II on aerobic training, the intensity starting from 20minutes @ 40% of HRR to 35 minutes @ 65% HRR, followed from first week to twelve weeks. Group–III on concurrent training two session per day (morning and evening), the intensity of the training increased progressively across the weeks. As followed as the resistance training and aerobic training group schedule. Every odd numbered week they performed the strength training in the morning session and endurance training in the evening session. Every even numbered week they performed endurance training in the morning session and strength training in the evening session.

Experimental design and statistical technique

The experimental design in this study was random group design involving 60 men subjects, who were divided at random in to four group of fifteen each. All the four groups selected from the same population. No effort was made to equate the groups prior to the commencement of the experimental treatment. The pre test means of the selected dependent variable was used as a covariate. In order to nullify the initial differences the data collected from the four groups prior to and post experimentation on selected dependent variable were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since four groups were involved, whenever the obtained 'F' ratio for adjusted post test means was found to be significant, the Scheffe's test was applied as post hoc test to determine the paired mean differences. In all the cases level of confidence was fixed at 0.05 for significance.

Table 1: analysis of covariance on muscular strength of experimental and control groups

	Resistance Training	Aerobic Training	Concurrent Training	Control Group	SOV	Sum of Squares	df	Mean squares	'F' ratio
Pre test	39.60	39.33	39.86	39.80	B	2.58	3	0.861	0.28
Mean SD	1.91	1.67	1.80	1.52	W	169.06	56	3.01	
Post test	52.73	45.86	48.93	40.73	B	1157.20	3	385.73	36.09*
Mean SD	2.84	4.03	3.84	1.90	W	598.53	56	10.68	
Adjusted Post test Mean	52.77	45.11	48.76	40.67	B	1169.06	3	389.68	43.55*
					W	492.11	55	8.94	

(The required table value for significance at 0.05 level of confidence with degrees of freedom 3 and 55 is 2.77 and degree of freedom 3 and 56 is 2.77)

*Significant at .05 level of confidence

Table-I shows that the pre test mean and standard deviation on muscular strength of resistance, aerobic, concurrent training and control groups are 39.60 + 1.91, 39.33 + 1.67, 39.86 + 1.80 and 39.80 + 1.52 respectively. The obtained 'F' ratio value of 0.28 for pre test means on muscular strength of resistance, aerobic, concurrent training and control groups were less than the required table value of 2.77 for the degrees of freedom 3 and 56 at 0.05 level of confidence. It reveals that there is statistically insignificant difference among the resistance, aerobic, concurrent training and control groups during pre test period. It inferred that the random assignment of the subjects for the four groups is successful.

The post test mean and standard deviation on muscular strength of resistance, aerobic, concurrent training and control groups are 52.73 + 2.84, 45.86 + 4.03, 48.93 + 3.84 and 40.73 + 1.90 respectively. The obtained 'F' ratio value of 36.06 for post test means on muscular strength of resistance, aerobic, concurrent training and control groups are greater than the required table value of 2.77 for the degrees of freedom 3 and 56 at 0.05 level of confidence.

The adjusted post test means on muscular strength of resistance, aerobic, concurrent training and control groups are 52.77, 45.11, 48.76, and 40.67 respectively. The obtained 'F' ratio value of 43.55 on muscular strength were greater than the required table value of 2.77 for the degrees of freedom 3 and 55 at 0.05 level of confidence. It is observed from this finding that significant differences exist among the adjusted post test means of experimental and control groups on muscular strength. Since, the adjusted post test 'F' ratio value is found to be significant the Scheffe's test is applied as post hoc test to determine the paired mean differences, and it is presented in table-II.

Table 2: Scheffe's test for the difference between the adjusted post test paired means of muscular strength

Adjusted Post Test Means				DM	CI
Resistance Training	Aerobic Training	Concurrent Training	Control Group		
52.77	45.11			7.66*	3.14
52.77		48.76		4.01*	3.14
52.77			40.67	12.1*	3.14
	45.11	48.76		3.65*	3.14
	45.11		40.67	4.44*	3.14
		48.76	40.67	8.09*	3.14

***significant**

Table-II shows the Scheffe's test results that there is a significant difference between the adjusted post test means of resistance training and aerobic training groups; resistance training and concurrent training groups; resistance training and control groups; aerobic training and concurrent training groups; aerobic training and control groups; concurrent training and control groups on muscular strength. Resistance training group had high impact to improve on muscular strength of the untrained college men students when compared to other experimental groups.

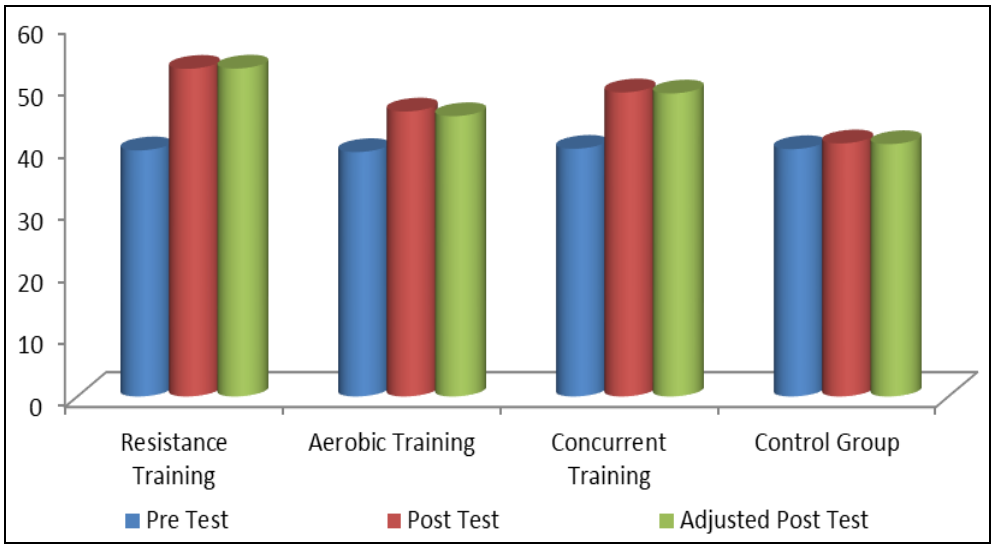

Fig 1: cylinder diagram showing the mean value on muscular strength of experimental and control groups

Discussion and conclusions

The result of the study stated that significant differences exist among the resistance, aerobic, concurrent training and control groups on muscular strength. The following studies are supporting our study results. Sale, *et al*., (1990) [7] reported no interference in strength gains and improvements in 1 RM squat of 23 and 22 percent for the resistance training and concurrent training groups respectively. The increases of 1 RM leg press and in 1 RM bench press in the resistance training and concurrent training groups are also similar to the magnitude of change reported by earlier investigators (Hennessy and Watson, 1994; Kraemer, *et al*., 1995; McCarthy, *et al*., 1995) [3, 4, 6]. Kumaran and Muthuraj (2013) [2] analysed the resistance training on strength and power parameters. The results of the study showed that there were significant improvements in strength and power parameters between the pre and post test of the experimental periods.

Conclusions

The conclusion of the study showed that the resistance, aerobic, concurrent training had significant improvement on muscular strength when compared to the control group. Moreover resistance training group had high impact to improve on muscular strength of the untrained college men students when compared to aerobic training and concurrent training groups.

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