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Effect of Strength Training and Endurance Training on Maximal Oxygen Uptake (Vo2max) among Football Players

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Abstract

The purpose of the study was to find out the effect of strength training and endurance training on maximal oxygen uptake (Vo_2 max). To achieve this purpose thirty men football players studying bachelor's of Engineering, Sri Sai-Ram Engineering College, Chennai, Tamil Nadu, India, were randomly selected and divided into three groups of ten each. The age of the subjects, ranged from 18 to 24 years. This study consisted of two experimental variables (strength training and endurance training). The allotment of groups was done at random, thus Group-I underwent strength training , Group-II underwent endurance training, for three days per week for twelve weeks, Group-III acted as control. All the subjects were tested prior to and after the experimentation period. The collected data were statistically treated by using ANCOVA, and 0.05 level of confidence was fixed to test the significance. When the obtained 'F' ratio was significant, Scheffe's post hoc test was used to find out the paired mean difference. The results of the study revealed that there was a significant difference among strength training group and endurance training group as compared to control group on maximal oxygen uptake (Vo_2 max). And also it was found that there was significant improvement on maximal oxygen uptake (Vo_2 max) due to endurance training as compared to strength training.

Keywords: Strength training, Endurance training, Maximal oxygen uptake (Vo_2 max).

Introduction

Strength and endurance training are used as the base of athletic training and basic fitness training. Unlimited range of methods, styles and techniques are used frequently to access better performance and fitness and are placed in front of these training, concurrent training methods (Melrose et al., 2005). In many sports, a combination of strength and endurance training is required to improve performance, but in some situations when strength and endurance training are performed simultaneously, a potential interference in strength development takes place, making such a combination seemingly incompatible. The phenomenon of concurrent training, or simultaneously training for strength and endurance, was first described in the scientific literature in 1980 by Robert C. Hickson, and work that followed provided evidence for and against it (Nader, 2006). Theoretically, training induced muscle adaptations are divergent and can even be antagonistic to improvement in strength or endurance (Chatra et al., 2005). Strength and endurance training produce widely diversified adaptations, with little overlap between them (Nader, 2006). Adaptations to strength and endurance training are generally different and at times opposed to each other (Glowacki, 2004; Tanaka et al., 1998). Strength training has little effect on aerobic capacity, but result in increased muscle force production, glycolitic enzymes activity, and intramuscular ATP/ Phospho-creatine, also because the muscle fiber hypertrophy is associated with an increase in contractile protein (Glowacki et al., 2004; Chatra et al., 2005). Strength training also decreases the activity of oxidative enzymes, which can impede endurance capacity, but has minimal effect on capillary density or the conversion from fast (type Π) to slow twitch (type I) fiber types (Chatra et al., 2005; Gravelle et al., 2000; Sale et al., 1990).

Previous studies on the effect of concurrent training on maximal oxygen uptake (Vo_2 max) or maximal aerobic power have also produced conflicting results. The data available suggest that concurrent training does not interference effect on development of Vo_2 max (Sale et al., 1990; Hickson, 1980; Bell et al., 2000; Izquierdo et al., 2005). However, these results disagree with studies showing a lower magnitude of endurance development with combined training in healthy active men and endurance trained subjects (Glowacki et al., 2004; Nelson et al., 1990; McCarthy et al., 1995). According to previous studies in connection concurrent training (strength and endurance).

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Methodology

Subjects

The purpose of the study was to explore the effect of strength training and endurance training on maximal oxygen uptake (Vo_2 max). To achieve this purpose of the study, thirty men football players studying bachelor's of Engineering, Sri Sai-Ram Engineering College, Chennai, Tamil Nadu, India, were selected as subjects at random. The age of the subjects, ranged from 18 to 24 years. The selected subjects were randomly divided in to three groups and each group consists of ten subjects. The groups were randomly segregated as strength training group, endurance training group and control group. The dependent variable selected was maximal oxygen uptake (Vo_2 max) and was assessed by Cooper test formula $Vo_2 \text{ max} = \frac{d_{12} - 504.9}{44.73}$. The data were collected before and after the twelve weeks of strength and endurance training.

Training Protocol

The experimental group performed both the strength and endurance training programs three days per week on alternative days for twelve weeks. The strength training program was a total body workout the group started with 60% of intensity and it was increased once in two weeks by 5% and 3 set of 8-10 repetitions on eight exercises that trained all the major muscle groups. A percentage of each subject 1RM for each exercise was used to determine the intensity of each week. The endurance training consisted of 20-40 minutes running, 2-3 times per week with 65-80% HRR. The running intensity was determined by a percentage of heart rate reserve (HRR). The duration of each session was increased once in two weeks as the training progressed.

Statistical Technique

The data collected from the three groups prior to and post experimentation were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since three groups were involved, whenever the obtained F ratio was found to be significant for adjusted post test means, the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any. In all the cases statistical significance was fixed at .05 levels.

Results

Table I. Analysis of covariance for pre and post test data on maximal oxygen uptake (vo2 max) of strength training endurance training groups and control group

	Group I	Group II	Group III	Source of variance	Sum of Squares	df	Mean squares	'F' ratio
Pretest Mean SD	42.87	43.25	43.23	Between	0.915	2	0.458	0.94
	2.37	2.12	2.08	Within	130.94	27	4.85	
Posttest Mean SD	47.95	53.26	43.32	Between	495.09	2	247.54	62.48*
	2.35	1.60	1.93	Within	106.96	27	3.96	
Adjusted Posttest Mean	48.12	53.17	43.24	Between	492.83	2	246.41	146.59*
				Within	43.70	26	1.68	

*** Significant at 0.05 level of confidence. The table value required for significance at 3.37**

The adjusted post-test mean on maximal oxygen uptake (Vo_2 max) for strength training group is 48.12, endurance training group is 53.17 and control group is 43.24. The obtained 'F' ratio of 146.59 for adjusted post-test mean is more than the table value of 3.37 required for significance at 0.05 level for df 2 and 26. The results of the study showed that there was significant difference among three groups on maximal oxygen uptake (Vo_2 max).

Table II. Scheffe's post hoc test for the adjusted post-test paired mean differences on maximal oxygen uptake (Vo2 Max)

ADJUSTED POST TEST MEANS				Confidence Interval
Strength Training Group	Endurance Training Group	Control Group	Mean Difference	
48.12	53.17		5.05*	1.50
48.12		43.24	4.88*	1.50
	53.17	43.24	9.93*	1.50

***Significant at 0.05 level of Confidence.**

The table II shows that the adjusted post test paired mean difference between strength training and endurance training, strength training and control group and endurance training and control group are 5.05, 4.88 and 9.93 for muscular strength respectively. All the three are higher than the confidence interval of 1.50 required for significance at 0.05 level of confidence. It is inferred that the twelve weeks of strength training and endurance training groups have significantly increased the maximal oxygen uptake (Vo_2 max) as compared to the control group. The result also reveals that the increase in maximal oxygen uptake (Vo_2 max) is significantly more for endurance training group as compared to strength training group.

Discussion on finding

The result of present study was that maximal oxygen uptake (Vo_2 max) has increased significantly for strength training and endurance training groups as compared to control group. However the result of the present study also reveals increase in maximal oxygen uptake (Vo_2 max) significantly more for endurance training group than strength training group. It is inferred that endurance training has produced statistically significant effect on maximal oxygen uptake (Vo_2 max). However, maximal oxygen uptake (Vo_2 max) also improved significantly after strength training protocol. The findings of this research is related to Gormly et al, (2008) who conducted a study to determine the effect of various intensities of aerobic training and concluded that the volume of exercise is the contributing factor for the most effective improvement of Vo_2 max. Helgerud et al, (2007) also conducted a similar study to determine the effect of aerobic endurance training at different intensities and concluded that high intensity endurance interval training is significantly more effective in improving Vo_2 max. Mcmilan et al, (2005) studied the physiological adaptation to a ten week high intensity aerobic interval training and found significant increase in Vo_2 max of soccer players with no negative interference effect on strength, jumping ability and sprinting performance. Less improvement of increased Vo_2 max in endurance and strength training groups toward endurance group can some how be due to strength training part from concurrent training. Because strength training might cause reduction in mitochondrial density and impede activity of oxidative enzymes which these factors can be negative influence on improving capacity of endurance (Nelson et al., 1990). Also, strength training can cause increase of Vo_2 max through increment of muscle capillary. Corpostagu and Borch (2010) concluded that the fat oxidation is significantly higher during running than cycling at the same relative intensity load. This may be one of the reasons that endurance training influence maximal oxygen uptake (Vo_2 max) and is significantly higher than strength training.

Conclusion

1. Strength training and endurance training groups significant increase in maximal oxygen uptake (Vo_2 max) as compared to control group.
2. Endurance training produced significant increase in maximal oxygen uptake (Vo_2 max) as compared strength training group.

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