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Training and detraining impact on cardio respiratory endurance: An over view

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Abstract
The purpose of this study was to examine the impact of aerobic training and concurrent resistance and aerobic training and detraining on cardio respiratory endurance performance. Forty five subjects were selected and they were divided into three equal groups of fifteen each. The first group performed concurrent resistance and aerobic training and the second group performed aerobic training and third group acted as control. After the completion of twelve-weeks training period the subjects of group I and II were physically detrained for forty days. The pre and posttest data on cardio respiratory endurance was statistically analyzed by applying the analysis of covariance (ANCOVA). The data collected on post experimentation and during detraining were statistically analyzed by using two way (3 x 5) factorial ANOVA with last factor repeated measures. Statistical analysis found significant improving in cardio respiratory endurance performance and significant decline during detraining period.

Keywords: concurrent resistance and aerobic training, detraining, cardio respiratory endurance

Introduction

Athletes in predominately strength and endurance sports are frequently given training programs designed to induce positive changes in both endurance and strength attributes, particularly during the off-season. Strength and conditioning professionals prescribing aerobic exercise for their strength and endurance athletes often cite the benefit of enhanced recovery during the limited rest periods which intersperse the supra maximal work efforts. Recovery from anaerobic exercise is highly dependent upon aerobic metabolism. Thus, aerobic endurance training may help athletes recover more quickly between anaerobic work intervals, such as multiple sets in resistance training or repeated sprints. Strength and endurance athletes may perform endurance exercise in order to maintain an optimal body weight or to reduce body fat levels. Aerobic endurance exercises are an effective and efficient method of reducing body fat. Another possible benefit of aerobic training for strength and endurance athletes is the increased tolerance for exercise in the heat and during hyperthermia in aerobically trained individuals. In extreme heat, 15 to 20% of the cardiac output may be distributed to the skin for heat dissipation (Mcardle *et al*., 2001) [4]. This limits the blood flow to the working muscles. Aerobically-trained individuals have an increased sensitivity and capacity of the sweating response so that they are better able to regulate their body temperatures (Mcardle *et al*., 2001) [4].

Concurrent training can also yield benefits to those individuals who want to improve their endurance as athletes. The benefits aren't quite as drastic as those seen by untrained individuals, but if we have primarily focused on endurance training, adding strength training can yield some great benefits. Primarily, individuals would be able to put on some lean muscle mass and increase strength. And athletes are able to do this without much of a loss in endurance capacity and often an increase.

Detraining is equally important but that has been given considerably less attention by the athletes and the coaches and practically ignored by the research scholars in exercise and sports sciences. Detraining induces a partial or complete loss of training induced adaptations in response to insufficient training stimuli. The influence of detraining on endurance performance has received little attention and not completely understood. The aim of the present study was to assess the effect of endurance training and concurrent strength and endurance training and detraining on endurance performance.

Methodology

To achieve the purpose of the study, forty five male students studying bachelor's degree in physical education, from the Department of Physical Education and Sports Sciences, Acharya Nagarjuna University, Guntur District, Andhra Pradesh, India were selected as subjects at random. The age of the subjects ranged from 20 to 23 years. The selected subjects were randomly assigned to one of the three groups. The experimental group-I underwent concurrent resistance and aerobic training and experimental group-II underwent aerobic training and group-III acted as control. Further, the researcher was interested in finding out the detraining impact on cardio-respiratory endurance performance. The data on cardio respiratory endurance performance was collected by administering Cooper's twelve minutes run or walk test. Pretest data were collected prior to the training programme and posttest data were collected immediately after the twelve-weeks of training programme from both the experimental groups and control group. During the detraining period the data were collected once in ten days for 40 days from both the

experimental groups and control group.

Training protocol

The experimental groups underwent their respective training programme three days per week (alternate days) for twelve weeks. The first group performed concurrent resistance and aerobic training and the second group utilized aerobic training only. The aerobic training consists of 20-40 minutes running with 65- 80% HRR. The running intensity was determined by a percentage of heart rate reserve (HRR). The resistance training program was a total body workout consisting of 3 sets of 6-10 repetitions on 8 exercises that trained all the major muscle groups. Concurrent resistance and aerobic training group performed every odd numbered week resistance training in the morning session and aerobic training in the evening session. Every even numbered week they performed aerobic training in the morning session and resistance training in the evening session. After the completion of twelve-weeks training period the subjects of group I and II were physically detrained for forty days.

Statistical Technique

The data collected from the three groups prior to and post experimentation on cardio respiratory endurance was statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Whenever the obtained F ratio value was found to be significant for adjusted posttest means, the Scheffe's test was applied as post hoc test. The data collected on post experimentation and during detraining were statistically analyzed by using two way (3 x 5) factorial ANOVA with last factor repeated measures. The simple effect and the Scheffe's test were used as follow up and post hoc test. The analysis of data on cardio respiratory endurance was presented in table-I to V.

Table 1: Analysis of Covariance on Cardio Respiratory Endurance Performance.

	Concurrent Training	Aerobic Training	Control Group	SoV	SS	df	MS	'F' ratio
Adjusted Post test Mean	2131.42	2088.08	1854.32	B	482451.69	2	211225.85	24.97*
				W	346813.78	41	8458.87	

The required table value for significance at 0.05 level of confidence with degrees of freedom 2 and 41 is 3.226.

The result of the study shows that, significant differences exist among the adjusted post-test means of experimental and control groups on cardio respiratory endurance performance. Since the 'F' ratio is found to be significant, the Scheffe's post hoc test is applied, which shows that both the experimental groups contributed to the significant improvement on cardio respiratory endurance performance. However, concurrent resistance and aerobic training is better than aerobic training alone in improving cardio respiratory endurance performance.

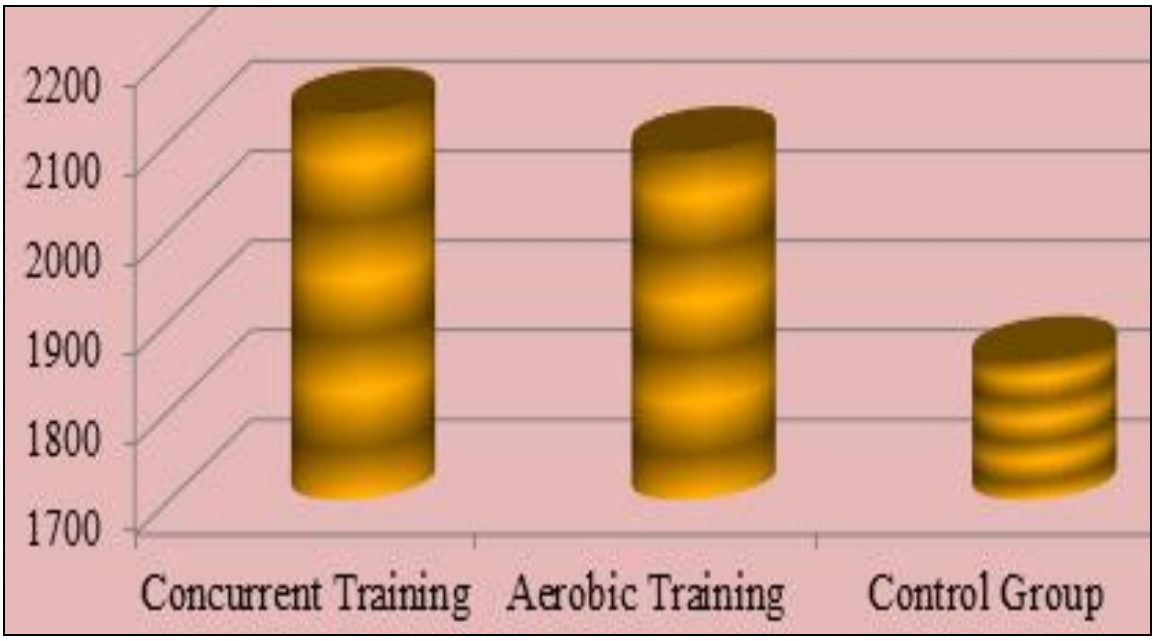

Fig 1: Diagram Showing the Adjusted Post Test Mean Values on Cardio Respiratory Endurance Performance of Experimental and Control Groups.

To determine the detraining impact on cardio respiratory endurance two-way factorial ANOVA (3x5) with repeated measures on last factor was applied and it has been found that the interaction effect was significant. Hence, simple effect test was used as a follow up test.

Table 2: Simple Effect Scores of Groups at Five Different Stages of Tests on Cardio Respiratory Endurance Performance.

Source of Variance	Sum of Squares	df	Mean Squares	Obtained "F" ratio
Groups at Post test	981555.5	2	490777.8	221.92*
Groups at First Cessation	766055.6	2	383027.8	173.197*
Groups at Second Cessation	378166.8	2	189083.4	85.499*
Groups at Third Cessation	241722.1	2	120861.1	54.650*
Groups at Fourth Cessation	184888.8	2	92444.42	41.801*
Tests of Group I	266200	4	66550.01	30.092*
Tests of Group II	85050.01	4	21262.5	9.614*
Tests of Group III	5616.673	4	1404.168	0.634
Error	371533.3	168	2211.508	

*Significant at .05 level of confidence

(Table values required for significance at .05 level with df 2 and 168, & 4 and 168 are 3.053 and 2.423 respectively.)

The result of the study indicates that significant difference exists between groups during posttest and all four cessation periods on cardio respiratory endurance performance. The result of the study also indicates that significant difference exists among tests of group-I and tests of group-II on cardio respiratory endurance performance. Since, 'F' ratio is found to be significant, the Scheffe's post hoc test was applied and the result obtained for groups at posttest, first, second, third and fourth cessation periods shows that significant differences exist among the three groups during posttest period. During first, second, third and fourth cessation periods, no significant difference exists between experimental groups, but experimental groups maintained significant difference with the control group.

Table 3: Scheffe's Test for the Differences between Paired Means of Experimental Groups at Different Stages of Testing on Cardio Respiratory Endurance Performance.

Groups	Mean Differences	First cessation	Second cessation	Third cessation	Fourth cessation
Concurrent Training	Post test	76.67	110.00*	170.00*	186.67*
	First cessation		33.33	93.33*	110.00*
	Second cessation			60.00	76.67
	Third cessation				16.67*
Aerobic Training	Post test	87.65	198.04*	286.67*	326.67*
	First cessation		93.33*	180.00*	220.00*
	Second cessation			86.67	126.67*
	Third cessation				40.00

*Significant at .05 level of confidence

The confidence interval required for significance at 0.05 level is 0.90.

From the above table, it is inferred that the cardio respiratory endurance performance of aerobic training and concurrent resistance and aerobic training groups deteriorated significantly during second cessation.

Discussion

The results of the study showed significant improvement on cardio respiratory endurance performance due to the impact of aerobic training and concurrent resistance and aerobic training. As previously stated, increases in endurance capabilities most commonly measured by increases in Vo_2max, are accomplished by performing repeated sub-maximal contractions with loads of low resistance (Dudley *et al*., 1985; Sale *et al*., 1990) [1, 8]. Many studies have examined the possible interference of strength training on endurance improvements. To maintain cardio-respiratory endurance, training must be conducted at least three times per week and training intensity should be 70% VO_2 max (Wilmore & Costill, 1999) [9].

These results are conformity with the following findings. Concurrent training improves endurance performance, both with trained cyclists (Paton & Hopkins, 2005) [7] and other trained athletes (Hoff *et al*., 1999; Johnston *et al*., 1997; Millet *et al*., 2002; Paavolainen *et al*., 1999) [2, 3, 5, 6]. Paton and Hopkins (2005) [7] found that 1- km and 4-km time trial performance increased could have also been a result of high intensity interval training being employed in addition to resistance training. It has been well documented by Senthil *et al.*, (2011) found significant improvement in Cardio-respiratory endurance due to the effects of concurrent strength and endurance training.

The results of the study also indicated that the cardio respiratory endurance performance of concurrent resistance and aerobic training group and aerobic training group decreased significantly due to detraining. But the significant decrease started after the second cessation toward the base line. These results of the study are in conformity with the finding of Nageswaran (1997) and Nugroho (2005) that the detraining losses of cardio-respiratory endurance are much greater than losses of muscle strength and power.

Conclusion

The results of the study proved that due to twelve weeks of aerobic training and concurrent resistance and aerobic training the cardio respiratory endurance performance is significant improved. However, concurrent resistance and aerobic training is better than aerobic training alone in improving cardio respiratory endurance performance. It is also observed

in the present study that throughout the detraining period, the gradual decline of cardio respiratory endurance performance for concurrent resistance and aerobic training group is similar to that of aerobic training group. Since, gradual loss of training induced adaptations on cardio respiratory endurance performance within two weeks of detraining were found, it is suggested that the athlete must resume training within ten days of detraining.

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