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Effect of Aerobic Training Detraining and Retraining on Cardio Respiratory Endurance

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Abstract

The purpose of the study was to determine the effect of aerobic training detraining and retraining on cardio respiratory endurance. Thirty male bachelor degree students undergoing various courses at Vivekananda Arts & Science College, Villupuram were randomly assigned into experimental and control) groups consisting of 15 subjects each. The experimental group underwent 12 weeks aerobic training followed by 40 days detraining and there after the four weeks of retraining programme. Cardio respiratory endurance was measured at the base line and immediately after the training and also during the detraining and after the retraining period. The data on post experimentation and detraining period (four cessations) and after retraining were analysed by two way (2x 7) factorial ANOVA with last factor repeated measures. Although aerobic training improved cardio respiratory endurance the training induced gain had been decreased after forty days of detraining and after retraining period not reached the 12 weeks of aerobic training level.

Keywords: Aerobic Training, Detraining, Retraining and Cardio Respiratory endurance.

Introduction

Sports training is a programme of exercise designed to improve the skills and to increase the energy capacity of an athlete for a particular event. Therefore training is essential for the development of physical fitness components (William & Sperryn, 1976). It is the process of increasing sports potential based on scientific and pedagogical principles for higher performance (Singh, 1991). Aerobic means "with oxygen" and aerobic system comprises of heart, lungs, blood vessels and muscles. The benefit of aerobic exercise is based on how well one's body can deliver oxygen to one's muscles and use it for energy. Regular aerobic workouts increase one's ability to take in and transport that oxygen and improve one's aerobic capacity.

The performance of repeated bouts of exercise over a period of time causes numerous physiological changes that result in improved performance in that exercise activity. The magnitude of the training response depends on the duration of the exercise bouts, their intensity and the frequency with which they are performed. Wenger and Bell, (1986), along with the initial training status, genetic potential, age and gender of the individual. The specificity of the training stimulus is also important in terms of the type of training practised (endurance, strength or speed) and the exercise modality used. Pierce et al, (1990) Appropriate recovery periods are required to allow adaptation to the training load: an insufficient training stimulus and/or too much recovery can lead to lack of progress or detraining, (Neufer, 1989), while too great a training overload with insufficient recovery can lead to overtraining. McKenzie and Markers, (1999) endurance can be defined as the capacity to sustain a given velocity or power output for the longest possible time. Performance in endurance events is therefore heavily dependent upon the aerobic resynthesis of ATP; this requires an adequate delivery of oxygen from the atmosphere to cytochrome oxidase in the mitochondrial electron transport chain and the supply of fuels in the form of carbohydrates and lipids. Davies and Thompson, (1979) endurance can be crudely described through the generation of individual 'velocity-time curves' which relate a series of velocities (or power outputs) to the time for which these velocities or power outputs can be sustained. Wilkie, (1980) endurance training causes adaptations in the pulmonary, cardiovascular and neuromuscular systems that improve the delivery of oxygen from the atmospheric air to the mitochondria and enhance the control of metabolism within the muscle cells. These adaptations shift the velocity-time curve to the right and therefore result in improved endurance exercise performance.

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Methodology

To achieve the purpose of the study, thirty male bachelor degree students undergoing various courses at Vivekananda Arts & Science College, Villupuram during the academic year 2014-15 were randomly selected as subjects by random number method from a total of 150 students. They were randomly divided into two groups and each group consisted of fifteen participants. A

written consent duly signed was obtained from all participants after they had been informed of all risk, discomforts and benefits involved. The dependent variable selected for the present study was cardio respiratory endurance and was assessed by Coopers twelve minutes run/ walk test. The data were collected prior to and immediately after the twelve weeks of training, during the detraining period once in ten days for forty days and also after four weeks retraining.

Training Protocol

The experimental group performed aerobic training programmes three sessions per week on alternative days for 12 weeks. The aerobic 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. After the completion of twelve weeks of aerobic training the subjects of the experimental group was physically detrained for 40 days. During this period the subjects were instructed not to participate in any strenuous physical activity. After forty days of detraining period the retraining program was implemented for four weeks duration. During retraining also the over load principle was adopted.

Statistical Technique

The data collected from two groups on post experimentation, detraining (four cessations) and retraining were statistically analysed by using two way 2×7 factorial ANOVA with last factor repeated measures. Whenever the obtained F ratio for interaction effect was found to be significant the simple effects test was used as a follow up test. Since two groups and 6 different stages of test were compared, whenever the obtained F-ratio value in the simple effect test was significance the scheffe's test was applied as post hoc test to determine the paired mean difference if any. In all the cases, statistical significance was fixed at 0.05 level.

Result of the study

Table I. The mean and standard deviation values on cardio-respiratory endurance of pre test, post test, first cessation, second cessation, third cessation, fourth cessation and after retraining period scores of aerobic training and control groups

Groups		Pre test	Post test	C1	C2	C3	C4	Re training
Aerobic Training Group	Mean	2448.7	2720	2617.7	2541	2518.3	2459.3	2583.3
	S.D	104.7	158.9	160.96	130.05	147.30	145.28	95.06
Control Group	Mean	2441.3	2452.7	2452	2446	2436.7	2442.7	2450.7
	S.D	87.16	95.27	97.18	96.64	88.20	92.61	96.02

The table I show that the pre test mean values on cardio-respiratory endurance for aerobic training and control groups are 2448.7, and 2441.3 respectively. The post test means values on cardio-respiratory endurance for aerobic training and control groups are 2720 and 2452.7 respectively. The first cessation mean values on cardio-respiratory endurance for aerobic training and control groups are 2617.7 and 2452 respectively. The second cessation mean values on cardio-respiratory endurance for aerobic training and control groups are 2541 and 2446 respectively. The third cessation mean values on cardio-respiratory endurance for aerobic training and control groups are 2518.3 and 2436.7 respectively. The fourth cessation mean values on cardio-respiratory endurance for aerobic training and control groups are 2459.3 and 2442.7 respectively. The mean values after four weeks of retraining period on cardio-respiratory endurance for aerobic training and control groups are 2583.3 and 2450.7 respectively. The two way analysis of variance was applied on cardio-respiratory endurance for two groups at seven different stages of training and the result are presented in Table II.

Table II. Two factor ANOVA on cardio respiratory endurance of aerobic training and control groups at seven different stages of training

Source of variance	Sum of squares	df	Mean squares	F- ratio
A factor(groups)	629214.40	1	629214.40	8.50*
Error	2072617.61	28	74022.05	
B factor (tests)	447794.76	6	74632.46	20.40*
AB factor (interaction)	364828.09	6	60804.68	16.62*
Error	614505.71	168	3657.77	

*significant at 0.05 level
The table value required for significance at 0.05 level for df 1 and 28, 6 and 168 or 4.20 and 2.16 respectively

Table II shows that the obtained 'F' ratio 16.62 for interaction effect (groups × tests) on cardio-respiratory endurance was higher than the required table value of showing 2.16 significant for df 6 and 168. The results of the study indicated that there was a significant difference in the interaction effect [between rows (groups) and columns (tests)] on cardio-respiratory endurance. Since, the interaction effect was significant, the simple effect test was applied as a follow up test and the result are presented in table III.

Table III. The simple effect values for groups (row) at seven different stages of tests (columns) and among the tests for experimental and control group on cardio respiratory endurance

Source of variance	Sum of squares	df	Mean squares	F- ratio
Groups and pre test	410.7	1	410.7	0.11
Groups and Post test	535869.7	1	535869.7	146.50*
Groups and first cessation	205923.7	1	205923.7	56.29*
Groups and second cessation	67687.5	1	67687.5	18.50*
Groups and third cessation	50799.67	1	50799.67	13.88*
Groups and fourth cessation	2066.7	1	2066.7	0.56
Groups and retraining	131870.7	1	131870.7	36.05*
Test and Experimental group	809350.4	6	134891.7	36.87*
Test and control group	3538.62	6	589.77	0.16
Error	17.37	168	0.103	

***** Significant at .05 level of confidence.
(The table value required for significance at .05 level of confidence with df 1 and 168, and 6 and 168 were 3.90 and 2.16 respectively).

The obtained 'F' ratio for tests in experimental group was 36.87 which were higher than the table value of 2.16 with df 6 and 168 required for significance at 0.05 level of confidence. The result of the study indicates that significant difference existed among tests in experimental group. Since, two groups and seven different stages of tests were compared, whenever they obtained "F" ratio value in the simple effect was significant, the Scheffe'S test was applied as post hoc test to find out the paired mean difference, if any and it is presented in Table IV.

Table IV. Scheffe's test for the differences among paired means of aerobic training group with different tests on cardio respiratory endurance

Pre test	Post test	first cessation	Second cessation	Third cessation	Fourth cessation	Re training	Mean difference	Confidence interval
2448.7	2720	---	---	---	---	---	271.30*	78.50
2448.7	---	2617.7	---	---	---	---	1690*	78.50
2448.7	---	---	2541	---	---	---	92.30*	78.50
2448.7	---	---	---	2518.3	---	---	69.60	78.50
2448.7	---	---	---	---	2459.3	---	10.60	78.50
2448.7	---	---	---	---	---	2583.3	134.60*	78.50
---	2720	2617.7	---	---	---	---	102.30*	78.50
---	2720	---	2541	---	---	---	179.00*	78.50
---	2720	---	---	2518.3	---	---	201.70*	78.50
---	2720	---	---	---	2459.3	---	260.70*	78.50
---	2720	---	---	---	---	2583.3	136.70*	78.50
---	---	2617.7	2541	---	---	---	76.70	78.50
---	---	2617.7	---	2518.3	---	---	99.40*	78.50
---	---	2617.7	---	---	2459.3		158.40*	78.50
---	---	2617.7	---	---	---	2583.3	34.44	78.50
---	---	---	2541	2518.3	---	---	22.70	78.50
---	---	---	2541	---	2459.3	---	81.70*	78.50
---	---	---	2541	---	---	2583.3	42.30	78.50
---	---	---	---	2518.3	2459.3	---	59.00	78.50
---	---	---	---	2518.3	---	2583.3	65.00	78.50
---	---	---	---	---	2459.3	2583.3	124.00*	78.50

Table IV shows that the mean difference between pre test and post test values, pre test and first cessation values, pre test and second cessation values, pre test and after retraining period values, post test and first cessation values, post test and second cessation values, post test and third cessation values, post test and fourth cessation values, post test and after retraining period values, first cessation and third cessation values, first cessation and fourth cessation values, second cessation and fourth cessation values, fourth cessation and after retraining period values 271.3, 169, 92.3, 134.6, 102.3, 179, 201.7, 260.7, 136.7, 99.4, 158.4, 81.7, and 124 respectively on cardio-respiratory endurance of aerobic training group which are greater than the confidence interval value 78.50 at .05 level of confidence. And the mean difference between pre test and third cessation values, pre test and fourth cessation values, first cessation and second cessation values, first cessation and after retraining period, second cessation and third cessation values, second cessation and after retraining period values, third cessation and fourth cessation values and third cessation and after retraining period values, 69.6, 10.6, 76.7, 22.70, 42.3, 59 and 65 respectively on cardio-respiratory endurance of aerobic training group which are lesser than the confidence interval value 78.50 at .05 level of confidence.

Discussion on Findings

The present study was aerobic training of 12 weeks caused significant improvement in cardio respiratory endurance. The cessation of 10 days of training program caused significant reduction in the cardio respiratory endurance. But even after 20 days of cessation of training the endurance did not decrease significantly and post test value remained almost constant in this variable. The decrease in cardio respiratory endurance gradually reached the pre test value after 30 days. The cardio respiratory endurance, at each cessation C1, C2, and C3 lasted for 10 days and decreased significantly in the subsequent 10 days. The strength endurance at each cessation C1, C2, C3 lasted for 20 days thereafter decreased significantly in the subsequent 10 days. The four weeks of retraining caused significant increase in cardio respiratory endurance but the values were higher than the post and pre test values. Aerobic training increases the intramuscular substrate stores, oxidative enzyme activities of Kreb's cycle and Electron transport system. There is a dilation of capillaries and also increase in the number of capillaries supply blood to the working muscles. The greater availability of aerobic energy might be due to increased mitochonotion and also its density which is called as power house of the cell. The result of the study showed significant improvement in cardio respiratory endurance for aerobic training group as compared to control group. Helgerud and others (2007), conducted a

study on effect of aerobic training on the performance during soccer match and concluded that the training group improved soccer performance by increasing cardio respiratory endurance. Rutenfranz et al, (1982) conducted graded exercise tests on treadmill and noticed improved cardio respiratory endurance capacity as assessed by the ventilatory threshold. Baker et al, (2010) conducted a study of high intensity exercise and concluded that to sustain muscle contraction, ATP needs to be regenerated at a rate complementary to ATP demand and improved the cardio respiratory endurance.

Conclusion

1. Twelve weeks of aerobic training significantly improved cardio respiratory endurance.
2. The comparison of post test mean of aerobic training with different cessations shows significant improved on cardio respiratory endurance for first, second, third, fourth cessation and retraining respectively.
3. The retraining has positive effect on cardio respiratory endurance when compared to pre test and fourth cessation.
4. The four weeks of retraining is not sufficient to attain the cardio respiratory endurance of post experimentation level.

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