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Effect of aerobic cross training and aerobic training on cardiovascular endurance

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Abstract
The purpose of the present study was to find the effect of aerobic cross training and aerobic training on cardiovascular endurance. For this purpose of the study thirty subjects studying various course of bachelor degree at Vivekananda Arts and Science College, Villupuram, Tamil Nadu, India were selected at random as subjects in the age group of 19 – 24 years. They were divided into three equal groups, each group consisted of ten subjects, in which group – I underwent aerobic cross training, group – II underwent aerobic training and group – III acted as control group who did not participate in any special training. The training period for this study was three days in a week for twelve weeks. Prior to and after the training period the subjects were tested for cardiovascular endurance. The analysis of covariance (ANCOVA) was used to find out the significant difference if any, among the experimental groups and control group on selected criterion variable. In all the cases, 05 level of confidence was fixed to test the significance, which was considered as an appropriate. Since there was three groups were involved in this study, the Scheffe's test was used as post-hoc test. It was concluded that both training groups have increased the level of cardiovascular endurance significantly. However the increase was higher for aerobic training group than aerobc cross training groups.

Keywords: Aerobic cross training, Aerobic training, Cardio respiratory endurance

Introduction
Training programs are important for developing and maintaining many aspects of motor fitness, therefore reduced training program will impact on fitness in a negative way, despite some controversy over the importance of fundamental motor skills in the maintenance of physical activity levels. Children often withdraw from physical activity opportunities as a consequence of their movement incompetence (Bouffard *et al.*, 1996; Cairney *et al.*, 2005b) [1, 3]. The success of athletes in competitions with duration between 3 and 10 minutes is strongly influenced by the aerobic metabolism. Several methods have been developed to get reliable information about the aerobic capacity of middle and long distance runners Coen *et al.* (1999) **[4].** In addition to respiratory parameters, methods based on determining blood lactate concentration during continuously increasing exertion are favored for this. The determination of the individual anaerobic threshold (IAT) serves as an objective measure for aerobic endurance (Roecker *et al*., 1994) [12]. Improving a middle distance runner is a function of addressing the basic training principles**.** Without covering these principles adequately, there's little chance that the athlete will race faster. The basic tenet of competitive distance running is that a poorly conditioned athlete will make the greatest gains in performance by focusing on developing their aerobic capacity. But in case of middle distance runner the Athlete must have Aerobic and Anaerobic capacity to work hard.

Cross-training means engaging in two or more sports activities which provides variety, fitness and injury prevention. Running and resistance works (*such as weight training*) are examples. Dance and gymnastics provide muscular strength and develop better balance, flexibility and agility. The concept of cross training is a relatively recent athletic application, in which a training regime includes the use of one distinct athletic discipline to build skills or fitness in another. Cross-training is when an athlete undertakes training in a discipline other than their main sport for the sole purpose of enhancing performance in their main sport. One gets off easy by doing two different exercises with moderate exertion instead of doing one exercise with increased exertion. For a distance runner any non-running activity qualifies as cross

training. To get the best results from cross training, one should do only two or three different activities.

While some studies have demonstrated that respiratory muscle endurance training (RMET) improves performances during various exercise modalities, e.g., cycling, rowing, or running (McConnell, 2009) [10]. and brings about changes in pulmonary function, increased vital capacity and decreased residual volume. Esposito *et al*., (2010) [5], controversy continues about the transfer of RMET effects to swimming performance. Harms *et al*. (1997) [6]. have found a reciprocal relationship between the work of breathing and legs blood flow during maximal exercise on cycle ergo-meter. Thereafter, several authors (Sheel *et al*., 2002) [15]. have concluded that the stimulus for limb vasoconstriction was a cardiovascular reflex originating within the inspiratory muscles. As reminded by McConnell (2009) **[10],** this reflex seems be activated when metabolites are accumulated within the inspiratory muscles. Indeed, these metabolites stimulate the afferent nerve fibers, which increase their firing frequency. This stimulation precipitates an increase in the strength of sympathetic neural outflow, which induces a generalized vasoconstriction. To resume, the inspiratory muscle fatigue (IMF) reduces active limbs blood flow and exacerbates fatigue in these limbs (Romer *et al*., 2006) **[13]**. Consequently, it may be supposed that RMET may improve performance. This hypothesis has been confirmed by McConnell and Lomax (2006) **[11]**. who have suggested that inspiratory muscle training attenuates or delayed the vasomotor changes induced by the inspiratory muscle metaboreflex, which adaptation may produce an improvement of performance. The present study was to find out the effects of aerobic cross training and aerobic training on cardio respiratory endurance of college male students.

Methodology

The purpose of the study was to analyze the effects of aerobic cross training and aerobic training on cardio respiratory endurance. To achieve the purpose of the study, forty five (N=45) male students studying various course of bachelor degree at Vivekananda Arts and Science College, Villupuram, Tamil Nadu, India were selected at random as subjects from a population of 200. The age of the subjects, ranged from 18 to 24 years. The selected subjects were medically and physically fit enough to undergo the aerobic cross training and aerobic training programme. The subjects were randomly divided into three groups and each group comprised of fifteen (n=15) subjects. Group-I underwent aerobic cross training (swimming and cycling), group-II underwent aerobic training (running) and group–III acted as control. The group I underwent aerobic training programme and group II underwent aerobic cross training programme (swimming and cycling), for three days per week for twelve weeks, and Group III acted as control who did not participate any special training programmes. Cardio respiratory endurance was selected as criterion variable and was measured by cooper's 12 minutes run/walk test.

Training Programme

The prescribed exercise program focused on one or more cardiovascular endurance activities. Traditionally, the activities prescribed most frequently for cross training have been walking, jogging, running, hiking, cycling and swimming. However in the present study only cycling and swimming were selected for cross training, aerobic training includes only running. The intensity of the exercise about how to appear is the most important factor. Evidence now suggests that a substantial training effect can be accomplished in by training at intensities of 45% or less of their aerobic capacities. For most, however, the appropriate intensity appears to be at a level of at least 60% of Vo_2 max.

Exercise intensity can be quantified on the basis of the training heart rate (THR), the metabolic equivalent (MET), or the rating of perceived exertion (RPE). In the present investigation the training intensity has been prescribed on the basis of metabolic equivalent (MET) system. The amount of oxygen his body consumes is directly proportional to the energy athlete expend during physical activity. At rest, the body uses approximately 3.5 ml of oxygen per kilogram of body weight per minute ($ml.kg^{-1}. min^{-}$). This resting metabolic rate is referred to as 1.0 MET. All activities can be classified by intensity according to their oxygen requirements. An activity that is rated as a 2.0 MET activity would require two times the resting metabolic rate, as 7 $ml.kg^{-1}. min^{-1}$. Some activities and their MET value are presented in Table II. These values are only approximations, because metabolic efficiency varies considerably from one person to the next, and even in the same individual, even though the MET system in useful as a guideline for training (Jack and David, 1994) [8].

Table I.

Weeks	Aerobic Cross Training						Aerobic Training	
	Cycling		Swimming				Running	
	Duration (minutes)	Distance (mile)	Set	Rep	Distance (mts)	Recovery (sec)	Duration (minutes)	Distance (mts)
1-2	18.46	4	2	4	50	90	16	3200
3-4	19.66	4.5	2	5	50	90	20	4000
5-6	21.85	5	2	6	50	90	24	4800
7-8	24.03	5.5	2	7	50	90	28	5600
9-10	26.23	6	2	8	50	90	32	6400
11-12	28.40	6.5	2	9	50	90	36	7200

* Swimming set Recovery 5 min

** Work and recovery ratio was followed repetition

METS

Cycling 4 mints 37 sec - 1 mile (1600 mts)

Swimming 16.6 sec - 10 mts

Running 8 mints - 1 mile (1600 mts)

Statistic Technique

All the subjects of three groups were tested on dependent variables at prior to and immediately after the training programme. The analysis of covariance (ANCOVA) was used to analyze the significant difference, if any among the groups. Since, three groups were compared, whenever the obtained 'F' ratio for adjusted posttest was found to be significant, the Scheffe's test to find out the paired mean differences, if any. The. 05 level of confidence was fixed as the level of

significance to test the 'F' ratio obtained by the analysis of covariance, which was considered as an appropriate and the results are presented below.

Result and Discussion

Cardio Respiratory Endurance

Analysis of covariance on cardio respiratory endurance for the pre and posttests scores of aerobic cross training group, aerobic training group and control group

Test	Aerobic cross training group	Aerobic training group	Control Group	SOV	Sum of squares	df	Mean Squares	'F' ratio
Pre Test								
Mean	2439.33	2445.33	2447.33	B	520.00	2	260.00	0.02
S.D.	108.32	100.56	98.59	W	441960.00	42	10522.85	
Post Test								
Mean	2568.00	2655.33	2452.66	B	310013.33	2	155006.66	11.51*
S.D.	102.83	143.96	95.27	W	565306.66	42	13459.68	
Adjusted Post test								
Mean	2572.769	2653.971	2449.260	B	318726.05	2	159363.02	62.98*
				W	103733.77	41	2530.09	

* Significant at 0.05 level of confidence

(The table values required for significance at 0.05 level of confidence for 2 and 42 and2 and 41 are 3.22 and 3.23) respectively.

The Table-II shows that the adjusted posttest mean values on cardio respiratory endurance of aerobic cross training group, aerobic training group and control group are 2572.76, 2653.97 and 2449.26 respectively. The obtained 'F' ratio of 62.98 for adjusted post test scores is greater than the table value of 3.23 for df 2 and 41 required for significance at 0.05 level of confidence on cardio respiratory endurance. The results of the study indicated that there was a significant difference between the adjusted posttest means of aerobic cross training group, aerobic training group and control group on cardio respiratory endurance. Since, the obtained 'F' ratio for the adjusted posttest mean was found to be significant, the Scheffe'S test was applied to find out the paired mean differences, if any, among the groups and the results are presented is table-III.

Table III: Scheffe's Test for the Differences between Paired Means on Cardio Respiratory Endurance

Aerobic cross training group	Aerobic Training group	Control group	Mean Differences	Confidence interval value
2572.76	2653.97		81.21*	46.06
2572.76		2449.26	123.50*	46.06
	2653.97	2449.26	204.71*	46.06

*Significant at 0.05 level of confidence.

The Table-III shows that the adjusted posttest paired mean differences on cardio respiratory endurance between aerobic cross training and aerobic training groups, aerobic cross training and control groups and aerobic training and control groups were 81.21, 123.50 and 204.71 respectively. All the three are higher than the confidence interval of 46.06 required for significance at 0.05 level of confidence. It is inferred that the twelve weeks of aerobic cross training and aerobic training groups have significantly increased the cardio respiratory endurance as compared to the control group. The result also reveals that the increase in cardio respiratory endurance is significantly more for aerobic training group as compared to aerobic cross training group.

Discussion Finding

Aerobic training increases the intramuscular substrate stores, oxidative enzyme activities of Kreb's cycle and Electron transport system. There is a dilation of capilleries and also increase in the number of capilleries 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 both aerobic training group and aerobic cross training group as compared to control group. However the increase in cardio respiratory endurance was significantly more for aerobic training group than aerobic cross training group. Helgerud and others (2001) [7]. 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) **[14]** conducted a study in which the subjects underwent graded exercise tests on treadmill and noticed improved cardio respiratory endurance capacity as assessed by the ventilatory threshold. Branch and others, (2000) **[2].** 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.

Conculsion

1. There was a significant increase in cardio respiratory endurance for both aerobic cross training and aerobic training groups as compared to control group.
2. There was a significant increase in cardio respiratory endurance for aerobic training group as compared to aerobic cross training group.

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