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Effect of Aerobic and Aerobic Cross Training Programs on Pulmonary Function

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Abstract

The purpose of the study was to find out the effect of aerobic and aerobic cross training on pulmonary function. For this purpose of the study forty five 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 fifteen subjects, in this study consisted of two experimental variables aerobic training and aerobic cross training. The allotment of groups was done at random, thus Group-I aerobic training, Group-II aerobic cross 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 was fixed as a test the significance. When the obtained 'F' ratio was significant, Scheffe's post hoc test was used to find out the significant paired mean differences. The results of the study revealed that there was a significant difference among aerobic training and aerobic cross training groups as compared to control group on forced vital capacity and forced expiratory volume one second. And also it was found that there was a significant improvement on forced vital capacity and forced expiratory volume one second due to aerobic training group as compared aerobic cross training group.

Keywords: Aerobic training, Aerobic cross training, Forced vital capacity, Forced expiratory volume one second and Spirometry.

Introduction

Sports training are a major part of the sports preparation process as it is a physical and educational process based on exercises to improve the physical preparation components necessary for achieving the highest possible level in sports, through various methods of training and various means of load formation and rest intervals. It concentrates on specific physical and psychological aspects in each sport (Szczepanowska et al., 1998). Training interruption has passive effects over training, especially in competitive sports that depend on muscular strength, flexibility, reaction speed, agility and power. Athletes in such sports may lose, in a very short period of time, a high percentage of their physical and technical adaptations that were built with regular training for prolonged periods of time (Rushall & Pyke , 1991).

Among the various methods of sports training, cross-training is relatively new. Some advocates of this type of training argued that it is the ideal and most plausible solution according to its inclusiveness and variance. Other thinks that it contradicts with the training specialty principle. But most authors agreed that it can be used during the preparation and competition (transitive) phases to break the stillness of specific training programs as this type of training depends on various integrative activities that enables more mental relaxation. Cross-training is a type of training that includes various sports activities that can be planned to improve the physical level and other physiological variables through variety and decreasing injury risks in addition to excitement (Jermyn, 2001). It is a prolonged type of training that includes various sports activities that aim at increasing variation and decreasing injury risks while improving physical fitness components. This is done through using another sport, activity or training technique other than the main sport of the athlete to help him/her improving the main sport (Hassan, 2004). Sports activities vary in energy demands and the speed of using such energy like long-distance running and long-distance swimming that depend on aerobic power system. On the other hand, there are activities that depend on huge amounts of energy in very short durations that is they depend on anaerobic power system (Moran & McGlynn, 1997).

The pulmonary system or the respiratory system in healthy humans includes the airways, two lungs, and the respiratory muscles, such as the diaphragm, which together with the ribs attaches the lungs. The internal intercostals muscles and the external intercostals muscles also contribute during inspiration and expiration together

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with the diaphragm. The diaphragm is a large dome-shaped muscle and is the primary muscle involved in active inspiration (Guenette & Sheel, 2007). Spirometry is a helpful tool in clinical use, in detecting and follow up lung diseases in both healthy individuals and patients. It is used to determine how an individual inhales or exhales volumes of air as a function of time (Miller et al., 2005). The test measures first of all the rate at which the lung changes volume during forced breathing maneuvers. Different PF measures or lung capacities can then be measured during a spirometry maneuver, for instance forced vital capacity (FVC), which measures the total volume of air that can be exhaled during a maximal forced expiration effort. Forced expiratory volume in 1 s (FEV1) is the maximal volume of air exhaled during the first second of a forced expiration from a position of full inspiration, usually 75 % of FVC ≥80 % of predicted is accepted as the lower limit of normal values for FEV1 and FVC (Ruppel & Enright, 2012). Percentages of predicted (%) are reference values from large populations, based on the subjects' gender, age, height, and ethnic origin. The use of %of predicted values (% pred.) allows comparison with other studies, which may have a different balance of sex and age. The FEV1 ⁄FVC ratio expresses the percent of FVC that can be breathed out during the first second and is often reduced in asthmatic patients. The forced expiratory flow (FEF) in 25-75 % and 50 % of FVC (FEF25-75% and FEF50) is the average forced expiratory flow between 25% and 75% of the FVC, or percentage of FVC. It can be helpful in the diagnosis of an obstructive disease and can give information about airway resistance. A reduction of less than 60 percent of predicted values may confirm airway obstruction. Both FEF25-75 % and FEF50 is highly dependent on the validity of the FVC measurement and expiratory effort (Barreiro & Perillo, 2004).

Methodology

The purpose of the study was to analyze the effects of aerobic training and aerobic cross training on pulmonary function. 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 training and aerobic cross training programme. The subjects were randomly divided into three groups and each group comprised of fifteen (n=15) subjects. Group-I underwent aerobic training (running), group-II underwent aerobic cross training (swimming and cycling) 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. Forced vital capacity and forced expiratory volume one second was assessed in liters before and immediately after the training period, by digital spirometry.

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).

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 post test 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.

Table II. Analysis of covariance for pre and post test data on forced vital capacity and expiratory reserve volume one second of aerobic and aerobic cross training groups and control group

		Aerobic Training group	Aerobic cross Training group	Control group	SOV	Sum of square	df	Mean squares	'F'ratio
Forced vital capacity	Pre–test								
	Mean	3.155	3.165	3.157	B	0.001	2	0.0005	0.05
	SD	0.104	0.100	0.090	W	0.408	42	0.010	
	Post–test								
	Mean	3.734	3.597	3.168	B	2.624	2	1.312	72.24*
	SD	0.175	0.104	0.113	W	0.763	42	0.018	
	Adjusted Post-Test Mean	3.738	3.593	3.170	B	2.615	2	1.308	100.34*
					W	0.534	41	0.013	
Forced expiratory volume one second	Pre–test								
	Mean	3.04	3.01	3.03	B	0.007	2	0.004	0.48
	SD	0.09	0.07	0.10	W	0.31	42	0.007	
	Post–test								
	Mean	3.69	3.46	3.04	B	3.32	2	1.66	80.74*
	SD	0.17	0.14	0.10	W	0.86	42	0.02	
	Adjusted Post-Test Mean	3.69	3.47	3.04	B	3.25	2	1.62	85.42*
					W	0.78	41	0.019	

*** Significant at 0.05 level of confidence. The table value required for significance at 3.22**

The adjusted post test mean values on vital capacity of aerobic cross training group, aerobic training group and control group were 3.738, 3.593 and 3.170 respectively. The obtained 'F' ratio of 100.37 for adjusted post test scores was greater than the table value of 3.23 for df 2 and 41 required for significance at 0.05 level of confidence on vital capacity. The results of the study indicated that there was a significant difference between the adjusted post test means of aerobic training group, aerobic cross training group and control group on forced vital capacity.

The adjusted post test mean values on expiratory reserve volume one second of aerobic cross training group, aerobic training group and control group were 3.69, 3.47 and 3.042 respectively. The obtained 'F' ratio of 85.42 for adjusted post test scores was greater than the table value of 3.23 for df 2 and 41 required for significance at 0.05 level of confidence on expiratory reserve volume one second. The results of the study indicated that there was a significant difference between the adjusted post test means of aerobic training group, aerobic cross training group and control group on expiratory reserve volume one second.

Table III. Scheffe's post hoc test for the adjusted post-test paired means difference on forced vital capacity and expiratory reserve volume one second

	Adjusted Post-Test means				
	Aerobic Training group	**Aerobic cross Training group**	**Control group**	**Mean difference**	**Confidence interval**
Forced vital capacity.	3.738	3.593		0.145*	0.104
	3.738		3.170	0.568*	0.104
		3.593	3.170	0.423*	0.104
Forced expiratory volume one second	3.69	3.47		0.21*	0.12
	3.69		3.04	0.64*	0.12
		3.47	3.04	0.43*	0.12

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

The table III shows that the adjusted post test paired mean differences on forced vital capacity and forced expiratory volume one second between aerobic training and aerobic cross training groups, aerobic training and control groups and aerobic cross training and control groups were 0.145, 0.568 and 0.423 for forced vital capacity and 0.21, 0.64 and 0.43for expiratory reserve volume one second respectively. Which are higher than the confidence interval of 0.104 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 forced vital capacity and forced expiratory volume one second between as compared to the control group. The result also reveals that the increase in forced vital capacity and forced expiratory volume one second between is significantly more for aerobic training group was higher than aerobic cross training group.

Discussion of study

The result of the present study showed significant increase in forced vital capacity and forced expiratory volume one second for both aerobic training and aerobic cross training as compared to control group. Whereas the increase was significantly higher for aerobic training as compared to cross training. Huang and Osness (2005) have concluded that 10 weeks of aerobic training of moderate or high intensity increased the forced vital capacity and at the same time the high intensity aerobic group showed significant increase in forced expiratory volume one second along with increase in forced vital capacity. Doberty and Dimitriou (1997) have showed greater level of forced vital capacity, forced expiratory volume in one second and peak expiration flow for runner and swimmer. Shaw and shaw (2011) have conducted a study of intervention of aerobic exercise and concluded significant improvement in forced vital capacity and forced expiratory volume one second. Doberty and Dimitriou (1997) have found that swimmers had superior forced vital capacity and forced expiratory volume one second independent of stature and age. Farid et al, (2005) conducted a study on effect of aerobic training on pulmonary function and tolerance activity in asthmatic patients and found an improvement in forced vital capacity and forced expiratory volume one second. On the contrary, Vedala et al., (2013) found increased FVC, FEV1, and FEV1/FVC (% pred.) in male and female Indian marathon runners compared to healthy sedentary subjects. Armour et al., (1993) have reported greater FVC and FEV1 in the healthy swimmers compared to the significant older runners and age-matched controls. Kunzli et al., (1995), have resulted from Pulmonary function test was conducted among healthy male (20-30 years) volunteers who were regular swimmers (n=51) and was compared with controls (n=51) who practiced athletic events but not swimming. Swimmers (23.52 ±1.87 years) were significantly younger than controls (24.39 ± 2.22 years) with 5.33±1.82 years of swimming practice. Swimmers exhibited increased VC, FVC, FEV1, PEFR, MEF25%, MEF50%, MEF25/75% than controls. Swimmers demonstrated a significant positive correlation between duration of swimming practice and airway caliber (FEV1, MEF25%, MEF50%, MEF25/75%), whereas, muscular efficiency (VC and PEFR) did not demonstrate any correlation. This demonstrates that, airway modulation takes place proportionately with duration of swimming practice. Contrary, muscle efficiency did not showed such behavior, thereby; a ceiling effect on skeletal muscle efficiency could be expected with prolonged duration of swimming practice (Deepali et al., 2014).

Conclusion

There was a significant increase in forced vital capacity and forced expiratory volume one second, for both aerobic training and aerobic cross training groups as compared to control group. There was a significant increase forced vital capacity and forced expiratory volume one second,for aerobic training group as compared to aerobic cross training group.

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