Original Article

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Physiology Section

Effects of Isotonic Exercises on Pulmonary Function and Free Radical Status in Healthy Young Adults: A Prospective Cohort Study

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ABSTRACT

Background and Aims: Different types of exercises affect body systems in variable manner. The present study was undertaken to assess the effect of isotonic exercises, yoga and aerobics on pulmonary functions and free radical status in healthy young adults.

Methods: The prospective cohort study was conducted in the departments of physiology and biochemistry at a teaching hospital in north India. Thirty subjects, 18-30 year old apparently healthy volunteers were included in 2 groups, aerobic and yogic, based upon regular performance of exercises. The subjects were assessed at the start of and after 3 months and 6 months of the training schedule. The parameters assessed were pulmonary function tests (FVC, FEV1, PEFR) and estimation of free radicals, malondialdehyde (MDA) & super oxide dismutase (SOD). The results were compared using student 't' test & ANOVA.

Results: The subjects in yoga group showed significant improvement in FEV1 & PEFR and in MDA and SOD level from baseline to 3 months. In the aerobic exercise group a significant change was observed in terms of FVC, FEV1 & PEFR, MDA & SOD at 3 months. No further significant change was observed from 3 to 6 months in any parameter among both groups.

Conclusions: Though the observations suggest clear effect of isotonic exercises and various parameters, a further study with larger sample size and assessing more objective parameters can provide better insight into the suggested relationship.

Key Words: Malondialdehyde, super oxide dismutase, exercise tolerance

INTRODUCTION

Different types of exercises affect body systems in variable manner. Over the years, the positive effects of isotonic exercises on health have been recognized [1]. Pulmonary functions are considered to be clear reflection of the adaptation of physiological functions to exercise. On the other hand, the deleterious effects of exercise stress are reflected by production of harmful free radicals. The present study was undertaken to assess the effect of isotonic exercises, yoga and aerobics on pulmonary functions and free radical status in healthy young adults.

MATERIALS AND METHODS

The prospective cohort study was conducted in the departments of physiology and biochemistry at a teaching hospital in north India. The subjects were 18-30 year old apparently healthy volunteers regularly practicing aerobic (cycling, jogging or isotonic weight bearing) and yogic (shavasana, bhastrika or surya anulome vilome) exercises at adjoining centres in the city. Thirty subjects were included in each group (aerobic & yoga). Those with history of chronic hemodynamic or respiratory illnesses or smoking in past or present were excluded. At the start of the training schedule, after taking sociodemographic details, detailed history of present or past illnesses and a through physical examination, a 5 ml blood sample of the subjects was taken for the biochemical estimation of free radicals, malondialdehyde (MDA) (modified Okhawa method, 1990) & super oxide dismutase (SOD) (McCord and Fridovich, 1969) [2,3]. All the reagents used were from Sigma Co, St Lewis, USA. Volunteers were also subjected to do the pulmonary function test using the medspiror (MED systems, Chandigarh, India) spirometer and following parameters were assessed, forced vital capacity (FVC), forced expiratory volume in first second (FEV1) and peak expiratory flow rate (PEFR). Similar evaluations were performed at the end of 3 months & 6 months respectively. The study was approved by Institutional ethical committee and informed consent was obtained from subjects after detailed description of their involvement. Statistical analysis of the work was done using Student's paired t – test on a statistical software. Analysis of variance (ANOVA) was done to get the differences amongst the means of different time intervals. The pair wise comparisons were done, if overall significant was observed, the contrast was used to find out the pair wise comparisons. The mean and standard deviation of the data were determined and p value <0.05 was considered significant.

RESULTS

Sixty subjects, 30 in each group, were enrolled and underwent complete evaluation. The groups were similar in terms of age, gender distribution and other sociodemographic characteristics. The observed parameters on pulmonary function testing are depicted in [Table/Fig-1]. There was a significant increase in FVC in group A at 3 months. The FEV1 showed a significant increase in both the groups during first 3 months however, changes at 6 months were not significant. After subsequent months of exercises it was

	Aerobic exercises group (A)			Yogic exercises group (B)		
	Baseline	3 months	6 months	Baseline	3 months	6 months
Forced vital capacity (Litres)	2.85 +0.27	3.02 +0.24	3.14 +0.23	3.15 +0.13	3.30 +0.11	3.48 +0.29
Forced expiratory volume in first second (Litres)	2.80 +0.17	2.94 +0.15	3.05 + 0.14	3.01 + 0.19	3.18 +0.98	3.32 +0.81
Peak expiratory flow rate (Litre/minutes)	9.19 + 0.45	10.10 +0.46	11.07+ 0.5	9.77 + 0.57	11.46 +0.22	12.35 +0.58

[Table/Fig-1]: Pulmonary function parameters in the subject from each group over the study period

	Aerobic exercises group (A)			Yogic exercises group (B)		
	Baseline	3 months	6 months	Baseline	3 months	6 months
Malondialdehyde (U/L)	9.28 +0.16	8.92 +0.96	8.03+0.16	9.52 +0.11	8.16 +0.15	7.47 +0.28
Super oxide dismutase (U/L)	11.43 +1.24	12.5 +1.27	13.41 +1.33	11.23 +0.39	13.09 +0.14	14.15 +0.36

[Table/Fig-2]: Free radical status in the subject from each group over the study period

observed that the PEFR was significantly increase in yogic exercise from beginning of training to 3 months of training (p=0.000) as compared to aerobic exercises, however the pair wise comparison indicates that differences of PEFR in yogic and aerobic exercises group was not significant from 3 months to 6 month of training (p>0.05).

The changes in free radical status among the subject in the groups over the study period is depicted in [Table/Fig-2].

[Table/Fig 2] shows significant change in MDA level in aerobic and yogic exercise group after 3 months in comparison to before training. The MDA level change was greater in yogic exercise than the aerobic exercise group after 3 month training. Between 3 month and 6 month of training, the change in MDA level was not significant.

It was observed that SOD significantly increased in yogic exercise as compared to aerobic exercise from beginning of training to 3 months of training (p<0.001). The pair wise comparison indicates that differences of SOD in yogic exercise is greater then aerobic exercise from before the training and after 3 month of training but difference is not significant between yogic exercise and aerobic exercise from 3 month to 6 month of exercise (p>0.05).

DISCUSSION

The study highlights the effect of isotonic exercise over pulmonary function parameters and free radical status of body. The subjects in yoga group showed significant improvement in FEV1 & PEFR and in MDA and SOD level from baseline to 3 months. In the aerobic exercise group a significant change was observed in terms of FVC, FEV1 & PEFR, MDA & SOD at 3 months. No further significant change was observed from 3 to 6 months in any parameter among both groups. Though the observations suggest clear effect of isotonic exercises and various parameters, a further study with larger sample size and assessing more objective parameters can provide better insight into the suggested relationship. Our results are easily applicable to the population at large since we recruited apparently healthy unprofessionally trained adult subjects.

Udupa showed reduction in body weight, improved lung function, decrease respiratory rate increased vital capacity and breath holding time with yoga exercises [4].

Kulpati et al followed 75 patients of COPD in three different groups. The first group received conventional treatment. Second group did breathing exercises alone while the third group did yogic exercises. They reported that the group undertaking yogic exercises best maintained their lung function [5]. Makawana et al showed effect of short-term yogic practice on ventilatory function after 10 weeks of training. There was increase in vital capacity FEV and decrease in respiratory rate [6].

Strenuous exercise stimulates catecholamine secretion in circulation. There is evidence that catecholamines could potentially generate free radicals in the body either through auto-oxidation or through metal ion or superoxide catalyzed oxidation (Freeman 1982, Jewett 1989) [7,8]. Glutathione-S-transferase, SOD and xanthine oxidase activities increased significantly with the increase in exercise period. Lipid peroxidation in terms of MDA expression also increased with exercise. It was concluded that increase in MDA was indicator of the rate of lipid peroxidation in wake of exhaustive exercise (Vani, 1990) [9]. Ji (1992), concluded that exhaustive exercise can impose a severe oxidation stress on skeletal muscle and that peroxides, systems as well as antioxidant enzymes are important in coming with free radical mediated injury [10]. There is induction of oxidative stress in the pulmonary tissue upon exhaustive physical exercise. This is effectively combated by introduction of vitamin E and Se (Veera, 1992) [11]. Investigations on blood platelets of 41 healthy men subjected to submaximal physical exercise showed increase in SOD (Kedziora, 1995) [12].

Our findings reframe the exercise and oxidative stress paradox as follows: although a single bout of acute maximal aerobic exercise causes oxidative stress, participation in regular physical exercise training results in adaptations to exercise and exercise induced oxidative stress that reduce deleterious oxidation relate effects. Hence a physically de-conditioned sedentary individual who experienced exercise mediated oxidative injury during the course of activities of daily living can be protected by becoming physically conditioned.

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