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Original Research Article

Does Aerobic Training Affect Maximum Voluntary Ventilation?

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ABSTRACT

Background and Objectives: Aerobic exercise is an important component of pulmonary rehabilitation for patients with chronic obstructive pulmonary disease (COPD). The aim of this study was to evaluate the effect of aerobic training on Maximum Voluntary Ventilation (MVV) which is a measure of respiratory muscle performance.
Methods: We recruited forty apparently healthy male medical students aged 17-20 years. Informed consent was obtained. Participants were non-athletes, non-smokers, non-obese and non-alcoholics. Randomization into experimental and control groups (20 each), was carried out with a table of random numbers. The experimental group participated in a 16 weeks aerobic exercise plan. Subjects were asked to refrain from tea, coffee, chocolates and caffeinated soft-drinks on the day of recording Spirometry. MVV was recorded before the commencement of training and at the end of training. The MVV maneuver was demonstrated to all the subjects. MVV was recorded by a computerized spirometer (CPFS/DUSB, Medgraphics Company) in standing position. Subjects were instructed to ventilate with her or his maximal ventilation volume and frequency for 15 seconds. The obtained value was multiplied by 4 to get MVV in L/min.
Results: The data were analyzed by paired 't' test. $P < 0.05$ was considered significant. There was significant improvement in MVV in the intervention group at the end of training.
Conclusion: In conclusion, the current study has shown that, there is significant positive relationship between aerobics training and respiratory muscle performance.
Keywords: Aerobics; Training; Exercise; MVV; Spirometry; Pulmonary Function Tests

INTRODUCTION

Background: Aerobic exercise is an important component of pulmonary rehabilitation for patients with chronic obstructive pulmonary disease (COPD).

The American College of Sports Medicine (ACSM) defines aerobic exercise as "any activity that uses large muscle groups, can be maintained continuously, and is rhythmic in nature." It is a type of exercise that overloads the heart and lungs and causes them to work harder than at rest. [(1)] Examples: walking, jogging, running, skipping, dancing, swimming etc.

Maximum voluntary ventilation (MVV) is a measure of the maximum amount of air that can be inhaled and exhaled within one minute. MVV is the measure of respiratory muscle performance. For the comfort of the patient this is done over a 15 second time period before being extrapolated to a value for one minute expressed as liters/minute. Average values for males and females are 140–180 and 80–120 liters per minute respectively. [(2)]

Impaired pulmonary functions are associated with increased mortality and morbidity. [(3-5)] Physical activity is known to improve physical fitness and to reduce morbidity and mortality from numerous chronic ailments. [(6)] There are very few studies on aerobic exercise and pulmonary function in general population. [(7)] Most studies on the effects of physical activity are cross sectional ones, on special populations such as athletes or patients with COPD. [(8-11)] Physical activity rehabilitation is widely used in patients with pulmonary diseases. Exploration of the relation between aerobic exercise and respiratory functions, will aid in understanding how aerobics improves patient's quality of life and in finding a better way to evaluate the effects of rehabilitation. The present study was carried out to investigate the relationship between aerobics training and MVV in healthy young men.

MATERIALS AND METHODS

This study was approved by ethics committee of the institute. We recruited forty apparently healthy male medical students aged 17-20 years. Informed consent was obtained. Participants were non-athletes, non-smokers, nonobese and non-alcoholics. Randomization into experimental and control groups (20 each), was carried out with a table of random numbers. Subjects' height and weight were measured; BMI was calculated. Subjects were asked to refrain from tea, coffee, chocolates and caffeinated soft-drinks on the day of recording Spirometry. The MVV maneuver was demonstrated to all the subjects. MVV was recorded by a computerized spirometer (CPFS/DUSB, Medgraphics Company) in standing position. Subjects were instructed to ventilate with her or his maximal ventilation volume and frequency for 15 seconds. The obtained value was multiplied by 4 to get MVV in L/min. The best of the three trials was considered for data analysis. Calibration of spirometer and all testing protocols were performed as outlined in the instruction manual of the spirometer.

Subjects participated in 16 weeks aerobic exercise plan which included five 20 minute sessions of jogging in a week with 5 minutes of warm-up and 5 minutes of cool down exercises. The distance covered was 2.5 Km i.e. 5 laps of college ground and exercise heart rate was 116 ± 8 beats/min. This was a moderate intensity exercise according to WHO classification. PFT was repeated at the end of the training.

The data were analyzed using Microsoft Excel software. Student's paired 't' test was applied to compare the pre and post training values. Statistics were tested at the $P<0.05$ level of significance and data were reported as mean ± standard deviation.

RESULTS

Subjects in both the groups were comparable for all parameters at baseline. After 16 weeks of aerobics training there was statistically significant ($P < 0.05$) increase in MVV values in the intervention group (pretest MVV= 143 L/min, posttest MVV= 161 L/min, $P = 0.0013$). There was no significant change in the control group (pretest MVV= 145 L/min, posttest MVV= 148 L/min, $P = 0.369$). There were no serious adverse events and the subjects were comfortable during the study period.

DISCUSSION

Physical inactivity and low cardio-respiratory fitness are recognized as important causes of morbidity and mortality. [6, 7] It is generally accepted that people with higher levels of physical activity tend to have higher levels of fitness and that physical activity can improve cardiorespiratory fitness. [8]

In the present study, MVV increased significantly after 16 weeks of jogging. Thus positive relationship between aerobics training and respiratory muscle performance was supported by our data. Other studies comparing respiratory function among men and women engaged in various sports found that sports person have better level of pulmonary function than sedentary people. [12] Our study result is supported by study by Cheng YJ et al. [13] who found that physical activity improves pulmonary function in healthy sedentary people.

Farid R et al. [14] showed an improvement in pulmonary function with aerobic exercise training in asthma patients. Nourrey C et al. [15] showed in a prospective study that aerobic exercise improves pulmonary function and alters exercise breathing pattern in children. Fitch KD et al. [16] studied the effect of five months swimming training on school children with asthma and found improved lung function, and improved posture and fitness. Bruce GN et al. [17] have shown in their study that distance running program improved fitness in asthmatic children without pulmonary complications.

Clark CJ [18] found that cardio-respiratory fitness significantly improved and breathlessness decreased over a wide range of physical work corresponding to activities of daily living. Kaufman C et al. [19] studied the effect of aerobic training on ventilatory efficiency in overweight children, and found that the training helped to reverse the decrements in cardiopulmonary function observed over a period of time in overweight children.

Our study also showed that the subjects were able to have more powerful and more effective inspiration and expiration as opposed to what they have been able to before participating in such aerobics training. One limitation of our study is that most of our healthy subjects were from mid to upper socioeconomic strata and only male students were included in the study. This shortcoming may affect the generalization of the results to other sections of society.

CONCLUSION

In conclusion, the current study has shown that, there is significant positive relationship between aerobics training and respiratory muscle performance in healthy young men. The increase in MVV could be due to increased strength and endurance of respiratory muscles.

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