International Journal of Research in Medical Sciences
Angane EY et al. Int J Res Med Sci. 2016 Jun;4(6):2059-2063
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20161760

Research Article

Effects of aerobic exercise on pulmonary function tests in healthy adults

Esha Y. Angane*, Amit A. Navare

Department of Physiology, Seth G.S. Medical College & KEM Hospital, Mumbai, India

Received: 26 March 2016
Accepted: 27 April 2016

***Correspondence:**
Dr. Esha Y. Angane,
E-mail: angane402@gmail.com

ABSTRACT

Background: Healthy living and physical fitness are closely related. Physical activity is known to improve physical fitness and to reduce morbidity and mortality from numerous chronic ailments. This study was done to evaluate the effects of aerobic exercise on pulmonary function tests in healthy adult volunteers. Exercise is the body's most common physiologic stress, and it places major demands on the cardiopulmonary system
Methods: The present study was done to study the effects of aerobic exercise on pulmonary function tests in 65 healthy adult volunteers in age group of 20- 35 years. The same volunteers were chosen as both study as well as control group in order to minimize the confounding factors and make the study reproducible. The pulmonary function tests were carried out with a computerized spirometer medgraphics.
Results: The study revealed that the pulmonary functions are improved after undergoing aerobic exercise training. Regular aerobic exercise is related to better cardiorespiratory efficiency and good pulmonary function. Higher lung volumes and flow rates were achieved in aerobic trainees after their training period, as compared to their own values obtained before their training period.
Conclusions: The present study suggests that there is an improvement in pulmonary functions following aerobic exercise training. Hence regular physical activity causes many desirable physiological, psychological and physical changes in the individual.

Keywords: Aerobic, Exercise, Healthy, Pulmonary function tests

INTRODUCTION

Healthy living and physical fitness are closely related. Physical activity is known to improve physical fitness and to reduce morbidity and mortality from numerous chronic ailments.[1] Previous studies have shown that regular exercise training and good physical fitness are related to better pulmonary functions.

One such programme is aerobic or cardiovascular fitness. Aerobic exercise is an important component of pulmonary rehabilitation for patients with chronic obstructive pulmonary disease (COPD).[2] Pulmonary function is a long-term predictor for overall survival rates in both genders and could be used as a tool in general health assessment.[3] Impaired pulmonary functions are associated with increased mortality and morbidity. Lung function parameters were also found to vary in different settings with results suggesting that the size of lung is governed by genetic, environmental, and nutritional factors.[4] There are very few studies on aerobic exercise and pulmonary function in general population.[5] Most studies on the effects of physical activity are cross sectional ones, on special populations such as athletes or patients with COPD.[6-8]

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 the mechanisms of how aerobics improve 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 aerobic exercise and pulmonary functions in healthy adult volunteers.

METHODS

The study was carried out after the approval from ethics committee in 65 healthy adult volunteers in the age group of 20-35years who visited the fitness centre having treadmill facility and had not yet started to exercise but was keen to exercise and ready to volunteer for the study.

The same volunteers were chosen as both study as well as control group in order to minimize the confounding factors and make the study reproducible.

Inclusion criteria

- Healthy adults of age group 20-35 years willing to actively participate in jogging on treadmill.
- Volunteers willing to participate in 30 minutes of continuous session of jogging on treadmill 5 times a week with 5 minutes of warm-up exercise before jogging and 5 minutes of cool down ex-ercise after the jogging. They were told to achieve a training intensity of 70-85%.
- Volunteers willing to undergo sixteen weeks of continuous exercise training.

Exclusion criteria

- Subjects with history of bronchial asthma, COPD, Tuberculosis and known cardiac and respiratory diseases.
- Subjects with history of smoking ,alcohol, severe chest trauma, obvious chest and spinal deformity.
- Subjects who were chronically ill.
- Subjects on medications for long duration.
- Subjects with history of any major surgery (cardiac, pulmonary, abdominal) related to study.
- Subjects undergoing any physical conditioning program.
- Subjects with history of active sports training.
- Subjects with history of hypertension, diabetes mellitus.
- Subjects suffering from arthritic disorders, skeletal deformities, or neuromuscular abnormalities.

Equipment's

- Computerized spirometer manufactured by MedgraphicsR cardiorespiratory diagnostic systems, USA which consists of Breeze Suit version 6.2c software, CPFS/D TM USB and pre Vent TM pneumotach. This spirometer assembly is programmed to measure various pulmonary functions. FVC, SVC, MVV test protocols were used in this study.
- Stop watch.

Parameters measured

- FVC (litres) [Forced Vital Capacity]
- FEV1 (litres) [Forced Expiratory Volume in 1st Second]
- FEV1/FVC
- FEFmax (litres/sec) [Forced Expiratory Flow Max]
- IC (litres) [Inspiratory Capacity]
- MVV(litres/min) [Maximum Voluntary Ventilation]

Statistical analysis

Results are entered in Microsoft Office Excel 2007 and analyzed using the Statistical Package for Social Sciences (SPSS) version 16. Data is expressed as Mean± Standard deviation. Test used is paired 't' test. P value of <0.05 is considered as significant.

RESULTS

In this study 65 healthy adults in age group of 20-35 years were taken and there pulmonary functions were studied and compared before and after undergoing aerobic exercise training.

Mean FVC was 4.56 litres after aerobic exercise training which is more and statistically significant as compared to 3.7litres before aerobic exercise training (Table 1).

Mean FEV1 was 3.85 litres after aerobic exercise training which is more and statistically significant as compared to 3.16 litres before aerobic exercise training (Table 2).

Mean FEV1/FVC was 84.38 after aerobic exercise training which is similar and statistically not significant as compared to 84.98 before aerobic exercise training (Table 3).

Mean FEFmax was 9.22litres/sec after aerobic exercise training which is more and statistically significant as compared to 7.72litres/sec before aerobic exercise training (Table 4).

Mean IC was 3.22litres after aerobic exercise training which is more and statistically significant as compared to 2.31litres before aerobic exercise training (Table 5).

Mean MVV was 174.25litres/min after aerobic exercise training which is more and statistically significant as compared to 135.00litres/min before aerobic exercise training (Table 6).

Table 1: Comparison of FVC before undergoing aerobic exercise training and after undergoing aerobic exercise training (FVC (litres).

Parameter	Before aerobic exercise training (Mean±SD)	After aerobic exercise training (Mean±SD)	P value
FVC (litres)	3.70±0.67	4.56±0.70	0.0001*

By paired t Test, * Significant.

Table 2: Comparison of FEV1 before undergoing aerobic exercise training and after undergoing aerobic exercise training (FEV1 (litres).

Parameter	Before aerobic exercise training (Mean ± SD)	After aerobic exercise training (Mean ± SD)	P value
FEV1(litres)	3.16±0.56	3.85±0.58	0.0001*

By paired t Test, * Significant.

Table 3: Comparison of FEV1/FVC before undergoing aerobic exercise training and after undergoing aerobic exercise training (FEV1/FVC).

Parameter	Before aerobic exercise training (Mean ± SD)	After aerobic exercise training (Mean ± SD)	P value
FEV1/FVC	84.98±3.98	84.38±2.81	0.284(NS)

By paired t Test, Not Significant (NS)

Table 4: Comparison of FEFmax before undergoing aerobic exercise training and after undergoing aerobic exercise training (FEFmax (litres/sec)).

Parameter	Before aerobic exercise training (Mean±SD)	After aerobic exercise training (Mean±SD)	P value
FEFmax (litres/sec)	7.72±1.13	9.22±1.29	0.0001*

By paired t Test, * Significant.

Table 5: Comparison of IC before undergoing aerobic exercise training and after undergoing aerobic exercise training (Inspiratory capacity (litres)).

Parameter	Before aerobic exercise training (Mean ± SD)	After aerobic exercise training (Mean ± SD)	P value
IC(litres)	2.31±0.74	3.22±0.64	0.0001*

By paired t Test, * Significant

Table 6: Comparison of Mean MVV before undergoing aerobic exercise training and after undergoing aerobic exercise training (MVV (litres/min)).

Parameter	Before aerobic exercise training (Mean±SD)	After aerobic exercise training (Mean±SD)	P value
MVV(litres/ min)	135.00±27.50	174.25±33.07	0.0001*

By paired t Test, * Significant

DISCUSSION

Results indicates that Pulmonary function tests after undergoing aerobic exercise training were better as compared to before undergoing aerobic exercise training. Mean values of FVC, FEV1, FEFmax, IC, and MVV are more and statistically significant after undergoing aerobic exercise training than before undergoing aerobic exercise training. Mean value of FEV1/FVC is similar and statistically not significant before and after undergoing aerobic exercise training. Thus positive relationship between aerobics training and pulmonary function 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]

Present study result is supported by Cheng YJ et al. study in which the physical activity improved pulmonary function in healthy sedentary people.[6] Farid R et al. showed an improvement in pulmonary function with aerobic exercise training in asthma patients.[7] Nourrey C et al. showed in a prospective study that aerobic exercise improves pulmonary function and alters exercise breathing pattern in children.[8] Fitch KD et al. studied the effect of five months swimming training on school children with asthma and found improved lung function, and improved posture and fitness.[13] Kaufman C et al. 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.[14] Bharali R et al studied the effect of aerobic exercises in 100 medical students and concluded that the spirometric variables increased after acute exercise and the values were higher in boys than in girls.[15] Shashi M, et al in a study conducted on Punjab young male adults concluded that regular exercise enhances physical capabilities and physiological responses of the human body and the lungs are no exception.[16]

Present study showed effects of aerobic training on pulmonary function in healthy postmenopausal women. Aerobic exercise training was done for 8 weeks and 3 sessions per week. After 8 weeks of training, anthropometric parameters and VO_{2max} of active group showed a significant increase. Furthermore, aerobic exercise training causes a significant increase in FVC and FEV1 parameters of pulmonary functions. Thus study shows that aerobic training leads to increase in the strength and/or endurance of the respiratory muscles.[17]

With respect to significant increase in FVC after undergoing aerobic exercise training were due to strengthening of respiratory muscles (expiration and inspiration muscles). Muscular exercise increases the rate and depth of respiration and so improves FVC, the consumption of O_2 and the rate of diffusion. Breathing exercise promotes a more efficient breathing pattern, improvement in ventilation and increases in FVC, the increase in FVC post exercise might be related to the enhanced strength of respiratory muscles following training, a reduction air way resistance and the process of motivation which enforces the subject to take deep inspiration and fill all air passages after training.[18] The training induced increase in aerobic enzyme levels and oxidative capacity of respiratory musculature contribute to enhanced ventilator muscle function.

FEFmax is a simple index of pulmonary function often used in clinical and epidemiological studies for the assessment of ventilator capacity. It is effort dependent and reflects the status of large airways. FEFmax is the single best test for the ventilator efficiency. The difference in the values of FEFmax after undergoing aerobic exercise training compared to before undergoing aerobic exercise training is statistically significant.

The mean values of FEV1 as a percentage of FVC (FEV1/FVC %) were found to be almost similar in both groups. The difference was statistically not significant. The subjects were healthy adults and free from any respiratory diseases hence the ratio of FEV1/FVC was found normal.[4]

The mean values of MVV after undergoing aerobic exercise training was higher and statistically significant as compared to before undergoing aerobic exercise training. The higher MVV is advantageous for physical work capacity of the volunteers.[4] The findings of this study supported the view expressed by Leith DE et al that endurance training increases the lung capacity, sustained ventilation and thus MVV.[19] The higher MVV values after undergoing aerobic exercise training is in accordance to findings of Shapiro W et al who observed that athletes have larger mean vital capacity and MVV.[20]

These results indicate that there is significant difference in the static lung volumes as well as flow rates amongst the groups. This indicates that regular exercise has a facilitatory effect on functioning of lungs. The possible explanation for this could be that regular forceful inhalation and deflation of the lungs for prolonged periods leads to strengthening of respiratory muscles. The physical training must have helped in developing reduced resistance to respiration and greater endurance in respiratory muscles, accounting for increased FVC, FEFmax and MVV.

This is advantageous for the physical work capacity in volunteers. Also the flow rates were shown to have higher values after undergoing aerobic exercise training. These flow rates are effort dependent. During training there is adaptation to frequent higher ventilatory load which might bring about some structural changes that may lead to less compression of airways at lower lung volumes. Hence regular physical activity causes many desirable physiological, psychological and physical changes in the individual. Thus lifestyle modification by including daily physical activity for better health is suggested.

CONCLUSION

The present study suggests that there is an improvement in pulmonary function following aerobic exercise training. There is significant positive relationship between aerobics training and lung functions in healthy adults. The improvement in pulmonary function could be due to increased strength of respiratory muscles, improved thoracic mobility and balance between lung and chest elasticity gained from regular exercise. The positive role of aerobics in improving respiratory functions in healthy individuals proves that exercise can be considered as an important component of pulmonary

rehabilitation for patients with lung diseases. So, pursuing exercise regularly will improve pulmonary function and cause a decline in morbidity and mortality due to lung causes.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Chaitra B, Maitri V. Effect of aerobic exercise training on peak expiratory flow rate: A pragmatic randomized controlled trial. Int J Biol Med Res. 2011;2(3):789-92.
2. Chaitra B, Narhare P, Puranik N, Maitri V. Moderate intensity aerobics training improves pulmonary function in young Indian men. Biomedical Research 2012; 23 (2): 231-233.
3. Holger J. Schiinemann et al. Pulmonary function is a long-term predictor of mortality in general population: 29 year follow-up of the Buffalo health study. Chest. 2000;118:656-64.
4. Lakera SC, Kain TC, Bandopadhyay P. Changes in lung functions during adolescences in athletes and non-athletes. J Sports Med Phys Fitness. 1994;34(3):258-64.
5. Twisk JW, Staal BJ, Brinkman MN, Kemper HC, van Mechelen W. Tracking of lung function parameters and the longitudinal relationship with lifestyle. Eur Respir J. 1998;12:627-34.
6. Cheng YJ, Macera CA, Addy CL, Sy F, Wieland D, Blair S. Effects of physical activity on exercise tests and respiratory function. Br. J. Sports Med. 2003;37:521-8.
7. Farid R, Azad FJ, Atri AE, Rahimi MB, Khaledan A, Talaei-Khoei M, et al. Effect of aerobic exercise training on pulmonary function and tolerance of activity in asthmatic patients. Iran J Allergy Asthma Immunol. 2005;4(3):133-8.
8. Nourry C, Deruelle F, Guinhouya C. High intensity running training improves pulmonary function and alters exercise breathing pattern in children. Eur J Appl. Physiol. 2005; 94(4):415-23.
9. Miller MR, Crapo R, Hankinson J, Brusasco V, Burgos F, Casaburi R, et al. General Considerations for lung function testing ATS/ERS TASK FORCE: standardization of lung function testing. Eur Respir J. 2005;26(1):153-61.
10. Wanger J, Clausen JL, Coates A, Pedersen OF, Brusasco V, Burgos F, et al. Standardisation of the measurements of lung volumes ATS/ERS TASK FORCE: Standardisation of lung function Testing. Eur Respir J. 2005;26(3):511-22 .
11. Hetzel MR. The pulmonary clock. Thorax. 1981;36:481-6.
12. Chaitra B, Narhare P, Puranik N, Maiyri V. Effect of aerobic exercise training on pulmonary function tests: A pragmatic randomized controlled trail. International Journal of Pharma and Bio Sciences 2011;2(4):455-60.
13. Fitch KD, Morton AR, Blanksby BA. Effects of swimming training on children with asthma. Archives of disease in childhood.1976;51:190-4.
14. Kaufman C, Kelly AS, Kaiser DR, Steinberger J, Dengel DR. Aerobic exercise training improves ventilator efficiency in overweight children. Pediatr. Exerc. Sci. 2007;19:82-92.
15. Bharali R, Chutia H, Jahan W. A comparative study on effect of acute exercise on pulmonary function test of first year M.B.B.S. StudentsInternational Journal of Medical and Health Research. 2015;1(1):90-3.
16. Shashi M, Anterpreet AK, Gupta P. Effects of aerobics training on pulmonary functions in young male adults of Punjab:Pak J Physiol. 2013;9(2):23-5.
17. Moazami M, Farahati S. The effects of aerobic training on pulmonary function in post – menopausal women. International Journal of Sport Studies. 2013;3 (2):169-74.
18. Delket K, David A, Kervy R. The effect of biofeed back assisted breathing retraining in lung function in patient with cystic fibrosis.Chest. 1994;100:23-8.
19. Leith DE, Bradley M. Ventilatory muscle strength and endurance training .J Appl Physiol. 1976;41(4):508-16.
20. Shapiro W, Johnson CE, Damerson RA, Patterson JL. Maximum ventilator performance and its limiting factors. J Appl Phsiol.1964;19:199-203.

Cite this article as: Angane EY, Navare AA. Effects of aerobic exercise on pulmonary function tests in healthy adults. Int J Res Med Sci 2016;4: 2059-63.