## ORIGINAL ARTICLE

# EFFECT OF MODERATE AEROBIC EXERCISE TRAINING ON PULMONARY FUNCTIONS AND ITS CORRELATION WITH THE ANTIOXIDANT STATUS

**Anju Madan Gupt[1], Mukesh Kumar[2], Rajesh Kumar Sharma[3], Rajesh Misra[4], Anadi Gup[5]**

**Author's Affiliations:** [1]Senior Resident, Dept of Physiology, IGMC, Shimla; [2]Professor, Dept of Physiology, BPS GMC for women, Khanpur kalan, Haryana; [3]Additional Professor, Dept of Physiology, AIIMS, Jodhpur; [4]Principal and Dean, Shridev Suman Subharti Medical College, Dehradun; [5]MPH, SPO, National Health Mission, H.P.
**Correspondence:** Dr. Anju Madan Gupt, Email: dranjugupt@gmail.com

## ABSTRACT

**Background:** Nowadays, keeping fit has become a primary concern and one of the methods to remain fit is by aerobic exercises. These exercises are performed at moderate level of intensity for extended period of time. The term "aerobic exercises" and the specific exercise methods were developed by Kenneth H. Coopper and Col. Pauline Potts.

**Aim:** The aim of the present study was to see the effect of moderate Aerobic exercise training on pulmonary functions and its correlation with antioxidant status.

**Methodology**: 30 healthy volunteers in the age group of 18-22 years were screened. They underwent short term moderate aerobic exercise training. Various Pulmonary function tests including FVC, MVV & SVC were taken prior to aerobic exercise training and later after the exercise period. Antioxidant status was assessed by the level of malondialdehyde in plasma.

**Result**: FVC showed a significant increase while PEFR, IRV, MVV and MRF showed a highly significant increase after the aerobic exercise training. Physical exercise also provided a favorable change in the biochemical parameters such as MDA.

**Conclusion:** We concluded that indulgence in regular physical exercise can result in betterment of health in general and improvement in pulmonary functions and antioxidant status in particular.

**Keywords**: Aerobic exercise, Pulmonary functions, Antioxidant status.

## INTRODUCTION

In recent times, more and more people are becoming aware of the requirement of physical activity for maintenance of health. Nowadays, keeping fit has become a primary concern and one of the methods to remain fit is by aerobic exercises. Aerobic exercise is an exercise that involves or improves oxygen consumption by the body. These exercises are performed at moderate level of intensity for extended period of time. The term "aerobic exercises" and the specific exercise methods were developed by Kenneth H. Coopper and Col. Pauline Potts [1].

Aerobic exercise works towards increasing total pulmonary ventilation.[2] During aerobic exercise, minute ventilation increases. An increased load is placed on the respiratory muscles. Both the frequency and the speed of contraction of the muscles are increased. It also increases the mechanical efficiency of the heart by increasing cardiac output which is proportionate to increase in oxygen consumption.

Pulmonary function test is a valuable tool for evaluating the respiratory system. Pulmonary function test includes variety of maneuvers that are performed using standardized equipment to measure the lung functions. Buffalo health study concluded that 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].

Antioxidants are substances that are capable of counteracting the damage done by the process of oxidation in our body. Free radicals such as superoxide anion radical, $H_20_2$ and $OH^-$ are common

product in an aerobic environment and these agents are responsible for oxygen toxicity. Studies are being conducted to see the beneficial effect of antioxidants.

Exercise is considered an acceptable method for improving and maintaining physical and emotional health. This study is to validate the beneficial effect of aerobic exercise on pulmonary functions and find the correlation with antioxidant status. We planned the study to see the effect of moderate Aerobic exercise on pulmonary functions and its correlation with antioxidant status.

## METHODOLOGY

The study was approved by the Ethical committee of the institute and each subject was provided written informed consent prior to participating in this study, conforming to the Declaration of Helsinki. .We performed Pulmonary function test by RMS-Helios 401 Spirometer, which consists of main unit turbine transducer and mouth piece. It was attached to the CPU by USB cable.

The subject was instructed to sit comfortably on the stool and the procedure explained was to the subject. Person's personal data including age, weight, gender height smoker/non smoker and position were fed in the computer. We asked the person to breathe through the mouth piece fixed over turbine transducer of the spirometer as per instruction accordingly for FVC, SVC and MVV test

Procedure was repeated thrice after a gap of few min and best maneuver was selected. The Pulmonary function test were done pre exercise and after three weeks of moderate aerobic exercise training.

The tests were analyzed and interpreted as;

**FVC**-FVC, FEV1, FFV1/FVC, FEV25-75 & PEFR
**SVC** - SVC, ERV, IRV & TV
**MVV**- MVV, MRF & MVT

We assessed the antioxidant status by the level of malondialdehyde in plasma which was done by spectrophotometeric method.MDA was quantified by Cell Biolabs' TBARS Assay Kit[4]. MDA forms a 1:2 adduct with thiobarbituric acid. The MDA-TBA adduct formed from the reaction of MDA in samples with TBA was measured.

We made the subjects to perform Aerobic exercise on treadmill according to the modified Bruce protocols till the fourth stage[5].

We made the comparison on subjects between the pre and post training within the group by using paired t test. We applied Pearson's correlation to see the correlation between pulmonary functions and antioxidant status. Statistical analysis was done using Graph Pad Instat3.10, 32 bit (Graph Pad software Inc.) for windows.

## RESULT

In the FVC parameters we observed a significant change in forced vital capacity (FVC p value = 0.0114) and peak expiratory flow rate (PEFR p value =0 .0005). In the MVV parameters a significant change was observed in breaths per min (MRF p value< 0.0001) and Maximum ventilation volume expired per min (MVV=0.0013), and in the SVC parameters we observed a significant change in inspiratory reserve volume (IRV p value = 0.0074). We also observed a significant change in the biochemical parameters such as MDA (p value = 0.0179) and a correlation between tidal volume and MDA.

**Table 1: Effect of Aerobic exercise on Pulmonary functions test FVC, SVC and MVV Parameters**

| Parameters | Pre-exercise Mean ± SD | Post-exercise Mean ± SD | P value |
|---|---|---|---|
| FVC (L) | 3.52 ± 0.91 | 3.69 ± 1.01 | 0.011 |
| $FEV_1$ (L) | 3.04 ± 0.76 | 3.07 ± 0.74 | >0.05 |
| $FEV_1$/FVC | 85.82 ± 8.44 | 84.04 ± 6.82 | >0.05 |
| PEFR (L/min) | 6.74 ± 2.04 | 7.59 ± 2.01 | < 0.01 |
| FEF 25-75 (L/min) | 3.48 ± 1.39 | 3.54 ± 1.49 | >0.05 |
| SVC (L) | 4.90 ± 0.86 | 5.11 ± 0.86 | >0.05 |
| ERV (L) | 1.69 ± 0.80 | 1.72 ± 0.74 | >0.05 |
| IRV (L) | 1.31 ± 1.48 | 1.54 ± 0.64 | < 0.01 |
| TV (L) | 0.39 ± 0.20 | 0.41 ± 0.20 | >0.05 |
| MVV (L/min) | 80.3 ± 22.87 | 89.9 ± 21.83 | < 0.01 |
| MRF (breaths/min) | 133.91±25.85 | 147.66±27.79 | < 0.01 |
| MVT (L) | 0.70 ± 0.36 | 0.77 ± 0.39 | >0.05 |

FVC- Forced vital capacity, $FEV_1$- Forced expiratory volume in 1sec, $FEV_1$ /FVC, PEFR - Peak expiratory flow rate and FEF 25-75 - Forced expiratory flow during 25-75% of expiration. SVC - Slow vital capacity, ERV - Expiratory reserve volume, IRV- Inspiratory reserve volume and TV- Tidal volume. MVV- Maximum ventilation volume expired per min, MRF- MVV maneuver breaths per minute and MVT- MVV maneuver Tidal volume.

**Table 2: Effect of Aerobic exercise on Antioxidant status**

| Test | Pre-exercise Mean ± SD | Post-exercise Mean ± SD | P value |
|---|---|---|---|
| **MDA** (nmol) | 3.05 ± 1.49 | 2.42 ± 1.10 | 0.018 |

MDA-Malondialdehyde

**Table 3: Correlation of MDA with Pulmonary parameters**

| Variables | r value | P value |
|---|---|---|
| FVC | -0.1735 | 0.4645 |
| $FEV_1$ | -0.2391 | 0.3101 |
| $FEV_1$ /FVC | -0.2003 | 0.3972 |
| PEFR | -0.1439 | 0.5450 |
| $FEF_{25-75}$ | -0.4043 | 0.0770 |
| MVV | -0.1491 | 0.5303 |
| MRF | 0.3102 | 0.1831 |
| MVT | -0.2871 | 0.2196 |
| SVC | -0.0382 | 0.8729 |
| ERV | 0.3562 | 0.1232 |
| IRV | 0.0063 | 0.9979 |
| TV | -0.5457 | 0.0128 |

## DISCUSSION

The present study was planned with an aim to find out how aerobic exercise help in maintaining physical fitness in terms of pulmonary functions, and do they have any impact on antioxidant status.There are many cross sectional studies which have observed the effects of aerobic exercise on pulmonaryfunction , with emphasis on populations such as athletes or patients with COPD[6,7,8]. There are very few studies which have observed the effect aerobic exercise and pulmonary function in general population. This study was aimed to look whether the same changes can be observed after a short duration of physical training in general population and do they correlate with MDA which is marker of oxidative stress.

We observed a significant change in forced vital capacity(FVC), peak expiratory flow rate(PEFR),Maximum ventilation volume expired per min(MVV), breaths per min (MRF) and inspiratory reserve volume(IRV). During aerobic exercise, minute ventilation increases and an increased load is placed on the respiratory muscles. Both the frequency and the speed of contraction in the muscle are increased. Increased work of breathing during strenuous exercise in healthy subjects can limit exercise performance whereas unloading the respiratory muscles during the strenuous activity, using assisted ventilation, results in significantly longer exercise tolerance. (Harms CA et al 2000)[9].

With exercise-induced diaphragmatic fatigue, a sympathetic response is activated, causing locomotormuscle vasoconstriction to redirect blood flow to the respiratory muscles. (Dempsey JA et al 2006)[10] PEFR is considered as the simple index of pulmonary function to assess the ventilatory capacity. It is effort dependent and reflects mainly the caliber of the bronchi and larger bronchioles which are subjected to reflex bronchoconstriction (Cotes JE 1993 [11] Khaliq F et al 2006)[12]

Farid et al[13]study shows that a course of aerobic sport exercise causes an obvious increase in FEV1, FVC, PEF, FEF 25%-75% in asthmatic patients, and a regular aerobic sports program can be complementary to medical treatment in asthma rehabilitation. Regular indulgence in aerobic exercise has also been shown to benefit these pulmonary function parameters in normal individuals, although the effect depends on the type and duration of training. Prakash S et al[14] observed higher FEV1 and PEFR in athletes as compared to sedentary individuals. A significant change was observed in the plasma level of malondialdehyde (MDA) after a period of three weeks of aerobic exercise.

Robertson et al[15] had also observed a high antioxidant status in trained runners than sedentary individuals. Toskulkaoet al[16] also observed a higher erythrocyte enzyme activity in trained runners than untrained subjects. Priscilla M Clarkson et al[17] had observed that exercise training seems to reduce the oxidative stress of exercise, such that trained athletes show less evidence of lipid peroxidation for a given bout of exercise and enhanced defense system in relation to untrained subjects.

## CONCLUSION

Our results are in conjugation with the findings in the literature and it reinforces the fact that even a short duration of physical exercise of three weeks can result in a favorable changes in pulmonary functions as well as biochemical parameters such as MDA. Our results vindicate the earlier observations that even short term moderate physical exercise training can result in favorable physiological and biochemical outcome. Therefore we can conclude that indulgence in regular physical exercise can result in betterment of health in general and improvement in pulmonary functions and antioxidant status in particular.

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