

# Effect of Aerobic Exercise Training on Pulmonary Function and Tolerance of Activity in Asthmatic Patients

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## ABSTRACT

The aim of the present study was to examine the effects of a course of aerobic exercise on pulmonary function and tolerance of activity in asthmatic patients.

Among the asthmatic patients, 36 patients (M= 16, F= 20) were chosen after clinical examinations, pulmonary function test, skin prick test (SPT) for aeroallergen and a six minute walk test (6MWT) on their own free will. A patient was said to have Exercise Induced Asthma (EIA) when he/she fulfilled the following criteria; (1) FEV<sub>1</sub> < 80%, (2) 12% increase or more in FEV<sub>1</sub> or PEF after short-acting  $\beta_2$  agonist prescription and (3) 15% decrease in FEV<sub>1</sub> or PEF after 6MWT with 70% or 80% of maximum heart rate. The patients were randomly put into two groups of case (M=8, F=10, Mean age=27) and control (M=8, F=10, Mean age=29). Case group participated in eight-week aerobic exercise plan, while control group had no plan of exercise. Pulmonary function tests were done before and after the course of exercise.

There were significant changes in FEV<sub>1</sub>, FVC, PEF, FEF<sub>25-75%</sub>, MVV, RF and 6MWT between asthmatic patients of the two groups ( $P \leq 0.05$ ), but FEV<sub>1</sub>/FVC showed no significant change. Mean of changes in FEV<sub>1</sub>, FVC, PEF, FEF<sub>25-75%</sub>, MVV, RF and 6MWT were -25.56, -17.19, 32.09, -27.93, -22.18, 5.63 and -307.5 in case group respectively while they were 6.2, 4.67, 1.96, 6.65, 15.56, -2.87 and 18.78 in the control group.

This study shows that aerobic exercises in asthmatic patients lead to an improvement in pulmonary functions. Aerobic exercise rehabilitation can be a complement to medical treatment of asthma.

**Keywords:** Aerobic exercise; Asthma; Pulmonary function test

## INTRODUCTION

Asthma is a chronic inflammatory disease of the respiratory system. Its incidence has been increasing in the last 20 years in many countries all around the world. It is said that 10 percent of people in developed countries suffer from asthma.<sup>1</sup>

The main goal in the treatment of asthma is to prevent signs and symptoms of asthma, decreasing medication intake, improvement of respiratory system and increasing the patient's function and quality of life.

Asthmatic patients do not intend to engage in sports and physical exercises due to dyspnea and it leads to decrease in their levels of physical abilities and thus increasing their respiratory problems. In a study, sport exercises were called to be the main cause

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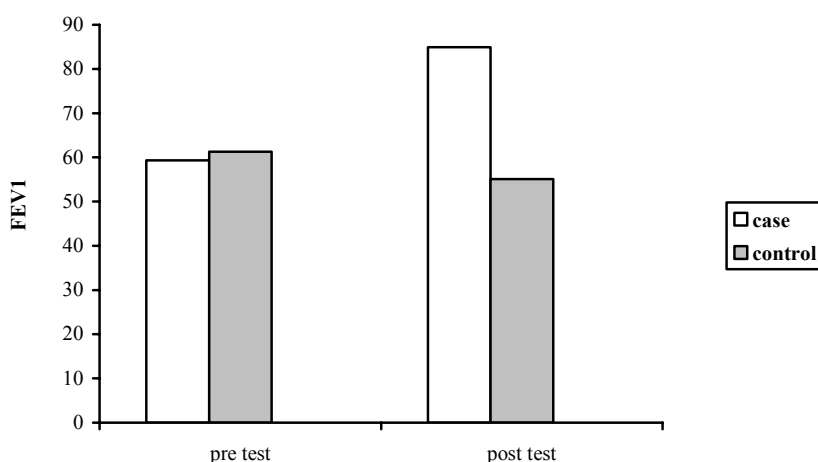


Figure 1. Mean FEV<sub>1</sub> in pre and post test in case and control groups.

of narrowness of airways in ninety percent of asthmatic patients.<sup>2</sup>

Several studies were done to investigate the effects of physical activities and sport exercises on pulmonary function in asthmatic patients. These studies had different results which can be explained due to their variety in the kind of tests, measurement tools, exercise schedule and program, disease severity, pulmonary rehabilitation and environmental conditions.<sup>2-5</sup>

A regular short duration sports activity (less than a few minutes) has fewer problems than long duration sports activity. When courses of exercise within short intervals are embarked, narrowness of bronchus increases gradually. On the contrary, doing light sport exercises before strenuous sport activities can reduce stricture of respiratory airways to minimum.<sup>6,7</sup>

### MATERIALS AND METHODS

Among the patients complaining of asthmatic symptoms who were referred to Dr. Farid Allergy Clinic, 36 patients (M=16, F=20) were chosen on their own free will after confirmation of their asthma with clinical examinations, pulmonary function tests, skin prick test (SPT) for aeroallergen and a six minute walk test (6MWT).

The chosen patients were said to have exercise induced asthma (EIA) when they had FEV<sub>1</sub> less than eighty percent and after inhalation of short acting  $\beta_2$ -agonist, a twelve percent or more increase was seen in their FEV<sub>1</sub> or PEF,<sup>8</sup> and the after six minute walk test

(6MWT) on the treadmill with 70-80% of maximum heart rate, they showed a fifteen percent decrease in FEV<sub>1</sub> or PEF in comparison to what they were before any activity.<sup>9-11</sup>

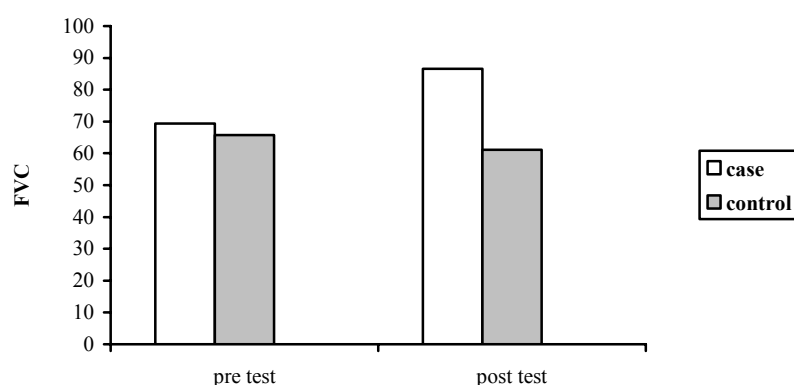
Our patients had no problem in cardiovascular and musculoskeletal systems and had no other pulmonary disease. The patients were randomly put into two groups of case (M=8, F=10, Mean age=27) and control (M=8, F=10, Mean age=29).

The case group participated in an eight-week aerobic exercise plan (three 20 minute sessions of aerobic exercise in a week with 15 minutes of warming up and tensile exercise before aerobic practice), while control group had no plan of exercise during this period of time. Pulmonary function test such as spirometry are the main procedures which are used for lung volumes, lung capacity and respiratory air way resistance.<sup>12</sup>

Spirometry included FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC, PEF, FEF<sub>25%-75%</sub>, MVV, RF and 6MWT were done before exercise commencement and at the end of eighth week in both the two groups.

### RESULTS

The mean of FEV<sub>1</sub> changes in the case group before and after the test was -25.56 and in the control group was 6.2 (Figure 1), thus there was statistically significant difference between the two groups ( $P \leq 0.05$ ).



**Figure 2. Mean FVC in pre test and post test in case and control groups.**

The mean of changes in the FVC before and after the test in the case and the control groups were 17.19 and 4.67 respectively (Figure 2), which was statistically significant ( $P \leq 0.05$ ). However, there was no significant difference between means of changes in  $FEV_1/FVC$  before and after the test in case and control groups (-11.1 and 4.81 respectively) (Figure 3).

The mean of changes in the PEF of the case group before and after the test was -32.9 and in control group was 1.96 (Figure 4) which showed statistically significant difference ( $p \leq 0.05$ ). Significant difference ( $p \leq 0.05$ ) was also shown in mean of  $FEF_{25-75\%}$  changes in case and control group (-27.93 and 6.65 respectively) (Figure 5). The means of changes in MVV, RF and 6MWT of case group before and after

the test were -22.18, 5.63 and -307.5, while they were 15.56, -2.87 and 18.78 in control group respectively. These changes were also statistically significant ( $P \leq 0.05$ ).

## DISCUSSION

Measurement of  $FEV_1$  showed an increase in the case group but decrease in the control group after engaging in an eight week aerobic exercise plan. It can be explained that as both groups had similar conditions at the beginning of the study, aerobic exercise caused the increase among the asthmatic patients.

**Table 1. Mean of changes in spirometry indexes (pre test and post test) in case and control groups.**

Statistical indexes variables	Study groups	Pre test x $\pm$ -SD	Post test x $\pm$ -SD	Mean of change (case group)	Mean of change (control group)	Mean of change in study (post test)	P value	Significant differences
FEV1	Case	59.33 $\pm$ 11.40	84.89 $\pm$ 11.38	-25.56	6.2	29.81	0.000	significant
	Control	61.28 $\pm$ 13.88	55.08 $\pm$ 14.30					
FVC	Case	69.36 $\pm$ 13.48	86.55 $\pm$ 8.32	-17.19	4.67	25.44	0.000	significant
	Control	65.78 $\pm$ 18.27	61.11 $\pm$ 14.66					
FEV1/FVC	Case	90.55 $\pm$ 20.95	101.65 $\pm$ 12.60	-11.1	4.81	7.488	0.117	not significant
	Control	98.98 $\pm$ 16.35	94.17 $\pm$ 15.19					
PEF	Case	53.02 $\pm$ 20.15	85.11 $\pm$ 16.59	-32.09	1.96	37.93	0.000	significant
	Control	49.13 $\pm$ 20.44	47.17 $\pm$ 25.75					
FEF <sub>25-75%</sub>	Case	46.81 $\pm$ 22.36	74.74 $\pm$ 22.17	-27.93	6.65	31.08	0.000	significant
	Control	50.30 $\pm$ 22.60	43.65 $\pm$ 21.73					
MVV	Case	63.99 $\pm$ 18.69	86.17 $\pm$ 13.21	-22.18	15.56	49.5	0.000	significant
	Control	52.22 $\pm$ 22.03	36.66 $\pm$ 12.37					

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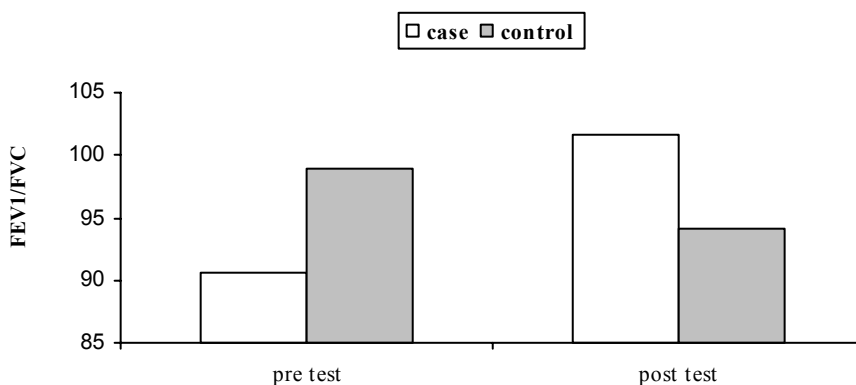


Figure 3. Mean FEV1/FVC in pre test and post test in case and control groups.

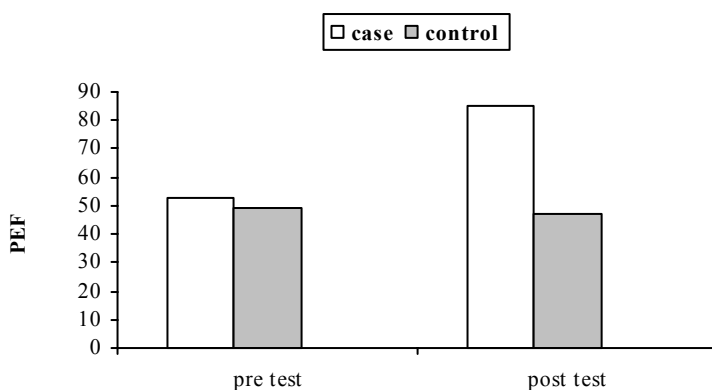


Figure 4. Mean PEF in pre test and post test in case and control groups.

Our results correspond with Emtener's results who prescribed ten week rehabilitation exercise in water for asthmatic patients<sup>13</sup> and also with Beri who showed an increase in FEV<sub>1</sub> in fourteen patients after doing swimming exercise.<sup>14</sup> However, our results had no conformity with the study done by Farzad Ghafoori.<sup>15</sup> This could be attributed to the difference

in the administrative protocol (Sport program) in the two studies. In our study, patients performed aerobic exercise three sessions in every week for eight weeks, but in Ghafoori's study, asthmatic patients did tensile exercise for one session after which effects of such an exercise on FEV<sub>1</sub> changes were measured.

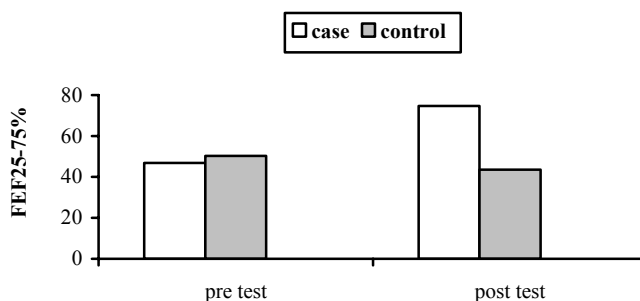


Figure 5. Mean FEF<sub>25-75%</sub> in pre test and post test in case and control groups.

One of the important advantages of sport activity in asthmatic patients is their accumulative desensitization on fear of dyspnea.<sup>16</sup> The physical exercises can increase the asthmatic patients' residual air flow and decrease the ventilation with reinforcement of bronchi expansion during an exercise. This makes an asthmatic patient save a air flow during exercise.<sup>17</sup> Less than five minute sport activities with low severity can improve asthma and its symptoms.<sup>18</sup> In a study, patients started the exercise with four and half minutes of walking and thirty seconds of jogging in the first week. In the next weeks, walking time was decreased and jogging time was increased gradually as in the end of the eight week, patients had no discomfort feeling or dyspnea with the pattern of ten minute walking and ten minute jogging. Studies show that sport exercises can increase residual air flow in asthmatic patients.<sup>19</sup> Our study also showed that asthmatic patients were able to have more powerful and more effective inspiration and expiration after three sessions of eight weeks of aerobic sport exercises as opposed to what they had been able to do before participating in such aerobic sport exercises.

In conclusion, this study shows that a course of aerobic sport exercise causes an obvious increase in FEV<sub>1</sub>, FVC, PEF, FEF<sub>25%-75%</sub> in asthmatic patients, and a regular aerobic sports program can be complementary to medical treatment in asthma rehabilitation.

Our results may suggest that the method of exercising and regular short duration sports activity are involved in the improvement of pulmonary function.

Therefore in each study the methods which are used should be considered for result interpretation.

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#### REFERENCES

1. Moein M. editor. Asthma; basic and clinical sciences. Tehran: Tehran University Publishing Center, 2003: 22-4.
2. William S. Can regular exercise program improve your patient,s asthma? *Torax* 1990; 45:345-51.
3. Elpern EH, Stevens D, Kesten S. Variability in performance of timed walk tests in pulmonary rehabilitation programs. *Chest* 2000; 118(1):98-105.
4. Emtner M, Herala M, Stalenheim G. High-intensity physical training in adults with asthma. A 10-week rehabilitation program. *Chest* 1996; 109(2):323-30.
5. Bendstrup KE, Ingemann Jensen J, Holm S, Bengtsson B. Out-patient rehabilitation improves activities of daily living, quality of life and exercise tolerance in chronic obstructive pulmonary disease. *Eur Respir J* 1997; 10(12):2801-6.
6. Belman MJ, Kendregan BA. Exercise training fails to increase skeletal muscle enzymes in patients with chronic obstructive pulmonary disease. *Am Rev Respir Dis* 1981; 123(3):256-61.
7. Siegel W, Blomqvist G, Mitchell JH. Effects of a quantitated physical training program on middle-aged sedentary men. *Circulation* 1970; 41(1):19-29.
8. Edington and Vadgerton , *Biology of Exercise*, Translated by Dr. Hojatollah Nikbakht, 1993; 280.
9. Walling AD, *Management of exercise-induced asthma: American family physician* , 2000;830.
10. Kukafka DS, Lang DM, Porter S, Rogers J, Ciccolella D, Polansky M, et al. Exercise-induced bronchospasm in high school athletes via a free running test: incidence and epidemiology. *Chest* 1998; 114(6):1613-22.
11. Virant FS. Exercise-induced bronchospasm: epidemiology, pathophysiology, and therapy. *Med Sci Sports Exerc* 1992; 24(8):851-5.
12. Wagner jack :pulmonary function testing . A practical approach :Williams and Wilkins , 1966; 251-2.
13. Emtner M, Herala M, Stalenheim G. High-intensity physical training in adults with asthma. A 10-week rehabilitation program. *Chest* 1996; 109(2):323-30.
14. Berry MJ, Walschlager SA. Exercise training and chronic obstructive pulmonary disease: past and future research directions. *J Cardiopulm Rehabil* 1998; 18(3):181-91.
15. Ghafoori F, editor. Effects of stretching exercises before physical activity on asthmatic patients, Thesis for master of sciences, College of physical education and sport sciences. Tehran: Tehran University 1993: 75-6.

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16. Moser KM, Bokinsky GE, Savage RT, Archibald CJ, Hansen PR. Results of a comprehensive rehabilitation program. Physiologic and functional effects on patients with chronic obstructive pulmonary disease. *Arch Intern Med* 1980; 140(12):1596-601.
17. Patessio A, Donner CF. Selection criteria for exercise training in patients with COPD. *Z Kardiol* 1994; 83(Suppl 3):155-8.
18. Katz RM. Prevention with and without the use of medications for exercise-induced asthma. *Med Sci Sports Exerc* 1986; 18(3):331-3.
19. William M, Katch F, Katch V, editors. *Essentials of exercise physiology*. USA: Williams and Wilkins, 2000: 239.