# Effects of Exercise Rehab on Male Asthmatic Patients: Aerobic Verses Rebound Training

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## ABSTRACT

**Background:** There are some auspicious records on applying aerobic exercise for asthmatic patients. Recently, it is suggested that rebound exercise might even increase the gains. This study was designed to compare the effects of rebound therapy to aerobic training in male asthmatic patients.

**Methods:** Sample included 37 male asthmatic patients (20-40 years) from the same respiratory clinic. After signing the informed consent, subjects volunteered to take part in control, rebound, or aerobic groups. There was no change in the routine medical treatment of patients. Supervised exercise programs continued for 8 weeks, consisting of two sessions of 45 to 60 minutes per week. Criteria measures were assessed pre- and post exercise program. Peak exercise capacity ($VO_{2peak}$) was estimated by modified Bruce protocol, Forced vital capacity (FVC), Forced expiratory volume in 1 second (FEV1), and FEV1% were measured by spirometer. Data were analyzed by repeated measure analysis of variance (ANOVA).

**Results:** Significant interactions were observed for all 4 criteria measures ($P < 0.01$), meaning that both the exercise programs were effective in improving FVC, FEV1, FEV1%, and $VO_{2peak}$. Rebound exercise produced more improvement in FEV1, FEV1%, and $VO_{2peak}$.

**Conclusions:** Regular exercise strengthens the respiratory muscles and improves the cellular respiration. At the same time, it improves the muscular, respiratory, and cardio-vascular systems. Effects of rebound exercise seem to be promising. Findings suggest that rebound exercise is a useful complementary means for asthmatic male patients.

**Keywords:** Aerobic training, asthma, forced expiratory volume in 1 second, forced vital capacity, rebound therapy, $VO_{2peak}$

## INTRODUCTION

Asthma is the common chronic inflammatory disease of the airways. It is the most common chronic respiratory disease in the world and one of the most common chronic diseases among children.[1] Incidence and prevalence rate of asthma in Iran follows the world pattern.[2] This disease is characterized by variable and recurring symptoms, reversible airflow obstruction, and bronchospasm.[3] Symptoms include wheezing, coughing,

chest tightness, and shortness of breath. Asthma is clinically classified according to the frequency of symptoms, forced expiratory volume in 1 second (FEV1), and peak expiratory flow rate.[4]

There is no doubt about the biopsychosocial benefits of exercise for healthy people. But, especially in Iran, the general opinion is not so certain about the benefits of exercise for asthmatic patients. Exercise can induce asthmatic attacks in 10-15% of children and adolescents. This problem is known as exercise induced asthma (EIA). The incidences of EIA among the asthmatic patients were differed according to season (48% in summer, 73% in spring/fall, and 91% in winter. This phenomenon is widespread among allergic children and cannot be accurately predicted from the history.[5] Because of the risk of EIA, some people generally believe exercise might be harmful for asthmatic patients. It is contrary to a medically accepted claim that states asthmatic patients need exercise as much as healthy people do, provided they consider some precautions to secure safety and avoid EIA in exercise. With appropriate medical intervention and knowledge of asthma triggers, most asthmatics are able to exercise symptom-free.[6] In developed industrial countries, this problem is so controlled that many Olympic champions have come from asthma sufferers.[7] In the contemporary world, exercise rehabilitation is known as a complementary and necessary treatment for asthmatic patients.[8-10] Therefore, today's question asks about the type of exercise modality that leads to more benefits for asthmatic patients. Until now, the literature mostly supports aerobic exercise. It is showed that about 8 to 12 weeks aerobic exercise is effective in controling asthma symptoms, and improves pulmonary indices and quality of life.[11-13]

Recently, some evidences emerged that verified rebound training as another beneficial method of exercise. Rebound training is a type of plyometric exercise which is performed on trampoline. Plyometric exercise includes jumping, hoping, and leaping. It creates a safe and efficient framework for people of all age and ability groups.[14,15] Trampoline is also introduced as a safe and useful equipment for exercising all different parts of body. Trampoline allows a person to bounce up and down on one or two legs with various upper and lower extremities movements. A National Aeronautics and Space Administration (NASA) study demonstrated that at a certain level of oxygen intake, the pulse rate is lower on trampoline compared to running on treadmill. It suggests that oxygen efficiency is higher in trampoline exercises.[16] There is an evidence that suggests 12 week rebound exercises on rebounder shoes also improve the aerobic capacity.][17]

Spirometry indices such as forced vital capacity (FVC), FEV1, and FEV1/FVC ratio along with peak aerobic capacity ($VO_{2peak}$) are traditionally used to document the progression in asthmatic patients.[9] FVC is the volume of air that can forcibly be blown out after full inspiration, measured in liters. It is the most basic maneuver in spirometry tests. FEV1 is the volume of air that can forcibly be blown out in one second, after full inspiration. In respiratory inflammatory diseases, the required time for forced expiratory increases and, as a result, the FEV1 decreases. FEV1/FVC ratio (FEV1%) is the ratio of FEV1 to FVC. In young healthy people, this ratio is around 85% which gradually decreases to 75% by aging. In obstructive diseases (asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, emphysema), both values of FEV1 and FVC is diminished, but the drop in FEV1 is higher and this will cause the value of FEV1% to drop down to below threshold values.[18] The average values of FVC, FEV1, and FEV1% for untrained healthy 30-year males are respectively 5.25, 4.5 liter, and 85%.[19]

$VO_{2max}$ is the maximum capacity of body to transport and use oxygen during incremental exercise. It is widely accepted as the single best measure of cardiovascular fitness and maximal aerobic power. The average values for untrained healthy male and female are respectively 35-40 and 27-31 ml/kg/min. The values decrease by aging and disease.[20] In patients, traditional maximal $VO_{2max}$ tests would be too risky, as any problem with respiratory and cardiovascular systems may be greatly exacerbated when a person exercise at his/her highest capacity. Thus, some cautious protocols have been developed to measure the peak of $VO_2$ at sub-maximal workloads. The procedure of sub-maximal tests is generally similar to maximal tests, but a certain percent (usually 75-80% of maximum capacity) of cardio-respiratory system is attained. Values measured during sub-maximal tests are called $VO_{2peak}$.

Aerobic exercise, alone[8,11] or along with strength training,[13] increases spirometry indices. It

is indicated that exercise improves the pulmonary performance and reduces symptoms such as wheezing, coughing, chest tightness, and shortness of breath in asthmatic patients.[21,22] In this study, we document the effects of aerobic and rebound exercises on FEV1, FVC, FEV1%, and $VO_{2peak}$ of asthmatic patients.

## METHODS

### Study design

This study was approved by Isfahan University Research Board. It was a quasi-experimental study conducted on one control and two experimental groups, namely aerobic and rebound training. As random group assignment had confliction with obtaining informed consent, group formation was voluntarily. Out of 37 consecutive volunteers, 30 patients completed the experiment. All subjects took part in pre-and post tests. The control group received just its own routine medical treatment. Experimental group, further to routine medical treatment, participated in their specific exercise programs. Both exercise programs were supervised, consisted of two sessions of 45 to 60 minutes per week, and continued for 8 weeks.

### Selection criteria

Sample included asthmatic patients from the Respiratory Clinic of Alzahra hospital in Isfahan, Iran. Inclusion/exclusion criteria were being male aged 20 to 40 years, suffering intermittent to mild asthma for at least one year, being under routine medical treatment of the same respiratory clinic, ability of performing offered exercises, and suffering from no other disease complications. Subjects, who experienced any radical changes in their routine medical treatment during the study, were excluded. For every group, sample recruitment continued until 10 patients completed all the requirements. Sample size was determined based on power analysis.

### Exercise training

In both groups, every exercise session consisted of three parts: 15 minutes warm-up exercises, main exercises, and 15 minutes cool down exercises. The main exercises of rebound group were performed on trampoline. Main exercises of the first session lasted for 15 minutes and consisted of low intensity movements. Session by session, the length and intensity of the main exercises were gradually increased, so that the final session lasted for 30 minutes and consisted of moderate to high intensity movements. The main exercise of aerobic group was jogging and was performed on a soccer pitch. Time and intensity of exercises of aerobic group were matched to rebound group. In both groups, the intensity of exercises was controlled by interval self-monitoring of HR on radial pulse.

### Measurements

Exercise testing guidelines (published by the American College of Sports Medicine) were observed.[23] Before exercise, each subject was familiarized with the testing procedures. Subjects were then encouraged to exercise to the limit of their tolerance on an automated treadmill (Power Jack, England). The work rate increments were based on modified Bruce protocol. Heart rate was monitored during exercise by Polar pulse meter. The equipment was calibrated before each exercise test. $VO_{2peak}$ and peak heart rate (HR) were defined as the highest values achieved during exercise. All subjects were monitored during exercise recovery until HR returned to within 20% of baseline values. Target HR was calculated as resting HR plus 75% of Reserved HR. FEV1 and FVC were measured by spirometer (Jager, Germany). As measurement of $VO_{2peak}$, FEV1, and FVC are influenced by asthma medications, for every subject the time and dosage of medication were fixed for pre- and post tests. Other measurements: In this study, we also measured plasma endothelin level (by enzyme-linked immunosorbent assays (ELISA) method) and quality of life (by Asthma quality of life questionnaire). The results of these measures are published in a separate article.[24]

### Data analysis

Data were analyzed by repeated measure analysis of variance (RM-ANOVA).

## RESULTS

Demographic data are shown in Table 1. These data suggest that the groups are comparable, except for weight. Descriptive information about FEV1, FVC, FEV1%, and $VO_{2peak}$ of asthmatic patients are shown in Table 2. Compared to values reported in introduction section for healthy untrained male adults, the data shows that FEV1, FVC, FEV1%,

**Table 1:** Patients demographics (mean±standard deviation)

| Variable | Control (*n*=10) | Aerobic (*n*=10) | Rebound (*n*=10) |
|---|---|---|---|
| Age (y) | 33.3±6.1 | 34.6±4.2 | 34.9±4.3 |
| Weight (kg) | 80.0±8.3 | 73.2±5.8 | 74.0±4.8 |
| Height (cm) | 171.0±6.5 | 171.1±7.1 | 172.0±8.2 |
| Diagnosis (y) | 2.6±0.8 | 2.8±1.3 | 2.9±1.3 |

*n*=Number, y=Year, kg=Kilogram, cm=Centimeter

and $VO_{2peak}$ of asthmatic patients are dramatically dropped. Last row of Table 2 shows the results of RM-ANOV. RM-ANOVA makes three comparisons, namely interaction, within, and between. The interaction comparison is the most important one and when it is significant, it would be enough to focus on it. Table 2 demonstrates that interactions are significant for all four dependent variables. Detailed comparisons are illustrated in Figures 1-4. They demonstrate that, during the study, control group had no progress, while experimental groups made significant improvement.

**Table 2:** Patients descriptive statistics and result of repeated measure analysis of variance

| Groups | FEV1 (lit) | FVC (lit) | FEV1/FVC (%) | $VO_{2peak}$ ml/min/kg |
|---|---|---|---|---|
| Control | | | | |
| Pre | 2.81±0.18 | 3.42±0.25 | 82±3 | 26.2±2.5 |
| Post | 2.81±0.19 | 3.42±0.27 | 82±4 | 26.1±2.7 |
| Aerobic | | | | |
| Pre | 2.86±0.26 | 3.49±0.22 | 80±3 | 27.7±2.2 |
| Post | 3.00±0.30 | 3.57±0.26 | 82±4 | 28.4±2.8 |
| Rebound | | | | |
| Pre | 2.91±0.32 | 3.72±0.26 | 78±5 | 27.5±3.2 |
| Post | 3.23±0.33 | 3.78±0.26 | 85±5 | 28.9±3.1 |
| Differences F (*P*) | | | | |
| Interaction | 12 (0.000) | 6.0 (0.007) | 7.2 (0.003) | 10 (0.001) |
| Within | 34 (0/000) | 26 (0.000) | 16 (0.000) | 23 (0.000) |
| Between | 3.2±(0/063) | 3.7 (0.033) | 0.7 (0.930) | 2.1 (0.142) |

lit=Liter, %=Percent, ml/min/kg=Milliliter/minute/kilogram, F=F value, *P*=*P* value, FEV1=Forced expiratory volume in 1 second, FVC=Forced vital capacity

## CONCLUSION

The present study suggests that exercise is better than no exercise. To understand which kind of exercise is more beneficial, it is necessary to pay attention to the slope of improvement lines in Figures 1 to 4. The improvements in VO2peak, FEV1, and FEV1% are more in rebound group. But the improvement in FVC is the same in both exerrcise groups.

## DISCUSSION

Present study has shown that FEV1, FVC, FEV1%, and $VO_{2peak}$ of asthmatic participants were much lower than healthy adults. However, they were improved by 2 months exercise (aerobic or rebound). It seems that there is still much room for more improvement with longer periods of exercise. These findings are comparable to findings of previous studies.[8,11,13,21,22] They generally declare that regular exercise improves pulmonary function of asthmatic patients. It is well-documented that exercise improves work tolerance by decreasing ventilation rate for a given workload.[6] Improvement in respiratory muscles strength, cellular respiration, and cardio-vascular systems along with re-vascularization of skeletal muscles are among the direct physiologic reasons suggested for this claim. Also, it seems that exercise rehab indirectly raises the knowledge and experience of patients for better care and management of the disease, and it subsequently alleviate the symptoms and reduces the consumption of bronchodilators.[9]

Although benefits of aerobic exercises such as jogging and walking are evident, some patients still are not interested in such activities and would withdraw from them sooner or later. We decided to examine the effects of a totally different exercise such as rebound training. Ordinary people might consider rebound training dangerous. Present study showed that by good supervision, patients could achieve self-management in rebound exercise without any risk of injury. Therefore, it is not sensible to limit the type of aerobic exercise for asthmatic patients. It was shown that effects of rebound exercise not only are equivalent but even better than traditional aerobic exercises. It is the fact that the participants of the study were volunteers, and it might have intensified the results. However, it is just the point: Exercise demands a lot of effort and, therefore, needs interest and should be accompanied with fun and enjoyment. We suggest for unskilled exercises such as rebound training, a period of supervised exercise is attempted before independence. Supervisors need to address the skill acquisition as well as the

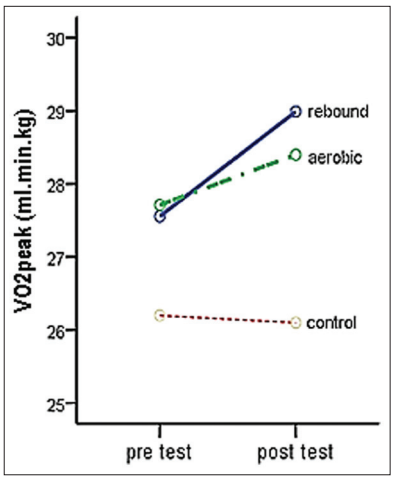


**Figure 1:** Chartline of $VO_{2\ peak}$

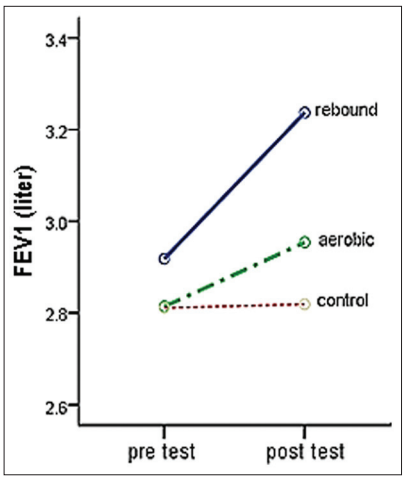


**Figure 2:** Chartline of FEV1

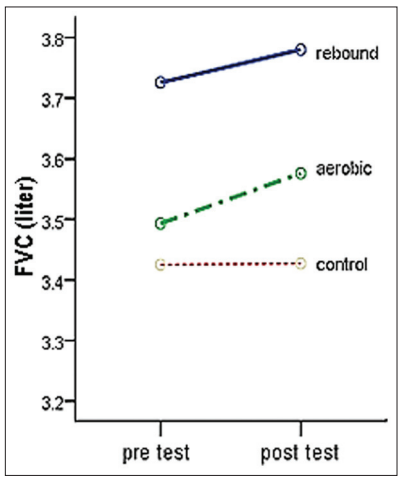


**Figure 3:** Chartline of FVC

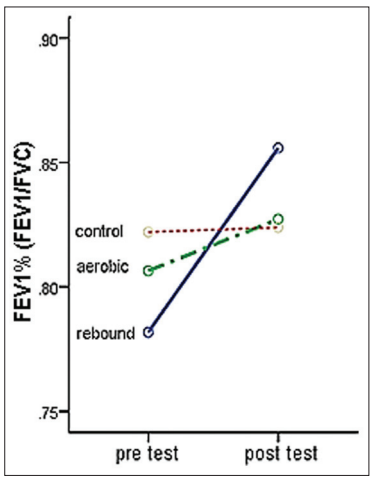


**Figure 4:** Chartline of FEV1%

volume (frequency, intensity, and time) of training.

How effects of rebound therapy are justified? We noted that rebound exercises are fun and they encourage a longer period of workout. We also noted that keeping balance and position on trampoline burden a lot of pressure on anti-gravity muscles and increases the blood flow to active muscles, and subsequently improves the functional capacity.[25-27] Movement on trampoline has a vibration effect on muscle spindles that fine tune the muscle tension. In another words, any hop or jump on a hard surface such as land activates the stretch reflex and increase the muscle tension. But, hop and jumps on trampoline are anticipated and flexibility of the surface cushions the contact and increases its time. It in turn controls the stretch reflex and leads to less muscle tone.[25] It is why at a certain level of oxygen intake, the pulse rate is lower on trampoline compared to running on treadmill and oxygen efficiency is higher in trampoline exercises.[16]

Last but not least, sedentary life style is one of the major disadvantages of the modern life. Chronic diseases, including asthma, complicate and worsen the situation. In today's Iran, asthmatic patients are inhibited from doing exercises since it may lead to EIA. This causes a feeling of fear and prevents patients from performing daily activities. Subsequently, the general fitness and specially the aerobic fitness fall lower than average of the society. On the other hand, when no supervised exercise is practiced, patients would find no opportunity to raise their awareness for preventing symptoms and asthma attacks. This process exposes them to more risks, especially when encountering emergency situations. Further to these disadvantages, lack of physical activity lowers the quality of psychosocial life as well.[24]

### Practical applications

Present study demonstrated that both aerobic and rebound exercises were worthwhile for mild to moderate male asthmatic patients. Both exercises stimulate the cardiovascular and respiratory systems by overloading musculoskeletal system. We demonstrated that the use of rebound exercises resulted in some advantages in $VO_{2peak}$ and respiratory indices, provided patients would be interested and enjoy the exercises. Thus, the use of different exercise modalities in accordance to patients' interests seems advisable.

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