Indian J. Applied & Pure Bio. Vol. 30(1), 33-39 (2015).

Impact of Two Types of Exercise on Inflammation in Patients with Asthma: Endurance Exercise Reduces Serum Concentrations of Interleukin-1β

Daniel Tarmast[1], Vahid Imanipour[1], Mehdi Kasbparast JR[2], Ali Sajedi[1], and Korosh Morovatnya[1]

[1]Department of Physical Education and Sport Sciences, Parand Branch, Islamic Azad University, Parand City, Tehran, Iran
[2]Department of Sport Injury and Biomechanics, Faculty of Physical Education and Sport Sciences, Islamic Azad University, Karaj Branch, Alborz, Iran

Abstract

Different typesof exercise seem to have medical benefits for many diseases such as asthma.The objective of this research was to study the effects of two types of exercise:1) a single bout, and 2) a three-monthexercise on serum cytokine – interleukin-1β(IL-1β) concentrations in 32adult asthma patients (age 36±5.5 y, weight 94.3±9.0 kg, height 173±6.0 cm). The patients of the study randomly divided to training and control groups. For this purpose, the participants of the training group performed a single bout of exercise on an ergometer. Before and after the exercise, blood samples were taken for serum determinations of IL-1β. Also, a spirometry test was done to diagnose lung conditions of the patients. After one week, the participants started the endurance exercise, and they exercised 3 times per week for threemonths.A blood sample was also taken after one month of the last trial. Participants'anthropo-metrical indexes were examined during two occasions. All data were compared by t - tests.Resultsindicated that after a single bout of exercise IL-1β significantly increased compared to the baseline (p<0.05), and subsequent to the three-month exercise IL-1β significantly decreased (p<0.05). But, after one month of detraining, the IL-1βdeclined to the baseline. No differences were found in the IL-1β of the control group. We conclude that endurance exercise can help asthma patients by the anti-inflammatory effect.

Key words: Endurance exercise, Interleukin-1β, anti-inflammatory, asthma patients.

There is much evidence that physical activity is one the most important issues for any patients who are suffering from a chronic diseases such as asthma[9,13,24,31]. The health

of asthmatic patients depends on their life style, so physical fitness as a part of life style could be one of the triggers of the changes in the asthma. Those patients who chose to contribute in one kind of exercise on a weekly basis of training are commonly healthier than those who have not contributed habitually yet.The health benefits of frequent and regular physical activity are well-known for patients with asthma[14]. Many asthmatic patients are able to participate in anyphysical activity program if their symptoms are managed properly, as some elite athletes have asthma[1,2,15,23].

It is well demonstrated that physical activity affects the levels of circulating cytokines such asinterleukin (IL)-1β. Asthma is a chronic inflammatory disease that is associated with the blood levels of cytokines. Cytokines have been shown to have a significantfunction in inducing the inflammatory response in asthma as a part of the body defense system[12], and the IL-1β is one of the proinflammatory cytokines that is involved in chronic airway disease[3,8]. Some studies has shown that physical activity reduced the IL-1βblood concentrations after endurance exercise[6], and a single bout of exercise[8]. In contrast, some studies have shown IL-1β blood levels are increased after exercise[8,18]. Training with consistency is important for securing fitness effects, and decreasedphysical activity may be a part of the cause in the severity and rising prevalence of asthma[14]. The asthmatic patients maybe are encouraged to participate in different kinds of the physical activity based on the duration or intensity of exercise.Some studies have shown that the endurance exercise of low to moderate intensity would be suitable to manage asthma symptoms and overall physical fitness for patients with asthma[5,6,14]. For instance, the ACSM recommends walking or types of physical activity that applies large muscle groups 3 to 5 days per week at 50% of maximal effort[32]. Also, it has been suggested that the asthmatics can train 60 to 75% of maximal work rate for duration of 20 to 30 minutes per day for 2 to 5 days per week[20]. Although, these recommendations are provided for asthma patients to improve their life style via exercise, but the physiologic basis is not clear.Hence, there is still limited evidence on IL-1β responses to physical activity in patients with asthma.The aim of the present study was to determine whether exercise increases the serum concentrations of IL-1β could be explained by the duration of activity. Thiskind of information would be helpful in determining how asthmatic patients can choose a type of exercise based on the inflammatory responses.

This study was approved by the Ethics Committees from Parand Branch ofIslamic Azad University. The aim of this experimental study was to evaluate serum IL-1β response totypes of training including a single bout anda three-month endurance exercise in asthma patients. For this purpose, 32 adult asthmatic men (age = 39±5 years, BMI = 29.06±3 $Kg.m^{-2}$) participated in this study by accessible sampling, and randomly separated into exercise (3 days/ 12 weeks) and control (no exercise) groups. One week before the three-month endurance exercise, the exercise group participated in a single bout of exercise. The single bout of exercise was pedaling on an ergometer based

on the YMCA submaximal cycle ergometer protocol[32]. All participants were asked to cycle for as long as possible at a constant 50 rpm. This test involved four stages pedaling,and if the heart rate was more than 100 beats.min^{-1} then the workload was increased for 25 rpm for the next stage. Each stage was a three minutes of cycling, and during the 10 seconds at the end of each stage the heart rate was measured. All asthmatic patients of the exercise group participated in an exercise training program for three days during 12 weeks. After 10 minutes warm-up participants exercised at 60 to 80 percent of their relative maximum heart rate. The endurance exercise was walking or running, and cycling on an ergometer for 25 to 40 minutes. The exercise intensity was controlled by the heart rate monitor (Polar, Finland). After the exercise, they warm-down for ten minutes.

Spirometry tests (Minispire, Italy) were performed in order to asthma diagnosis as well as to determine the asthma severity. FEV1 and forced expiratory volume in 1 s / forced vital capacity (FEV1/FVC) were measured. All participants were requested to avoid having tea or coffee as well as other airways dilator food for at least 4 hours prior to spirometry test. Before signing a consent form, all participants received written and verbal explanations about the nature of the study. All participants were inactive, and none reported engaging in systemic (more than one time per week) sport activities before the study. Inclusion criteria for study group were determined as existing asthma for at least 2 years. Exclusion criteria included medications that alter carbohydrate metabolism, diabetes, inability to exercise, and history of hypertension or heart disease. All participants of both groups completed the anthropometrical measurements and blood samples before and after the exercise protocol. Height (m) and weight (kg) of the subjects were recordedby the barefoot and dressed in shorts and shirt to calculate the body mass index (BMI = weight.height^{-2}). Visceral fat, and body fat percentage was determined using body composition monitor (OMRON, Finland).

All participants were advised to avoid any physical activity 48 hours prior to the blood sampling. Blood samples (5 mL) were taken between 8:00 am to 9:00 am after 10 to 12 hours overnight fast to measure serum concentration of the IL-1β from brachial vein in sitting position. Serums were immediately separated and stored at – 80 °C until the assays were performed. In fact, fasting blood samples were taken pre-training (pre-test) and 48 hours after the training (post-test). Serum IL-1β was determined using the ELISA method (Diagnostics Biochem Canada Inc.). Also, after one month of detraining the last blood sample was taken in the laboratory. All participants in the control group were barred from contributing in any exercise. Finally, all measurements consist of fasting blood sampling; anthropometric measurements repeated 48 h after the last exercise trial.

At baseline, two groups were considered homogeneous regarding the IL-1β serum concentration (Fig. 1). The IL-1β serum concentration increased significantly in the exercise group after a single bout of exercise (p<0.05).

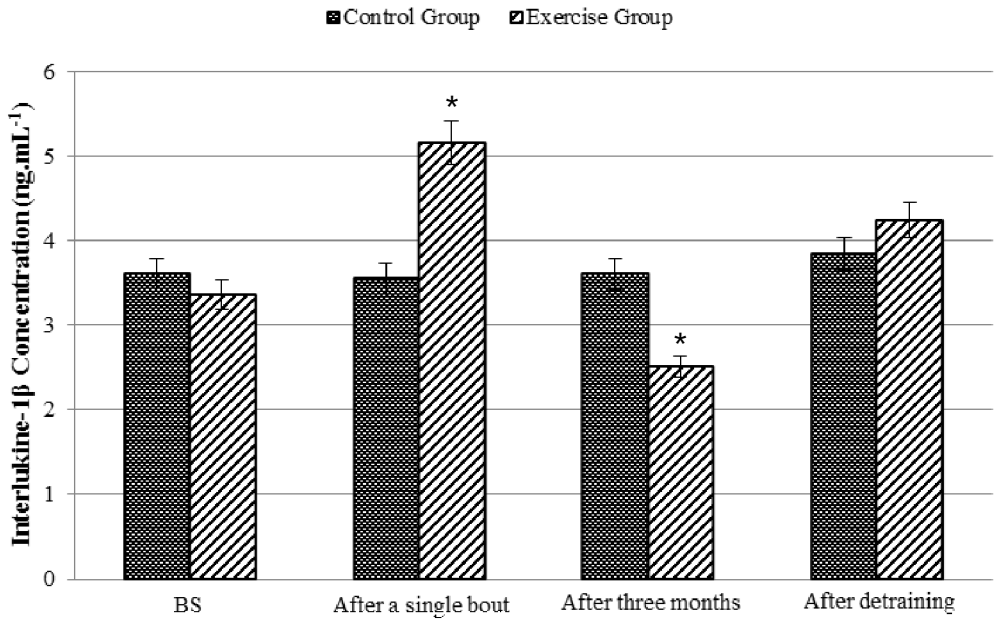

Figure 1. The serum changes of interlukine-1β in patients with asthma. BS=Baseline.
*Significantly different from baseline (p< 0.05).

In response to three-month endurance exercise, the serum concentration of IL-1β reduced significantly after 12 weeks of endurance exercise(p<0.05).There were no significant differences between the IL-1β serum concentrations in the control group (p>0.05).

Table 1. Mean and standard deviation of anthropometrical variables at baseline and after trial.

Variables	Control group		Exercise group	
	Pretest	post-test	Pretest	post-test
Age (years)	39 ± 5		40 ± 4	
Height (cm)	174 ± 8.8		175 ± 9.5	
Weight (kg)	88 ± 9.6	89 ± 5.6	90 ± 11	86 ± 12*
Body fat (%)	27.4 ± 4.1	27.6 ± 3.8	28 ± 3.2	26 ± 3.11*
Body mass index ($kg.m^{-2}$)	29.06 ± 2.9	29.36 ± 3.4	29.83 ± 2.6	28.08 ± 3.14*

**Significantly changed $p < 0.05$*

The results obtained fromthe anthropometrics variables are presented in Table 1. After 12 weeks of endurance exercise, the anthropometrics variables significantly improved in the exercise group. BMI levels were significantly reduced in response to endurance exercise when compared with baseline (p = 0.021). Also, we found that the endurance exercise diminished the body fat percentage, body weight and visceral fat in the exercise group (p> 0.05).

In this study, both single bout of exercise and three-month endurance exercise resulted in changes in serum concentration of IL-1β as a proinflammatory biomarker of asthma.The most important clinically relevant finding wasthe reduction of the IL-1β serum concentration in asthmatic patients after three months of endurance exercise. However, the IL-1β concentration was increased subsequent to a single bout of exercise. This finding supports previous researchregarding the inflammatory process during physical activity. It was determined that short duration of exercise yields an inflammatory response; on the other hand the long duration of activity has anti-inflammatory effects[11]. The production of cytokine is one of the responses of immune system to asthma[27,28]. The reduction of IL-1β in the serum shows that it is one of the benefits of the consistent endurance exercise.This study produced results which support the findings of some of the previous work in this field. It has been shown that physical activity decreases airway inflammation and oxidative stress in the patients with asthma[17,21,30]. Also, physical training in the asthmatic causes declined serum hs-CRP concentrationsand improved pulmonary activity[10,30]. Exercise perhaps effect of the lung protection in ischemia in rats via improving pulmonary vascular permeability[19].

A contribution ofa regular exercise program will enhance the level of physical fitnessin helping to reach the lifestyle goals, and improve psychological health[29]. All patients are able to participate in a physical fitness program means designing a plan for aphysical activity or anorder of activities that can be performedwith consistency. However, for some patients it is common to drop off of such activities resulting in inconsistency of physical fitness in their lifestyle.To achieve consistency, they have to choose the suitable types of exercise that they can perform on a regular basis for the best effects. Training with consistency is an important element to pulmonary rehabilitation[14]. Some studies have shown that patients with asthma have reduced endurance capacity than other patients who have not asthma. This lowered ability level in the asthmatics is not related to their degree of disease, but rather to their reduced levels of consistent activity[4]. In 1882, Henry Hide Salter recognized that exercise could be a treatment for asthma[25]. Theresults of our study are consistent with those of other studies and suggest that the health benefits for patients with asthma will be improved via regular physical activity[4,22,26].

The optimal frequency of exercise for asthmatics that is suggested by the ACSM is 3 to 5 days per week of 20 to 30 minutes continuous exercise[32]. The intensity of exercise is around 50% of peak oxygen uptake.The types of physical activity that has been reported in some studies whichconfirmedthe enhanced-level of fitness in asthmatics is included cycling, walking, gymnastics, running, calisthenics,

swimming, and rowing[14]. The average of exercise duration is 18 weeks for asthma patients, with a range of 6 to 80 weeks[14]. It is concluded that patients can train based on the heart rate without consideration of exercise type[16]. Despite growing knowledge of an inflammation modulatory consequence of physical activity, more examination is required to find out which type of exercise is associated with the largest anti-inflammatory effect, or which kind of asthmatics could benefit most from this approach.

In conclusion, three months of endurance exercise improves anthropometrical indexes in patients with asthma, and the proinflammatory biomarker of IL-1β reduced after the 3 months. The mechanisms concerned with its anti-inflammatory role and information about determinants of physical activity are not clearly explained yet. The patients with stable asthma should be encouraged to join in regular training programs, with no fear of symptom exacerbation. More investigation is required to recognize the mechanisms by which physical activity effects asthma management.

We wish to acknowledge all the asthmatic patients who participated in this study. This study was financially supported by Islamic Azad University, Parand Branch from the central department of Islamic Azad University.

References :

1. Arie, S. (2012). *British Medical Journal,* 344.
2. Bar-Or, O. (1996). *The Encyclopaedia of Sports Medicine: An IOC Medical Commission Publication, The Child and Adolescent Athlete. Wiley.*
3. Chung, K. (2001). European Respiratory *Journal, 18(34):* 50s-59s.
4. Clark, C. (1992). *CHEST Journal, 101(5):* 293S-298S.
5. Cooper, C. (2001). *Med Sci Sports Exerc, 33:* S643–S646.
6. Dogra, S., J. Kuk, J. Baker and V. Jamnik, (2011). *European Respiratory Journal, 37(2):* 318-323.
7. Eizadi, M., F. Kiani and H. Dooaly (2014). *European Journal of Experimental Biology, 4(3):* 484-489.
8. Eizadi, M., M. Kohandel, JR,M. Kasbparast and A. Sarshin, (2011). *International Journal of Biosciences, 1(3):* 100-106.
9. Hewitt, M., K. Estell, I. C. Davis and L. M. Schwiebert (2010). *American Journal of respiratory cell and molecular biology, 42(2):* 243-249.
10. Juvonen, R., A. Bloigu, A. Peitso, S. Silvennoinen-Kassinen, P. Saikku, M. Leinonen, J. Hassi, and T. Harju, (2008). *Trai. J Asthma, 45(3):* 237-42.
11. Kasapis, C. and P. D. Thompson, (2005). *Journal of the American College of Cardiology, 45(10):* 1563-1569.
12. Kimura, H., M. Suzui, F. Nagao, and K. Matsumoto (2001). *(IFN gamma). Analytical sciences, 17(5):* 593-598.
13. Lowder, T., K. Dugger, J. Deshane, K. Estell and L.M. Schwiebert (2010). *Brain, behavior, and immunity, 24(1):* 153-159.
14. Lucas, S. R. and T. A. Platts-Mills (2005). *Journal of Allergy and Clinical Immunology, 115(5):* 928-934.
15. Lund, T., L. Pedersen, B. Larsson and V. Backer, (2009). *Scandinavian journal of medicine & science in sports, 19(2):* 174-178.

16. McConnell, R., K. Berhane, F. Gilliland, S. J. London, T. Islam, W.J. Gauderman, E. Avol, H. G. Margolis and J. M. Peters, (2002). *Lancet, 359(9304):* 386-391.
17. Mendes, F. A., F. M. Almeida, A. Cukier, R. Stelmach, W. Jacob-Filho, M.A. Martins and C.R. Carvalho (2011). *Med Sci Sports Exerc, 43(2):* 197-203.
18. Moldoveanu, A.I., R.J. Shephard and P.N. Shek (2001). *Sports Medicine, 31(2):* 115-144.
19. Mussi, R. K., E. A. Camargo, T. Ferreira, C. De Moraes, M. A. Delbin, I. F. Toro, S. Brancher, E. C. Landucci, A. Zanesco, and E. Antunes (2008). *Eur Respir J, 31(3):* 645-9.
20. Nici, L., C. Donner, E. Wouters, R. Zuwallack, N. Ambrosino, J. Bourbeau, M. Carone, B. Celli, M. Engelen,B. Fahy, C. Garvey, R. Goldstein, R. Gosselink, S. Lareau, N. MacIntyre, F. Maltais, M. Morgan, D. O'Donnell, C. Prefault, J. Reardon, C. Rochester, A. Schols, S. Singh and T. Troosters (2006). *Am J. Respir. Crit. Care Med., 173(12):* 1390-413.
21. Onur, E., C. Kabaroglu and O. Gunay, *Allergol Immunopathol (Madr), 39(2):* 90-5.
22. Orenstein, D. M. (2002). *Pediatr Clin North Am, 49(4):* 709-21, v-vi.
23. Parsons, J.P. and J.G. Mastronarde (2005). *CHEST Journal, 128(6):* 3966-3974.
24. Pastva, A., K. Estell, T. R. Schoeb, T. P. Atkinson and L. M. Schwiebert (2004). *The Journal of Immunology, 172(7):* 4520-4526.
25. Salter, H. H. (1868). *On asthma; its pathology and treatment.*
26. Satta, A. (2000). *The Journal of sports medicine and physical fitness, 40(4):* 277-283.
27. Simon, H. B. (1984). *JAMA, 252(19):* 2735-8.
28. Simpson, R. J. and J. A. Bosch, (2014). *Brain Behav Immun, 39: 1-7.*
29. Tarmast, D. (2009). *Journal of Science and Medicine in Sport, 12:* S33-S34.
30. Tarmast, D., A. Zand, G. Faraji and H. Parsian (2012). *International Journal of Biosciences (IJB), 2(6):* 159-164.
31. Vieira, R.P., R.C. Claudino, A.C.S. Duarte, Â. B. Santos, A. Perini, H. C. Faria Neto, T. Mauad, M. A. Martins, M. Dolhnikoff, and C. R. Carvalho (2007). *American journal of respiratory and critical care medicine, 176(9):* 871-877.
32. Whaley, M.H., P. H. Brubaker, R. M. Otto and L. E. Armstrong (2006). *ACSM's Guidelines for Exercise Testing and Prescription. New York: Lippincott Williams & Wilkins.*