INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 5, No. 1, p. 467-473, 2014

SHORT COMMUNICATION OPEN ACCESS

Six weeks aerobic training can not affect serum interleukin-1 beta in obese/overweight females

Alinoori Fariba *, Maryam Husseini Shakib, Leila Husseini

Department of Physical Education and Sport Sciences, Karaj Branch, Islamic Azad University, Alborz, Iran

Key words: Obesity, Aerobic training, Inflammation.

http://dx.doi.org/10.12692/ijb/5.1.467-473 Article published on July 16, 2014

Abstract

Accumulating evidence indicates that inflammation is associated with obesity and metabolic syndrome. The objective of this study was to assess the effect of 6 weeks aerobic training on serum interleukin-1 beta in adult obese/overweight women. For this purpose, twenty four non-trained healthy obese/overweight aged 39± 4 years, BMI 31.47±1.89 kg/m2 were participated in study and divided into exercise (n=12) and control groups (n=12). Pre and post training (6 weeks, 3 time / weekly) of fasting serum IL-1ß and anthropometrical markers were measured in two groups. Student's paired 't' test was applied to compare the pre and post training values. A p-value of less than 0.05 was considered to be statistically significant. Exercise program resulted in significant decreased in body weight, BMI and body fat (%) ($P \leq 0.05$). No significant difference was found in serum IL-1ß between pre and post training values ($p = 0.104$). Based on these data, we can say that 6 weeks aerobic training was not associated with anti-inflammatory property in obese or overweight women.

* **Corresponding Author:** Alinoori Fariba ✉ fa_alinoori@yahoo.com

Introduction

Today, the problem of obesity is the main concern of healthcare professionals. Because, not only mental health problems, but also several metabolic disorders and chronic diseases, including type 2 diabetes and cardiovascular disease are consequences of obesity (Dilyara*et al.*, 2007; Okita *et al.*, 2004).

Literature supports disturbance or imbalance of cytokines in obesity-related diseases such as cardiovascular diseases, type 2 diabetes or metabolic syndrome (Dilyara*et al.*, 2007; Okita *et al.*, 2004; Maedler *et al.*, 2009). As higher levels of inflammatory cytokine such as IL-1ß or TNF-α and lower levels of anti-inflammatory cytokine such as adiponectin or IL-10 in obese or related patient populations has been reported compared to normal weight healthy populations by many recent studies (Osborn *et al.*, 2008; Bruun *et al.*, 2003). However, the precise molecular mechanisms of the association between obesity and immune dysfunction are not yet completely known. Among the peptides secreted from adipose tissue, IL-1ß is the most important inflammatory cytokine, and its levels are increased in the presence of obesity (Osborn *et al.*, 2008), and weight loss can decrease its systemic levels (Balducci *et al.*, 2009). Increase in it has repeatedly been reported in most diseases associated with obesity such as type 2 diabetes (Osborn *et al.*, 2008) or respiratory diseases such as asthma (Ridker *et al.*, 2002).

Given the inflammatory characteristics of these cytokines, numerous ways have been presented to prevent its significant reduction or increase in the obese or patient population. Although, different regimes of training programs have been conducted to improve profile of inflammatory or anti-inflammatory cytokines in obese or obesity-related patient populations, so far, the general consensus regarding the application of a comprehensive training method in this context is not known. Of course, regardless of the type of exercise or physical activity, responds of cytokines depends on other factors such as type or intensity of the disease. In obese patients, some studies have associated improvements in inflammatory cytokine to weight loss which was resulted from training courses, and have shown that at least 5% weight loss is as a requirement of improvement in profiles of cytokine (Ando *et al.*, 2009; Fleisch *et al.*, 2007). However, there also exist studies that reported improvement in cytokines in the absence of weight loss (Kadoglou *et al.*, 2007).

For example, reduction in IL-1ß levels has been reported in obese or diabetic patients or animal species in response to long-term training programs or combined aerobic-resistance exercise (Balducci *et al.*, 2009; Martin-Cordero *et al.*, 2009). Some other studies have reported no significant changes in this inflammatory cytokine in response to short or long-term training programs (Fatouros *et al.*, 2010; Visetnoi *et al.*, 2009). Given the contradictory findings in this field and the limited number of related studies in women, the present study aimed to indicate the effect of 6 weeks of aerobic training on serum levels of IL-1ß in obese or overweight women.

Material and methods

Study subjects

Subjects were twenty four non-trained healthy obese/overweight matched for age (39±4 years), gender (women), height (162±5.9 cm) and BMI (31.47±1.89 kg/m2). All participants reported being weight stable (±1kg) for 6 months prior to the study and engaged in physical activity less than once per month. Written consent was obtained from each subject after the experimental procedures and possible risks and benefits were clearly explained.

Inclusion and exclusion criteria

Obesity and overweight was measured by BMI. None of the subjects used drugs or therapies for obesity, and none had a past history of disease or injury that would prevent daily exercise. Participants were included if they had not been involved in regular physical activity/diet in the previous 6 months. We also excluded people who had any self reported physician diagnosed chronic disease (arthritis, stroke, diabetes, hypertension, cancer, heart attack, chronic

cough, or bronchitis). Exclusion criteria also included medications that alter carbohydrate or fat metabolism and inability to exercise.

Anthropometry

All anthropometrical markers were measured at pre and post training. Weight was measured by an electronic balance. Height was measured while the shoulders were tangent with the wall. The BMI was calculated as the weight in kilograms divided by the square of the height in meters. Percentage of body fat was estimated by bioelectrical impedance method (Omron Body Fat Analyzer, Finland). The abdominal circumference was measured to the nearest 0.1 cm, using a non-extendable flexible tape applied above the iliac crest and parallel to the ground; with the subject standing erect with abdomen relaxed, arms along the body, and feet together. Hip circumference was measured at the maximum circumference between the iliac crest and the crotch while the participant was standing and was recorded to the nearest 0.1 cm.

Laboratory measurements and exercise program

Pre and post training blood samples, anthropometrical markers were taken of all subjects. Subjects were asked to avoid doing any heavy physical activity for 48 hours before blood sampling. A venous blood sample was collected from all the subjects who came after a 12-h overnight fast between the hours of 8 to 9 am. Blood was drawn from the antecubital vein, separated by centrifugation, frozen, and stored −80 °C until biochemical analysis was performed. Serum IL-1ß concentrations were measured by immunosorbent assay ((Enzyme-linked Immunosorbent Assay for quantitative detection of human IL-1β, Austria) (Intra-assay CV: 5.1%; Inter-assay CV: 8.6%). Aerobic training lasted 6 weeks at 60-80% of maximal heart rate (3 time / weekly). Each session was performed 45 – 60 min. Target heart rate was monitored by polar telemetry. Exercise intensity and exercise volume at initial training sessions was in at least of mentioned range. Control subjects were instructed to maintain their habitual activities.

Data analysis

All values are reported as mean and standard deviation. Data were analyzed by computer using the Statistical Package for Social Sciences (SPSS) for Windows, version 11.5. Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. Independent student t test was used for comparison of variables between two groups at baseline. Student's paired 't' test was applied to compare the pre and post training values. A p-value of less than 0.05 was considered to be statistically significant.

Results

Descriptive characteristics Anthropometric markers and serum IL-1ß are showed in table1. All values are reported as mean and standard deviation. Data an independent T test showed no significant differences in all anthropometrical and biochemical markers between two groups at baseline ($p \geq 0.000$).

Table 1. Anthropometrical markers and serum IL-1ß at pre and post-training program of two studied groups.

Group	Height (cm)	Weight (kg)	Abdominal (cm)	Hip (cm)	BMI (kg/m2)	Body fat (%)	IL-1ß (pg/ml)
Exercise (pre-test)	*161 (6.4)*	*82.6 (6.31)*	*109 (7.96)*	*114 (4.78)*	*31.75 (2.03)*	*45.3 (3.28)*	*2.41 (1.08)*
Exercise (post-test)	-----	*81.4 (6.54)*	*108 (7.88)*	*113 (5.3)*	*31.28 (2.06)*	*44.7 (3.07)*	*2.81 (1.43)*
Control (pre-test)	*162 (5.7)*	*81.8 (5.76)*	*110 (7.06)*	*114 (3.19)*	*31.18 (1.77)*	*45.4 (2.95)*	*2.43 (0.82)*
Control (post-test)	-----	*81.9 (5.93)*	*110 (6.51)*	*114 (3.06)*	*31.21 (1.78)*	*45.5 (2.75)*	*2.60 (0.82)*

Body weight decreased significantly by aerobic training program in exercise group when compared with pre-training values ($p < 0.001$). Aerobic exercise training were also resulted in significant decrease in body weight ($p < 0.001$), abdominal obesity ($p < 0.01$), hip circumference ($p = 0.027$) and body fat

percentage ($p < 0.01$) compared to baseline in exercise group. There was no statistically significant differences in serum IL-1β between pre and post training in exercise group ($p = 0.104$, Fig 1). All variables remained without change in control group ($p \geq 0.05$).

Discussion

Based on what was mentioned earlier, in the present study, the effect of 6 weeks of aerobic training on serum levels of the inflammatory cytokine IL-1ß Aare measured in obese or overweight women. The findings showed that levels of this inflammatory cytokine in the response to exercise were not significantly changed. In other words, 6-week aerobic exercises are not associated with anti-inflammatory characteristics on obese or overweight adult women. Recently, several studies are aimed at establishing appropriate strategies to reduce or improve the levels of these inflammatory cytokines in healthy or patients, athlete or non-athletes, and obese and overweight populations, however, these studied scarcely mention IL-1ß compared to other cytokines, especially in women.

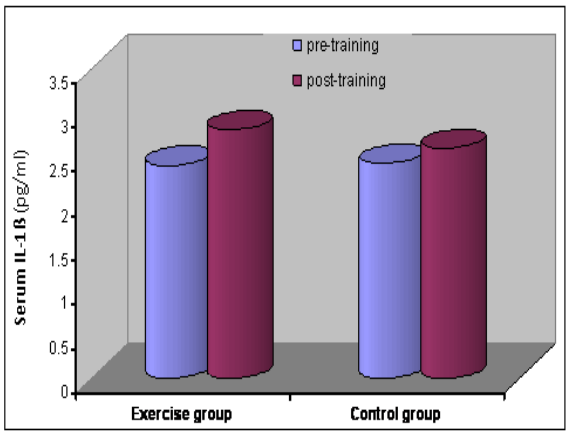

Fig. 1. Serum IL-1β in pre and post training program. No significant changed was found in this cytokine by aerobic program.

A close association between pro-inflammatory markers such as IL-1ß and the prevalence of overweight and obesity and its role in fat mass and lipid metabolism has been reported by some previous studies (Manica-Cattani *et al.*, 2010). IL-1ß is known as a regulator of inflammatory responses of the body and plays an important role in the relationship between obesity and inflammatory diseases such as diabetes, metabolic syndrome, and chronic cardiac failure (Maedler *et al.*, 2009). IL-1ß production by macrophages in insulin-sensitive tissues leads to the development of inflammation and insulin resistance associated with obesity and overweight (Maedler *et al.*, 2009). IL-1ß is the most important cytokine investigated from interleukin-1 family with multiple biological characteristics. Its main functions include defense against infection by organisms, including bacteria (Hsu *et al.*, 2008), fungi (Gross *et al.*, 2009) and viruses (Kanneganti *et al.*, 2006). However, apart from its physiological role in host protection, IL-1ß has been introduced as an important inflammatory cytokine in several inflammatory diseases, such as certain inherited diseases, and polygenic inflammatory diseases. Most of these diseases are treated by anti-IL-1ß drugs (Ozen *et al.*, 2011; Quartier *et al.*, 2011).

In addition, the importance role of this inflammatory cytokine in the other common diseases such as gout (Schumacher *et al.*, 2012), type II diabetes (Maedler *et al.*, 2002) and cancer (Okamoto *et al.*, 2010) have been reported. This inflammatory cytokine functions in two forms of IL-1α and IL-1ß as inflammatory mediators with approximately 30% common structural characteristics, but target receptors are similar in both of them and have relatively similar biological effects. These cytokines play an important role in inflammation (Matsuki *et al.*, 2003) and are involved in inflammatory and innate immune responses. Evidence has been found regarding that IL-1ß levels are not only important in and respiratory inflammatory diseases, but also disorders in its systemic levels affects metabolic disorders affecting body fat levels and obesity (Urboniene *et al.*, 2008; Guler *et al.*, 2004). Literature suggests that they play an important role in lipid metabolism by regulating insulin levels and lipase activity under psychological conditions (Matsuki *et al.*, 2003).

Lack of significant variations in serum levels of this inflammatory cytokine in response to 6 weeks of aerobic training can be attributed to the low number

of samples; however it is possible that 6 weeks of aerobic exercise in not sufficient for reducing inflammatory cytokine levels in obese individuals. Because most of the studies that indicated an improved inflammatory profile particularly in healthy obese or patient populations were conducted in a longer period of time (Ho *et al.*, 2013; Babbitt *et al.*, 2013). However, some studies have found that even with a longer period of time, no changes in inflammatory cytokine was observed (Bouchonville *et al.*, 2013). Some previous studies, even in the presence of a significant reduction in body weight and other obesity indices, did not observe variations in the cytokine (de Luis *et al.*, 2007). In the present study, although some anthropometric indices of obesity (not all) decreased significantly in response to training, it seems that this amount of weight loss was not effective in improving the inflammatory profile. Some studies have shown that a weight loss of at least 10 percent is required for the improvements in cardiovascular risk factors or inflammatory profile (Dow *et al.*, 2013). Yet, it is likely that the inflammatory effects of training programs are effective through improving the level of receptor or gene expression of this inflammatory cytokine in skeletal muscle, not in adipose tissue, which highlights the need for further molecular studies in this field.

References

Ando D, Hosaka Y, Suzuki K, Yamagata Z. 2009. Effects of exercise training on circulating high molecular weight adiponectin and adiponectin oligomer composition: a randomized controlled trial. Journal of Atherosclerosis and Thrombosis **16(6),** 733-9.
http://dx.doi.org/10.5551/jat.2089

Babbitt DM1, Diaz KM, Feairheller DL, Sturgeon KM, Perkins AM, Veerabhadrappa P, Williamson ST, Kretzschmar J, Ling C, Lee H, Grimm H, Thakkar SR, Crabbe DL, Kashem MA, Brown MD. 2013. Endothelial activation microparticles and inflammation status improve with exercise training in african americans. International Journal of Hypertension **4,** 538017.

Balducci S, Zanuso S, Nicolucci A, Fernando F, Cavallo S, Cardelli P. 2009. Anti-inflammatory effect of exercise training in subjects with type 2 diabetes and the metabolic syndrome is dependent on exercise modalities and independent of weight loss. Nutrition, Metabolism & Cardiovascular Diseases [Epub ahead of print].

Bouchonville M1, Armamento-Villareal R, Shah K, Napoli N, Sinacore DR, Qualls C, Villareal DT. 2013. Weight loss, exercise or both and cardiometabolic risk factors in obese older adults: results of a randomized controlled trial. International Journal of Obesity (Lond). [Epub ahead of print]

Bruun JM, Lihn AS, Verdich C, Pedersen SB, Toubro S, Astrup A, Richelsen B. 2003. Regulation of adiponectin by adipose tissue-derived cytokines: in vivo and in vitro investigations in humans. American Journal of Physiology - Endocrinology and Metabolism **285,** 527–33

de Luis DA, Aller R, Izaola O, Gonzalez Sagrado M, Bellioo D, Conde R. 2007. Effects of a low-fat versus a low-carbohydrate diet on adipocytokines in obese adults. Hormone Research **67(6),** 296-300.
http://dx.doi.org/10.1159/000099329

Dilyara G. Yanbaeva, Mieke A. Dentener, Eva C. Creutzberg, Emiel FM. Wouters. 2007. Systemic Effects of Smoking. ccChest **5,** 1557-1566.

Dow CA, Thomson CA, Flatt SW, Sherwood NE, Pakiz B, Rock CL. 2013. Predictors of Improvement in Cardiometabolic Risk Factors With Weight Loss in Women . Journal of the American Heart Association **2(6),** 152.

Fatouros I, Chatzinikolaou A, Paltoglou G, Petridou A, Avloniti A, Jamurtas A. 2010. Acute resistance exercise results in catecholaminergic rather than hypothalamic-pituitary-adrenal axis stimulation

during exercise in young men. Stress. [Epub ahead of print].
http://dx.doi.org/10.3109/10253891003743432

Fleisch AF. 2007. Influence of serum leptin on weight and body fat growth in children at high risk for adult obesity. Journal of Clinical Endocrinology & Metabolism **92(3),** 948-54.
http://dx.doi.org/10.1210/jc.2006-1390

Gross O, Poeck H, Bscheider M. 2009. Syk kinase signalling couples to the Nlrp3 inflammasome for antifungal host defence. Nature **459,** 433–436.
http://dx.doi.org/10.1038/nature07965

Guler N, Kirerleri E, Ones U, Tamay Z, Salmayenli N, Darendeliler F. 2004. Leptin: does it have any role in childhood asthma? Journal of Allergy and Clinical Immunology **114(2),** 254-9.
http://dx.doi.org/10.1016/j.jaci.2004.03.053

Ho SS, Dhaliwal SS, Hills AP, Pal S. 2013. Effects of chronic exercise training on inflammatory markers in Australian overweight and obese individuals in a randomized controlled trial. Inflammation. **36(3),** 625-32.
http://dx.doi.org/10.1007/s10753-012-9584-9

Hsu LC, Ali SR, McGillivray S. 2008. A NOD2-NALP1 complex mediates caspase-1-dependent IL-1beta secretion in response to Bacillus anthracis infection andmuramyl dipeptide. Proceedings of the National Academy of Sciences of the United States **105,** 7803–7808.

Kadoglou NP, Perrea D, Iliadis F, Angelopoulou N, Liapis C, Alevizos M. 2007. Exercise Reduces Resistin and Inflammatory Cytokines in Patients With Type 2 Diabetes. Diabetes Care. **30(3),** 719-21.
http://dx.doi.org/10.2337/dc06-1149

Kanneganti TD, Body-Malapel M, Amer A. 2006. Critical role for Cryopyrin/Nalp3 in activation of caspase-1 in response to viral infection and double-stranded RNA. Journal of Biological Chemistry **281,** 36560–36568.
http://dx.doi.org/10.1074/jbc.M607594200

Maedler K, Dharmadhikari G, Schumann DM, Størling J. 2009. Interleukin-1 beta targeted therapy for type 2 diabetes. Expert Opinion on Biological Therapy **9(9),** 1177-88.
http://dx.doi.org/10.1517/14712590903136688

Maedler K, Sergeev P, Ris F. 2002. Glucose-induced beta cell production of IL-1beta contributes to glucotoxicity in human pancreatic islets. Journal of Clinical Investigation **110,** 851–860.
http://dx.doi.org/10.1172/JCI15318
http://dx.doi.org/10.1172/JCI200215318

Manica-Cattani MF, Bittencourt L, Rocha MI, Algarve TD, Bodanese LC, Rech R, Machado MM. 2010. Association between interleukin-1 beta polymorphism (+3953) and obesity. Molecular and Cellular Endocrinology 15, **314(1),** 84-9.

Martin-Cordero L, Garcia JJ, Giraldo E, De la Fuente M, Manso R, Ortega E. 2009. Influence of exercise on the circulating levels and macrophage production of IL-1beta and IFNgamma affected by metabolic syndrome: an obese Zucker rat experimental animal model. European Journal of Applied Physiology **107(5),** 535-43.
http://dx.doi.org/10.1007/s00421-009-1140-4

Matsuki T, Horai R, Sudo K, Iwakura Y. 2003. IL-1 plays an important role in lipid metabolism by regulating insulin levels under physiological conditions. Journal of Experimental Medicine **198(6),** 877-88.
http://dx.doi.org/10.1084/jem.20030299

Okamoto M, Liu W, Luo Y. 2010. Constitutively active inflammasome in human melanoma cells mediating autoinflammation via caspase-1 processing and secretion of interleukin-1beta. Journal of Biological Chemistry **285,** 6477–6488.
http://dx.doi.org/10.1074/jbc.M109.064907

Okita K, Nishijima H, Murakami T, Nagai T, Morita N, Yonezawa K. 2004. Can exercise training with weight loss lower serum C-reactive protein levels? Arteriosclerosis, Thrombosis, and Vascular Biology **24(10),** 1868-73. http://dx.doi.org/10.1161/01.ATV.0000140199.14930.32

Osborn O, Brownell SE, Sanchez-Alavez M, Salomon D, Gram H, Bartfai T. 2008. Treatment with an Interleukin 1 beta antibody improves glycemic control in diet-induced obesity. Cytokine. **44(1),** 141-8. http://dx.doi.org/10.1016/j.cyto.2008.07.004

Ozen S, Bilginer Y, Aktay Ayaz N, Calguneri M. 2011. Antiinterleukin 1 treatment for patients with familial Mediterranean fever resistant to colchicine. Journal of Rheumatology **38,** 516–518. http://dx.doi.org/10.3899/jrheum.100718

Quartier P, Allantaz F, Cimaz R. 2011. A multicentre, randomised, double-blind, placebo-controlled trial with the interleukin-1 receptor antagonist anakinra in patients with systemic-onset juvenile idiopathic arthritis (ANAJIS trial). Annals of the Rheumatic Diseases **70,** 747–754. http://dx.doi.org/10.1136/ard.2010.134254

Ridker PM, Rifai N, Rose L. 2002. Comparison of C-reactive protein and low-density lipoprotein cholesterol levels in the prediction of first cardiovascular events. New England Journal of Medicine **347,** 1557 -65. http://dx.doi.org/10.1056/NEJMoa021993

Schumacher HR Jr, Sundy JS, Terkeltaub R. 2012. Rilonacept (interleukin-1 trap) in the prevention of acute gout flares during initiation of urate-lowering therapy: results of a phase II randomized, double-blind, placebo-controlled trial. Arthritis & Rheumatology **64,** 876–884. http://dx.doi.org/10.1002/art.33412

Urboniene D, Sakalauskas R, Sitkauskiene B. 2008. C-reactive protein levels in patients with chronic obstructive pulmonary disease and asthma. Medicina (Kaunas). **44(11),** 833-40.

Visetnoi S, Chawengkirttikul R, Chaiyaroj SC, Kitiyanant Y, Pholpramool C. 2009. Serum antibodies and cytokines in C4-deficient mice and their responses to exercise. Asian Pacific journal of allergy and immunology **27(4),** 199-206.