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

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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 ≤ 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.

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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-1β 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 ≥ 0.000).

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

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

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-1β 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-1β 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.](image)

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-1β 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-1β 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 between obesity and inflammatory diseases such as diabetes, metabolic syndrome, and chronic cardiac failure (Maedler et al., 2009). IL-1β 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-1β 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-1β 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-1β drugs (Ozen et al., 2011; Quartier et al., 2011). A close association between pro-inflammatory markers such as IL-1β 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-1β is known as a regulator of inflammatory responses of the body and plays an important role in the relationship
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.

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