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Serum interleukin -1 beta in relation to cardiorespiratory fitness and anthropometry on obese and overweight women

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Key words: Cardiorespiratory fitness, Inflammation, Anthropometry.

Abstract

Epidemiologic studies clearly show that obesity and sedentary is associated with low physical fitness. The purpose of this study was to analyze whether cardiorespiratory fitness (CRF) and obesity determinants are associated with serum IL-1ß as inflammatory cytokine in women with obesity or overweight. For this purpose, forty sedentary healthy overweight/obese women, 38 ± 4.2 year-olds were participated in this study by accessible sampling. Serum IL-1ß was measured after an overnight fast. Anthropometry, resting and submaximal heart rate and maximal oxygen consumption (VO2max) were measured by standard cycling test. Pearson correlation coefficients were used to determine the associations between VO2max with other variables. A p-value less than 0.05 were considered statistically significant. Analysis data showed no significant correlation in VO2max with all anthropometrical markers. Serum IL-1ß was not correlated with VO2max, anthropometrical markers, resting and submaximal heart rate. Based on these data, it's concluded that cardiorespiratory fitness is not directly correlated with inflammation in obese or overweight women. Further studies are necessary to elucidate mechanisms underlying by which inflammation affect physical fitness in this population.

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Introduction

Although the role of heredity and genetics in the incidence of obesity and its related disorders is undeniable, literature suggests that environmental factors such as nutrition, physical activity, and sedentary lifestyle also play a major role in this matter. Mechanisms involved in positive energy balance, such as inflammation and release of some adipokines, are the determinants of the pathophysiology of the diseases associated with obesity and metabolic disorders (Klöting *et al.*, 2010). Evidences indicate an increase in the prevalence of overweight and obesity both in developed and developing countries. In addition to being the major source of triglyceride, the adipose tissue is an endocrine organ that secretes lipid or protein mediators that have a major contribution in metabolism mechanisms and lipid or glucose homeostasis (Sigal *et al.*, 2006; Kaplan, 2002). Literature support the presence of cytokine disorders in some chronic diseases, especially cardiovascular disease, type 2 diabetes or metabolic syndrome, which are consequences of obesity and overweight (Dilyara *et al.*, 2007; Okita *et al.*, 2004; Maedler *et al.*, 2009). 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 obesity-related patient populations compared to normal weight or healthy populations has been reported 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 them, IL-1ß is an effective inflammatory cytokine, which was first discovered in 1970 and introduced as a lymphocyte activating factor (Gery *et al.*, 1972). This cytokine is a member of interleukin-1 family with at least 11 members (Dinarello *et al.*, 2009), which applies its biological responses through activation of the IL-1 receptor type I, where IL-1Ra acts as an antagonist receptor. Apart from its physiological role in host protection, IL-1ß has been suggested to be 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). Moreover, its important role has also been reported in other common diseases such as gout (Schumacher *et al.*, 2012), type 2 diabetes (Maedler *et al.*, 2002) and cancer (Okamoto *et al.*, 2010). Evidence support higher levels of the inflammatory cytokine in healthy obese patient populations compared to those with normal body weight (Osborn *et al.*, 2008). On the other hand, the question is whether the levels of these inflammatory cytokines affect the levels of cardiovascular fitness in the obese or the patients. Few researches have been conducted about the direct relationship between the levels of this inflammatory cytokine and determinant physiological factors of cardiorespiratory fitness in obese populations. Hence, the present study aimed to investigate the relationship between IL-1ß with VO2max and resting and submaximal exercise heart rate in obese or overweight women.

Material and methods

Human subjects

This study aimed to determine the relation of VO2max with inflammatory profile in obese or overweight women. Subjects was forty sedentary healthy obese/overweight women aged 38 ± 4.2 years, BMI 31.2 ± 3.13 kg/m2 that participated in study by accessible sampling. All participants were no-trained, no smoker and non-pregnant. Informed consent was obtained from all the subjects prior to enrolment. A detailed history and physical examination of each subject was carried out. 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.

Anthropometrical measurements

The weight and height of the participants were measured by the same person when the participant had thin clothes on and was wearing no shoes. Weight was measured by an electronic balance. Height was measured while the shoulders were tangent with the wall. Body mass index (BMI) was calculated by dividing body mass (kg) by height in meters squared (m2). Percentage of body fat was estimated by bioelectrical impedance method (Omron Body Fat Analyzer, Finland). Waist and hip circumferences were measured with the subject standing erect with arms at the sides and feet together, wearing only underwear. Waist circumference was measured after a normal expiration under the midline of the subject's armpit, at the midpoint between the lower part of the last rib and the top of the hip. Hip circumference was measured at the level of the greater trochanter, all parameters being measured by well-trained dietitians.

Biochemistry and exercise test

All subjects were asked to attend hematology lab after overnight fast between 8:00 a.m. and 9:00 a.m. Venous blood samples were obtained in order to measuring serum IL-1ß by ELIZA methods. The subjects did not perform any serious physical activity for 48 hours before the blood collection. Cardiorespiratory fitness was assessed as VO2max (mL kg-1 min-1) was measured using Rockport Walking Test. In performing the Rockport Walking Test (Kline, 1989), 1 mile is walked (no jogging) as fast as possible on a level surface. It is important that an even pace be maintained throughout the walk, but that the pace is as fast as possible. A heart rate is obtained immediately at the end of the walk as well as the time for walking the 1 mile in minutes and fractions of minutes. Resting and submaximal heart rate were monitored before and during exercise test.

Statistical analysis

Experimental data are presented as means ± SD and were analyzed with the SPSS software version 15.0. Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. The bivariate association between VO2max with IL-1ß and other variables were examined with the Spearman rank correlation analysis. P value of <0.05 was accepted as significant.

Results

As above mentioned, this study aimed to determine the relationship between serum IL-1ß as an inflammatory cytokine with VO2max and anthropometrical markers. Anthropometric and physiological characteristics and serum IL-1ß of the study participants are described in Table 1. All values are reported as mean and standard deviation.

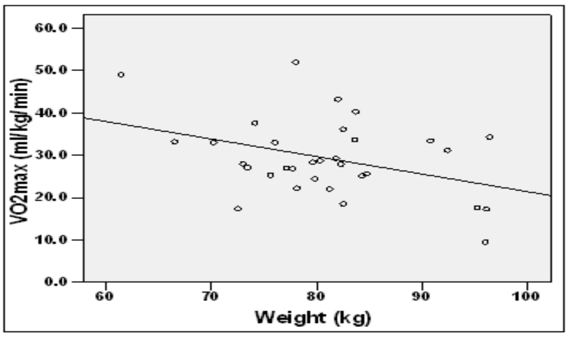

Fig. 1. Correlation coefficient between VO2max and body weight (p=0.030, r=0.39).

Based on Pearson correlation coefficients method, we observed that VO2max was negatively correlated with body weight in studied subjects (p=0.030, r=0.39, Fig 1). VO2max was also negatively correlated with body mass index (p=0.022, r=0.40, Fig 2). Negative significant correlation was also found between VO2max and body fat percentage in study subjects (p=0.034, r=0.038, Fig 3).

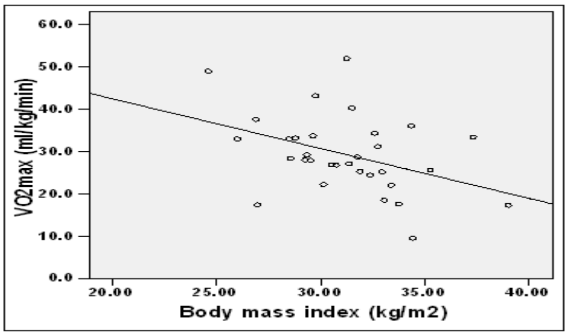

Fig. 2. Correlation coefficient between VO2max and body mass index (p=0.022, r=0.40).

We also observed negative significant correlation between VO2max with resting (p=0.027, r=0.39) and submaximal (p=0.025, r=0.40) heart rate.

There were no correlation between serum IL-1ß and VO2max (p=0.030, r=0.39, Fig 4). There was no significant relationship between serum IL-1ß resting and submaximal heart rate and all anthropometrical markers (p ≥ 0.05).

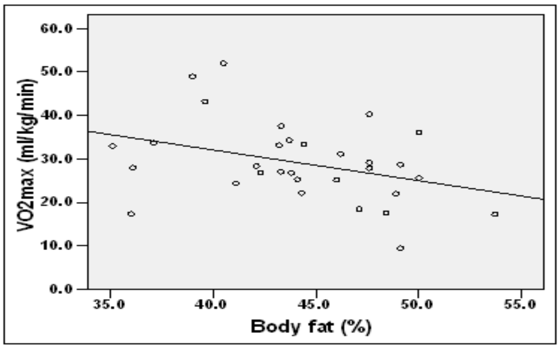

Fig. 3. Correlation coefficient between VO2max and Body fat percentage (p=0.034, r=0.038).

Discussion

Many studies have been conducted to determine the effects of training programs, especially long-term, on the levels of inflammatory cytokines. They often reported that if the training program leads to a significant reduction in body weight, the inflammatory cytokine levels are reduced in obese or patient populations (Varady *et al.*, 2009). In sum, most studies support the reduction in the inflammatory cytokines (also, IL-1ß) after a long-term training program (Hammett *et al.*, 2006; Balducci *et al.*, 2009). However, these training programs led to an increase in cardiorespiratory fitness in the studied population as well. These findings may show an inverse relationship between the inflammatory cytokines, such as IL-1ß, and VO2max or resting and exercise heart rate, which are a physiological indicator of cardiorespiratory fitness. On the other hand, since obesity is associated with both a decrease in cardiorespiratory fitness and an increase in IL-1ß, a close relationship between the levels of these variables together in the presence of obesity is not unexpected. But contrary to this notion, the findings of this study showed a relationship between these variables. In other words, in this study, no significant relationship were found between serum levels of IL-1ß with VO2max and resting and submaximal heart rate in the obese or overweight populations.

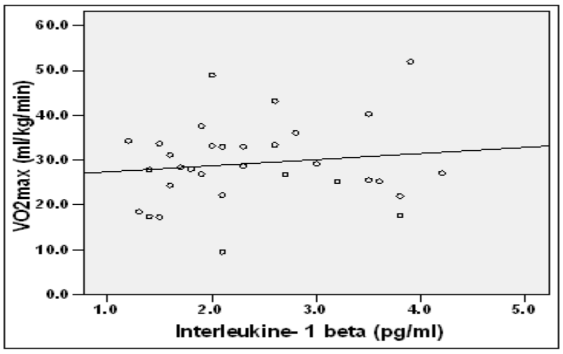

Fig. 4. Correlation coefficient between VO2max and Body weight (p=0.030, r=0.39).

The findings of this study were presented while some previous studies suggested a significant relationship between inflammatory cytokines with VO2max in other populations. For example, in a recent study, a significant relationship was observed between VO2max levels and inflammatory markers such as IL-6 and TNF-α in overweight children (Utsal *et al.*, 2013). In another study, a significant relationship was observed between cardiorespiratory fitness (VO2max) and IL-1ß but not TNF-α level in young overweight men (Varra *et al.*, 2012). However, this is not the first study that suggests the lack of relationship between serum levels of cytokines and VO2max, because, in another study, serum leptin levels in obese children were not significantly correlated with VO2max (Cicchella *et al.*, 2013). In another study which was previously mentioned, despite the significant relationship between VO2max and IL-6, its relationship with IL-1ß and CRP, as other inflammatory cytokines was not significant in obese children (Utsal *et al.*, 2013).

The lack of significant relationship between VO2max and IL-1ß were observed while VO2max levels were significantly correlated with each indices of obesity, such as body weight, BMI, body fat percentage, and visceral fat. In other words, the increase in obesity indices such as body fat, especially visceral fat, was associated with a significant reduction in VO2max in the studied population. However, none of the anthropometric indices of obesity was associated with serum levels of IL-1ß.

On the other hand, the lack of relationship between VO2max and other variables such as IL-1ß, resting and submaximal heart rate, and anthropometric measurements may be attributed to the low number of samples, because the low number of samples is one of the main limitations of the present study. However, it is possible that despite the lack of relationship between VO2max, as an indicator of cardiorespiratory fitness, and IL-1ß, there exist a reciprocal relationship between the index of cardiorespiratory fitness and levels of IL-1ß receptor in muscle tissue or fat tissue levels, which requires future molecular studies.

References

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].

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.

Cicchella A1, Stefanelli C, Purge P, Lätt E, Saar M, Jürimäe T. 2013. The associations between peak O2 consumption and leptin in 10- to 12-year-old boys. Clinical Physiology and Functional Imaging's **33(4),** 313-6.
http://dx.doi.org/10.1111/cpf.12030

Dilyara G, Yanbaeva, Mieke A, Dentener, Eva C, Creutzberg, Geertjan Wesseling, Emiel F. M. Wouters. 2007. Systemic Effects of Smoking. ccChest **4,** 1557-1566.

Dinarello CA. 2009. Immunological and inflammatory functions of the interleukin-1 family. Annual Review of Immunology **27,** 519–550. http://dx.doi.org/10.1146/annurev.immunol.021908.132612

Gery I, Waksman BH. 1972. Potentiation of the T-lymphocyte response to mitogens. II. The cellular source of potentiating mediator(s). Journal of Experimental Medicine **136,** 143–155.
http://dx.doi.org/10.1084/jem.136.1.143

Hammett CJ, Prapavessis H, Baldi JC, Varo N, Schoenbeck U, Ameratunga R. 2006. Effects of exercise training on 5 inflammatory markers associated with cardiovascular risk. American Heart Journal **151(2),** 367-76.
http://dx.doi.org/10.1016/j.ahj.2005.08.009

Kaplan NM. 2002. Hypertension and diabetes. Journal of Human Hypertension **16(Suppl 1),** 56-60.

http://dx.doi.org/10.1038/sj.jhh.1001344

Kline GM. 1989. Estimation of VO2max from a one-mile track walks, gender, age, and body weight. Medicine and Science in Sports and Exercise **19,** 253-259.

Klöting N, Fasshauer M, Dietrich A, Kovacs P, Schön MR, Kern M. 2010. Insulin sensitive obesity. American Journal of Physiology - Endocrinology and Metabolism [Epub ahead of print].
http://dx.doi.org/10.1152/ajpendo.00586.2009

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

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? Arterioscler Thrombosis 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

Schumacher Jr HR, 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

Sigal RJ, Kenny GP, Wasserman DH, Castaneda-Sceppa C, White RD. 2006. Physical activity/exercise and type 2 diabetes: a consensus statement from the American diabetes association. Diabetes Care **29,** 1433–1438.
http://dx.doi.org/10.2337/dc06-9910

Utsal L, Tillmann V, Zilmer M, Mäestu J, Purge P, Saar M, Lätt E, Maasalu K, Jürimäe T, Jürimäe J. 2013. Negative correlation between serum IL-6 level and cardiorespiratory fitness in 10- to 11-year-old boys with increased BMIPediatric Endocrinology and Metabolism **26(5-6),** 503-8.

Varady KA, Tussing L, Bhutani S, Braunschweig CL. 2009. Degree of weight loss required to improve adipokine concentrations and decrease fat cell size in severely obese women. Metabolism **58(8),** 1096-101.
http://dx.doi.org/10.1016/j.metabol.2009.04.010

Varra JP, Fogelholm M, Vasankari T, Hakkinen K, Santtila M, Kyrolanen H. 2012. Associations of cardiorespiratory and muscular fitness with IL-6 and TNF concentrations in normal and overweight young men. Acta Physiologica **206(691),** 59.