INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 2, p. 322-326, 2014

RESEARCH PAPER OPEN ACCESS

Aerobic exercise program affect insulin resistance in asthma patients

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Key words: Insulin resistance, asthma, aerobic training.

http://dx.doi.org/10.12692/ijb/4.2.322-326 Article published on January 28, 2014

Abstract

A growing body of evidence supports relation between insulin resistance and chronic diseases, although its relationship with asthma has been poorly evaluated. This study aimed to determine whether 12 wk aerobic exercise program altered insulin resistance in adult males with asthma. Twenty four no trained adult men with chronic asthma [mean (SD): 37.4 (7.39) yr, body mass index 31.29 (5.53) kg/m(2)] participated in this study by accessible sampling and divided into exercise or control groups by randomly. Exercise group were completed an aerobic exercise program for three months and control group were not participate in exercise. Pre and post training of fasting serum insulin and glucose were measured in order to insulin resistance measuring. Student's t-tests for paired samples were performed to determine significance of changes in variables by exercise intervention. Anthropometrical markers decrease significantly by exercise program ($p = 0.05$). Exercise program were also resulted significant decrease in fasting glucose 0.000) and insulin resistance ($p = 0.022$) when compared with baseline. Our findings indicate that aerobic training intervention is associated with improving in glucose homeostasis in asthma patients.

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Introduction

Increased insulin concentration in response to increasing secretion of insulin by pancreatic beta cells and insulin resistance phenomenon have frequently been reported in patients with diabetes, obesity and obesity-related illnesses (Butler et al., 2003). Transmembrane transport of glucose is one of the main functions of insulin. In addition to inadequate secretion of insulin, reduced sensitivity of the target cells or increased resistance of target cells even in the presence of adequate insulin resistance are particularly important in increased hyperglycemia or increased blood glucose levels. Although the increase in blood glucose levels in patients with asthma is not expected to be similar or parallel with diabetes or other diseases caused by obesity, the literature has pointed to the fact that these patients have higher levels of fasting glucose levels compared to healthy counterparts (Hilda et al., 2007). Asthma is a disease of air pathways with an allergic origin which appears physiologically by narrowing of the respiratory air pathways and clinically by sudden attacks of shortness of breath, coughing and wheezing (Figueroa-Munoz et al., 2001). Some studies support insulin resistance and impaired insulin secretion and glucose metabolism in patients with asthma (Ma et al., 2010).

Although the primary mechanism of increased blood glucose in patients with asthma is not well understood, phenomenon of insulin resistance appears to have an important role in blood glucose increase in these patients compared to healthy subjects. In this regard, some previous studies support the role of the peptide hormones disorder or inflammatory cytokines in the increase of insulin resistance in asthmatic patients (Popovic et al., 2005). A kind of close correlation has been reported between inflammatory mediators of insulin resistance or elevated blood glucose levels in patients with asthma by other studies (Fleisch, 2007). Hence, it appears that the cytokines or inflammatory mediators affect blood glucose levels and insulin resistance in patients with asthma directly or through indirect mechanisms.

The role of exercise as a non-pharmacologic factor in improving blood glucose levels and insulin resistance in obese or diabetic patients frequently has been reported in many previous studies (Nassis et al., 2005; Aldhahi et al., 2003). However, there few studies available on insulin resistance or glucose response to long-term training programs in asthmatic patients. Hence, this study aims to determine the effects of a long-term aerobic training on the said clinical markers in asthmatic patients.

Materials and method

Participants

In this study, we aimed to estimate the effect of three month aerobic training on insulin resistance and fasting glucose in asthma patients. This study involved twenty four sedentary adult men with mild to moderate asthma that by accessible sampling and divided into exercise (3 months/3 sessions weekly) or control (no training) groups by randomly. Neither the control or exercise subjects had participated in regular exercise for the preceding 6 months, nor did all subjects have stable body weight.

Asthma diagnosis and its severity were determined by FEV1/FVC. Subjects were asked to refrain from tea, coffee, chocolates and caffeinated soft-drinks on the day of recording Spirometry. Subjects provided informed written consent and completed a health history questionnaire prior to participating in the study.

Inclusion and exclusion criteria

Inclusion criteria for study groups were determined mild to moderate asthma for 3 years ago. Participants were non-athletes and non-alcoholics. The exclusion criteria were as follows: Patients with known history of acute or chronic respiratory infections, diabetes, neuromuscular disease and cardiopulmonary disease. Subjects with history of smoking were also excluded from the study. Exclusion criteria also included medications that alter carbohydrate metabolism and inability to exercise.

Physical and biochemical measurements

Anthropometrical and biochemical variables were measured before exercise program and repeated 48 after lasted exercise session. Weight and height were measured in the morning, in fasting condition, standing, wearing light clothing and no shoes. Body mass index (BMI) was calculated by dividing body mass (kg) by height in meters squared (m2). Fasting blood samples were taken after an overnight fast to determine insulin and glucose concentration. Insulin and glucose levels were used for the homeostasis model assessment of insulin resistance ($HOMA_{IR}$ = (fasting insulin (μIU/ml) × fasting glycemia (mmol/l))/22.5 (Matthews et al., 1985)). Glucose was determined by the oxidase method (Pars Azmoon kit, Tehran). Insulin was determined by ELISA method (Demeditec, Germany) and the intra- assay and inter-assay coefficient of variation of the method were 2.6% and 2.88 respectively.

Exercise program

Exercise training program lasted three months included aerobic training at 60 – 80 % of maximal heart rate for 3 sessions per week. Each exercise session was supervised by an exercise physiologist or one of the study physicians. In each session, subjects completed a 5-10 min warm-up, followed by 60 min of aerobic exercise at 60-80%VO2max (with continuous heart rate monitoring) and a 5-min cool down. Aerobic exercise involved Running on a flat surface with no slope or treadmill. Target heart rate in each session monitored by polar telemetry.

Data Analysis

All data were tested for normal distribution by the Kolmogorov-Smirnov test. Independent student t test was used for between groups comparison at baseline. Student's paired 't' test was applied to compare the pre and post training values. Statistics were tested at the $P<0.05$ level of significance and data were reported as mean ± standard deviation.

Results

At baseline there were no differences in the age, body weight or body mass index and other physical markers between the two groups (Table 1). Mean and standard deviation of dependant variables showed in table 1.

Table 1. Pre and post training of anthropometrical and clinical markers exercise intervention and control groups. Data showed by mean and standard deviation.

Variables	Exercise group		Control group	
	Pretraining	post training	Pretraining	post training
Age (year)	37.4 (7.39)	37.4 (7.39)	36.8 (5.62)	36.8 (5.62)
Height (cm)	173.7 (2.38)	173.7 (2.38)	174.1 (3.81)	174.1 (3.81)
Weight (kg)	94.5 (11.9)	89.9 (13.2)	98.4 (6.51)	97.6 (5.41)
Abdominal circumference (cm)	1405 (10.6)	102.8 (11.6)	106.1 (6.25)	105 (7.41)
Hip circumference (cm)	105.7 (7.5)	103.6 (7.5)	106.1 (8.2)	105.4 (6.51)
BMI (kg/m2)	31.29 (3.53)	29.76 (3.96)	32.43 (2.52)	32.20 (3.12)
Serum insulin (μIU/ml)	9.16 (2.45)	6.77 (3.22)	8.97 (3.21)	9.14 (2.08)
Glucose concentration (mg/dl)	125 (42)	110 (38)	127 (31)	123 (26)
Insulin resistance (HOMA-IR)	2.89 (1.39)	1.82 (1.22)	2.98 (0.96)	2.86 (1.01)

Aerobic training program resulted significant decrease in all anthropometrical markers when compared to baseline ($p \leq 0.05$) but these markers remained without change in control group. Compared to pre-training, the fasting glucose levels decreased significantly ($p = 0.000$) after aerobic program in exercise group but not in the control subjects (Fig 1). Insulin resistance levels were significantly decreased in exercise intervention group ($p = 0.022$) but not in control group (Fig 2). After aerobic training intervention, serum insulin decreased in exercise patients ($p = 0.040$) but without change in control

subjects.

Discussion

Higher levels of glucose and insulin resistance in asthmatic patients than in healthy subjects have been observed previously by some studies (Ma et al., 2010). In this study, too, insulin resistance reduced significantly in response to a long-term exercise program. In this study, the blood glucose levels significantly decreased in response to a three-month aerobic training compared to baseline levels. These findings suggest that a long-term training program is associated with a decrease in blood glucose levels in asthmatic patients.

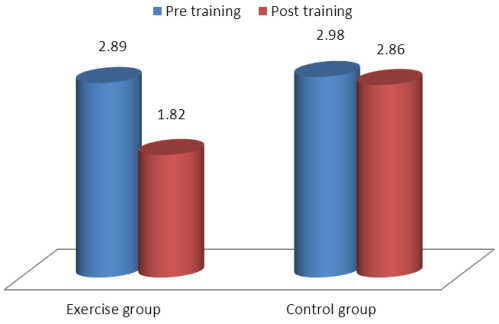

Fig. 1. Insulin resistance in pre and post training in exercise and control groups.

Reduced blood glucose levels in response to the exercise protocol may be attributed to the improvement of inflammatory cytokines, because some previous studies also report concomitant reduction of blood glucose levels in parallel to improvement of inflammatory or anti-inflammatory cytokines profile in obese or ill populations (Nadeau et al., 2009; Sung et al., 2008). In the present study, due to failure to measure inflammatory or anti-inflammatory cytokines, it is not possible to determine the relationship between changes in glucose levels or insulin resistance with these cytokines.

In this study although the relationship between blood glucose with the studied cytokines was not measured the statistical results showed that exercise is associated with insulin resistance in the subject patients. Confirming the foregoing, the findings of certain previous studies with higher numbers of samples support the close relationship between glucose or insulin resistance, inflammatory or anti-inflammatory cytokine in asthmatic patients (Fleisch, 2007). However, the main mechanisms responsible for the increase in blood glucose in patients with asthma are still unknown but the significant impact of insulin resistance on the increase in blood glucose, has already been confirmed repeatedly. In addition, some previous studies suggest that peptide hormone or cytokine abnormalities in patients with asthma are associated with insulin resistance (Popovic et al., 2005).

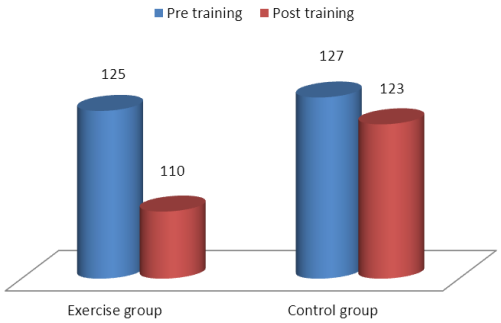

Fig. 1. Fasting glucose levels in pre and post training in exercise and control groups.

Significant reduction in fasting insulin levels or insulin resistance in the subject asthmatic patients may be attributed exercise-induced weight loss, because the aerobic exercise program in this study was associated with weight loss and reduction of body fat percentage. Here it should be noted that subject asthmatic patients were categorized as overweighed or obese. Thus, the effect of exercise-induced weight loss on improvement of insulin resistance or blood glucose also reported in some studies on obese populations or other diseases should not be ignored. In this context, the findings of a study on diabetic patients showed that exercise-induced weight loss would lead to a significant decrease in insulin resistance along with an increase in serum adiponectin (Aldhahi et al., 2003). Reduced insulin resistance or increased insulin sensitivity in response to 12 weeks of exercise training has been reported by some other studies (Nassis et al., 2005). In addition to the role of weight loss on blood glucose levels and insulin resistance, improvement of these clinical markers might be attributed to improvement or

balance of peptide mediators or inflammatory and anti-inflammatory cytokines in these patients which given the failure to measure them in the study , it is recommended to measure them in future studies.

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