



The Effect of Long-term Aerobic Training on Beta Cell Function in Asthma Patients

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ABSTRACT: It was reported that asthma is associated with insulin resistance and obesity. In present study, we aimed to evaluate the effect of a long term aerobic training included three months aerobic exercise for three times weekly on beta cell function and glucose concentration in non-trained adult males with asthma. For this purpose, twenty four males with mild to moderate asthma were randomly divided into exercise (aerobic training) or control groups. Pre and post training of insulin and glucose were determined after overnight fast between 8.00 a.m.–9.00 a.m of two group's subjects. Beta cell function and insulin sensitivity were calculated by fasting insulin and glucose. Paired sample T test used to determine significant changes in each variable between two occasions. Despite a significant decrease in fasting glucose, beta cell function did not change by aerobic training program when compared with pre test. Aerobic training resulted in significant decrease in insulin sensitivity in exercise group but not in control subjects. Based on this data, improved fasting glucose by exercise training can be attributed to the change in insulin sensitivity not beta cell function in asthma patients.

Keywords: Asthma, Beta Cell Function Aerobic Training, Glucose, Beta cell function, T test

INTRODUCTION

According to the literature, asthma is associated with obesity and its severity increases by weight gain and obesity [1, 2]. Studies have also suggested that type-2 diabetes and asthma are associated with obesity due to the presence of chronic systemic inflammation [3]. Asthma is a chronic disease caused by inflammation of respiratory airways with increased production of mucus and obstruction and airway hyperresponsiveness [4]. Some studies have attributed the association of asthma with obesity or diabetes to an increase in insulin resistance [4]. Some other studies have indirectly pointed out a correlation between asthma and type-2 diabetes [5, 6].

Despite the presence of inflammation in asthma, this hypothesis can be proposed that insulin resistance and impaired glucose uptake affect the incidence of obesity-induced asthma, although no comprehensive information exists in this regard [7, 8]. Some studies have attributed asthma-associated glucose dysfunction or glucose increment to impaired secretion of peptide mediators such as adiponectin [9], although the mechanisms responsible for this relationship are not yet fully understood.

It is likely that the impact of peptide mediators or inflammatory and anti-inflammatory cytokines on muscle glucose uptake and on its levels in blood and other tissues is somewhat associated with the presence of insulin and its secretion from beta-cells of the pancreas. Despite the numerous findings regarding the increased insulin resistance in asthmatic patients, especially those with obesity, some recent findings have reported no increase in insulin resistance in these patients [10].

Based on some articles, glucose increases in asthmatic patients in the presence of normal levels of insulin resistance, proposing this hypothesis that the increase in blood glucose in these patients may be arisen from impaired function of beta-cells. In a recent study, a positive correlation was found between beta-cells function and the anti-inflammatory cytokine adiponectin in patients with asthma [11]. Since the levels of this anti-inflammatory peptide decrease in asthmatic patients [12, 13] and also, given its direct correlation with beta-cells function, reduced function of beta-cells in the presence of the disease seems possible. Therefore, in this study, the effect of three months of aerobic exercise was investigated on the function of beta-cells and the fasting levels of glucose in a group of patients with asthma.

MATERIAL AND METHODS

A. Human Subjects and study inclusion

Twenty four sedentary, adult men with mild to moderate asthma aged 38 ± 8 year of old and weight 94 ± 9 kg were enrolled to the study by voluntarily. in present study. Asthma diagnosis and its severity were determined by FEV1/FVC. The purpose of this study was to determine whether fasting glucose concentration was affect by the change in beta cell function following of three months aerobic training in these patients. The ethics approval was taken from Islamic Azad University of Iran ethical committee. Written consent was obtained from each subject after the experimental procedures and possible risks and benefits were clearly explained.

A detailed history and physical examination of each subject was carried out. Asthma diagnosis at least for 3 years was main inclusion criteria. Participants were non-athletes, non-smokers and non-alcoholics. All subjects were non-smokers and had not participated in regular exercise/diet programs for the preceding 6 months. We also excluded people who had any self reported physician diagnosed chronic disease (arthritis, stroke, diabetes, hypertension, cancer, heart attack, chronic cough).

B. Spirometry and anthropometric measurements

Each participant responded to a questionnaire about respiratory symptoms and medical history and underwent a resting spirometry testing. Subjects were asked to refrain from tea, coffee, chocolates and caffeinated soft-drinks on the day of recording Spirometry. The Body Mass index (BMI) was calculated using the formula $\text{body weight}/\text{height}^2$ in terms of kg/m^2 . Anthropometric measurements were performed in all study participants before breakfast, with the subject wearing light clothing without shoes. Height was measured without shoes on standing while the shoulders were tangent with the wall. Body weight was measured in duplicate in the morning following a 12-h fast.

C. Clinical measurements and intervention

Pre and post training blood samples were taken at rest. Exercise training program lasted 3 months [3 days/wk] 60 to 80 percent of maximum heart rate. Each session started by 15 min of flexibility exercises, 30-40 min of aerobic exercise and 5-10 min of cool down activity. Aerobic exercises in each session included walking on a treadmill and stationary cycling. Initially, subjects exercised at low intensity and the intensity of exercise was gradually increased to 80% of peak heart rate in next sessions. The intensity of the activity of any person was controlled using the Polar heart rate tester (made in the US). In this 12-week period, participants in the control group were barred from participating in any exercise training. Blood samples were collected, via the cannulated antecubital vein, between 8:00-9:00 a.m. after an overnight fasting for all subjects. All participants refrained from any severe physical activity 48 h before measurements. 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. Beta cell function and insulin sensitivity were calculated by fasting insulin and glucose [14].

D. Data Collection

Data were analyzed by computer using the Statistical Package for Social Sciences (SPSS) for Windows, version 11.5. We verified normal distribution of variables with a Kolmogorov-Smirnov test, and the parametric variables with skewed distribution were expressed as mean \pm SD. Independent student t test was used for between groups comparison. Student's paired 't' test was applied to compare the pre and post training values.

RESULTS

As mentioned above, this study was aimed to evaluate the effect of aerobic training program lasted three months on beta cell function and glucose concentration. Table 1 show the descriptive spirometry features of the study patients.

Table 1: Mean and standard deviation of Spirometrical characteristics of studied subjects.

Variable	Mean	Standard deviation
Forced vital capacity (%)	90	9.4
Forced expiratory volume in 1 s (%)	78	9.5
Maximal voluntary ventilation (%)	31	3.8
Peak expiratory flow	80	15
FEV1/FVC	70	3

FEV1/FVC: forced expiratory volume in 1 s / forced vital capacity

The data were reported as mean and standard deviation. Baseline and post training ghrelin levels, anthropometrical indexes and clinical characteristics of two groups are shown in Table 2.

Based on data of independent T test, no significant difference was found in all anthropometrical or clinical markers at baseline ($p > 0.05$). There were no statistically significant differences in beta cell function between pre and post training in exercise group ($p = 0.434$). On the other hand, aerobic exercise program did

not change beta cell function in studied asthma patients. No significant change was also observed in serum insulin by exercise program when compared with pre test ($p = 0.068$).

Compared to pre-training, fasting glucose concentration decreased significantly ($p = 0.000$) after exercise program but this clinical variables was not changed in control subjects ($p = 0.684$). Insulin sensitivity was also increased by aerobic training program in exercise group ($p = 0.031$).

Table 2: Clinical data and Anthropometrical characteristics of exercise and control groups before and after exercise training intervention (mean \pm SD).

Variable	Exercise Group		Control Group	
	Pretest	post-test	Pretest	post-test
Age (year)	37.9 \pm 9	37.9 \pm 9	38 \pm 6.4	38 \pm 6.4
Height (cm)	173 \pm 2.3	173 \pm 2.3	173 \pm 1.4	173 \pm 1.4
Weight (kg)	94 \pm 12	90 \pm 14	95 \pm 9.5	95 \pm 9.1
Abdominal circumference (cm)	106 \pm 11	103 \pm 12	105 \pm 8.8	105 \pm 8
Hip circumference (cm)	107 \pm 9	105 \pm 9	106 \pm 7.9	106 \pm 8.9
AHO	0.99 \pm 0.05	0.99 \pm 0.04	0.99 \pm 0.04	0.99 \pm 0.04
BMI (kg/m ²)	31.4 \pm 3.6	30.3 \pm 4.08	31.5 \pm 3.19	31.6 \pm 3
BF (%)	28.4 \pm 5.7	26.5 \pm 6	30.4 \pm 3.06	30.9 \pm 2.93
Glucose (mg/dl)	125 \pm 43	110 \pm 41	123 \pm 36	122 \pm 35
Insulin (μ IU/ml)	9.3 \pm 2.65	7.1 \pm 3.77	9.4 \pm 1.43	9.29 \pm 1.74
Beta cell function (HOMA-BF)	72 \pm 37	78 \pm 42	73 \pm 27	70 \pm 29
Insulin sensitivity (HOMA-IS)	0.57 \pm 0.06	0.66 \pm 0.09	0.56 \pm 0.05	0.57 \pm 0.05

DISCUSSION

In the present study, a three-month aerobic exercise has not led to significant changes in beta-cells function in patients with asthma. In other words, long-term program of aerobic exercise did not affect beta-cells function in asthmatic patients. The National Heart and Lung Association and the World Health Organization defined asthma as a chronic inflammatory disease of the respiratory pathways, in which some cells, particularly mast cells, eosinophils, and T lymphocytes play an important role in its prevalence [15]. In contrast to the findings of this research, *i.e.* alteration of beta-cells function in asthmatic patients, there are some studies, performed on healthy and sick people, which have reported significant increases in the function of beta-cells in response to short- and long-term training programs. For example, in one study, the researchers stated that physical activity improves glucose homeostasis through not only decreasing insulin resistance, but also increasing the mass and the function of beta-cells [16].

In this context, some studies have shown improvement in beta-cells function in response to weight loss in type-2 diabetics [17, 18]. However, its response to diet- or exercise-induced weight loss in healthy obese individuals was less studied. The effect of weight loss

on beta-cells function is less known, however, several studies have reported improvement in this variable due to weight loss [19, 20]. In contrast to this evidence, in the present study, the function of beta-cells was not altered in the presence of a significant reduction in weight, body fat percentage, and BMI, resulted from three months of aerobic exercise. Increased insulin resistance in patients with asthma has been reported in some studies [21]. However, in a recent study performed in men with mild to moderate asthma, no significant association was observed between insulin resistance and spirometry parameters, which determine the severity of asthma [22]. Conflicting information have been reported about the association between asthma and type-2 diabetes [23]. However, in a recent study about the sensitivity to insulin in obese subjects with and without asthma, a particular association was found between asthma, obesity, and type-2 diabetes following observation of higher levels of insulin resistance in asthmatic obese subjects in comparison to non-asthmatic obese ones [24].

In a recent study, researchers stated that improved beta-cells function is closely associated with the maintenance of normal glucose and appears through exercise in hepatic and peripheral insulin resistance and blood glucose regulation [25].

However, in the present study, fasting blood glucose was significantly reduced in patients with asthma in the absence of changes in beta-cells function. This means that improvement in blood glucose in response to training programs in these patients is independent from changes in beta-cells function. This significant decrease in blood glucose in these patients following three months of aerobic exercise may be due to a decline in insulin resistance in them, because insulin resistance was significantly reduced in response to training program.

Although some studies have reported improvement in beta-cells function and insulin resistance through short-term training programs [26], it seems that significant improvement of these variables in healthy or sick obese people requires long-term training studies.

In general, the findings of the study showed that although three months of aerobic training leads to weight loss and decrease in body fat percent and fasting glucose levels in patients with asthma, the function of beta-cells is not affected in these patients. Significant improvement of glucose in the patients in response to training program can be attributed to the reduced sensitivity to insulin or direct and indirect effects of other hormonal variables such as peptide mediators.

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