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Short Term Aerobic Training Improves Fasting Glucose and Beta Cell Function in Obese/Overweight Women

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ABSTRACT: The objective of present study was to assess the effect of 6 weeks aerobic training on beta cell function and fasting glucose in adult obese/overweight women. For this purpose thirty healthy obese/overweight women aged 37.3 ± 6 years, body mass index (BMI) 32 ± 3 kg/m2 were divided into exercise or control groups by accidentally. Fasting blood samples were collected in order to measuring insulin and glucose before and after 6 weeks aerobic training in exercise group as well as control subjects. Glucose and insulin used to determine beta cell function. All anthropometrical markers were also measured in two mentioned occasions. BMI and body weigh were decreased by exercise training. Aerobic training was also resulted significant increase in beta cell function and significant decrease in fasting glucose. No differences were observed in all independent markers between two occasions in control subjects. Based on this data, it concluded that aerobic triaging even for short time can be improved glucose homeostasis and beta function in obese/overweight individuals.

Keywords: Beta call function, Aerobic training, Obesity

INTRODUCTION

Obesity, as one of the most prominent non-communicable diseases, has come into focus of health science researchers. The increased risk of obesity and its consequences, along with the industrialization of societies and lifestyle changes, foregrounds the prevention and treatment of obesity as a major challenge for the health system. Studies have demonstrated a strong association between inflammatory markers, metabolic disorders, obesity and its related diseases such as Atherosclerosis, diabetes and metabolic syndrome [1]. In obese people, the disorder in secreting certain Adipocytokine and inflammatory factors has multiple functional effects on appetite control, energy balance, insulin sensitivity and lipid metabolism. The increasing prevalence of obesity, especially in developed countries is linked to certain diseases such as diabetes 2, hypertension, metabolic syndrome, Atherosclerosis, asthma and cardiovascular disease [2].

Apart from genetic factors and overeating, inactivity and lack of exercise are the main causes of obesity and the related disorders. Besides, along with genetic and physical inactivity, obesity is the most important environmental factor underlying the syndrome of insulin resistance in a way that the loss of weight or reduction of body fat levels leads to both insulin balance and reduction of insulin resistance [3, 4]. However, factors that promote beta cell failure and diabetes in obese persons have not yet fully understood. The presence of Hyperglysymy and Hyperphagia in obese individuals, despite the presence of high insulin levels, indicates their resistance to this hormone [5].

It is quite obvious that the primary cause of diabetes type 2 is insulin resistance, and dysfunction of beta cells is second to the former one. Although some Asian studies have reported the beta-cell function as the primary factor in the pathogenesis of diabetes type 2 [6, 7], multiple risk factors for diabetes type 2 such as increased fat, decreased physical activity and the inactivity linked with increased insulin resistance or beta cell dysfunction develop with aging [8]. Longitudinal studies have shown that progression of damage due to beta-cell function in healthy people, especially obese people, is especially important in the prevalence of diabetes [9].

Exercise has been introduced as a non-pharmacologic approach to reduce the prevalence of obesity and its complications. It is known that exercise alone will lead to an improvement in insulin sensitivity [10, 11]. As in some other studies, 6 to 9 months of aerobic exercise improved insulin action and insulin resistance in healthy older adults [12, 13]. But the effect of exercise on beta-cell function in adults or elderly people has been less studied. Hence, in this study, the effect of 6 weeks of aerobic training on beta-cell function has been evaluated in obese female adults.

METHOD AND METHODS

Thirty healthy obese/overweight women aged 37.3 ± 6 years, body weight 83 ± 7.8 kg and height 161 ± 6 cm were recruited for this study through local advertising. Subjects then divided into exercise (n=15) or control (n=15) group by randomly. This study assessed the effect of aerobic training program (6 weeks, 3 times weekly, 60-75% of maximal heart rate) on beta cell function and fasting glucose. After the nature of the study was explained in detail, informed consent was obtained from all participants.

Participants were inactive, non-smoker and non-pregnancy. All subjects were non-smokers and had not participated in regular exercise/diet programs for the preceding 6 months. The exclusion criteria were as follows: Patients with known history of acute or chronic respiratory infections, neuromuscular disease, and cardiopulmonary disease. Furthermore patients with overt diabetic were also excluded from the study. In addition, exclusion criteria included inability to exercise and supplementations that alter carbohydrate-fat metabolism.

All anthropometric measurements were made by the same trained general physician and under the supervision of the same pediatrician following standard protocols. Body weight and height were measured on the same day to the nearest 0.1 kg and the nearest 0.1 cm, respectively. Body mass index (BMI) was calculated by dividing body mass (kg) by height in meters squared (m^2). Waist circumference and hip circumference were measured in the most condensed part using a non-elastic cloth meter. Percentage body fat was measured using body composition monitor (OMRON, Finland).

Pre and post training of fasting glucose and serum insulin were measured after an overnight fat at two occasions. Glucose was determined by the oxidase method. Insulin was also determined by ELISA method. Depending of the values of insulin and glucose Beta cell function (HOMA-BF) was calculated using the HOMA Calculator computer program [14]. Aerobic program lasted 6 weeks, 3 times per weeks. Each exercise session lasted 45-60 min at 60-75 percent of maximal heart rate. Exercise intensity increased graduately form first to last exercise sessions. Each exercise test started by warm up (5-10 min), walking or running on treadmill with no slope and cool up at the end.

A. Statistical analysis

Data were analyzed by computer using the Statistical Package for Social Sciences (SPSS) for Windows, version 15.0.

Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. The comparisons between the measurements of the parametric parameters were determined by paired and unpaired samples t test. A pH value less than 0.05 was considered statistically significant.

RESULTS

As mentioned previous, the effect of 6 weeks aerobic exercise on Beta cell function was investigated in present study. We also stated that all participants had an inactive lifestyle before study. No significant differences were found in anthropometrical and clinical markers at baseline. Anthropometric and clinical characteristics of the study participants in the exercise and control groups are shown in Table 1.

Table 1: Anthropometrical and clinical characteristics at pre and post-training of two groups (mean and standard deviation).

Variables	Exercise group		Control group	
	Pretest	post-test	Pretest	post-test
Age (year)	37.3 ± 5.6	37.3 ± 5.6	37.3 ± 3.88	37.3 ± 3.88
Height (cm)	161 ± 6.2	161 ± 6.2	161 ± 5.3	161 ± 5.3
Weight (kg)	82.9 ± 7.8	81.8 ± 7.9	82.3 ± 6.4	82.5 ± 6.3
Waist circumference (cm)	111 ± 8.3	109 ± 8.3	110 ± 6.9	110 ± 6.9
Hip circumference (cm)	114 ± 6.6	113 ± 6.6	112 ± 6.44	112 ± 6.37
Abdiminal to hip ratio	0.97 ± 0.071	0.97 ± 0.073	0.98 ± 0.027	0.98 ± 0.029
BMI (kg/m2)	32.1 ± 2.75	31.7 ± 2.76	31.7 ± 2.13	31.8 ± 2.17
Body fat (%)	46.6 ± 3.4	45.5 ± 3.24	45.8 ± 2.62	45.7 ± 2.57
Glucose (mg/dL)	93 ± 10	77 ± 7	94 ± 8	95 ± 8
Serum insulin ((μIU/ml))	6.89 ± 4.93	7.04 ± 4.17	6.9 ± 3.67	6.4 ± 3.02
Beta call function (HOMA-BF)	86 ± 48	124 ± 56	82 ± 33	74 ± 25

Body weight (p = 0.000), body fat percentage (p = 0.000) and BMI (p = 0.000) were significantly decreased by aerobic training in exercise group but not in control subjects. Aerobic training was also resulted in significant increase in beta cell function in exercise group (p = 0.002). Fasting glucose concentration was also decreased significantly after exercise program when compared with baseline (p = 0.000) (Table 1).

DISCUSSION

The main finding of the present study was a significant increase in beta-cell function in response to an exercise program. In a sense, 6 weeks of aerobic exercise three times a week within the range of 60 to 70 percent of maximum heart beat led to a significant increase in beta-cell function in obese female adults who had previously an inactive life style. The significant increase in beta-cell function in response to exercise came along with a significant reduction in fasting glucose in obese women.

While obesity, especially visceral obesity, has been introduced as an important risk factor in the incidence of diabetes type 2, the molecular mechanisms responsible for the spread of the disease in young people are still not fully understood. Sedentary, overweight, and obese people gradually become insulin-resistant but are often able to maintain normal glucose levels by compensatory response of increasing insulin secretion from the pancreas. Yet, the increase of insulin secretion from pancreatic beta cells for compensating insulin resistance leads, in the long run, to the reduction of the mass and function of these cells [15]. The study of non-diabetic obese insulin-resistant subjects has shown that insulin resistance is compensated by increasing insulin secretion from pancreatic beta cells [16] and also by increased beta-cell function [17]. Nonetheless, the adjustment of pancreatic beta cells for compensating for insulin resistance is not constant but a short-term adjustment, in a way that increased insulin secretion for long periods as a compensation for insulin resistance leads to the inability of these cells to secrete enough insulin [18]. For example, there is a reduction of 40 to 60 percent of beta cell mass in diabetic patients compared to that in non-diabetic people [18].

Some studies have indicated that regular physical activity reduces the secretion of insulin by its stimulators [19]; However, some other studies have suggested that long-term exercise increases glucose-dependent insulin secretion in humans and animal models suffering from diabetes type 2 [20]. As for beta-cell function, in response to short or long-term training programs, although few studies have been conducted on non-diabetic obese populations but some studies on diabetes type 2 in obese people suggest an improved beta-cell function in response to exercise [21]. In this regard, the findings of a study on short-term training exercise showed that 7 sessions of exercise led to improvements in insulin sensitivity associated with increased beta-cell function in elderly people with impaired glucose tolerance [22].

Increased levels of free fatty acids, triglycerides Citozolic or hyperglysymic associated with obesity and insulin resistance, severely affects the function of beta cells [23, 24], and their improvement in response to weight loss is a potential description for improvement of beta-cell function and insulin sensitivity. However, some researchers have reported that improvement of beta-cell function may possibly be affected by factors independent of weight loss [25]. In this regard, some studies have reported the improvement of beta-cell function in response to weight loss in those suffering from diabetes type 2 [26, 27] but their response to weight loss resultant from diet or exercise in obese non-diabetes patients have less been studied. In the present study, a significant increase in beta-cell function in obese female subjects was associated with a significant reduction in body weight. In other words, a 6-week aerobic exercise, in addition to a significant reduction in body weight, led to a significant reduction of BMI and body fat percentage. However, in a separate study, the improvement of beta-cell function and insulin sensitivity by training were associated with no change in body weight, fasting glucose, lipid profile, Catecholamines and some Adipocain such as leptin and Adiponectin [22].

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