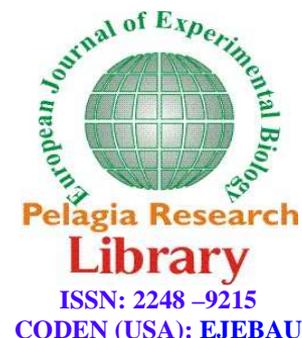




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The response of metabolic syndrome indicators to prolong aerobic exercise training in obese women

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ABSTRACT

The present study was conducted in order to investigate the effect of aerobic exercise performed regularly for twelve weeks on blood lipid and lipoprotein levels, total fat, hip circumference (HC), and insulin-resistance among obese women were used. Thirty two obese volunteer women underwent 12 weeks of aerobic training. The training intensity was established according to the maximal heart-rate reserve (HRR). They were randomly assigned to two groups: a test group and control group. Training group performed aerobic exercise at target heart beat rate of 55 to 70% for 1 h/day for 3 days per week during 12 week-trial. Anthropometric and biochemical measurements were performed before and after the training periods. The test group showed a significant decrease in body-mass-index, body fat percent, and in Hip circumference. In addition, we find a significant increase in HDLc. The training program induced a significant reduction of LDLc, Total cholesterol (TC) and a significant improvement in insulin resistance. In addition, the training program induced significant reduction in body mass and body fat percentage. Triglyceride (TG) levels were not affected by the training program. In conclusion, 12 weeks aerobic exercise program performed without a special diet in obese women may be led to favorable effects on blood lipid profile and Insulin resistance.

Key words: Obese women, lipids, insulin resistance, metabolic syndrome, aerobic exercise.

INTRODUCTION:

The worldwide epidemic of obesity becomes a major healthy, social, and economical burden [1]. In fact, it has been well proven that obesity directly increases cardio metabolic risk by altering the insulin sensibility. Furthermore, obesity causes additional health problems as it is closely associated with the development and development of coronary heart disease [2]. Metabolic syndrome (MetS) known as a clustering of cardiovascular risk factors associated with insulin resistance, hypertension, glucose intolerance, hypertriglyceridemia [3,4] and low HDL-C, and obesity [5]. This syndrome continues to increase in both developed and developing countries, and has already become a major threat to the global public health [6]. Several studies have reported the possibility that newly addressed lipid profiles might be more useful than the traditional ones used for CVD prediction, and measuring these variables might help identify insulin resistance and CVD [7]. Total cholesterol (T-C)/HDL-C, TG/ HDL-C,

and LDL-C/HDL-C ratio [7,8], as well as TG and HDL-C [9] are independently associated with insulin resistance and risk factors of CVD [10].

A number of prospective studies have identified dyslipidemia, particularly hypertriglyceridemia, as an independent predictor of incident type 2 diabetes mellitus [11-14]. An increase in body weight of nearly 1 Kg has been seen to increase the risk of metabolic syndrome as opposed to a decrease in 5–10% body weight improving symptoms [16]. Some epidemiological studies have demonstrated that MetS increases the risk of various cardiovascular diseases (CVD) [17] and diabetes [18].

Generally suggestion that aerobic exercise training is accepted to have a treating impact on blood lipid profile on a dose-dependent basis in either men or women [19]. Especially, levels of HDL-cholesterol which transports free cholesterol by esterifying with fatty acids from endothelium of vessels and peripheral tissues to liver (Reverse Cholesterol Transport) are very important and therefore named as “antiaterogenic factor” [20]. Exercise training programs can improve the insulin sensitivity, the vascular endothelium function, the glycemic control, and the blood pressure [21]. Aerobic exercise training has been reported to decrease glucose-stimulated insulin concentrations in older individuals [22,23]. Exercise has a number of beneficial effects that can play important roles in the prevention and treatment of the insulin resistance that leads to type 2 diabetes [24]. Also Dela expressed exercise training improves insulin action predominantly in skeletal muscle, where as much as a 2- to 3-fold increase in insulin stimulated glucose uptake in the physiological range of plasma insulin concentrations can be seen [29]. The studies showed regularly performed aerobic exercises, such as walking, jogging, cycling and swimming have positive impact on lipids, lipoprotein and prostaglandin profiles. Anaerobic exercise, however, does not influence at the same rate [30]. As physical exercise provides a means of increasing energy expenditure and may help adjust energy balance for weight loss and maintenance, to date, several studies have examined the beneficial effects of exercise training on obesity [27,28].

For the reasons that the risk of obesity and metabolic syndrome is very important in women therefore, its need to investigate effect of exercise training on this factors in women.

MATERIALS AND METHODS

Thirty two obese women volunteered to participant in this study. None of the obese women were involved in any regular exercise program within the previous 6 months. All of the participants divided into two groups (training and control). Written consent from the participants was taken after giving information about the study.

Experimental design

Body height of the participants was measured with height measuring mechanical weighing scale to the nearest 1 mm on a standing position. Body weight was measured to the nearest 100 g with possibly lightest clothing. Body mass index (BMI) was calculated by dividing body weight (kg) to square of height (m²).

The participants in the training groups participated in a aerobic exercise training, which exercise training intensity commenced at a level prescribed between 50% and 55% of the HR maximum (HR_{max}), and gradually increased so that, by week 6, the subjects were exercising at 70%–75% HR_{max}. For the duration of the 12-wk period, subjects exercised 3 day per week, for 50–60 min with a 10-15 min warm-up and cool-down.

Biochemical analysis

Blood samples of every participant were taken before and after the training program and plasma of the samples were obtained after centrifuging at +4°C with 3000 turnovers for 15 min. Concentrations of total cholesterol (TC), high density-cholesterol (HDL-C), low density-cholesterol (LDL-C) and triglycerides (TG) were measured with enzymatic methods.

Definition of IR

The HOMA1-IR index was calculated by the formula: $HOMA1-IR = \text{fasting plasma insulin } (\mu\text{U/ml}) \times \text{fasting plasma glucose (mmol/L)} / 22.5$ [29].

Statistical analysis

All data sets were tested for normal distribution using the Kolmogorov-Smirnov test. Baseline measurements were compared between groups using the independent test. The effects of training were assessed by t. paired test. All calculations were performed using the SPSS ver 19. Values are expressed as means_{sd}.

RESULTS

The physical characteristics of the control and training groups are presented in Table 1. All baseline variables in the pre-training stage were not different between the control and training groups ($p > 0.05$).

No variables in the control group were different between pre-training and post-training.

Levels of TC, HDL-C, LDL-C, TG, BF% and BMI data pre-training and post-training also are presented in Table 1. The changes in body mass index, body fat percentage after the exercise program, showed BMI and body fat percentage has decreased in training group. The training group had significant decreases in body weight, % fat and circumference hip ($p < 0.05$),

TC, LDLC. Levels decreased in training group after experimental period ($P < 0.05$)

The training group exhibited a significantly greater HDL-c after training ($P < 0.05$).

Insulin resistance and lipid profile parameters are presented in Figure 1. Fasting glucose and The HOMA1-IR index decreased in training group ($P < 0.05$). There wasn't a significant reduction in serum TG in test group; in addition there hasn't been a significant difference between blood pressure systolic and diastolic after exercise program Compared to baseline values in training group ($p > 0.05$).

Table- 1. physical and physiological characteristics of Experimental group. (mean&SD).(n=16)

variables	Pre training	Post training	Pv
Age(year)	37±5.55	37±5.55	
Height(cm)	159.43±7.37	159.43±7.37	
Weight (kg)	83.38±7.77	80.63±7.93	0.000
Body mass index (kg/m ²)	32.36±1.11	31.29±1.36	0.000
hip circumference(cm)	114.75±6.60	110.50±6.85	0.005
Body fat (%)	46.52±3.88	44.5±3.67	0.001
Fasting blood glucose (mg/dl)	92.25±9.88	82.81±12.32	0.001
HOMA IR	1.6125±1.01	1.05 ± 0.21	0.039
Blood pressure systolic	130/85±6.39	130/80±6.48	0.544
Blood pressure Diastolic	85.50±3.29	85.31±3.24	0.188
HDL (mg/dl)	41 ±9.42	46 ±9.95	0.004
LDL (mg/dl)	111.56±25	106 ±21.29	0.037
TG (mg/dl)	119 ±83.31	129 ±58.57	0.551
Total cholesterol (mg/dl)	183 ±34.73	168 ±27.21	0.015

DISCUSSION

Metabolic syndrome continues to increase in both developed and developing countries, and has already become a major threat to the global public health [6]. The research showed that regular physical activity generally improves blood lipid profiles in subjects with different age and fitness levels [22,23]

This study examines the role of 12 session aerobic exercise on indicators of metabolic syndrome with emphasis on changes in insulin resistance and lipid profile in obese women. Given that the women were healthy and only obese, and hadn't no metabolic disease, In this study, the role of exercise on changes in insulin resistance and lipid profile have examined.

Although the present study did not include a complete diet, but significant decrease it occur in body fat percentage and body mass index. Changes in body composition as a result of exercise are often associated with weight loss, reducing body fat and as well as a slight increase in lean mass. This is due to extra calories consumed and doing exercise training that is very important. Several studies have shown that exercise training has a fine effect on body

weight in overweight subjects and it can cause fat to be released [23,24,27,30]. Our result in this case is consistent with other reports.

In this study a three-month aerobic exercise leads to lower levels of total cholesterol and low-density lipoprotein in obese women than in the control group. Obesity is characterized by an impaired ability for fat mobilization and utilization, and aerobic exercise training is able to contract this metabolic dysfunction [30]. Indeed, physical activity enhances catecholamine secretion [31], and elevated catecholamine stimulates lipolysis via β adrenergic receptors, which are particularly abundant in visceral fat [32]. The most important result of the present study is finding favorable changes of 12-week aerobic training program on blood lipid profile and insulin resistance. Performed researches in this regard suggests that aerobic exercise reduces low-density lipoprotein cholesterol levels and the results of this study are consistent with other research in this area [24,27,30].

The impact of exercise training on the lipid profile is variable. Furthermore, the results showed the variation in HDL-C levels was significant that indicate the effect of exercise on changes HDL. A significant factor is atherogenic. Our finding that HDL-C increases with exercise is consistent with previous results [33, 34, 35, 36] However, not all studies have found gains in HDL-C following aerobic training [37, 38] this absence of gains have been justified with the higher initial levels of HDL-C, and with the lower exercise intensity. Also our finding showed TC, LDL-C levels diminish with exercise training. [33,34]. Some studies [33,34,39,40] have reported low-density lipoprotein cholesterol reductions after aerobic and resistance training.

Accordingly, Cox and colleagues [39] have demonstrated lower TC and LDL-C after 6 months of higher-, but not lower-, intensity exercise in middle and older sedentary women. However,

Sillanpaa and colleagues [38] failed to attain changes on TC, TG and LDL-C after 21-week of high-intensity endurance and heavy resistance strength training in healthy 40-65-year-old men. Independent of the mechanism underlying lipid changes, a reduction of 1% on TC has been shown to reduce the risk for coronary artery disease by 2% [42], which implies that our exercising participants have reduced about 12% their risk. Moreover, a 1% reduction in LDL-C reduces the risk of major coronary events by approximately 2% [43], which means that we have about a 26% gain. Further studies are indicated that reduce in LDL-C and total cholesterol levels also increase in HDL-c can prevent from the risk of heart disease and insulin resistance. [33, 34, 39, 40].

Our study did not find any blood pressure reductions after exercise training. of course The average blood pressure in subjects was normal and were not affected by hypertension. Also, triglyceride levels did not show a statistically significant decrease. Some reports indicate that levels of triglyceride in response to aerobic exercise program are reduced [37,43,44] Although, our finding do not support from this fact, it seems due to the long duration exercise in the present study, the lack of reduction in triglyceride levels can be caused by excess uptake triglycerides in subjects' diet. Another study demonstrated a trend toward triglyceride level reductions after resistance training only [45] whereas others did not find any change after aerobic, resistance, and combined training [46].

The result showed fasting glucose and value HOMA-IR decrease after exercise program in test group. Several studies have demonstrated direct relation between physical activity and insulin sensibility [47,48,49,50]. It has been demonstrated that one single physical exercise session increases the glucose disposition by means of the insulin in normal subjects, in individuals with insulin resistance who are blood relatives of individuals with diabetes type 2, in obese individuals with insulin resistance as well as in individuals with diabetes type 2, and the chronic physical exercise improves the insulin sensibility in healthy individuals, non-obese, non-diabetic and in individuals with diabetes types 1 and 2 [51,52]. The mechanism through which these exercise modalities improve the insulin sensibility seems to be different [53].

The investigators have also reported that exercise training with different intensity cause to improving insulin sensitivity in people with mild insulin resistance [54,55]. As Despres *et al.* Reported that the improvement in insulin resistance may play a central role in lipid metabolism [56], Indeed, insulin inhibits hormonal sensitive lipase in adipose tissue (decrease in circulating free fatty acid), stimulates lipoprotein lipase (metabolism of triglyceride-rich lipoproteins) and lecithin cholesterol acyl transferase (transforming HDL3 in HDL2), modulates hepatic lipase activity (HDL catabolism), and activates LDL receptors (LDL catabolism). In addition, it has been demonstrated that insulin inhibits phospholipid transfer protein (PLTP) and cholesteryl ester transfer protein (CETP) [57]. Plasma

CETP reduces HDL-C levels through the transfer of cholesteryl esters from HDL toward very low density lipoprotein (VLDL) and LDL leading to a plasma lipid phenotype with higher atherogenicity [58].

CONCLUSION

The main finding of this study is that aerobic exercise program resulted in positive changes in important cardiovascular risk factors, namely TC, LDL-C, HDL-C, DBP, BMI, and HC, in obese women. Also it can be said the exercise training improves the lipid profile and reduces the insulin resistance. All these effects are beneficial and help controlling obesity and other co-morbidities.

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