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Research Article

EFFECT OF CHRONIC AEROBIC TRAINING ON SOME INDICATOR OF METABOLIC SYNDROME IN DIABETES PATIENTS

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ABSTRACT
According to the population studies, impaired lipid profiles were observed in obesity, metabolic syndrome and type 2 diabetes. To estimate the effect of exercise training on lipid profile marker in diabetes patients, fasting venous blood samples were obtained before and after three months aerobic exercise (3 time /weekly) at 60-80 (%) of maximal heart rate in order to measuring lipid profile markers of twenty eight sedentary adult males with type 2 diabetes (age, 43±6 year; body mass index, 31±3 kg/m2 that divided to experimental (exercise training, n=14) and control (no training, n=14) groups. Statistical analysis was performed with the SPSS software version 15.0 using an independent paired t-test. Data were considered significant at $P<0.05$. Exercise program was associated with improvement in anthropometrical markers ($p<0.05$). No significant change was found in TC, LDL and HDL by aerobic training in experimental group ($p<0.05$). TG, TG/HDL and TC/HDL improved significantly after exercise intervention ($p<0.05$) but not in the control groups. In conclusion, aerobic training program for long term can be improving cardiovascular risk factors in patients with type II diabetes.

Keywords: *Exercise, Lipid Profile, Diabetes*

INTRODUCTION
Obesity and overweight are most common of metabolic disorders and predictor of the prevalence of some chronic disease such as type II diabetes, metabolic syndrome and cardiovascular disease. On the other hand, type 2 diabetes mellitus (T2DM) is the most common endocrine disorder worldwide and incidence rates are approaching epidemic proportions (Wild *et al.,* 2004). The dyslipidemias present in the metabolic syndrome and in diabetes predispose to heart disease (Puglisi *et al.*, 2008).

Extensive studies have mentioned that sedentary or inactivity is as a stronger predictor than risk factors such as hypertension, hyperlipidemia, diabetes, and obesity for all-cause mortality (Myers *et al.*, 2004).

Several important factors increase the risk of cardiovascular disease in these patients that named cardiovascular risk factor. The most common of these factors are increased triglyceride (TG), total cholesterol (TC) and low density lipoprotein (LDL) as well as decreased high density lipoprotein (HDL) (Stirban *et al.,* 2008) and they are associated with insulin resistance, hyperglycemia and hypertension (Hirani *et al.,* 2008). It has been previously reported that increased serum TC, triglycerides, LDL, VLDL, glycated haemoglobin (HbA1c), low concentration of HDL and increased body mass index (BMI) are significantly associated with coronary heart disease (McEneny *et al.*, 2000). There is some evidence that the prevalence of coronary artery disease in type II diabetes patients is 2–4 folds of non-diabetes subjects (Evans *et al.*, 1999).

Regular exercise offers protection against all cause mortality and a growing body of evidence supports the notion that physical training is effective as a treatment in patients with chronic heart diseases, type 2 diabetes and symptoms related to the metabolic syndrome (Petersen *et al.*, 2006). The role of exercise training for short or long term on insulin resistance, inflammatory cytokines was investigated by several previous studies. Also, there is evidence of benefice effects of exercise on lipid profile in obese or cardiovascular subjects (Stavropoulos-Kalinoglou *et al.*, 2013). It was also reported that physical activity reduces cardiovascular morbidity in diabetic patients. But limited studies was estimated the role of aerobic training program on lipid profile markers and relation between them with anthropometrical markers in these patients. This study was aimed to evaluate the effects of three months aerobic training on anthropometrical and lipid profiles markers in males with type II diabetes.

MATERIALS AND METHODS

Subjects and Inclusion Criteria

In this study, twenty eight obese men (43±6 years old; BMI, 31±3 kg/m2, mean± standard deviation) with type II diabetes were participated by accessible sampling. Participants were non-smoker, non-alcoholic and non-athletes. The study protocol was approved by Ethics Committee of Islamic Azad University, Iran. The subjects were given an oral and written description of the study and the possible risks and discomfort involved before giving their voluntary oral and written content to participate. Inclusion criteria for study groups were determined type II diabetes for 3 years ago. Those with having history of known hyperlipidemia, hypertension, coronary artery disease, cerebrovascular disease, and peripheral artery disease were excluded. Participants were included if they had not been involved in regular physical activity/diet in the previous 6 months. Those that were unable to avoid taking hypoglycemic drugs or insulin sensitivity-altering drugs for 12 hours before blood sampling were also barred from participating in the study.

Anthropometrical Measurement

Body weight was measured in the morning following a 12-h fast. Height and body weight were measured twice, with subjects being barefoot and lightly dressed; the averages of these measurements were recorded. Body mass index was measured for each individual by division of body weight (kg) by height (m2). Waist circumference (WC) was measured with a non-elastic tape at a point midway between the lower border of the rib cage and the iliac crest at the end of normal expiration. Hip circumference was measured at the maximum circumference between the iliac crest and the crotch while the participant was standing and was recorded to the nearest 0.1 cm. Body composition monitor (BF508-Omron made in Finland) with a precision error of less than 100 g was used to measure weight and body fat percentage of the subjects.

Biochemical Measurements and Protocol

Subjects were divided into experimental (participate in exercise program) and control 9no exercise) groups. Aerobic exercise training lased 3 months (60 min, 3 days/week for 12 weeks) with percentage rate between 60 to 80 % of maximal heart rate. The exercise intensity in initial sessions was in minimum and gradually increased in subsequent sessions. Target heart rate was controlled by polar telemetry. Each session included warm up for 5-10 min, main exercise for 40 – 50 min and cool up.

Blood sampling was performed before and 48 hours after lasted session of exercise program. Venous blood was collected from subjects after an overnight fast between 8:00 a.m. and 9:00 a.m. The blood was centrifuged immediately for separate serum. Total cholesterol, HDL and LDL cholesterol and tryglicerides were measured using the colorimetric enzymatic method. Those patients unable to avoid taking hypoglycemic drugs or other therapeutic drugs within 12 hours before blood sampling or exercise were barred from participating in the study. The subjects were advised to avoid any physical activity or exercise 48 hours before the blood sampling.

Statistical Analysis

All analyses were performed using SPSS (version 15.0; SPSS Inc, Chicago, IL, USA). Normality of distribution was assessed by Kolmog- orov-Smirnov test. After calculation of the mean and the standard deviation of all variables, the statistical analysis was conducted using unpaired T-test to compare mentioned variables in experimental with control groups at baseline. Student's t-tests for paired samples were performed to determine whether there were significant within-group changes in the outcomes. An alpha-error below 5% was considered as statistically significant.

RESULTS

Data were expressed as individual values or the mean ± SD for groups. The effect of long term aerobic exercise program on lipid profile markers in adult men with type II diabetes were investigated in this

study. Data of independent T test showed no significant differences in all variables between two groups at baseline (p – 0.05, see table 1).
Baseline and post training levels of anthropometrical indexes of two groups are shown in Table 1.
Aerobic training program resulted in significant decrease in body weight (($p \leq 0.001$), abdominal circumference ($p = 0.001$), Hip circumference ($p = 0.002$) and BMI ($p \leq 0.001$) in exercise group. All anthropometrical variables remained unchanged in the control group.
Baseline and post training levels of lipid profile markers of two groups are shown in Table 2. Total cholesterol ($p = 0.116$), LDL ($p = 0.77$) and HDL ($p = 0.655$) did not significant change by aerobic training program in exercise test. Compared to pre-training, TR ($p = 0.033$) decreased significantly when compared with baseline. We also found a significant decrease in TG/HDL ($p = 0.038$) and TC/HDL ($p = 0.019$) after exercise program but serum IgE was not changed. All lipid profile markers remained unchanged in the control group. A positive correlation was found between BMI with TG/HDL after aerobic program in exercise group ($p = 0.036$, $r = 0.54$).

Table 1: Anthropometrical markers (M ± SD) at before and after exercise program of two studied groups

group	**Weight** (kg)	**AC** (cm)	**HC** (cm)	**AHO**	**BMI** (kg/m2)	**Systolic BP** (mmHg)	**Diastolic BP** (mmHg)
Exercise (pre-test)	92.4 *(7.3)*	105 *(7)*	104 *(3)*	1.01 *(0.06)*	30.73 *(2.69)*	131 *(18)*	85 *(9)*
Exercise (post-test)	89 *(7.9)**	101 *(7)**	102 *(4)**	1 *(0.04)*	29.59 *(2.73)**	123 *(19)*	82 *(8)*
Control (pre-test)	93.2 *(5.6)*	106 *(6)*	105 *(5)*	1.01 *(0.05)*	30.96 *(2.14)*	130 *(14)*	86 *(11)*
Control (post-test)	93.6 (6.1)	107 (5)	105 (6)	1.02 *(0.06)*	31.09 *(3.12)*	132 *(15)*	85 *(10)*

***Abbreviations**: **BMI**, body mass index; **AC**, Abdominal circumference; **HC**, Hip circumference deviation.*
Data are Mean and Standard deviation
** represent significant changes compared to baseline levels.*

Table 2: Lipid profile markers (M ± SD) at before and after exercise program of two studied groups

Variables	**Exercise diabetic**		**Control diabetic**	
	Before exercise	**After exercise**	**Before exercise**	**After exercise**
TG (mg / dl)	177 *(67)*	147 *(37)*	181 *(56)*	176 *(48)*
TC (mg / dl)	203 *(36)*	193 *(23)*	211 *(37)*	202 *(29)*
LDL (mg / dl)	123 *(27)*	121 *(19)*	126 *(31)*	127 *(21)*
HDL (pg/ml)	46.4 *(5.5)*	47.1 *(2.9)**	45.8 *(3.2)*	44.1 *(2.8)*
TC/HDL	4.35 *(0.4)*	4.09 *(0.38)**	4.61 *(0.9)*	4.74 *(0.8)*
TG/HDL	3.84 *(1.48)*	3.10 *(0.69)**	3.95 *(0.71)*	3.99 *(0.63)*

***TG**, Triglyceride; **TC**, Total cholesterol; **LDL**, Low density lipoprotein; **HDL**, high density lipoprotein*
Data are Mean and Standard deviation
** represent significant changes compared to baseline levels.*

DISCUSSION

In this study, despite the insignificant changes of some lipid profile indices after three months aerobic exercises in diabetic patients, serum levels of triglyceride as one of the main cardiovascular risk factors significantly decreased. However, change pattern of other risk factors improved in response to exercise intervention. Yet, it was not statistically significant. The insignificance of these changes can probably be attributed to the small number of subjects under study as compared to previous research. Nevertheless, some recent studies have also implied the lack of cardiovascular risk factors variation but not in diabetic patients (Januszek *et al.*, 2014).
According to the population studies, it has been indicated that Type 2 diabetes is associated with an excessive risk of cardiovascular events (Williams *et al.*, 2002).

Diabetes (especially, type II) is almost accompanies with lipid metabolism disruptions. The increase of plasma fatty acids levels plays a critical role in enhancing insulin resistance. In addition, fatty acids result in dyslipidemia in diabetes mediated by the increase of VLDL synthesis in liver, cholesterol carrier proteins, LDL increase, and HDL decrease. This atherogenic performance of lipoproteins (LDL increase and HDL decrease) leads to the induction of arthrosclerosis and the increase of cardiovascular diseases risk which is the most prevalent cause of diabetes II mortality (Steinmetz *et al.*, 2003).

Much evidence suggests that show that regular physical activity prevents or at least delays the development of T2D Min those at risk (Tuomilehto *et al.*, 2001; Knowler *et al.*, 2002). In this area, Review of research evidence shows that exercise training for long time can help those with T2DM achieve a variety of goals, including weight loss, increased cardio-respiratory fitness and improved lipid profile (Sigal *et al.*, 2006).

The significant improvement of HDL in response to long term exercises in fat populations or diseases related to obesity has been reported by some studies before. That is, these studies have implied the significant increase of HDL after exercise program (Stavropoulos-Kalinoglou *et al.*, 2013; Di Raimondo *et al.*, 2013). However, despite the results of the abovementioned studies, HDL serum levels in response to three months aerobic exercise did not change in this study. Although this lack of change was attributed to the small number of specimens under study, results showed that TG/HDL and TC/HDL ratios among other important cardiovascular health factors were significantly reduced in response to exercise program. The reduction of both these ratios supports the reduction of cardiovascular risk profile in response to exercise program in patients under study in one way or another. This is because scientific references have implied the increase of cardiovascular diseases when triglyceride (or bad cholesterol) to HDL ratios increase.

Many studies have demonstrated that weight loss by exercise but not diet decreases skeletal muscle inflammatory gene expression in frail obese elderly persons (Charles *et al.*, 2008). Marked evidence indicates that, independently of BMI, regular physical activity is associated with lower risk of all cause mortality (Hu *et al.*, 2005).

Some studies have attributed the improvement of lipid profile indices or cardiovascular risk factors in response to exercise program to the reduction of weight and body fat percentage (Mikkelsen *et al.*, 2013). Results of the present study also showed that three months of aerobic exercise leads to the significant decrease of anthropometrical indices such as weight, belly circumference, BMI, and body fat percentage in asthma patients under study. It is possible that the reduction of the ratio of cardiovascular risk factors to HDL is resulted from body weight loss. In the same vein, positive significant relationship was observed here between BMI and TG/HDL after exercise program. In the end, it is implied that the small number of specimens under study is the main limitation of this research. Perhaps, if this number was further, significant changes were observed in other variables.

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