Original Article

Aerobic Exercise

Effects of Aerobic Exercise on Lipid Profile in Patients with Type 2 Diabetes (NIDDM)

1. Ghulam Murtaza Kaka 2. Mumtaz Ali Memon 3. Asmat Kamal Ansari

1. Asstt. Prof. of Physiology, GMMC, Sukkur 2. Prof. of Physiology, Isra University Hyderabad 3. Asstt. Prof. of Physiology, CMC, Larkana

ABSTRACT

Objectives: This study was undertaken to observe the effects of aerobic exercise on lipid profile in newly diagnosed type 2 diabetic patients.

Study Design: Observational study

Place and Duration of Study: This study was conducted at Physiology Department, JPMC Karachi from December 2001 to May 2002.

Materials and Methods: 30 adult male subjects with uncomplicated type 2 diabetes were selected from diabetic clinic of JPMC, Karachi. 30 apparently healthy adult male subjects were selected from friends, students and staff members of BMSI, as control. The subjects belonging to diabetic groups were then briefed about exercise protocol, which consisted of a regular brisk walk of 30 minutes on alternate days per week for 60 days.

Results: Base line Values of mean HDL-cholesterol serum cholesterol, serum total triglycerides, LDL- cholesterol, and mean fasting blood glucose were significantly different in diabetic groups as compared to control group ($P<0.001$) After aerobic exercise, all the parameters except HDL-C were significantly decreased while HDL-C was significantly increased as compared to the pre-exercise values.

Conclusion: Regular aerobic exercises improve blood glucose, TAG, LDLc and cholesterol and increases the HDLc in type 2 diabetic subjects has been concluded by the present study.

Key Words: HDL-C, LDL-C, Triglycerides, Aerobic exercise.

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INTRODUCTION

The incidence of non- insulin dependent diabetes mellitus (type 2 diabetes) has increased world wide during the last decades, despite the development of effective drug therapy and improved clinical diagnosis. Physical activity exerts pronounced effects on substrate utilization and insulin sensitivity, which in turn potentially lowers blood glucose and lipid levels. Exercise training improves many physiological and metabolic abnormalities that are associated with type 2 diabetes such as lowering body fat, reducing blood pressure ad normalizing dyslipoproteinemia[1]. Physical inactivity is an important risk factor and aids to other risk factors, such as obesity, high blood pressure and low level of HDL-C. A successful exercise program involves frequent physical activity that is rhythmic and repetitive, according to health experts. It should challenge your cardiovascular system and use large muscles, the exercise program must significantly increase the blood flow to the muscles for an extended period of time, promoting cardiovascular fitness[2]. Biological mechanisms that contribute to the lower risk associated with activity include improved lipoprotein profile and carbohydrate metabolism, lower blood pressure and weight loss[3]. Overweight subjects have worsening of all the elements of the cardiovascular risk profile, including dyslipidemia, hypertension, insulin resistant glucose intolerance, left ventricular hypertrophy, hyperuricemia and elevated fibrinogen[4]. Exercise-trained and physically active individuals generally exhibit lower plasma concentrations of triglycerides and higher levels of HDL-C than their untrained, sedentary counterparts[5]. Regular aerobic exercise elicits significant inhibition of ADP- and collagen-induced platelet aggregation as well as prolongation of PT INR and a PTT values without significantly altering lipoproteins[6].

Correspondence: Dr. Ghulam Murtaza Kaka
Assistant Professor Physiology
Indus Medical College, Tando Mohammad Khan, Hyderabad.
contact No.: 0334-2995071
E-mail: drgulammurtazakaka@gmail.com

MATERIALS AND METHODS

Newly diagnosed adult male subjects suffering from uncomplicated type 2 diabetes (NIDDM); who have not yet started any medication were included in this study. Subjects suffering from any acute or chronic disease other than type 2 diabetes. And those performing any regular exercise were excluded from this study.

Selection of Subjects: A total of 60 male subjects were selected from general population of Karachi for this study. Out of which, 30 apparently healthy adult male subjects (as control group). Group B (test group) a total of 30 adult male subjects with uncomplicated type 2 diabetes were selected from diabetic clinic JMPC, Karachi. The subjects belonging to groups B were then detailed about exercise protocol, which consisted of a regular brisk walk of 30 minutes on alternate days per week for 60 days. Initially a detailed medical history was taken from each subject and physical examination performed. Body weight was recorded and height was measured.in meters and BMI was calculated. Baseline blood samples were drawn for blood glucose and serum lipid levels before the start of study on the day of each subject's physical examination. Physical examination was also performed and blood samples for blood glucose and serum lipid levels collected from all the three groups at the end of study period of 60 days.

Methods of Estimation: Enzymatic Colorimetric method was used to estimate Serum glucose, Serum triglycerides and Serum cholesterol Serum HDL-cholesterol was determined by using Kit, Cat. No. 1001095. LDL-cholesterol was calculated according to frieldwald formula (Fireldwald, et al., 1972).

RESULTS

The observations of all the studied subjects were recorded on various parameters, at baseline and after two months of aerobic exercise (brisk walking for 30 minutes).

Table 1 shows age, Weight, and BMI of the study subjects baseline. When the age, weight and BMI of group B was compared with group A, the change was found to be statistically significant (P<0.001).

Table 2 shows total cholesterol, triglycerides, HDL-cholesterol, LDL-cholesterol and blood glucose of group A, and B before aerobic exercise. When mean serum cholesterol, mean HDL-cholesterol, mean LDL-cholesterol, mean serum total triglycerides, and mean fasting blood glucose were compared between group A and B a significant difference was found (P<0.001).

Table 3 shows total cholesterol, total triglycerides, HDL-cholesterol, LDL-cholesterol, and fasting blood gulcose of group A and B after aerobic exercise. The results of comparison between groups group B with group A showed significant change in the mean value of all parameters.

Table 4 shows the change in serum total cholesterol, HDL-cholesterol, LDL-cholesterol, total triglycerides and fasting blood glucose of patients with type 2 diabetes (group B) after aerobic exercise. The mean value of serum total cholesterol was deceased was by 10.37% (P<0.001). MeanHDL-cholesterol was increased by 25.30% (P<0.001). Mean LDL-cholesterol was decreased by 13.44% (P<0.001). Mean total triglycerides were reduced by 29.63% (P<0.001). Mean fasting blood glucose was reduced by 30.20% (P<0.001).

Table No.1: Comparison of age, weight, height and body mass index of control (group A) with type 2 diabetic (group B before aerobic exercise

Group	Parameters			
	Age (Years)	Weight (Kg)	Height (m)	BMI (Kg/m^2)
A (n=30	38.10± 1.00	70.30± 0.90	1.80± 0.00	22.60± 0.30
B (n=30)	41.00± 0.80	80.50± 0.00	1.80± 0.00	25.70± 0.50
A vs B	P<0.001	P<0.001	N.S	P<0.001

All values are expressed as Mean ±SEM.
N.S. = Non-significant

Table No.2: Comparison of total cholesterol, triglycerides, HDL-C, LDL-C and serum glucose levels of control (group A) with type 2 diabetic (group B) before aerobic exercise

Group	Perameters				
	Total Cholesterol (mg/dl)	HDL-C (mg/dl)	LDL-C (mg/dl)	Triglycerides (mg/dl)	F.Serum Glucose (mg%)
A	173.50± 1.70	41.20 ±0.90	109.00 ±2.10	115.20± 3.00	92.40 ±1.60
B	193.70± 3.10	33.20 ±0.50	127.90 ±3.20	163.00± 2.90	134.70 ±1.90
AvsB	P<0.001	P< 0.001	P< 0.001	P< 0.001	P< 0.001

All values are expressed as Mean ±SEM

Table No.3: Comparison of tatal cholesterol, triglyceride, HDL-C, LDL-C and serum glucose levels of control (group A) with Type2 diabetic (group B) after aerobic exercise

Group	Perameters				
	Total Cholesterol (mg/dl)	HDL-C (mg/dl)	LDL-C (mg/dl)	Triglycerides (mg/dl)	F.Serum Glucose (mg%)
A	173.50± 1.70	41.20 ± 0.90	109.00 ± 2.10	114.00± 3.10	91.50 ±1.20
B	173.60± 1.70	41.60 ±1.20	110.70 ±2.30	114.70± 2.90	94.00 ±1.60
AvsB	N.S	N.S	N.S	N.S	N.S

All values expressed as Mean ±SEM.
N.S. = Non-significant.

Table No.4: The change in serum total cholesterol, HDL-C, LDL-c, triglycerides and serum glucose levels in type 2 diabetic subjects (group B) After aerobic exercise

	Before aerobic Exercise	After aerobic Exercise	% change	P-value
TC	193.70± 3.10	173.60± 1.70	(-) 10.37	<0.001
HDL-C	33.20± 0.50	41.60± 1.20	(-) 25.30	<0.001
LDL-C	127.90± 3.20	110.70± 2.30	(-) 13.44	<0.001
TG	163.60± 2.90	114.70± 2.90	(-) 29.63	<0.001
Glucose	134.70± 1.97	94.00± 1.60	(-) 30.20	<0.001

All values are expressed ad mean ± SEM, N.S.- Non-significant.
(-) Shows decrease in pecentage change after aerobic exercise.
(+) Shows increase in percentage change after aerobic exercise.

DISCUSSION

Hypertension and type-2 diabetes are common inter-related medical problems that are associated with an increased risk of cardiovascular disease[7.] Exercise has been shown to decrease the risk factors and produce favorable changes in blood pressure, blood lipids and blood glucose levels[8,9,10.] Hyperlipidaemia is frequently associated with diabetes and is often considered a major determinant of its atherosclerotic squealae[4]. Hyperlipidaemia has also been associated with hypertention[11]. And increased risk of coronary heart disease[12,13.] In our study we also found that the serum cholesterol and triglycerides levels in type-2 diabetics were significantly higher as compared to the normal subjects. We observed significant decreased in total cholesterol and triglycerides after having aerobic exercise of 2 months period in type 2 diabetics (P<0.001). Aerobic exercise has been invastigated as a potential method of altering the levels of lipids and lipoproteins as exercise has been shown to increase metabolic rate by using fatty acid as fuel. It has been suggested that the lipolytic effect of aerobic exercise is due to selective increase in β_1 adrenergic activity[14,15]. Our study revealed that HDL-cholesterol in group B was low at the baseline than the recommended range which was significantly improved after the exercise training programme of 2 months[16]. Found that changes in HDL-cholesterol concentrations showed greater increases after exercise training. This finding is also in agreement with the findings of many different researchers[14]. The beneficial effect of an increase in HDL cholesterol is also well documented[17,18]. HDL-C concentration has been found to be inversely related to coronary heart disease[19] because of its antiatherogenic role[17].

The protective effect of HDL-C against atherosclerosis and hence hypertension and coronary heart disease has been shown to be due to its competitive inhibition of LDL-C incorporation into endothelial cells and mobilization of cholesterol away from the atherosclerotic lesion[20]. Levels of cholesterol, LDL-C and triglycerides have been shown to have a direct relationship with coronary heart disease[17] and in this regards diabetics have been found to have higher levels of LDL-C and triglycerides[9] The results of our study, found significant reduction in LDL-C in type 2 diabetics (P<0.001). A Postulated machanism of hypercholesterolemia is increased production of oxygen free redicals that may be responsible for impaired endothelium dependent relaxation due to destruction of nitric oxide, Aerobic exercise has been shown to prevent this destruction and increase the production of nitriic oxide[5]. A study by Amstrong and Welsman[21] found that physical activity has on beneficial effect on lipid and lipopoprotein levels; however other studies[11,22] are in agreement to our finding that aerobic exercise causes a decrease in the levels of total cholesterol, LDL-C and triglycerides and increase HDL-C levels. Some of the potential mechanism by which exercise modifies plasma and lipoprotien profile are related to increases in lipoprotien lipase (LPL) and lecithin cholesterol acid trandferase (LCAT) activity. HDL contains LCAT, and the enzyme catalyzes a reaction that gathers free cholesterol and returns it to the liver. LPL decreases HDL_2 breakdown and increases the use of triglycerides (HDL_2 is a major class of HDL). In addition, exercise lowers triglycerides by increasing insulin receptor activity and reduces abdominal body fat. Abdominal fat, commonly seen postmenopausally, is associated with decreased liver LPL activity, impairing the breakdown of triglycreides. Therefore the therapeutic effects of physical exercise have become a widely used strategy to reduce the risk of CVD[12].

CONCLUSION

The present study concludes that the aerobic exercises improve blood glucose, TAG, LDLc and HDL cholesterol in type 2 diabetic subjects. Aerobic exercise reduces bad cholesterol (LDLc) and increases the good cholesterol (HDLc) and thus may reduce the chances of atherosclerotic disease in diabetics.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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