Journal of Physical Activity and Hormones
Vol 1, No. 1, Ser. 1 (Jan 2017), 001-010

Effects of short term lifestyle activity modification on lipid profiles in obese and overweight middle aged men with type 2 diabetes

Jalil Ghasemianpoor [1*]
Mohadeseh Nematollahzadeh Mahani [1]

Received: 12 October 2016 / Accepted: 11 December 2016

(1) The General Department of Fars Province Education
(*) MS in Exercise Physiology
e.mail: j.ghasemianpoor@gmail.com

Abstract

Introduction: Diabetes care involves more than glycemic control and it is important to manage other cardiovascular risk factors. Along with dietary and pharmacological interventions, exercise is a key element of diabetes management. The aim of this study was to determine the effects of short term lifestyle activity modification (LAM) on lipid profiles obese and overweight middle aged men with type 2 diabetes.

Material & Methods: Sixteen obese and overweight middle aged men (age, 35-50 years) with type 2 diabetes participated in this study. The subjects were randomly assigned to LAM group (n=8) or control group (n=8). The subjects in LAM group walked 2 miles in 30 minutes on a treadmill on 4 days per week for 12 weeks according to the guidelines of the Centers for Disease Control and Prevention and American College of Sports Medicine.

Results: The results showed that total cholesterol (TC), triglycerides (TG) and LDL-c were decreased and Apolipoprotein A1 (Apo A1) and HDL-c increased in the LAM group compared to the control group ($P<0.05$). For Apolipoprotein B (Apo B) no significant change was observed after the intervention.

Conclusions: In conclusion, lipid profiles were improved after 12 weeks LAM in obese and overweight middle aged men with type 2 diabetes.

Key words: Lipid profiles, Obesity, Type 2 diabetes, Short term exercise

1. Introduction

The prevalence of type 2 diabetes has reached epidemic proportions world-wide. In 2011 there were 366 million people with diabetes and this is projected to increase to 552 million by 2030 with most people with diabetes living in low- and middle-income countries (1).

Diabetes care involves more than glycemic control and it is important to manage other cardiovascular risk factors including obesity, hypertension, and dyslipidemia. Along with dietary and pharmacological interventions, exercise is a key element of diabetes management. Although studies have evaluated the effects of exercise on various cardiovascular risk factors in people with type 2 diabetes, their findings have been inconsistent. Shantakumari et al. (2013) reported that after intervention with yoga for a period of 3 months, TC, TC and LDL-c were decreased and HDL-c was increased in the diabetes patients with dyslipidemia (2). However, Gordon et al. (2008) noted that TC level was decreased after six month exercise in type 2 diabetes patients, but no significant differences were found in the concentrations of LDL-c and HDL-c between the training and control groups (3). Centers for Disease Control and Prevention (CDC) and American College of Sports Medicine (ACSM) suggest that the accumulation of 30 minutes of moderate intensity physical activity on most days of the week (lifestyle activity modification or LAM) will produce significant health benefits (4). It is important to investigate whether or not these activity guidelines improve the health in type 2 diabete patients by alter the blood lipid profiles. Thus we examined the effects of short term LAM on blood lipid profiles in obese and overweight middle aged men with type 2 diabetes.

2. Material & Methods

Subjects

Fifty sedentary obese and overweight middle-aged men enroll and volunteered to participate in this study. All the people were asked to complete a personal health and medical history questionnaire, which served as a screening tool. Sixteen type 2 diabetic with a mean (±SD) body mass index of 31.2 ± 4.1 kg/m^2 selected as the subject after screening by inclusion criteria. All the subjects had slightly insulin resistance and all of them were complete inactive at least 6 month before the study and they were nonsmokers and free from unstable chronic condition including dementia, retinal hemorrhage and detachment; and they have no history of myocardial infarction, stroke, cancer, dialysis, restraining orthopedic or neuromuscular diseases. Thereafter, the subjects were randomly assigned to a control group (n=8) or LAM group (n=8). The subjects were given both verbal and written instructions outlining the experimental procedure, and written informed consent was obtained.

Exercise training

The subjects in the LAM group walked 2 miles at 30 minutes (40-59% maximal oxygen consumption [VO_{2max}]) on a treadmill without incline on 4 days/week for 12 weeks according to the CDC and ACSM guidelines.

Anthropometric and body composition measurements

Height and body mass were measured, and body mass index (BMI) was calculated by dividing body mass (kg) by height (m^2). Waist circumference was determined by obtaining the minimum circumference (narrowest part of the torso, above the umbilicus) and the maximum hip circumference while standing with their heels together. The waist to hip ratio (WHR) was calculated by dividing waist by hip circumference (cm) (5). Fat mass and lean body mass were assessed by bioelectrical impedance analysis using a Body Composition Analyzer (Biospace, Inbody 3.0, Jawn, Korea).

Biochemical analyses

Fasting blood samples were collected at rest (before training) and 48h after last session of training. All the subjects fasted at least for 12 hours and a fasting blood sample was obtained by venipuncture. Serum TC and TG levels were measured by enzymatic kits (Mann Chemical Company) using an auto analyzer. LDL-c and HDL-c were measured by an Auto analyzer using commercial kits (Pars Azema Company, Teheran, Iran).

Statistical analysis

Results were expressed as the mean $\pm$ SD and distributions of all variables were assessed for normality using kolmogorov-smirnov test. Data were analyzed using independent and paired sample t-test. The level of significance in all statistical analyses was set at $P<0.05$. Data analysis was performed using SPSS software for windows (version 17, SPSS, Inc., Chicago, IL).

3. Results

All data were not significant for normality check. Anthropometric and body composition characteristics of the subjects before and after training are presented in Table 1. Before the intervention, there were no significant differences in any of variables among the two groups. Body weight, BMI, fat mass, body fat percent and WHR decreased ($P<0.05$) after 12 weeks LAM training compared to the control group.

Table 1. Anthropometric and body composition characteristics (mean ± SD) of the subjects before and after training

	Control		LAM	
	Pre	Post	Pre	Post
Body mass (kg)	90.4 ± 13.9	90.6 ± 14.1	86.1 ± 4.6	84.1 ± 4.3(ab)
BMI (kg/m^2)	32 ± 5.3	32.1 ± 5.3	30.3 ± 2.1	29.5 ± 2.1(ab)
Body fat (%)	31.4 ± 5.5	31.4 ± 5.5	30 ± 3.4	28.1 ± 3.2(ab)
WHR	0.99 ± 0.08	0.99 ± 0.08	0.96 ± 0.03	0.95 ± 0.03(ab)

(a) $P<0.05$ for between-group differences.
(b) $P<0.05$, pretraining *vs.* posttraining values.

Our results showed that TC, TG and LDL-c were decreased and Apo A1 and HDL-c increased in the LAM group compared to the control group ($P<0.05$). For Apo B no significant change was observed after the intervention (Table 2).

Table 2. Metabolic characteristics (mean ± SD) of the subjects before and after training

	Control		LAM	
	Pre	Post	Pre	Post
TC (mg/dl)	169.3 ± 16.5	179.3 ± 44.1	188.3 ± 30.6	153.6 ± 23.2(ab)
TG (Mg/dl)	170.1 ± 118.4	204.3 ± 122.3	266.0 ± 94.2	123.5 ± 22.3ab
LDL-c (mg/dl)	99.7 ± 39.7	106.5 ± 41.0	94.2 ± 21.3	66.7 ± 16.5(ab)
HDL-c (mg/dl)	41.5 ± 9.1	40.3 ± 8.6	34.7 ± 8.0	37.3 ± 8.1(ab)
Apo A1 (mg/dl)	80.7 ± 14.5	79.5 ± 14.4	79.1 ± 21.6	91.3 ± 16.3(ab)
Apo B (mg/dl)	105.1 ± 29.5	103.5 ± 26.7	104.6 ± 16.1	95.1 ± 14.2

(a) $P<0.05$ for between-group differences.
(b) $P<0.05$, pretraining *vs.* posttraining values.

4. Discussion

Dyslipidemia is one of the major risk factors for cardiovascular disease in diabetes mellitus. The characteristic features of diabetic dyslipidemia are a high plasma TG concentration, low HDL-c concentration and increased concentration of LDL-c particles (6). Exercise is a key element of diabetes management and the aim of this study was to determine the effects of LAM on lipid profiles in obese and overweight middle aged men with type 2 diabetes.

The present study demonstrates that after 12 weeks LAM training, TC (18.4%), TG (53.5) and LDL-c (29.1) were decreased and Apo A1 (15.4%) and HDL-c (7.4%) increased in obese and overweight middle aged men with type 2 diabetes ($P<0.05$). Previously, Shantakumari et al. (2013) also reported that TC, TC and LDL-c were decreased and HDL-c was increased after 3 months yoga training in the diabetes patients with dyslipidemia (2); however, Holme et al. (2007) indicated that Apo B but not LDL-c is reduced by exercise training in overweight healthy men (6). Differences in the type and duration of exercise performed and type of the subjects maybe important factors in explaining these contrasting results.

The beneficial effect of exercise in cardiovascular diseases prevention in type 2 diabetes patients has been postulated to work mostly through increased HDL-c and improved carbohydrate metabolism. The superiority of ApoB vs LDL-C as a correlate to increased physical fitness was clearly demonstrated; however Aporatio was the best lipid correlate to changes in physical fitness. Aporatio or ApoB were almost not affected in their association to changes in fitness when LDL-c or LDL-ratio was adjusted for, i.e. apolipoproteins seem to be better and more robust markers of the effects. When changes in ApoB or Aporatio were kept constant increased fitness tended to be associated with increased LDL-c or LDL-ratio, i.e. a completely reversed direction compared to the unadjusted associations. It would appear that LDL-c particle distribution has changed towards an increased abundance of a more large and buoyant type with less atherogenicity based on the findings of the apoB/LDL-c ratio (8).

Day-to-day monitoring of LDL-c in exercise change behavior may thus be less predictive of prevention than using ApoB, which seems to follow fitness changes better than using the classical cholesterol content of whole serum or isolated lipoproteins. This mimics the argument of using apolipoproteins rather than lipoprotein cholesterol to monitor residual risk in statin treatment of cardiovascular disease high risk subjects (9).

Gill et al. (2006) reported that a 90-min treadmill walk in the afternoon before a fat tolerance test greatly reduced the postprandial concentration of chylomicrons and VLDL, as well as their apolipoprotein composition (10). There is, however, limited understanding of the underlying mechanisms by which increased exercise may change the lipoprotein profile. The association between changes in physical fitness and changes in apoB or apoB/apo A1 was attenuated, but still statistically significant, if adjustments were made for changes in waist circumference. Statistically, there seems to be at least two alternatives by which changes in fitness might be related to changes in apolipoproteins, one is through the relationship between waist circumference and apolipoproteins as also observed in our data, and additionally through a direct relationship between reduced TG and increased physical fitness. Part of the physiological basis for these associations could be that increased physical activity enhances the activity of skeletal muscle lipoprotein lipase, catalysing the catabolism of chylomicrons and VLDL, and also the activity of lecithin: cholesterol acyltransferase but reduces the activity of hepatic lipase. Thus, increased physical activity may reduce apo B through promoting an increased VLDL and chylomicron catabolism (7).

Exercise can improved lipid profiles. A meta-analysis suggested that every 1 mmol/L reduction in LDL-c reduced coronary heart death by 22%, major cardiovascular events by 21% and all-cause mortality by 9% (11). This would translate into a reduction of 4.4% coronary disease death, 4.2% coronary heart disease and 1.8% all-cause mortality with exercise. While the effect on LDL-c is less than seen with statins (0.19 mmol/L), it is comparable to the effects of fibrates (-0.23 mmol/L), or diet/surgery (-0.17 mmol/L) (12). Observational studies suggest that the risk of developing coronary artery disease decreases by 2–3% for every 1 mg/dl increase in HDL-C (13). It is suggested that 1500 kcal/week would be required to improve HDL-c levels; the average intensity of exercise in our studies was 13.5 MET-h/week (14,15). Thus it seems that LAM has the sufficient intensity for improves HDL-c in type 2 diabetes patients.

Despres suggested that changes in TG and HDL-c concentrations may dependent on substantial reductions in body fat mass (16). The decreasing body fat mass and BMI after 12 weeks training may respectful for decrease of TG and increase of the HDL-c respectively. Physical activity improve lipid metabolism and increases the conversion of VLDL-c to HDL-c that result activation of lipolysis of fat tissue and decreases insulin and increases glucagon which lead concentration of free fatty acids in plasma. This process effects cholesterol buildup and reduce it (17). Our results showed that after 12 weeks LAM, HDL-c level increases. The factors influencing HDL-c levels are: Increase utilizing lipids by skeletal muscle as fuel and decrease consumption glycogen (18). Also it is possible physical activity decreases homocysteine which increasing HDL-c. Some study show resistance training improves lipid metabolism by lowering the synthesis of free fatty acids and stimulating lipid oxidation (19). In the study we did not control dietary intake or measure the energy expenditure of the subjects during the study, however we asked participants do not change dietary habits.

5. Conclusion

Dyslipidemia is one of the major risk factors for cardiovascular disease in type 2 diabetes. Our results indicated that CDC and ACSM's prescription as LAM, has the beneficial for improves blood lipid profiles in obese and overweight middle aged men with type 2 diabetes.

Conflict of interests: No conflict of interests amongst authors.

References

[1] Whiting DR, Guariguata L, Weil C, Shaw J. IDF diabetes Atlas: global estimates of the prevalence of diabetes for 2011 and 2030. Diabetes Res Clin Pract 2011; 94: 311-321.

[2] Shantakumari N, Sequeira S, El deeba R. Effects of a yoga intervention on lipid profiles of diabetes patients with dyslipidemia. Indian Heart J 2013; 65: 127-131.

[3] Gordon LA, Morrison EY, McGrowder DA, Young R, Fraser YTP, Zamora EM, et al. Effect of exercise therapy on lipid profile and oxidative stress indicators in patients with type 2 diabetes. BMC Complement Altern Med 2008; 8: 21-31.

[4] Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C. Physical activity and public health, A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. J Am Med Associat, 273, 402-407.

[5] American Collage of Sport Medicine. Guidelines for exercise testing and prescription. Philadelphia: Lippincott Williams & Wilkins; 2005.

[6] Mooradian AD. Dyslipidemia in type 2 diabetes mellitus. Nat Clin Pract Endocrinol Metab 2009; 5: 150-159.

[7] Holme I, Høstmark AT, Anderssen SA. ApoB but not LDL-cholesterol is reduced by exercise training in overweight healthy men. Results from the 1-year randomized Oslo Diet and Exercise Study. J Inter Med 2007; 262: 235-243.

[8] Lamarche B, Tchernof A, Moorjani S. Small, dense low density lipoprotein particles as a predictor of the risk of ischemic heart disease in men. Prospective results from the Quebec Cardiovascular Study. Circulation 1997; 95: 69-75.

[9] Downs JR, Clearfield M, Weis S. Primary prevention of acute coronary events with lovastatin in men and women with average cholesterol levels: results of AFCAPS/TexCAPS. Air Force/Texas Coronary Atherosclerosis Prevention Study. JAMA 1998; 279: 1615-22.

[10] Gill JM, Al-Mamari A, Ferrell WR. Effects of a moderate exercise session on postprandial lipoproteins, apolipoproteins and lipoprotein remnants in middle-aged men. Atherosclerosis 2006; 185: 87-96.

[11] Kearney PM, Blackwell L, Collins R, Keech A, Simes J, Peto R, et al. Efficacy of cholesterol-lowering therapy in 18,686 people with diabetes in 14 randomised trials of statins: a meta-analysis. Lancet 2008; 371: 117-125.

[12] Briel M, Ferreira-Gonzalez I, You JJ, Karanicolas PJ, Akl EA, Wu P, et al. Association between change in high density lipoprotein cholesterol and cardiovascular disease morbidity and mortality: systematic review and metaregression analysis. Br Med J 2009; 338: b92.

[13] Maron DJ. The epidemiology of low levels of high-density lipoprotein cholesterol in patients with and without coronary artery disease. Am J Cardiol 2000; 86: 11L-14L.

[14] Ferguson MA, Alderson NL, Trost SG, Essig DA, Burke JR, Durstine JL. Effects of four different single exercise sessions on lipids, lipoproteins, and lipoprotein lipase. J Appl Physiol 1998; 85: 1169-1174.

[15] Hayashino Y, Jackson JL, Fukumori N, Nakamura F, Fukuhara S. Effects of supervised exercise on lipid profiles and blood pressure control in people with type 2 diabetes mellitus: A meta-analysis of randomized controlled trials. Diabet Res Clin Prac 2012; 98: 349-360.

[16] Despres JP. Dyslipidaemia and obesity. Baillier Clin Endocrinol Metab 1994; 8: 629-660.

[17] Marandi MS, Abadi BN, Esfarjani F, Mojtahedi H, Ghasemi G. Effects of intensity of aerobics on body composition and blood lipid profile in obese/ overweight females. Iran Int Sports Med Congr 2013; 4:118‑25.

[18] Calabresi L, Franceschini G. Lecithin: Cholesterol Acyltransferase, High-Density Lipoproteins, and Atheroprotection in Humans. Trends Cardiovasc Med 2010; 20: 50-53.

[19] Warburton DE, Nicol CW, Bredin SS. Health benefits of Physical activity: the evidence. CMAJ 2006: 174: 801-809.