Original Article

The Effect of Resistance Exercise on Lipid Profile of Coronary Artery Disease Patients: A Randomized Clinical Trial

Abstract

Background: Increased level of blood lipids is one of the risk factors for cardiovascular diseases. Considerable research has done to assess the effects of physical exercises on lipid profile, of which aerobic exercises are the main part of evidence. However, in recent years, resistance exercise has been less investigated. Thus, the present study investigates the effect of resistance exercise on lipid profile in coronary artery disease patients. **Materials and Methods:** This study was a randomized clinical trial. Forty eligible participants were selected through selective sampling and were assigned randomly to either intervention or control groups (20 participants in each group). Fasting blood sample was taken for measurement of lipid profile before, after, and after 4 weeks of the end of intervention. The intervention period lasted 8 weeks and included two exercise sessions of 45–60 minutes per week. Resistance exercise was performed by use of light weights in the range of motion of the elbow, shoulder, and knee joints. The number of repetitions was initially 10 and was gradually increased to 15. Then, the weight was increased by 3–5% and the number of sets too. Data were analyzed on significant level of $P < 0.05$. **Results:** In both the groups, the mean and mean changes of lipid profile, before, after. and 4 weeks after the end of the intervention were not significantly different ($P < 0.05$). **Conclusions:** The 8-week of resistance exercise did not lead to a significant decrease in the mean lipid profile.

Keywords: *Coronary artery disease, lipids, resistance training*

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Introduction

Cardiovascular diseases (CVD) account for the highest mortality in the world, and will likely become the first mortality cause by the year 2020.[1] In Iran, CVDs are the main mortality factor among adults and account for approximately 46% of overall deaths.[2] One of the risk factors for CVD is dyslipidemia.[3] Prevalence of dyslipidemia risk factors including high cholesterol, high triglycerides (TG), increased low density lipoproteins (LDL), and decreased high density lipoprotein (HDL) have been reported to be 40.4, 1.4, 64.51, and 78.1% among CVD patients, hospitalized in coronary care units, respectively.[4] In a recently published meta-analysis on the prevalence of dyslipidemia in Iran, prevalence of high cholesterol, high TG, increased LDL, and decreased HDL was reported to be 41.6, 46, 35.5, and 43.9%, respectively.[5] In Isfahan, Iran, prevalence of high TG and decreased HDL in women and men aged 35–65 years were 49 and 38%, and 57 and 33%,

respectively.[6] Evidences show that most of CVDs can be prevented by a healthy lifestyle and modification of the relevant known risk factors. Along with medicational treatments, nonmedicational methods are of significant importance to control and treat dyslipidemia, and consequently, reduction of CVDs.[7] Therefore, modification of lifestyle and its associated interventions are as effective as taking medication and acts as the main axis for prevention of CVDs, especially in those with dyslipidemia. It can also delay the progression of the disease in CVD patients.[8] Among different types of physical exercises, resistance exercises are at the heart of cardiology association's attention.[9] This is a type of exercise in which all movements are conducted versus a forced load or imposed pressure.[10] In other words, it is an exercise in which static or dynamic contraction is resisted by an external force, imposed either manually or mechanically.[11] Although resistance exercise has been suggested as a component of lifestyle modification

program and a nonmedicational treatment among coronary artery disease (CAD) patients with dyslipidemia, they have been scarcely welcomed by this group of patients and these exercises are not conducted for them. On the other hand, although exercises are counted as a part of nursing interventions,[12] nurses pay no attention and these exercises are not enforced by nurses. Nurses just act in medical treatment of CVD patients and rarely take part in rehabilitation. Based on the researcher's experience, CVD patients are not followed up concerning physical activity and exercises regularly and are ignored after discharge. On the other hand, research reports controversial findings concerning the effect of resistance exercise on patients' lipid profiles. In a study, resistance exercises were reported to be significantly effective on patients' cholesterol and TG reduction whereas LDL and HDL levels were steady.[13] In other studies, there was no significant effect of resistance exercise on patients' blood lipids.[14,15] The present study aimed at investigating the effect of resistance exercise on lipid profile of coronary artery disease patients.

Materials and Methods

It is a randomized clinical trial conducted in Isfahan Cardiovascular Research Center at 2014. Inclusion criteria for the patients referring to cardiac rehabilitation unit were an angiography result proving the involvement of coronary arteries, 2 months after myocardial infarction, 10 days after angioplasty of coronary arteries, and 3 months after open-heart surgery. The patients were selected and entered in the study after order of a cardiologist. Smoking cigarettes, playing elite sports, taking part in a sport program 3 months prior to the study, and limitation in physical activity were among the exclusion criteria. Absence in 3 sequential sessions of rehabilitation program and occurrence of critical health conditions were also exclusion criteria. Forty-three qualified patients were recruited through convenient sampling. After explanation of the research stages, an informed written consent was obtained from the participants. Sampling size was calculated by confidence interval of 95%, power of 80% and d = 0.9 s as 40 subjects (control = 20, study = 22, which decreased to 20 by exclusion of 2 subjects); the participants were randomly assigned to the study and control groups by random numbers table. The study was conducted for 8 weeks. In the study group, intervention was conducted as 45–60 min sessions in the morning (8–12 AM) twice a week and were held in the rehabilitation unit of Isfahan cardiovascular research center. First, data regarding demographic questionnaire, consumed medications, and history of performing physical exercises were recorded. Blood sample lipid profile measurements were administrated a day before the exercises and a day after as well as 4 weeks after the end of the intervention. Participants' weight and height were measured and recorded by a standard tape meter with no shoes and a calibrated

scale with light cloths, respectively, before the intervention. In the study group, first, routine exercises of the research center, and then, resistance exercises were conducted. In the first session, to determine the target load, weight with 12–15 repetitions in associated range of motion (ROM) was considered.[16,17] In all sessions, there were warm up, resistance exercise training, and cool down.

Warm up and cool down steps contained stretching exercises for 5–10 minutes. The resistance exercise training contained aerobic exercises (routine exercise in addition to resistance exercises conducted for 20–25 minutes). Resistance exercise was conducted by use of light weights and in the ROM of elbow, shoulder, and knee joints. Repetition number in ROM was initially considered as 10 which was gradually increased to 15. After the end of each set of exercises with 15 repetitions, the weight was increased by 3–5% and the number of sets was enhanced. In the 2nd session, the participants held their target weight in hand and conducted one set of side lateral, front and overhead raise, overhead triceps extension, alternating biceps curls, shoulder press, and squad with weight with 10 repetitions. In the 3rd to the 7th sessions, a set of the abovementioned exercises with 11–15 repetitions were conducted. In the 8th session, both the number of sets and weight were increased by 3–5% so that 2 sets of the abovementioned exercises were conducted with 10 repetitions and a rest time of 1 minute between the sets. In the 9th to 12th sessions, two sets of the abovementioned resistance exercises with repetition of 11 and 15 times in each session respectively and a 1-min rest between the sets were conducted. In the 14th session, the number of sets and weight were increased, and in the 15th and 16th session, 3 sets with repetition of 11 and 12 times were conducted, respectively. The participants were educated about the correct method of exercises and prevention of valsalva maneuver. To prevent valsalva maneuver, the weight was lifted within 2 s during exhalation and was put down within 4 s during inhalation.[16] In case of acute chest pain, dizziness, or respiratory distress, the patients were prohibited from continuation of the exercise in that session, and in the next session, were instructed to do the exercise with a lighter weight and lower number of repetitions if possible.[18] Control group underwent just the routine program of the cardiovascular research center rehabilitation unit, which was aerobic exercises. The routine included running on treadmill with an average speed of 4 km/h and stationary cycling for 15 min. Data were analyzed by the Statsistical Package for the Social Sciences, version 18. To conduct intragroup comparison of lipid profile (cholesterol, TG, LDL, and HDL), repeated measures analysis of variance, and for intergroup comparison, independent *t*-test were performed before intervention, after 8 weeks of intervention, and 4 weeks after the end of intervention. To compare the groups concerning demographic quantitative variables means, independent *t*-test, and for qualitative

variables, Chi-square and Mann–Whitney tests were performed. Significance level was considered $P < 0.05$ for all tests.

Ethical considerations

After explanation of the research stages, an informed written consent was obtained from the participants. This study was derived from a research project (no 322058) and was approved by the Research Ethics Committee of Isfahan University of Medical Sciences. Also, it was registered in Iranian Clinical trial site (IRCT2014121012551N2).

Results

Forty participants out of the 43 completed the study. Approximately 65% of the participants were males in each group. The highest education levels were high school diploma (25%) and middle school (25%) in the study group, and in control group, it was primary school (25%) and high school diploma (25%), respectively. In Table 1, demographic characteristics of both the groups have been presented showing no significant difference. Table 2 represents the mean lipid profiles in the study and control groups in three time points, and Table 3 shows the comparison between two groups in each mentioned time point. Mean changes of lipid profiles between the groups are presented in Table 4. Mean of lipid profiles and mean change of lipid profiles showed no significant difference. The changes in each group were not statistically significant.

Discussion

The response of lipid profile to aerobic exercise has been investigated thoroughly in several studies. Meanwhile, resistance exercises training has not been well studied

yet.[19] In the present study, although resistance exercises reduced TG, cholesterol, and LDL, the reduction was not significant. Changes in the mean lipid profile in resistance exercise group were similar to those of the control group who underwent routine exercise of rehabilitation unit (aerobic exercises), and there was no significant difference between the groups. Loimaala *et al*. in a study on the effect of long-term endurance and aerobic exercise on metabolic control and atrial elasticity of type 2 diabetic patients using a similar method as the present study, concluded that endurance exercise had a similar effect as aerobic exercise on lipid profile and there was no significant difference between the groups,[20] which is in line with the preset study, possibly due to similar methods of the studies as participants' medication were fixed during both the studies and there was no change. Resistance exercises were the same and increased gradually in both the studies. Elliott *et al*., in a study on the effect of resistance training and detraining on muscle strength and blood lipid profile in menopausal women, reported no significant effect of resistance training on participants' lipid profiles.[21] In a review of other studies with a higher number of participants and with a longer length, compared to the present study, the changes occurring due to resistance exercise have been reported to be similar to aerobic exercise. For instance, in the study by Berent *et al*. (2011) with a larger sample size ($n = 292$ vs. $n = 40$) and a longer duration (13 weeks vs. 8 weeks), although there was a significant decrease in blood lipid profile in resistance exercise group, the reduction was not significant compared to aerobic exercise group.[22] The study reported a similar effect of these two types of exercises.

Zotou *et al*. (2010) studied the effect of resistance exercises on women's TG profile and concluded that such exercises had a significant effect in the reduction of TG.[23] The difference in participants' age, sex, and physical fitness can lead to controversial results. In the present study, the participants were CAD men and women with a high mean age among whom the disease was accompanied with impaired lipid profile. Meanwhile, in a study by Zotou, only women with a mean age less than 32 ± 5 years were

Table 1: Comparison of demographic characteristics in two groups of intervention and control

Variable	Group (mean (SD))		Statistical tests (*t*)	P
	Intervention	Control		
Age	61.5(8.05)	61.8(8.49)	0.24	0.805
BMI (kg/m²)	27.33(3.97)	26.49(4.18)	0.65	0.516

BMI: Body mass index; SD: Standard deviation

Table 2: Comparison mean profile lipid in each of intervention and control groups through repeated measurement analysis of variance

Variable	Group (mean (SD))						Statistical tests			
	1 day before intervention		1 day after intervention		4 weeks after the end of the intervention		Intervention		Control	
	Intervention	Control	Intervention	Control	Intervention	Control	F	P	F	P
TG	161.70(62.13)	166.60(78.33)	155.35(61.52)	163.20(77.01)	154.15(42.30)	158.55(72.32)	0.029	0.770	0.059	0.577
Cholesterol	146.50(25.02)	149.80(41.18)	140.75(24.70)	145.05(42.05)	140.25(39.37)	150.4(28.41)	0.147	0.240	0.046	0.656
HDL	44.10(9.38)	44.00(11.30)	40.85(9.50)	40.65(9.79)	40.95(7.78)	41.25(9.16)	0.457	0.241	0.132	0.280
LDL	90.40(19.98)	91.95(37.92)	89.75(28.39)	97.95(31.59)	87.05(38.77)	98.50(28.13)	0.012	0.898	0.042	0.679

TG: Triglycerides; HDL: High density lipoprotein; LDL: Low density lipoproteins; SD: Standard deviation

Table 3: Comparison mean profile lipid between groups in every time

Variable	Group (statistical tests)					
	1 day before intervention		1 day after intervention		4 weeks after the end of the intervention	
	t	P	t	P	t	P
TG	0.048	0.828	0.127	0.724	0.055	0.816
Cholesterol	0.941	0.761	0.155	0.696	0.874	0.356
HDL	0.001	0.976	0.004	0.948	0.012	0.912
LDL	0.026	0.872	0.745	0.393	1.142	0.292

TG: Triglycerides; HDL: High density lipoprotein; LDL: Low density lipoproteins

Table 4: Comparison mean of changes profile lipid in two intervention and control groups

Variable	Group (mean (SD))		Statistical tests	
	Intervention	Control	t	P
TG	−7.55(50.80)	−8.05(33.18)	0.03	0.971
Cholesterol	−6.25(23.86)	0.60(30.55)	0.78	0.434
HDL	−3.15(3.97)	−2.75(8.91)	0.18	0.856
LDL	−3.35(33.78)	6.55(32.70)	0.94	0.352

TG: Triglycerides; HDL: High density lipoprotein; LDL: Low density lipoproteins; SD: Standard deviation

included the study who might have had different physical conditions which might be associated with controversial results of two studies. Research shows that resistance and endurance exercises affect lipid profile more among those who have higher basic levels of TG, cholesterol, LDL, and lower HDL.[24] As the participants in the present study had almost normal lipid profiles, the effect of resistance exercise was so high that it went beyond the reduction, occurring in aerobic exercise group and leading to a significant difference between the groups. The effect of physical exercises and sport on lipid profile is mostly imposed to the peripheral tissues and the liver and allow the existing mechanisms to increase the effect of Lecithin coulin acil transferase enzyme through sport activities. This enzyme is responsible for transferring cholesterol ester from HDL to other lipoproteins. Occurrence of these changes are associated with other factors including changes of plasma hormones and lipoprotein lipase,[25] and maybe these effective factors might have played a role in obtaining such findings.

Conclusion

Results showed that resistance exercise for 8 weeks led to a reduction in the lipid profile of CAD patients. Although this reduction was not significant, the same reduction occurred in aerobic exercise group, however, the difference was not significant. As this is the first study investigating the effect of resistance exercise on the lipid profile of CAD patients, further long-term clinical trials, and consequently, with more severity are suggested.

Conflicts of interest

There are no conflicts of interest.

References

1. Ghalamghash R, Gushe B, Omrani A, Keihani M, Fallahi A. The Effect Of Cardiac Rehabilitation On Functional Capabilities Of Patients With Valvular Heart Surgery. Journal of Medical Council of Islamic Republic of Iran 2008;26:213-21. [In Persian].

2. Kargarfard M, Basati F, Sadeghi M, Rouzbehani R, Golabchi A. Effects of a cardiac rehabilitation program on diastolic filling properties and functional capacity in patients with myocardial infarction. J Isfahan Medical School 2011;29:243-52.

3. Achari V, Thakur A. Association of major modifiable risk factors among patient with coronary artery disease: A retrospective analysis. J Assoc Physicians India 2004;52:103-8.

4. Esteghamti A, Abbasi M, Nakhgavani M, Yousefizadeh A, Basa A, Afshar H. Prevalance of diabetes and other cardiovascular risk factors in an Iranian population with acute coronary syndrome. Cardiovasc Diabetol 2006;5:15.

5. Tabatabaei-Malazy O, Qorban MI, Samavat T, Sharifi F, Larijani B, Fakhrzadeh H. Prevalence of Dyslipidemia in Iran: A Systematic Review and Meta-Analysis Study. Int J Prev Med 2014;5:373-93.

6. Sadeghi M, Roohafza HR, Shirani SH, Baghaie AM, Golshadi I, Aghdak P. Relationship between hematological factors and metabolic syndrome in an Iranian Population Isfahan Healthy Heart Program. JRUMS 2006;5(2):109-16. [In Persian].

7. Yeh G, Wang C, Wayne P, Phillips R. Thi chi exercise for patients with cardiovascular condition and risk factors: A systematic review. J Cardiopulm Rehabil Prev 2009;29:152-60.

8. Naghii M, Almadadi M. Effect of Regular Physical Activity as a Basic Component of Lifestyle Modification on Reducing Major Cardiovascular Risk Factors. Knowl Health 2011;6:27-35.

9. Oliveira J, Galvao C, Rocha S. Resistance exercise for health promotion in coronary patient: Evidence of benefits and risks. Int J Evid Based Health 2008;6:431-9.

10. Ormsbee M, Ormsbee J, Thyfault E, Raymond M, Myung D, Robert C. Fat metabolism and acute resistance exercise in trained men. J App Physiol 2007;102:1767-72.

11. Kisner C, Colby L. Therapiutic exercise: Foundation and techniques. USA: Davis Plus; 2007. p. 148.

12. Rose B, Keegan L. Exercise and movement. In: Montgomery B, Keegan D, Keegan L, editors. Holistic nursing. USA: Jones and Bartlet; 2009. p. 232-6.

13. Misra A, Alappan N, Vikram N, Goel K, Gupta N, Mittal K, *et al*. Effect of supervised progressive resistance exercise training protocol on insulin sensitivity, glycemia, lipids, and body composition in asian Indians with type 2 diabetes. Diabetes Care 2008;31:1282-7.

14. Okada S, Hiuge A, Naguma H, Makino H, Takaki H, Konishi H. Effect of exercise, intervention on endothelial function and incidence of cardiovascular disease in patients with type 2 diabetes. Atheroscler Thromb 2010;17:828-33.

15. Heffernan K, Fahs C, Iwamoto G, Jae S, Wilund K, Woods J, *et al*. Resistance exercise training reduces central blood pressure and improves microvascular function in African American and white men. Atherosclerosis 2009;207:220-6.

16. Leon A. Exercise following myocardial infarction. Sports Med 2000;29:301-11.

17. Moeini M, Salehi K, Salehi Z, Kargarfard M, Sadeghi M. Effect of resistance exercise on fasting blood glucose and 2 hourse after in coronary artery disease patient: Randomized clinical trial. J Clin Nurs Midwifery 2014;3:28-36.

18. Davoodvand S, Elahi N, Haghighizadeh M. Effectiveness of Short-term Cardiac Rehabilitation on Clinical Manifestations in Post-MI Patients. J Fac Nurs Midwifery 2009;15:63-73.

19. Akbarnejad A, Souri R, Sayyah M, Bigdeli M. The Comparison of the Effects of Intermittent and Continuous Training Programs on Some Selected Cardiovascular Risk Factors in Obese Young Females. J Sports Biosci 2011;3:77-93.

20. Loimaala A, Groundstroem K, Rinne M, Nenonen A, Huhtala H, Parkkar IJ, *et al*. Effect of Long-Term Endurance and Strength Training on Metabolic Control and Arterial Elasticity in Patients With Type 2 Diabetes Mellitus. Am J Cardiol 2009;103:972-7.

21. Elliott K, Sale C, Cable N. Effects of resistance training and detraining on muscle strength and blood lipid profiles in postmenopausal women. Br J Sports Med 2002;36:340-5.

22. Berent R, von Duvillard S, Crouse S, Sinzinger H, Green J, Schmid P. Resistance Training Dose Response in Combined Endurance-Resistance Training in Patients With Cardiovascular Disease: A Randomized Trial. Arch Phys Med Rehabil 2011;92:1527-33.

23. Zotou E, Magkos F, Koutsari C, Fragopoulou E, Nomikos T. Acute resistance exercise attenuates fasting and postprandial triglyceridemia in women by reducing triglyceride concentrations in triglyceride-rich lipoproteins. Eur J Appl Physiol 2010;110:869-74.

24. Mogharnasi M, Bagheri M. The Effect of 12 Weeks of Circuit Resistance Training on C-Reactive Protein and Lipid Profile in Inactive Women. J Sports Biosci 2014;6:233-44.

25. Jafari A, Zamani AR. The effect of 8 weeks of Concurrent Interval endurance training and resistance training and continuous endurance and resistance training on power, body composition, lipid profile in overweight, non-athletes 14-17 years boys. J Sports Biosci 2012;15:5-22.