

Is there any difference between non-obese male and female in response to cardiac rehabilitation programs?

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Introduction: Coronary artery disease (CAD) is the leading cause of death and disability all over the world. A sedentary lifestyle and dyslipidemia are known to be the major risk factors, which play an important role in the progression of coronary artery disease. Regarding gender differences, the risk of developing coronary heart disease is recognized as being different between non-obese males and non-obese females. Hence, the aim of this study is to assess the benefits of a comprehensive cardiac rehabilitation program (CRP) on the functional capacity and lipid profiles, such as, total cholesterol, triglycerides, low density lipoprotein cholesterol, and high density lipoprotein cholesterol in non-obese males and non-obese females with coronary artery disease, and comparing these groups. **Materials and Methods:** We evaluated 585 non-obese males and females with coronary artery disease. All the participants completed the cardiac rehabilitation program for two months, which included 24 exercise training sessions, medical evaluation, and consultation. For investigation of the effects of the cardiac rehabilitation program on the functional capacity and lipid profiles, exercise tests were carried out by each patient, and also, their blood samples were taken on entrance and at the end of this period. **Results:** The findings, following 24 sessions in the cardiac rehabilitation program, showed that the functional capacity ($P = 0.00$) and all lipid profiles had significantly improved in both the groups, except that the high density lipoprotein cholesterol did not show a significant difference in non-obese females. In addition, comparing the two groups did not show any significant differences in lipid profiles, but the changes in functional capacity were significant ($P = 0.00$) between the two groups, following the cardiac rehabilitation program. **Conclusion:** The CRP, which was performed by the patients under supervision of a physician and an exercise physiologist, plays a key role in improving the functional capacity (FC) and all lipid profiles in non-obese males and females with coronary artery disease, without any attention to gender differences.

Key words: Cardiac rehabilitation program, coronary artery disease, gender, risk factor

INTRODUCTION

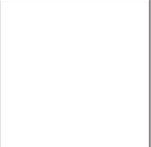
Coronary artery disease (CAD) is the leading cause of death and disability in males and females in industrialized societies and developing countries.^[1-4]

The major risk factors that play an important role in developing cardiovascular disease (CVD) are a sedentary lifestyle and hyperlipidemia, hypertension, smoking, obesity, and others. Several studies suggest that an increased level of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and a low level of high density lipoprotein cholesterol (HDL-C) are

associated with a worse prognosis of coronary artery disease.^[5,6]

Concerning gender differences, the risk of CVD progression is recognized to be different between males and females. According to a pervious study, CAD presents in males approximately 10 years earlier than in females;^[7] and the incidence of coronary events is 60% higher in males than in females.^[8] However, some studies reveal that females have similar improvements in functional capacity (FC) and risk factors compared to males, after the cardiac rehabilitation program.^[6,9]

It was suggested that CRP, which is based on supervised exercise training, medical evaluation, risk factor modification, education, and consultation is particularly well suited to improve the functional capacity, and helps to prevent and treat many established cardiovascular risk factors.^[2,10] A pervious study showed that CRP combined with resistance and aerobic training improved the exercise capacity by its beneficial effects on the skeletal muscle strength in patients with myocardial

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infarction.^[11] Also, Afzalaghaiee suggested that CRP had useful effects on the lipid profiles in male and female patients with CAD.^[12]

There are many investigations in this regard, but they have not paid any attention to the body mass index (BMI) in patients with CAD. So, the aim of this study is to assess the benefits of a comprehensive cardiac rehabilitation program on the functional capacity and lipid profiles in non-obese males and females with coronary artery disease, and in addition, to know if there is any difference between these groups?

MATERIALS AND METHODS

In an observational study between 2000 and 2011, we evaluated 585 non-obese patients with CAD, who referred to the Phase II Cardiac Rehabilitation Unit of the Isfahan Cardiovascular Research Institute. CAD was defined as a history of one of the following: Myocardial infarction (MI), coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI), or chronic stable angina. We elected these samples on the basis of their BMI. In fact, at first, the height and weight of each patient was measured by a nurse, and then the BMI was calculated by weight / height² (kg / m²), and patients who had a BMI < 30 were enrolled in our investigation. Also, a blood sample was taken after 12 – 14 hours of fasting, for measuring serum lipids, including triglycerides (TG), total cholesterol (TC), and high-density lipoprotein cholesterol (HDL-C), using enzymatic methods, and low density lipoprotein cholesterol (LDL-C) was calculated according to the Friedewald formula.^[13] All the patients used their angina treatment and the dose of these medications was not altered during the program. In addition, an exercise test with the protocol of Naughton was performed on each patient, under the supervision of a cardiologist. The exercise test provided an opportunity to evaluate the body reaction and FC. All the tests were assessed at the beginning of the study. Then the participants began CRP for two months, which consisted of 24 sessions, three times a week. CRP included exercise training sessions, nutritional and psychological

consultation, and risk factor modification. Exercise training consisted of combined aerobic and resistance training and it was performed in the Cardiac Rehabilitation Center, under the supervision of a physician and an exercise physiologist, by using a treadmill, stationary cycles, stationary steppers, stair climbing, rowing, jogging, and some resistance devices. Each session lasted up to 90 minutes, with a 20-minute warm-up followed by 60 minutes of aerobic and resistance training, and finally 10 minutes of cool-down. The intensity of training was established according to the clinical condition and calculated between 60 and 85% of the maximum heart rate. Also, all the participants had dietary instructions given by a visiting dietitian in this duration. After passing two months and completing the rehabilitation program, all the tests were carried out by each patient for a second time. The patients were classified into two groups, which were known as the non-obese male and non-obese female groups. The research was conducted under the Medical Ethics Standards and approved by the Ethics Committee of the Isfahan Cardiovascular Research Institute. Independent sample t-tests were used to identify baseline differences and to compare the changes between the two groups. For investigation of changes between the baseline and completion of CRP, we used the paired t-tests. The results were expressed as mean and standard deviation (SD) and the level of significance was set at $P < 0.05$.

RESULT

In this study 585 male and female patients with CAD were evaluated, as their BMI was lower than 30kg/m². The clinical and demographic characteristics of patients were mentioned in [Table 1]. Independent sample t-tests were used to identify the baseline differences among non-obese male and non-obese female patients [Table 2]. At baseline, the non-obese males had a higher functional capacity ($P = 0.001$), but TC and HDL-C were lower in males compared to females. Also, for examination of the changes between the baseline and completion of CRP, we used the paired sample t-tests [Table 3]. These tests revealed a significant improvement in all evaluated factors such as FC and lipid profiles in both the

Table 1: Clinical and demographic characteristics of patients

Characteristics	Male	Female	P-value
Number	464	121	-
Age (year, mean ± SD)	56.21 ± 9.94	58.09 ± 8.95	0.06
Body Mass Index (kg / m ² , mean ± SD)	25.45 ± 2.47	26.28 ± 2.66	0.001
Coronary Heart Disease, N (%)			
CABG	262 (56.8)	74 (61.7)	0.35
MI	90 (19.5)	9 (7.5)	0.002
PCI	68 (14.8)	22 (18.3)	0.32
Others	46 (8.9)	16 (12.5)	1.00
Hypertension, N (%)	126 (27.2)	59 (48.8)	0.00
Diabetes mellitus, N (%)	115 (24.8)	57 (47.1)	0.00

Table 2: Comparison between non-obese males and non-obese females at baseline

Variables	Non-obese male (n = 464) Mean ± SD	Non-obese female (n = 121) Mean ± SD	P
Functional capacity (METS)	9.43 ± 2.66	6.94 ± 2.44	0.00
Total Cholesterol (mg / dl)	204.95 ± 49.49	218.62 ± 55.42	0.00
Triglycerides (mg / dl)	193.56 ± 107.28	205.60 ± 112.34	0.27
LDL Cholesterol (mg / dl)	127.66 ± 42.41	135.70 ± 46.64	0.08
HDL Cholesterol (mg / dl)	39.31 ± 8.43	42.88 ± 9.69	0.00

Significant difference: $P < 0.05$, SD = Standard Deviation**Table 3: Comparison of the changes within groups and between groups following the cardiac rehabilitation program**

Variables	Non-obese males			Non-obese females			P**
	Before rehabilitation	After rehabilitation	P*	Before rehabilitation	After rehabilitation	P*	
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD		
Functional capacity (METS)	9.43 ± 2.65	11.86 ± 2.54	0.00	6.96 ± 2.44	8.70 ± 2.53	0.00	0.00
Total Cholesterol (mg / dl)	205.30 ± 49.45	189.95 ± 40.66	0.00	218.62 ± 55.42	204.70 ± 50.40	0.00	0.77
Triglycerides (mg / dl)	194.05 ± 107.56	174.17 ± 85.93	0.00	205.60 ± 112.34	185.83 ± 88.43	0.02	0.99
LDL-C (mg / dl)	128.24 ± 42.55	115.27 ± 35.73	0.00	134.27 ± 47.14	123.00 ± 40.01	0.01	0.71
HDL-C (mg / dl)	39.28 ± 8.46	40.64 ± 8.40	0.02	42.79 ± 9.74	43.90 ± 9.70	0.23	0.80

Significant difference: $P < 0.05$, SD = Standard Deviation, P* = Difference within group, P** = Difference between groups

groups, except HDL-C, which did not have any significant change in non-obese females.

Finally, for comparing the changes between the two groups, independent sample t-tests were used and the data showed a significant difference only in FC between the two groups [Table 3].

DISCUSSION

Our finding revealed that eight-weeks of comprehensive cardiac rehabilitation had beneficial effects on FC enhancement and improvement of all lipid profiles in both non-obese male and non-obese female patients with CAD. Only in HDL-C we did not see any significant changes in non-obese females.

Many studies confirm our finding.^[1,5,14,15] Plaza showed that patients who participated in the secondary prevention program experienced improvements in FC and lipid profiles.^[16]

Also, the study of Sarrafzadegan suggested that comprehensive CRP has a beneficial effect on TC, TG, LDL, and HDL in Iranian cardiovascular patients even without using anti-lipid drugs.^[2]

Yang's investigation showed that exercise interventions were useful for aerobic capacity, functional ability, and all lipid profiles, except HDL-C in patients, after stroke, with prior coronary artery disease.^[17] Another article proved that CRP had an important impact on improving the functional capacity and decreasing the serum lipid profiles in coronary patients.^[18]

Another study proposed that CRP played an important role

in improving exercise tolerance and HDL-C levels in younger and older females with CVD.^[19] Regarding no significant improvement being seen in HDL-C in non-obese females, we can state that a greater duration of exercise training and more attention to dietary restriction may have an effect on these patients and improve their HDL-C levels, significantly.

Concerning the FC, Jankowska implied that resistance training increased muscle strength and exercise capacity in patients with coronary heart failure.^[20]

Additionally, an attributed study demonstrated a significant improvement in maximal, submaximal, and endurance exercise capacity following 12 weeks of exercise training in patients with heart failure.^[21]

Also, another study that assessed FC by a six-minute walking test showed that CRP significantly improved the FC in patients after cardiac surgery.^[10]

In addition, we compared the response of non-obese males and females to CPR and exercise training, and the results showed that except in FC, two groups did not have any significant differences. This meant that although there were significant differences between the two groups at baseline, after CRP, both of them benefited alike from the advantages of this period, but the males showed more improvement in FC compared to the females. In relation to this difference, we could imply that baseline differences in FC and BMI levels, as also the risk of hypertension and diabetes mellitus, which were higher in females than in males, could be causes for the differences in the FC, endurance, and fitness levels between non-obese males and females following CRP.

An attributed study, which assessed gender differences

after CRP, showed that both genders benefited similarly from this program and they showed improvement in FC and lipid profiles.^[22]

Similar to our finding, Schuster suggested that males were significantly better able to tolerate physical activity and had greater efficacy in enduring exercise and activities of daily living than females, following CRP.^[23] On the contrary, Brochu revealed that neither male nor female patients obtained significant improvement in TC, LDL-C, or TG after the three-month exercise training alone.^[24]

Another investigation showed that CRP and exercise training prevented and controlled the established cardiovascular risk factors, such as, high triglycerides, cholesterol concentrations, and low high-density lipoprotein cholesterol (HDL-C) concentrations, in patients with CAD.^[3] In fact by CRP and exercise training, the cholesterol that sediments in muscles and vascular walls dissolves in the blood. Following this the liver removes this dissolved cholesterol from the blood and catabolizes it. Thus, this process leads to a decrease in the blood cholesterol levels.

Finally, we can state that regular physical training produces central and peripheral adaptations in the cardiac and skeletal muscles and vasculature that enhance FC and skeletal muscle strength. In fact, cardiac adaptations result in increased cardiac dimensions, stroke volume, and cardiac output that cause them to deliver more blood flow to the skeletal muscle, and the tissues receive adequate oxygen and these processes lead to an increase in aerobic capacity in the exercised muscle. On the other hand, vascular adaptations by increasing the density of skeletal muscle capillaries and improving endothelial-dependent vasodilatation in both epicardial and coronary arteries help in these progressions.^[25,26]

CONCLUSION

According to our study we can notify that CRP, which is performed by patients under supervision of a physician and an exercise physiologist, plays a key role in improving FC and all lipid profiles in non-obese males and females with CAD, and the two groups did not have any significant difference in lipid profiles.

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