Original Article

The effect of the cardiac rehabilitation program on obese and non-obese females with coronary heart disease

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Abstract

Introduction: Obesity is strongly associated with coronary heart disease and it is known as an independent risk factor. So, the aim of this study was to investigate the effects of phase II comprehensive cardiac rehabilitation program on obesity indexes, functional capacity, lipid profiles, and fasting blood sugar in obese and non-obese female patients with coronary heart disease and to compare changes in these groups.

Materials and Methods: Two hundred and five women with coronary heart disease participated in our study. At the beginning of study, body mass index, functional capacity, and lipid profiles and fasting blood sugar were evaluated; then, these patients were divided into two groups, patients who had BMI≥30 were known as obese and who had BMI<30 were known as non-obese patients. All of them completed the period of cardiac rehabilitation program, and 2 months later, all risk factors were examined for the second time in each group. Data were analyzed with SPSS software version 15. For comparing the mean of outcomes, independent *t*-tests and paired *t*-tests were used.

Results: Data revealed that unless in weight (P=0.00) and functional capacity (P=0.001), there were no significant differences in obese and non-obese female patients, at baseline. As a result of the cardiac rehabilitation program, both groups had significant improvement in functional capacity (P=0.00), weight reduction (P=0.00), triglyceride (P=0.01 and P=0.02, respectively), low-density lipoprotein cholesterol (P=0.01), and low-density lipoprotein cholesterol/high-density lipoprotein cholesterol ratio (P=0.00 and P=0.003, respectively). As well, significant improvement was observed in high-density lipoprotein (P=0.01) only in obese female, and non-obese female had significant differences in total cholesterol (P=0.003). However, there were not significant changes in total cholesterol (P=0.05) and fasting blood sugar (P=0.09) in obese female. Also, non-obese females didn't have favorable differences in high-density lipoprotein cholesterol (P=0.23) and fasting blood sugar (P=0.13). In addition, comparing two groups didn't show any significant differences in each risk factors except BMI (P=0.03).

Conclusion: Our study revealed that comprehensive cardiac rehabilitation program results in significant improvement in cardiovascular risk factors and functional capacity at all levels of BMI in female with coronary heart disease.

Key Words: Cardiac heart disease, obesity, risk factor

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INTRODUCTION

Obesity has significant adverse effects on cardiovascular disease (CVD) risk factors, including insulin resistance, blood pressure, plasma lipids, left ventricular hypertrophy, and functional capacity (FC).[1-3]

The prevalence of obesity has reached epidemic levels in industrialized societies as well as in developing countries. In Iran, the prevalence of obesity is as high as the United States and, Iranian women are more obese than American women.[4]

On the other hand, it was reported that the prevalence of obesity among patients who participate in the cardiac rehabilitation program (CRP) is more than 40%.[5]

Obesity is classified by body mass index (BMI) which is known as an indicator of total adiposity.[6] In adults, it is defined as a BMI ≥ 30 kg/m^2.[7]

Several studies mentioned that obesity has been known as an independent risk factor for the development of numerous cardiac diseases such as coronary heart disease (CHD), heart failure (HF), and sudden death because of its impact on the cardiovascular system and other risk factors in the CVD population.[8,9]

Many studies indicated cardiac rehabilitation and exercise training have beneficial effects on CVD risk factors such as improving plasma lipids, insulin sensitivity, exercise capacity, and lowering mortality.[10-13] But there are limited researches in relation to the benefits of CRP on obese cardiac patients, particularly in women. So, the aim of this study was to investigate the effects of phase II comprehensive CRP on obesity indexes, functional capacity, lipid profiles, and fasting blood sugar in obese and non-obese women patients with CHD.

MATERIALS AND METHODS

In an observational study between 2000 and 2011, we evaluated 205 female patients with CHD who were referred to phase II cardiac rehabilitation of Isfahan cardiovascular research institute. Patients' cardiac diagnoses were defined as a history of at least one of the following: [myocardial infarction (MI), 8.8%]; [coronary artery bypass grafting (CABG), 53.9%]; [percutaneous coronary intervention (PCI), 16.2%] and [chronic stable angina, 21.1%]. At first, height (without shoes) and weight were measured at admission to CRP in the morning after overnight fasting and after voiding by nurse, and BMI was calculated by body weight in kilograms divided by the square of the height in meter. Patients were classified into obese (BMI ≥ 30) and non-obese (BMI<30). Blood samples were taken after 12-14 h of fasting for measuring fasting blood sugar (FBS), serum lipids including triglycerides (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C) using enzymatic methods; then, low-density lipoprotein cholesterol (LDL-C) was calculated according to the Friedewald formula.[14] All patients treated with lipid lowering medication such as β blockers, nitrate, statine, and aspirin were at stable doses. Dose of these medications were not altered during the program. Also, the exercise test with the protocol of Naughton was performed on each patient under supervision of a cardiologist. The exercise test provides an opportunity to determine body reaction and FC. Then all participants began CRP for 2 months which consisted of 24 sessions and three times a week. CRP included exercise training sessions, nutritional and psychological consultation, and risk factor management. Exercise sessions were similar in obese and non-obese patients. Exercise training consisted of combined aerobic and resistance training and it was performed in cardiac rehabilitation center under supervision of physician, exercise physiologist and a nurse by using treadmill, stationary cycles, stationary steppers, stair climbing, rowing, jogging and some resistance devices. Each session lasted up to 90 min, 20-min warm-up followed by 60 min aerobic and resistance training, and finally 10 min cool-down. The intensity of training was established according to the clinical condition and calculated between 60% and 85% of maximum heart rate. As well, each patient had individual dietary instruction by visiting dietitian and all of them were encouraged by the exercise physiologists and dietitians and physicians, to fulfill CRP. After passing 2 months and finishing rehabilitation program, the tests were performed by each patient. Independent sample *t*-tests were used to identify baseline differences. For investigation about changes between baseline and completion of CRP, we used paired *t*-tests. The research was taken under the medical ethics standards. Results are expressed as mean ± standard deviation (SD) and the level of significance was set at $P<0.05$.

RESULTS

Two hundred and five women patients with CHD were evaluated. They were divided into two groups, patients who had BMI ≥ 30, n=84, with the age of 57.6 ± 7.94 year old set as the obese group and patients who had BMI<30, n=121, with the age of 58.09 ± 8.95 year old set as the non-obese group. Independent sample *t*-tests were used to identify baseline differences among obese and non-obese female patients [Table 1].

At baseline, obese female patients had lower functional capacity (P=0.001) and weight (P=0.00), and both groups were statistically similar in lipid profiles and FBS.

Also, paired *t*-tests were used to examine changes between baseline and completion of CRP. Obese female patients had significant improvements in all risk factors except TC and FBS [Table 2], and non-obese female patients had positive improvement in most risk factors unless HDL-C and FBS [Table 3].

Changes in data between groups were analyzed with independent sample *t*-tests [Table 4]. Results are expressed as mean ± SD.

DISCUSSION

In the present study, we demonstrated the benefits of comprehensive CRP in obesity indexes, most plasma lipids and FC on both obese and non-obese female patients with CHD. Obesity is highly prevalent in cardiac patients, and obese patients have greater adverse cardiovascular on some risk factors. In the current study, we observed significant improvement in obesity indexes including BMI and body weight in both obese female patients and non-obese female patients. However, obese female patients had greater relative improvement in body weight following CRP.

Table 1: Baseline differences between obese and non-obese female patients

Variables	Obese women (n=84) mean±SD	Non-obese women (n=121) mean±SD	*P* value
Weight(kg)	78.42 ± 8.08	62.94 ± 7.67	0.00
Functional capacity(METS)	5.94 ± 1.68	6.96 ± 2.44	0.001
Total cholesterol (mg/dl)	229.56 ± 57.49	218.62 ± 55.42	0.17
Triglyceride (mg/dl)	234.42 ± 106.48	205.60 ± 112.34	0.06
HDL cholesterol(mg/dl)	41.59 ± 8.60	42.79 ± 9.74	0.33
LDL cholesterol(mg/dl)	139.58 ± 51.8	134.27 ± 47.14	0.59
LDL-C/HDL-C	3.55 ± 1.72	3.25 ± 1.45	0.27
FBS(mg/dl)	115.60 ± 40.90	123.54 ± 57.63	0.32

Significant difference: P<0.05. SD = Standard deviation

As well, FC that is an important marker in CVD was affected by obesity.[15] In this report, at baseline, obese female patients had slightly lower FC than the non-obese female patients. The improvement in FC in obese female patients was greater than the non-obese female patients who had higher baseline value although this difference wasn't significant. In this regard, according to the Lavie study, patients who have lower FC generally have a greater improvement in fitness level and FC after CRP.[16] Related studies detected that CRP has short-term efficiency on FC and BMI in obese patients with CHD.[10,17] Also, lavie illustrated that exercise training can be cause of improvement in FC in both obese and non-obese patients.[1] Another investigation showed patients who attended to CRP had significant improvement in physical function than who did not -attend.[18]

In addition, our results didn't show differences in other risk factors such as TC, TG, HDL-C, LDL-C, LDL-C/HDL-C, and FBS between obese female patients and non-obese female patients, at baseline. Results imply that both groups had significant improvement in TG, LDL-C, and LDL-C/HDL-C ratio after CRP. But in obese female patients, we didn't observe favorable changes in TC, and non-obese female patients didn't have any significant improvement in HDL-C. Notably, we didn't see positive changes in FBS in both groups during this period. According to pervious article, there is no relationship between HDL-C and BMI in obese and non-obese female;[19] Moreover, considerable relationship was observed between TC levels and obesity, which is due to an increase in cholesterol production.[18] These explanations may be translated our finding. There are many studies which are similar to our results. Arthur suggested, exercise training and nutritional counseling have beneficial effects on losing body weight, decreasing TG and increasing HDL-C in all CHD patients.[20] The Lavie study revealed that the obese patients with CAD had improvement in BMI, and some lipid factors following CRP; also, in this study, non-obese patients didn't have statistically significant changes

Table 2: Improvement in variables after cardiac rehabilitation in obese female patients

Variables	Before rehabilitation mean±SD	After rehabilitation mean±SD	Change %	*P* value
Weight (kg)	78.42 ± 8.08	76.56 ± 8.78	−2.3	0.00
Body(kg/m^2) mass index	33.50 ± 2.75	32.69 ± 3.00	−2.4	0.00
Functional capacity (METS)	5.94 ± 1.68	7.87 ± 2.08	32.49	0.00
Total (mg/dl) cholesterol	229.56 ± 57.49	218.01 ± 51.63	−5	0.05
Triglyceride (mg/dl)	234.42 ± 106.48	210.69 ± 100.17	−10.1	0.01
HDL (mg/dl) cholesterol	41.59 ± 8.60	44.40 ± 8.57	6.7	0.01
LDL (mg/dl) cholesterol	139.58 ± 51.8	127.11 ± 45.83	−8.9	0.01
LDL-C/HDL-C	3.55 ± 1.72	2.91 ± 1.13	−18	0.00
FBS (mg/dl)	115.60 ± 40.90	110.48 ± 37.66	−4.4	0.09

Significant difference: P<0.05. SD = Standard deviation

Table 3: Improvement in variables after cardiac rehabilitation in non-obese female patients

Variables	Before rehabilitation mean±SD	After rehabilitation mean±SD	Change%	*P* value
Weight (kg)	62.94 ± 7.67	61.70 ± 7.53	−1.97	0.00
Body(kg/m^2) mass index	26.28 ± 2.66	25.76 ± 2.58	−1.9	0.00
Functional (METS) capacity	6.96 ± 2.44	8.70 ± 2.53	25	0.00
Total (mg/dl) cholesterol	218.62 ± 55.42	204.70 ± 50.40	−6.3	0.003
Triglyceride (mg/dl)	205.60 ± 112.34	185.83 ± 88.43	−9.6	0.02
HDL (mg/dl) cholesterol	42.79 ± 9.74	43.90 ± 9.70	2.59	0.23
LDL (mg/dl) cholesterol	134.27 ± 47.147	123.00 ± 40.01	−8.3	0.01
LDL-C/HDL-C	3.25 ± 1.45	2.86 ± 1.04	12	0.003
FBS (mg/dl)	123.54 ± 57.63	116.80 ± 40.56	−5.4	0.13

Significant difference: $P<0.05$. SD = Standard deviation

Table 4: Compare the changes in obese and non-obese female patients after cardiac rehabilitation

Variables	Change in obese	Change in Non-obese	*P* value
Weight (kg)	1.86 ± 2.45	1.23 ± 2.21	0.06
Body mass index (kg/m^2)	0.81 ± 1.05	0.51 ± 0.92	0.03
Functional capacity (METS)	1.92 ± 1.53	1.73 ± 1.72	0.41
Total cholesterol (mg/dl)	11.55 ± 53.62	13.91 ± 49.91	0.74
Triglyceride (mg/dl)	23.72 ± 81.90	19.76 ± 91.86	0.75
HDL cholesterol (mg/dl)	2.80 ± 10	1.11 ± 9.95	0.24
LDL cholesterol (mg/dl)	12.47 ± 44.18	11.27 ± 44.30	0.85
LDL-C/HDL-C	0.64 ± 1.49	0.39 ± 1.30	0.23
FBS (mg/dl)	5.11 ± 27.99	6.74 ± 49.62	0.76

Significant difference: $P<0.05$. SD = Standard deviation

in BMI, weight, and some lipid factors.[1] Other studies suggested all patients, either elderly or young and even over weight patients with CHD, had significant improvement in FC, obesity indexes, lipid profiles, and FBS following CRP.[4,13,21,22] Brochu demonstrated that exercise training alone results in modest risk factor improvements in coronary patients after 3 months; also, their outcomes showed significant improvement only in HDL-C and TG, but there were no overall effects on body weight, TC, LDL-cholesterol, TG, and FBS.[23] Another attributed results showed that cardiac rehabilitation and exercise training have significant effects on obesity indexes, FC, and lipid profiles in both hypertriglyceridemia patients and non-hypertriglyceridemia patients.[24-26] In spite of some disparities, a number of these results are similar to our findings. We can notify the difference in measuring cut point of BMI for obesity identification in cardiac patients[1,2] or even sex differences and patients' population[2,27] may be the cause of these variations. Finally, it should be mentioned that our data didn't show any significant differences in risk factors and FC between obese and non-obese female patients following CRP.

Generally, we concluded comprehensive CRP results in significant improvement in cardiovascular risk factors and functional capacity at all levels of BMI in CHD women patients. Also, obese female patients may attain significant health benefits in overall fitness level as same as non-obese female patients. So, CRP is known as an acceptable management for enhancement and maintenance of cardiovascular health through individualized programs.

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