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The Effects of Phase 2 Cardiac Rehabilitation on Changes in Obesity Anthropometric Indices among Military and Non-military Men with Coronary Artery Disease Referred to Cardiac Rehabilitation Center

Alireza Manafi [1], Adel Joharimoghadam [2,*], Azime Dehghani Firouzabadi [3], Hanieh Abdi [4], Seyyed Hossein Mousavi [2]

[1] Faculty of Medicine, Aja University of Medical Sciences, Tehran, IR Iran
[2] Department of Cardiology, Aja University of Medical Sciences, Tehran, IR Iran
[3] Department of Sports and Exercise Medicine, Shiraz University of Medical Sciences, Shiraz, IR Iran
[4] Cardiovascular Research Center, Shiraz University of Medical Sciences, Shiraz, IR Iran

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ABSTRACT

Background: Cardiac rehabilitation program reduces cardiovascular risk factors and increases respiratory capacity in patients with Coronary Artery Disease (CAD). High-stress lifestyle is established in military patients with CAD. Military groups have been proposed to have an active lifestyle and better anthropometric changes compared to civilians. However, no studies have been conducted on their response to the cardiac rehabilitation program.

Objectives: This study aimed to evaluate the effects of cardiac rehabilitation on alterations in obesity anthropometric indices among military personnel.

Methods: This cross-sectional study was conducted on 50 military patients with CAD and 100 non-military ones at a cardiac rehabilitation center. The two groups were compared with regard to obesity anthropometric and rehabilitation indices before and after a 20-session cardiac rehabilitation program. At first, normal distribution of the data was checked using Kolmogorov-Smirnov test. Then, independent sample t-test was used to compare the means between the two groups. Paired t-test was also applied to compare the indices before and after the cardiac rehabilitation program. The data were analyzed using the SPSS statistical software, version 16 and $P < 0.05$ was considered to be statistically significant.

Results: The mean age of the patients was 59.72 ± 4.6 and 58.03 ± 5.3 years in the military and civilian groups, respectively ($P = 0.060$). The results showed no significant differences between the two groups regarding the frequency of diabetes mellitus, hypertension, and hyperlipidemia, history of smoking, and positive family history of cardiovascular disease ($P = 0.46$, 0.48, 0.48,0.29, and 0.47, respectively). Obesity anthropometric indices were significantly decreased in each study group, but there was no significant difference between the two groups. Additionally, rehabilitation indices were increased more in the military group than in the civilian group, but the difference was not statistically significant.

Conclusion: Despite the military patients' probably lower rates of obesity anthropometric indices, they did not benefit more from the cardiac rehabilitation program. However, as in the previous research, the results indicated that the cardiac rehabilitation program after cardiac events and interventions were helpful to improve both military and civilian patients' capabilities and quality of lives. Rehabilitation indices were also equally increased in the two groups without any significant differences.

**Corresponding author:* Adel Joharimoghadam, #21, Shahid Ma'sumi Alley, Sheikh Bahaee Street, Mollasadra Street, Vanak Square, Tehran, Iran. PO Box: 1991735391, Cellphone: +98-9121341514, Fax: +98-2143822081, Email: adeljoharim@yahoo.com.

1. Background

Urbanization has increased in developing countries. Coronary Artery Disease (CAD) is likely to become the most common cause of death worldwide until 2025 (1,

2). The prevalence of CAD risk factors is rising rapidly. The most common risk factors include sedentary lifestyle, Hyperlipidemia (HLP), body weight gain, high Body Mass Index (BMI), impaired blood glucose, high blood pressure, smoking, stress, anxiety, and depression (3).

Anthropometric indicators are important indices, which are able to predict the likelihood of death in some diseases. These indicators include BMI, waist to hip ratio, Waist Circumference (WC), Hip Circumference (HC), and waist to height ratio. Obesity anthropometric indices are vogue and valuable body composition metrics to determine individual- and population-level risk for cardiovascular diseases (4). These indices and their correlations with cardiovascular disease risk factors vary by ethnicity. For instance, higher BMIs and truncal fat per kilogram of total body fat were detected among Asian groups compared to the Whites (5-8). In addition, occupational stress is one of the most important factors affecting metabolic syndrome components and anthropometric indices.

Military personnel comprise one of the large population groups with high stress levels in Iran (9). Unlike developed countries, Iranian military personnel have a lower rate of cardiovascular risk factors and their related anthropometric indices in comparison to the normal population (10, 11).

Cardiac rehabilitation program is a multi-disciplinary treatment for improving CAD patients' physical activity as well as psychological and social conditions (12). Rehabilitation programs have been reported to reduce the risk of mortality in patients with CAD (13, 14). Many meta-analyses have also revealed that exercise therapy was more effective compared to other routine medical cares. Accordingly, rehabilitation planning reduced the rate of cardiac mortality by about 20-32% compared to usual medical therapies (15-18).

2. Objectives

Generally, military personnel, particularly in Iran, have a highly active lifestyle with fewer risk factors of cardiovascular disease compared to the normal population. Up to now, no studies have described these personnel's response to cardiac rehabilitation program after cardiac events. Therefore, this study aims to evaluate the effects of cardiac rehabilitation on alterations in obesity anthropometric indices among military personnel.

3. Patients and Methods

3.1. Study Design and Subjects

This cross-sectional study was conducted on 50 military patients with CAD and 100 non-military ones at the Cardiac Rehabilitation Center of Al-Zahra hospital, a cardiac referral center in southern Iran, affiliated to Shiraz University of Medical Sciences, Shiraz, Iran from September 2017 to July 2018. According to a one-year review of CAD patients referring to this center, it was found that 33% of them were military personnel (P = 0.33). The study sample size was determined based on the mean difference formula:

$$n = (1.96 + 0.84)^2 \left(\frac{1}{0.55}\right)^2 = 50,$$

$$z_\alpha = 1.96, z_\beta = 0.84, effect\ size = 0.55, n = 50$$

Accordingly, 50 patients in the military group and 100 ones in the civilian group were selected via convenience sampling. All patients referring to cardiologists were included according to the American Heart Association criteria of diagnosing cardiovascular diseases (19). Patients in the military group had a previous history of a military job for more than ten years, history of unstable angina, Non-ST Segment Elevation Myocardial Infarction (NSTEMI), or ST-Segment Elevation Myocardial Infarction (STEMI) diagnosed by cardiologists, and were referred to the cardiac rehabilitation center one month after Percutaneous Coronary Intervention (PCI) or Coronary Artery Bypass Grafting (CABG). The other group included 100 non-military patients with similar disease and interventions. The exclusion criteria of the study were suffering from unstable angina, uncontrolled blood pressure, uncontrolled metabolic conditions, severe musculoskeletal problems, acute cardiopulmonary conditions, inability to walk on the treadmill, renal failure, hepatic failure, and congestive heart failure. All patients attended a 20-session cardiac rehabilitation program held over eight weeks.

3.2. Anthropometric Indices

A Seca scale (Germany) with the accuracy of 100 grams was used to measure weight while the patients were wearing light clothes and were barefoot. Indeed, a height gauge with the accuracy of 0.5 cm was utilized to measure height. WC and HC were measured in standing position using a plastic non-detachable meter with the accuracy of 0.1 cm (20). Central obesity was defined as waist to hip ratio of more than 0.9 in males and more than 0.8 in females (21) as well as waist to height ratio of more than 0.5 in Asian ethnic groups (22), which was correlated to increased cardiovascular risks. These indicators were measured in the two groups before and after the rehabilitation program. The previous history of Hypertension (HTN), HLP, Diabetes Mellitus (DM), and smoking and positive family history of cardiovascular diseases were also assessed in each study group.

3.3. Cardiac Rehabilitation

Phase 1 cardiac rehabilitation involved running in slow speed without any respiratory or cardiac manifestations and time considerations. Aerobic exercises comprised the main part of phase 2 rehabilitation period. Indeed, programming was individualized for each patient according to their personal characteristics. A treadmill, a fixed bicycle, and an ergometer of upper and lower extremities were used in the program. The severity of sports was managed such a way that the patients' heart rate and blood pressure were respectively kept under 120 beats per minute and 170/100 mmHg in resting position. This was done to achieve the optimal heart rate without any dyspnea or arrhythmia in electrocardiography. The intensity of exercises was also very important. Firstly, a symptom-limited exercise test was done, which is an exercise rather than a diagnostic method in cardiac rehabilitation settings. The intensity of the trainings was 40 - 60% of Heart Rate (HR) reserve formula; i.e., [(220-age) - heart rate rest] *40-60% + heart rate rest. In case of HR at rest > 120 beats per minute, blood pressure > 160/100 mmHg, or symptoms of typical

chest pain, the training session would not start until the situation became under control. Three phases of exercises were as follows: 1) active and regular movements in the normal range of joints, 2) use of treadmill, fixed bicycle, and ergometer of upper and lower extremities, and 3) slowly slowing down the activity level and doing some stretching movements. The patients' activities were performed on the basis of Borg criteria together with electrocardiography check (23).

3.4. Metabolic Equivalent of Task

Metabolic Equivalent of a Task (MET) is a physiological scale that expresses the amount of energy consumption associated with a physical activity and is explained as a proportion of the metabolic rate (and hence the ratio of energy consumption) during a particular physical activity compared to a reference metabolic ratio. One MET is defined as kilocalorie/kilogram/hour and equals the consumption of energy during sitting down (23). In addition, its value varies from 0.9 (during sleep) to 23 (during running at the speed of 22.5 kilometers/hour).

Patients who did not have consent to participate in the study and those who interrupted their rehabilitation program during the study were excluded from the research.

This study was approved by the Ethics Committee of AJA University of Medical Sciences (approval No. 960080-96/j/4901/2/5147). The study protocol was also approved by the Institutional Review Board of the University. Indeed, written informed consents were obtained from all participants.

3.5. Statistical Analysis

All statistical analyses were performed using the Statistical Package for Social Sciences, version 16.0 (SPSS Inc., Chicago, IL, USA). Descriptive data were expressed as mean ± Standard Deviation (SD) with 95% confidence interval. At first, Kolmogorov-Smirnov test was used to check the normal distribution of the continuous variables. Then, t-test was applied to compare the means between the two groups. Considering the normal distribution of the data, paired t-test was applied to examine the mean differences of cardiac rehabilitation indices in the two groups before and after the program. Additionally, independent sample t-test was employed to compare the reduction of obesity anthropometric indices in the two groups. Pearson's correlation coefficient was also used to assess the relationship between age and obesity anthropometric indices and rehabilitation ones. Level of significance was set at 0.05.

4. Results

This study was conducted on 50 military patients with CAD and 100 civilian ones referred to the Cardiac Rehabilitation Center of Al-Zahra hospital. The mean age of the patients was 59.72 ± 4.6 years in the military group and 58.03 ± 5.3 years in the civilian group (P = 0.060). Additionally, the means of wrist circumference were 18.10 ± 0.8 and 17.90 ± 0.8 cm in the military and civilian groups, respectively (P = 0.157). Therefore, there were no statistically significant differences between the two groups with respect to demographic characteristics.

The frequency of DM, HTN, HLP, history of smoking, and positive family history of cardiovascular disease were 15 (30%), 26 (52%), 25 (50%), 20 (40%), and 16 (32%), respectively in the military group. In the civilian group, these values were 36 (36%), 58 (58%), 56 (56%), 9 (49%), and 38 (38%), respectively. There were no significant differences between the two groups regarding the above-mentioned risk factors (P = 0.46, 0.48, 0.48, 0.29, and 0.47, respectively).

The results revealed that the rehabilitation program had a positive effect on decreasing the obesity anthropometric indices in both military and civilian groups. Accordingly, weight, BMI, WC, HC, and abdominal circumference significantly decreased in both civilian and military patients after the exercises (P < 0.001). Then, the data were analyzed to determine any significant differences between the two groups. The results have been presented in Table 1. As the table depicts, these indices were reduced in the military group, but no significant differences were observed between the two groups in this regard (confidence interval: 95%).

Rehabilitation indices were compared in the two groups before and after the rehabilitation program. The results indicated much more improvement in the military group, but the difference was not statistically significant. The data related to the rehabilitation indices have been presented in Table 2.

The two groups were compared regarding DM, HTN, HLP, smoking, and positive family history of cardiovascular disease. The results showed no significant relationships between these risk factors and reduction of obesity anthropometric indices and increase of cardiac rehabilitation indices in the military group. The results also showed no significant correlations between age and increase in rehabilitation indices in both study groups. However, a negative correlation was observed between the patients' age and anthropometric indices. Accordingly, higher ages were accompanied with lower rehabilitation indices. According to Table 3, negative values indicated a negative correlation between age and reduction in anthropometric indices. This implies that higher ages were associated with lower reductions in anthropometric indicators.

5. Discussion

In line with previous researches, the present study indicated that the cardiac rehabilitation program was beneficial for CAD patients after any intervention. The two study groups were compared regarding weight, BMI, WC, HC, and waist to hip ratio. Based on the results, the military group also benefitted from attending the cardiac rehabilitation programs irrespective of their previous active lifestyle. All military and civilian patients benefited from this program similarly and their obesity anthropometric indices were significantly decreased. However, no statistically significant differences were observed between the two groups in this regard. Payab et al. and Iravani et al. (9, 24) also found a significantly lower rate of metabolic syndrome in military personnel than in civilians in Iran. However, this rate was higher in comparison to military personnel of other countries. On the other hand, some other researches have

Table 1. Differences between the Two Groups Regarding the Reduction in the Mean Obesity Anthropometric Indices before and after the Cardiac Rehabilitation Program

Indicator	Military Group (n = 50), Mean ± SD	Civilian Group (n = 100), Mean ± SD	P-value
Weight	2.88 ± 1.80	2.78 ± 2.13	0.777
BMI	0.98 ± 0.60	0.94 ± 0.71	0.743
Waist C	3.06 ± 0.76	2.83 ± 0.77	0.089
Hip C	2.10 ± 0.50	1.97 ± 0.41	0.094
Waist C/Hip C ratio	0.01 ± 0.009	0.01 ± 0.008	0.388
AC	3.98 ± 0.91	3.84 ± 0.95	0.391
Waist C/height ratio	1.78 ± 0.43	1.65 ± 0.44	0.080

Abbreviations: BMI, body mass index; C, circumference; AC, abdominal circumference; N, number; SD, standard deviation

Table 2. Differences between the Two Groups Regarding the Reduction in the Mean Cardiac Rehabilitation Indices before and after the Cardiac Rehabilitation Program

Indicator	Military group (n = 50), Mean ± SD	Civilian group (n = 100), Mean ± SD	P-value
Bicycle (wat)	21.34 ± 11.46	19.86 ± 12.67	0.488
Bicycle (Mets)	1.07 ± 0.64	0.93 ± 0.66	0.222
Treadmill (wat)	35.60 ± 10.17	33.83 ± 11.09	0.346
Treadmill (Mets)	2.60 ± 0.69	2.46 ± 0.76	0.287

Abbreviations: Mets, metabolic equivalent of task; N, number; SD, standard deviation; Sig, significance

Table 3. The Relationship between Age and Obesity Anthropometric and Rehabilitation Indices in Both Military and Civilian Groups

Age and Obesity Anthropometric Indices				
Indicator	**Military group (n = 50)**		**Civilian group (n = 100)**	
	Pearson's correlation	**Significant**	**Pearson's correlation**	**Significant**
Weight	-0.173	0.230	-0.084	0.404
BMI	-0.140	0.333	-0.099	0.328
Waist C	-0.357	0.011	-0.165	0.102
Hip C	-0.058	0.691	0.041	0.684
Waist C/Hip C ratio	-0.307	0.030	-0.148	0.143
AC	-0.054	0.708	0.032	0.749
Waist C/Height ratio	-0.349	0.013	-0.158	0.117
Age and rehabilitation indices				
Indicator	**Military group (n=50)**		**Civilian group (n=100)**	
	Pearson's correlation	**Significant**	**Pearson's correlation**	**Significant**
Bicycle (wat)	-0.084	0.562	-0.107	0.287
Mets of Bicycle	-0.183	0.204	-0.180	0.074
Treadmill (wat)	-0.063	0.665	-0.070	0.491
Mets of Treadmill	-0.079	0.587	-0.057	0.573

Abbreviations: BMI, body mass index; C, circumference; AC, abdominal circumference; N, number; SD, standard deviation; MET, metabolic equivalent of a task

shown a greater risk of developing metabolic syndrome and cardiovascular risk factors among military personnel in other countries due to their stressful lifestyle (25, 26).

In order to review the effectiveness of exercise-based cardiac rehabilitation in patients with coronary heart disease, Taylor et al. conducted a meta-analysis in 2004. They concluded that cardiac rehabilitation contributed more to reduction of cardiac mortality and morbidity compared to the usual care. Accordingly, significant reductions were found in total cholesterol level and systolic blood pressure. Lower rates of self-reported smoking were detected, as well. However, the two groups were similar with respect to quality of life (14).

Cornelissen et al. surveyed CAD patients to determine the impact of an activity-based cardiac rehabilitation program on endothelial function. In that study, all patients took part in a twelve-week cardiac rehabilitation course. They recorded two indicators of epithelial function; i.e., pulse amplitude and brachial artery diameter. Finally, they found that the exercise-based rehabilitation program was associated with improvement of endothelial function and its related factors that could be measured by flow-mediated dilation (27).

In a similar investigation, Jamshidpour et al. researched the impact of cardiac rehabilitation exercises on anthropometric variables among both diabetic and non-diabetic males with CAD referred to a cardiac rehabilitation center in an Iranian population. They enrolled 71 male CAD patients (32 diabetic and 39 non-diabetic patients) in 6 - 8 weeks of moderate intensity aerobic exercise training. Both groups' anthropometric obesity indices were measured at the beginning, middle, and end of the exercise sessions. The results indicated a significant increase in all anthropometric variables, except for HC, in diabetic patients ($P < 0.05$). However, BMI, WC, and

waist to height ratio showed a significant increase in non-diabetic patients ($P < 0.05$). This implied that exercise training alone in the cardiac rehabilitation program was not sufficient to reduce the anthropometric obesity indices in non-diabetic patients (28). Nevertheless, Saeidi et al. reported that all female and male patients participating in the cardiac rehabilitation course similarly benefited from this program. They performed a cross-sectional survey on 310 cardiac patients, including 44 percutaneous transluminal coronary angioplasty (PTCA), 150 CABG, and 110 patients with other causes like myocardial infarction and angina. They came to the conclusion that the patients under medical treatments could improve their cardiovascular status before revascularization and sometimes postpone the intensive procedures (29).

Maleki et al. (11) investigated the prevalence of metabolic syndrome in air forces of Iran's Army. They measured anthropometric indices among 1000 air guard officers. They found that despite the relatively high prevalence of metabolic syndrome in Iran, the incidence of the associated risk factors was low among the air guard officers, which might be related to the military lifestyle. Finally, they recommend a comprehensive program to train susceptible cases and propose treatment strategies.

Considering these findings, the present study researchers investigated obesity anthropometric indices among army personnel. In line with the previous studies, the results revealed that the cardiac rehabilitation program after cardiac events and interventions was helpful in improving the patients' capabilities and quality of lives in both study groups. Military patients did not significantly benefit from the cardiac rehabilitation program due to their probably lower rates of metabolic syndrome components and anthropometric indices. Indeed, rehabilitation indices equally increased in both study groups without any significant differences.

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Authors' Contribution

Study concept and design: A M and A J, Acquisition of data: A D and H A, Analysis and interpretation of data: A M, A J and S H M, Drafting of the manuscript: A M and H A. Critical revision of the manuscript for important intellectual content: A M and A D. Statistical analysis: H A. Administrative, technical, and material support: A.M, A D and S H M

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The authors have no financial interests related to the material in the manuscript.

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