ORIGINAL ARTICLE

The effect of age on outcomes at a cardiac rehabilitation center in Turkey

Türkiye'de bir kardiyak rehabilitasyon merkezinin hastalarında yaşın sonuçlar üzerine etkisi

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ABSTRACT

Objective: The aim of this study was to assess the effectiveness of a 12-week phase II cardiac rehabilitation (CR) program in Turkish patients aged between ≤65 years and >65 years using psychical parameters, echocardiography measurements, lipid profiles, and psychological parameters.

Methods: A total of 68 patients who completed a phase II CR program were enrolled in this retrospective study. The echocardiography measurements, as well as assessment of physical parameters, psychological state, and serum lipid level of the patients were evaluated before the entry into the program and just after the completion. Patients were divided into 2 groups: those aged 65 years and under and those over the age of 65, and the effects of the CR program were compared.

Results: There was a statistically significant difference in the average heart rate (HR), left ventricular ejection fraction (LVEF), Beck Depression Inventory (BDI) score, and State-Trait Anxiety Inventory (STAI) I-II scores of young patients before and after cardiac rehabilitation. The LVEF, high-density lipoprotein (HDL), BDI, STAI-I, and STAI-II parameters of older patients were statistically significant. In the comparison between those who were 65 years and under and those over the age of 65, the change in the mean HR (+11.24±12.62 bpm vs. +3.96±12.50 bpm; p=0.039), LVEF (+21.31±21.37% vs. +9.55±13.50%; p=0.035) and STAI I scores (-11.33±11.51 points vs. -23.25±14.08 points; p=0.025) were significantly different.

Conclusion: The results of the present study revealed that patients in a Turkish population aged 65 and over benefited from CR as much as younger patients did in terms of physical parameters, echocardiography measurements, lipid profiles, and psychological parameters.

ÖZET

Amaç: Bu çalışmanın amacı ≤65 yaş ve >65 yaş arasındaki Türk hastalarda fizyolojik parametreler, ekokardiyografi ölçümleri, lipit profilleri ve psikolojik parametreler açısından 12 haftalık faz II kalp rehabilitasyonunun (KR) etkinliğini değerlendirmektir.

Yöntemler: Bu geriye dönük çalışmaya, faz II kalp rehabilitasyon programlarını tamamlamış 68 hasta alındı. Hastaların ekokardiyografi ölçümü, fiziksel parametreleri, psikolojik durumları ve serum lipit düzeyleri programa girmeden önce ve program tamamlandıktan hemen sonra değerlendirildi. Hastalar 65 yaş ve altı ve 65 yaş üstü olmak üzere iki gruba ayrıldı ve KR programının etkisi karşılaştırıldı.

Bulgular: KR öncesi ve sonrası 65 yaş ve altı hastaların ortalama kalp hızı (KH), seans sırasında egzersiz seviyesi, sol ventrikül ejeksiyon fraksiyonu (SVEF), Beck Depresyon Envanteri (BDE), Durumluk-Sürekli Kaygı Envanteri (STAI) I-II, istatistiksel olarak anlamlı farklılık gösterdi. Altmış beş yaş üstü hastaların ortalama seans sırasında egzersiz seviyesi, SVEF, yüksek dansiteli lipoprotein (HDL), BDE, STAI-I ve STAI-II parametreleri istatistiksel olarak anlamlıydı. Altmış beş yaş ve altı ve 65 yaş üstü hasta gruplarının yüzde değişimleri karşılaştırıldığında, ortalama KH (+11.24±12.62 ve +3.96±12.50; p=0.039), SVEF (+21.31±21.37 vs +9.55±13.50; p=0.035) ve STAI I (-11.33±11.51 ve -23.25±1 4.08; p=0.025) parametreleri istatistiksel olarak anlamlıydı.

Sonuç: Bu çalışma Türk toplumunda yaşlı hastaların KR'den genç hastalar kadar fiziksel parametreler, ekokardiyografi ölçümleri, lipid profili ve psikolojik parametreler açısından yarar sağladığını ortaya koymuştur.

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Cardiac rehabilitation (CR) is a multidisciplinary process that includes medical evaluation, prescribed exercise training, behavioral changes, education, psychological support, and counseling of patients and their families about cardiac disease.[1,2] The basic aim of CR is to improve the health-related quality of life, functional status, and prognosis of cardiac patients.[3] It is recommended that CR should be comprehensive, individualized, and carried out by a large, experienced team. It has been established that CR can reduce the risk of death by 18% to 25%, and decrease the risk of recurrent cardiac events, morbidity, and hospitalization due to cardiovascular causes.[4–6] In addition to all of these benefits, CR has been documented to be useful in the effort to improve cardiovascular risk factors, such as blood pressure, weight loss, stress modification, plasma lipids, and insulin sensitivity.[7,8]

Although patients over 65 years of age account for more than half of all cardiac events, generally, they are not adequately represented in clinical trials.[9] This is unfortunately also true among CR patients.[10] Despite the lack of evidence, it may be inaccurately thought that elderly patients are not suited to rehabilitation programs.[11] Following recognition of this, some studies investigating and comparing the effectiveness of CR in elderly patients have been published.[12–14] In a prospective study with 1273 patients, Grace et al.[12] compared patients aged ≤65 years and >65 years, and found a significant difference in some clinical parameters, such as blood pressure, angina class, and the number of diseased vessels, but not in the lipid profile. Kligfield et al.[13] compared the physical parameters of patients aged ≤65 years and >65 years before and after CR and found differences in exercise capacity and heart rate recovery (HRR) values. They suggested that younger patients benefited more from CR rehabilitation than elderly patients. Socha et al.,[15] however, found that there was no difference in metabolic equivalent of a task (METs) measures of energy expenditure between HRR patients aged ≤65 years and >65 years.[15] The effect of CR on the physical parameters of young and elderly patients remains a point of debate. The degree of improvement in patients' lipid profile after CR has not yet been examined according to age. Given the selective effect of lipid-lowering drugs on serum lipids and the importance of lipid regulation in patients with cardiovascular disease (CAD), it is important to clarify the effect of CR on serum lipids.

As far as we know, no previous study has been performed in a Turkish population to evaluate changes in the lipid profile after CR. The aim of this study was to assess and compare the effectiveness of a 12-week, phase II CR program in terms of echocardiography measurements, lipid profile, and psychological parameters in patients aged ≤65 years and >65 years.

Abbreviations:

BDI	*Beck Depression Inventory*
CAD	*Cardiovascular disease*
CR	*Cardiac rehabilitation*
HDL	*High-density lipoprotein*
HR	*Heart rate*
HRR	*Heart rate recovery*
LDL	*Low-density lipoprotein*
LVEF	*Left ventricular ejection fraction*
MET	*Metabolic equivalent of task*
PCI	*Percutaneous coronary intervention*
STAI	*State-Trait Anxiety Inventory*
TC	*Total cholesterol*
TG	*Triglyceride*

METHODS

Patients

A total of 68 patients who completed the 12-week phase II CR program at Istanbul Sultan Abdulhamid Han Training and Research Hospital between September 2016 and September 2018 were enrolled in this retrospective study. Only patients followed up by the cardiology clinic were included. Consecutive patients with CAD, heart failure, history of percutaneous coronary intervention (PCI) and/or cardiac surgery, were included in the program according to the need for CR as determined by cardiologists. When referring patients to the CR program, clinical symptoms, such as exercise intolerance and exercise angina, were evaluated by 2 experienced cardiologists according to the indications published by the British Association for Cardiac Rehabilitation.[16] All of the participants were treated pharmacologically in accordance with the European Society of Cardiology guidelines. Patient files with missing data were excluded from the study. In addition, patients who did not give permission for the use of their data for academic purposes were not included.

The protocol of the study was approved by the Zeynep Kamil Women's and Children's Disease Training and Research Hospital Research Ethics Committee on 05/09/2018 (no: 129). All stages of the study were carried out in accordance with the Helsinki Declaration.

Study design

The echocardiography findings, physical parameters, measurement of psychological state, and serum lipid

level data of the patients were evaluated before beginning the program and just after the completion of the CR program. The HRR of the patients was determined before and after the CR program using an ergometer. Each subject's height and weight was measured to calculate their body mass index (kg/m^2), and physical parameters, such as heart rate (HR), were measured using a treadmill during CR exercise before beginning the program. Transthoracic echocardiography (IE33 Matrix; Philips Medical Systems International B.V., Best, Netherlands) was also performed on all of the patients before and after the CR program. Left ventricular ejection fraction (LVEF) was measured using the biplane Simpson method. Depressive symptoms were evaluated using the Beck Depression Inventory (BDI) and anxiety symptoms were assessed according to the State-Trait Inventory. Blood samples of all of the patients were taken from the antecubital vein by applying a minimum tourniquet between 9 and 11 o'clock in the morning after at least 8 hours fasting. Serum triglyceride (TG), total cholesterol (TC), and high density lipoprotein (HDL) concentrations were measured using an auto-analyzer. Low density lipoprotein (LDL) concentrations were calculated according to the Friedewald equation.[17] After all of the data were collected, the patients were divided into 2 groups: those aged ≤65 years and those aged >65 years, according to the age classification of the World Health Organization, and the findings of the CR program were compared between groups.

Cardiac rehabilitation program

In the study hospital, the CR program consists of individualized supervised exercise training, education, and counseling for patients and their families. The Phase II CR program of the patients included in this study was initiated according to the results of an exercise test and the exercise prescription was regulated individually. The program has a multidisciplinary approach, with a cardiologist, a sports physician, a psychologist, and an experienced nurse working under the coordination of a cardiologist experienced in CR. The program includes 36 sessions and lasts 12 weeks, a frequency of 3 times a week. Each session comprises 45–55 minutes of exercise, including a warm-up and cool-down period. The exercise level for the first session is determined according to the preliminary exercise test; however, adjustments are made to the level of intensity according to the HRR during exercise training with the bicycle. The patients and their relatives were given training in small groups about ischemic heart disease, physical education, diet management, stress management, risk factors, and lifestyle changes. In addition, when appropriate, patients were referred to the outpatient smoking cessation clinic, diet clinic, or psychiatry clinic.

Beck Depression Inventory (BDI)

The BDI consists of 21 questions and each question is scored between 0 and 3 points. Thus, the total score ranges from 0 to 63. A high score indicates an increase in the severity of depressive symptoms. The tool was first developed by Beck et al. in 1961 and the Turkish version of the scale was created and validated by Hisli.[18]

State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory was developed in 1970 by Spielberger, Gorsuch, and Lushen. A Turkish adaptation of the 2 scales was developed by Öner and Compte.[19] The State Anxiety Scale (STAI I) score indicates the individual's anxiety level at a given time and conditions, and the score obtained from the Trait Anxiety Scale (STAI II) indicates the level of general anxiety independent of conditions. There are 20 items on each scale and the items are scored 1–4.

Data analysis

The statistical analysis was performed with IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp., Armonk, NY, USA). Power analysis using a medium effect size of 0.5, power of 0.80, and significance level of 0.05, recommended a sample size of 72 participants, 36 in each group. Categorical data were expressed as a percentage and continuous variables as mean±SD. A chi-square test was used to compare the effect of categorical variables between the 2 age groups. The Kolmogorov-Smirnov test was used to test the normal distribution of continuous variables. In the comparison of continuous variables of 2 independent groups, the Student's t-test was used if normal distribution was present, and the Mann-Whitney U test was used when the distribution was not normal. In the comparison of continuous variables of 2 dependent groups, a paired samples test was used if normal distribution was determined, and the Wilcoxon signed-ranked test was used if non-normal distribution was detected. A p value <0.05 was considered significant.

RESULTS

Sample characteristics and the comparison of sociodemographic and clinical factors between patients aged ≤65 years and >65 years who attended a CR program are presented in Table 1. A total of 68 patients were included in the study: 37 (54.4%) were ≤65 years of age and 31 (45.6%) were aged >65 years. The mean age of the participants was 61.6±13.3 years, and 22 (32.4%) were female. The frequency of married status was greater in the group aged ≤65 years (p=0.048). The frequency of atrial fibrillation, CAD, and hypertension was greater in the older group (p=0.029, 0.026, 0.032, respectively). The frequency of smoking was greater in the ≤65 years group (p=0.013).

The effects of age and CR exercise on the clinical parameters in the patients of the 2 groups are presented in Table 2. In a comparison of data before and after CR, the mean HR and LVEF was higher in the patients aged ≤65 years after participating in the program (p<0.001 and <0.001, respectively). In the older patients, the LVEF and HDL parameters were higher than before the CR (p<0.002 and <0.015, respectively). The BDI, STAI I, and STAI II scores were lower after CR in both groups.

In the comparison of age groups, changes in the mean HR and LVEF parameters were greater in the patients aged <65 years (p value=0.039 and 0.035, respectively). Changes in the STAI I score were greater among the older patients (p=0.025).

DISCUSSION

This study was an investigation of the effect of age on CR outcomes. We compared the physical parameters, echocardiography measurements, lipid profile, and psychological parameters of the patients. One of the most important findings of the study is that the mean HR and LVEF measurements in patients younger than 65 years were better than that of those aged 65 years or more. It was also determined that the change in anxiety symptoms was greater in the group of patients aged >65 years. The increase in mean HR was statistically significant in patients younger than 65 years of age and the increase in HDL was found to be statistically significant in the older patient group. To our knowledge, these results are the first to evaluate the effect of age on CR in the Turkish population.

The primary factor governing participation in a CR program is doctor's advice.[20] Previous studies have pointed out that doctors may think that older patients will not benefit from CR.[7,12] This has likely contributed to lower CR participation rates among elderly patients.[12,20] At the same time, as can be seen in our results, the greater frequency of comorbidities in the patients aged >65 years may also be a barrier between CR and elderly patients.[12,14] However, some studies have shown that elderly patients with cardiac disease benefited from CR as much as younger patients, both with and without comorbidities.[12,13,15] In brief, the results of the present study show that patients over the age of 65 can benefit from CR, which is consistent with the literature. Based on this result, we suggest that physicians should not be prejudiced against referring elderly patients to CR and that patients with indications should be guided accordingly.

There are a limited number of studies in the literature comparing the results of CR between patients aged >65 years and ≤65 years. Kligfield et al.[13] compared METs and HRR before and after CR and found that the younger patients had more benefit from CR than older patients. Socha et al.[15] showed that a 3-week CR program led to a significant benefit in weight and body mass index in elderly males but not females. However, as far as we know, there are no studies examining the effect of CR on lipid profile, physical, echocardiography, and psychological parameters by age. We found no significant difference in the maximum HR changes between the groups. However, the mean HR was higher in the younger patients than in those over the age of 65.

Previous studies have shown that CR leads to an increase in LVEF.[21,22] The results of our study also revealed an increased LVEF in both age groups, with a greater improvement in the younger patient group. These results may be explained by the fact that the young people have more adaptability and contractile reserve. However, comparison of the 2 age groups in this study did not reveal a significant difference in diastolic dysfunction, left ventricular systolic diameter, or left ventricular diastolic diameter after CR. This information is presented for the first time as a contribution to the literature. A 12-week CR program may be of insufficient duration to alter these parameters in those over the age of 65. Longer periods of time may be needed for left ventricular remodeling.

Table 1. Sample characteristics and comparison of sociodemographic and clinical factors between patients ≤65 years of age and >65 years who attended cardiac rehabilitation

	Total patients	Patients ≤65 years old	Patients >65 years old	t/z value	p value
N, n (%)	68 (100)	37 (54.4)	31 (45.6)		
Age (years), mean±SD	61.62±13.31	52.86±7.63	75.67±6.33	-13.244	[a]<0.001**
Gender, n (%)					
Female	22 (32.4)	12 (54.5)	10 (45.5)	0.000	[b]0.988
Male	46 (67.6)	25 (54.3)	21 (45.7)		
Body mass index	27.91±4.61	27.74±4.71	28.17±4.57	-0.291	[a]0.773
Marital status, n (%)					
Married	57 (83.8)	34 (59.6)	23 (40.4)	3.896	[b]0.048
Single	11 (16.2)	3 (27.3)	8 (72.7)		
Atrial fibrillation, n (%)					
Yes	14 (20.6)	4 (10.8)	10 (32.3)	4.746	[b]0.029
No	54 (79.4)	33 (89.2)	21 (67.7)		
CAD, n (%)					
Yes	59 (86.8)	29 (78.4)	30 (96.8)	4.971	[b]0.026
No	9 (13.2)	8 (21.6)	1 (3.2)		
History of MI, n (%)					
Yes	30 (44.1)	17 (56.7)	13 (43.3)	0.110	[b]0.740
No	38 (55.9)	20 (52.6)	18 (47.4)		
History of CABG, n (%)					
Yes	19 (27.9)	8 (42.1)	11 (57.9)	1.610	[b]0.205
No	49 (72.1)	29 (59.2)	20 (40.8)		
History of PCI, n (%)					
Yes	33 (48.5)	17 (48.5)	16 (51.5)	0.905	[b]0.341
No	35 (51.5)	21 (60.0)	14 (40.0)		
CHF, n (%)					
Yes	26 (38.2)	18 (69.2)	8 (30.8)	3.727	[b]0.054
No	42 (61.8)	19 (45.2)	23 (54.8)		
Hypertension, n (%)					
Yes	41 (60.3)	18 (43.9)	23 (56.1)	4.598	[b]0.032*
No	27 (39.7)	19 (70.4)	8 (29.6)		
Diabetes mellitus, n (%)					
Yes	21 (30.9)	11 (52.4)	10 (47.6)	0.051	[b]0.822
No	47 (69.1)	26 (55.3)	21 (44.7)		
COPD, n (%)					
Yes	14 (21.6)	7 (50.0)	7 (50.0)	0.138	[b]0.710
No	54 (79.4)	30 (55.6)	24 (44.4)		
Smoking, n (%)					
Yes	23	17 (73.9)	6 (26.1)	6.181	[b]0.013*
No	43	18 (41.9)	25 (58.1)		

CABG: Coronary artery bypass graft; CAD: Coronary artery disease; CHF: Congestive heart failure; COPD: Chronic obstructive pulmonary disease; MI: Myocardial infarction; PCI: Percutaneous coronary intervention; SD: Standard deviation. [a]Student's t-test; [b]Chi-square test. *p≤0.05; **p≤0.01.

Table 2. Effect of age and cardiac rehabilitation exercise on clinical parameters

Parameter	Age	Cardiac rehabilitation		t/z value	p value	% Change	t/z value	p value
		Baseline	12 weeks					
Average heart rate (beats × minute^{-1})	≤65 years	86.16±16.48	93.80±16.74	–3.963	[b]<0.001**	+11.24±12.62	2.112	[d]0.039*
	>65 years	86.75±14.89	90.91±18.73	–1.753	[a]0.080	+3.96±12.50		
Maximum heart rate (beats × minute^{-1})	≤65 years	110.06±27.87	111.96±19.46	–1.081	[a]0.280	+4.18±19.54	-1.254	[c]0.210
	>65 years	107.50±24.75	111.37±29.07	–1.044	[b]0.308	+4.24±18.08		
Left ventricle ejection fraction (%)	≤65 years	43.41±17.35	49.70±16.38	–5.324	[b]<0.001**	+21.31±21.37	-2.111	[c]0.035*
	>65 years	49.89±13.58	54.78±13.29	–3.146	[a]0.002**	+9.55±13.50		
Diastolic dysfunction (mm)	≤65 years	1.20±0.42	1.00±0.47	–1.414	[a]0.157	+11.11±33.33	-0.300	[c]0.864
	>65 years	1.12±0.75	0.35±0.46	–1.732	[a]0.083	+16.66±40.82		
Left ventricular diastolic diameter (mm)	≤65 years	55.76±11.13	56.58±10.11	–0.781	[b]0.446	+2.06±7.95	-0.208	[c]0.835
	>65 years	50.86±7.43	51.26±7.29	–0.378	[b]0.711	+1.20±8.90		
Left ventricular systolic diameter (mm)	≤65 years	42.00±13.27	41.37±13.40	0.528	[b]0.605	-1.02±13.09	0.485	[d]0.632
	>65 years	36.80±8.57	35.13±8.02	1.274	[b]0.223	-3.38±14.09		
Total cholesterol (mg/dL)	≤65 years	182.00±36.40	178.91±37.78	0.608	[b]0.549	-0.83±15.40	0.437	[d]0.664
	>65 years	169.61±36.64	163.19±44.97	0.940	[b]0.358	-3.08±19.06		
Low-density lipoprotein (mg/dL)	≤65 years	105.65±36.64	106.79±34.59	–0.218	[b]0.829	+5.56±27.16	1.419	[d]0.163
	>65 years	97.82±30.70	90.37±33.55	1.396	[b]0.178	-5.59±25.33		
High-density lipoprotein (mg/dL)	≤65 years	49.80±11.20	49.79±13.76	–0.376	[a]0.707	-1.30±5.50	-0.579	[d]0.566
	>65 years	47.13±13.56	50.15±12.79	–2.627	[a]0.015*	-0.22±6.53		
Triglycerides (mg/dL)	≤65 years	131.04±77.95	132.70±59.37	–0.365	[a]0.715	+11.03±40.98	0.925	[d]0.360
	>65 years	115.61±45.33	109.00±36.40	0.725	[b]0.477	+0.95±30.48		
Beck Depression Inventory (points)	≤65 years	15.92±10.45	8.77±7.55	5.611	[b]<0.001**	-17.98±15.64	0.962	[d]0.836
	>65 years	15.05±8.66	7.95±5.12	4.545	[b]<0.001**	-19.61±18.17		
STAI-I (points)	≤65 years	38.90±11.99	34.31±10.34	4.281	[b]<0.001**	-11.33±11.51	2.366	[d]0.025*
	>65 years	42.25±5.47	32.25±6.04	4.425	[b]0.003**	-23.25±14.08		
STAI-II (points)	≤65 years	41.54±11.99	33.72±10.38	3.632	[b]0.005**	-47.41±22.72	-0.331	0.778
	>65 years	41.87±3.31	33.62±7.42	3.247	[b]0.014*	-44.71±24.59		

STAI: State-Trait Inventory. [a]Wilcoxon signed-ranked test; [b]Paired samples test; [c]Mann-Whitney U test; dStudent's t-test. *p≤0.05; **p≤0.01.

The importance of the lipid profile in both primary and secondary prevention strategies to reduce cardiovascular risk factors has been well documented.[23] It has been demonstrated that CR can lead to improvement in the lipid profile of both patients who used an anti-lipid drug and those who did not.[7] Lavie et al.[23] observed that CR resulted in increased HDL in elderly patients; however, LDL, TG, and TC levels showed no change. Improvement in HDL and TG levels were seen in younger patients. However, they did not compare the changes in the 2 patient groups. We concluded that CR was associated with an increased HDL level in the patients aged over 65, which is partially consistent with the literature. But, when we compared the changes between age groups, we found that the difference was not significant. The varying results of past studies may be due to ethnicity and dietary differences.

Improvement in anxiety and depression is an expected result of a CR program.[24–26] We found that there was a decrease in anxiety and depression symptoms in both study groups. Although a decrease in anxiety and depression symptoms is not a specific target, it is a useful result. The mechanism of this recovery has not yet been fully explained, but possible mechanisms have been explored.[27] Decreased severity of symptoms of anxiety and depression may be related to the exercise and psychological and social support components of the CR program.

This study has several limitations, including the small sample size. Studies with a larger sample of CR patients will be useful to further assess the role of age in CR. Second, this study was a single-center, retrospective study. Although the limits of the study are clearly defined, randomized, controlled trials are warranted to validate our results. In addition, the 12-week period may be considered too short to compare some of the values used in our study. The results of longer follow-up studies will make this clearer. Finally, anxiety and depressive symptoms of the patients were determined by self-report tests. More detailed study of patient subgroups according to the initial diagnoses will be a guide for more well-defined results.

Conclusion

Our research revealed that patients over the age of 65 benefited from CR as much as those 65 years and under. Based on the results of this study, it is possible to say that the prejudices of some physicians who fail to recommend elderly patients to CR are inappropriate. We recommend that physicians should refer appropriate patients over the age of 65 years to CR to improve quality of life and functional status. However, there is a need for large-sample, prospective, and long-term studies to confirm our results.

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