

## The Effect of Cardiac Rehabilitation Program on Quality of Life, Biophysiological Parameters, and Psychological Features in Patients with Cardiovascular Disease

Kardiyovasküler Hastalarda Kardiyak Rehabilitasyon Programının Yaşam Kalitesi, Biyofizyolojik Parametreler ve Psikolojik Özelliklere Etkisi

### ABSTRACT

**Objective:** Secondary prevention is crucial in cardiovascular disease to halt disease progression and prevent complications. Comprehensive cardiac rehabilitation (CR) programs, encompassing exercise training, cardiovascular risk factor modification, and psychological intervention components, are conducted by a multidisciplinary team created for this purpose. This study aims to investigate the effects of the comprehensive CR program on quality of life, biophysiological parameters, and psychological features.

**Methods:** Data were collected in phase I (before discharge) and at the follow-up appointment in the early (30<sup>th</sup> day) phase III period of CR. The "SF-36 Quality of Life Scale", "Depression, Anxiety, and Stress Scale (DASS-21)", and biophysiological parameters were compared before and after the CR program.

**Results:** The mean age was  $61.56 \pm 8.22$  years, and 27 (51.9%) of the patients were male. All SF-36 sub-dimensions after CR demonstrated a significant increase. The SF-36's main components, the "physical component summary" and the "mental component summary" ( $30.36 \pm 8.38$  and  $28.53 \pm 12.59$  vs.  $77.27 \pm 13.66$  and  $64.48 \pm 6.48$ ;  $P < 0.001$ ), both showed a significant increase. Depression, anxiety, and stress scores significantly decreased after CR across all variables. A statistically significant decrease in systolic blood pressure, diastolic blood pressure, low-density lipoprotein, and triglyceride levels, as well as an increase in hemoglobin value, were found in the biophysiological parameters.

**Conclusion:** This study demonstrates that implementing all components of the CR program significantly improves patients' quality of life, biophysiological parameters, and psychological features.

**Keywords:** Anxiety, biophysiological parameters, cardiac rehabilitation, depression, quality of life, stress

### öz

**Amaç:** Sekonder koruma, kardiyovasküler hastalıklarda hastalığın ilerlemesini durdurmak ve komplikasyonları önlemek açısından çok önemlidir. Egzersiz eğitimi, kardiyovasküler risk faktörü modifikasyonu ve psikolojik müdahale bileşenlerini içeren kapsamlı kardiyak rehabilitasyon (KR) programları, bu amaçla oluşturulan multidisipliner bir ekip tarafından yürütülmektedir. Bu çalışmada kapsamlı KR programının yaşam kalitesi, biyofizyolojik parametreler ve psikolojik özellikler üzerindeki etkilerini araştırmayı amaçladık.

**Yöntem:** Veriler faz I'de (taburcu olmadan önce) ve KR'nin erken (30. gün) faz III dönemi takibinde elde edildi. KR programı öncesinde ve sonrasında "SF-36 Yaşam Kalitesi Ölçeği", "Depresyon, Anksiyete ve Stres Ölçeği (DASS-21)" ve biyofizyolojik parametreler karşılaştırıldı.

**Bulgular:** Yaş ortalaması  $61,56 \pm 8,22$  yıl olup, hastaların 27'si (%51,9) erkekti. KR sonrası tüm SF-36 alt boyutları anlamlı bir artış gösterdi. SF-36'nın ana bileşenleri olan "fiziksel bileşen özeti" ve "zihinsel bileşen özeti" ( $30,36 \pm 8,38$  ve  $28,53 \pm 12,59$  karşı  $77,27 \pm 13,66$  ve  $64,48 \pm 6,48$ ;  $P < 0,001$ ) anlamlı bir artış gösterdi. Depresyon, anksiyete ve stres puanları KR sonrası tüm değişkenlerde anlamlı düzeyde azaldı. Biyofizyolojik parametreler incelendiğinde sistolik kan basıncı, diyastolik kan basıncı, düşük yoğunluklu lipoprotein ve trigliserit düzeylerinde istatistiksel olarak anlamlı bir düşüş ve hemoglobin değerinde ise artış tespit edildi.

**Sonuç:** Bu çalışma, KR programının tüm bileşenlerinin uygulanmasının hastaların yaşam kalitesini, biyofizyolojik parametrelerini ve psikolojik özelliklerini önemli ölçüde iyileştirdiğini gösterdi.

**Anahtar Kelimeler:** Anksiyete, biyofizyolojik parametreler, kardiyak rehabilitasyon, depresyon, yaşam kalitesi, stres

### ORIGINAL ARTICLE

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## Introduction

Cardiovascular diseases (CVD) stand as the leading cause of morbidity and mortality both in Türkiye and globally.<sup>1,2</sup> Secondary prevention plays a pivotal role in impeding disease progression and averting complications subsequent to CVD.<sup>3,4</sup> Cardiac rehabilitation (CR) programs, designed to be multidisciplinary and comprehensive, are tailored for this purpose.<sup>4</sup> These initiatives encompass supervised medical evaluations, personalized training, counseling, and exercise regimens, among others. Their overarching aim is to mitigate the physical and psychological toll of the disease, enhance patients' quality of life, forestall secondary cardiac events, manage symptoms, and facilitate patients' return to an active lifestyle. According to guidelines endorsed by esteemed organizations such as the American Heart Association (AHA) (Class I-A), the European Society of Cardiology (ESC) (Class I-B), and the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) (Class II-A), individuals with CVD are encouraged to enroll in CR programs.<sup>3,5,6</sup> However, the current level of referral to and uptake of CR programs remains inadequate.

The cardiac rehabilitation program traditionally consists of three phases. Phase I involves inpatient rehabilitation during the index hospitalization. Phase II entails supervised physical activity after discharge under physician supervision. Phase III marks the unsupervised outpatient phase. During this period, patients are expected to apply the knowledge and skills acquired through education and counseling to their daily lives.<sup>3</sup> The CR program is offered to patients with a range of cardiac conditions including coronary artery disease, coronary revascularization, heart failure, stable angina, peripheral artery disease, pacemaker or implanted cardiac defibrillator (ICD), ventricular assist device (VAD), percutaneous coronary intervention, heart valve surgery, and post-heart transplantation. Contraindications primarily relate to the exercise component of the program.<sup>3-5</sup>

Comprehensive CR programs encompass exercise training, cardiovascular risk factor modification, and psychological intervention components, all of which are administered by a multidisciplinary team. It's important to note that implementing only one of these components does not constitute CR; rather, it's a part of the program.<sup>5</sup> Existing literature highlights the beneficial effects of the exercise component of CR programs,

such as improvements in exercise capacity and quality of life, positive psychological effects, and reductions in morbidity, mortality, and costs.<sup>7-9</sup> However, studies examining all components of the CR program are limited, with most focusing solely on exercise training. Consequently, there remains insufficient knowledge regarding the overall effects of the comprehensive CR program. Thus, in this study, we aimed to investigate the effects of the comprehensive CR program on quality of life, biophysiological parameters, and psychological features.

## Research Hypotheses

**H1:** CR programs following a cardiovascular event or disease have a positive effect on quality of life.

**H2:** CR programs following a cardiovascular event or disease lead to improvements in biophysiological parameters.

**H3:** CR programs following a cardiovascular event or disease have a positive impact on psychological features.

## Materials and Methods

This study is prospective and observational, adhering to the ethical principles outlined in the Declaration of Helsinki. Approval for the study was obtained from the Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Research and Training Hospital Clinical Research Ethics Committee (Approval Number: 2021/09, Date: 23.02.2021). Verbal and written (informed consent) approval was obtained from all patients meeting the study criteria.

## Study Population and Procedure

A total of 1,103 patients were referred to CR during Phase I of the study, with 105 patients participating in the Phase II exercise program. Among them, only 52 patients completed Phase II and proceeded to Phase III.

At the institution where the research was conducted, there is a CR center. Following admission for CVD, patients undergo evaluation by a physician to determine their suitability for the CR program. Eligible patients receive training and counseling from a CR nurse prior to discharge during their hospitalization. Additionally, they are provided with a sample nutrition program prepared by a dietitian. Upon discharge from the hospital, patients receive training booklets and scheduled physician appointments.

Patients, depending on their disease, attend a follow-up appointment between 2 and 6 weeks after discharge from the hospital, where they are assessed by cardiology and physical therapy and rehabilitation specialists. At this appointment, various tests (including laboratory tests and exercise tests) and a physical examination are conducted to evaluate patients' condition. If patients assessed by a physical therapist and rehabilitation specialist consent to participate in the exercise program, the supervised in-hospital phase, known as Phase II, begins. During this phase, patients are expected to participate regularly in the exercise program. They also continue to receive training and counseling from the CR nurse. Following Phase II, the Phase III out-of-hospital unsupervised period commences, which typically lasts for an average of 12 weeks.

## MAIN POINTS

- This study revealed that the CR program led to improvements in patients' quality of life, biophysiological parameters, and psychological features.
- Compared to prior research, the positive effects observed in the quality of life, biophysiological parameters, and psychological characteristics of the patients in this study following CR are believed to be directly linked to the comprehensive implementation of all components of the CR program.

### Patient Selection

Patients aged 18 and above, literate, who have completed both Phase I and Phase II of the CR program, and have provided consent to participate in the study were eligible for inclusion. Patients with confirmed psychological disorders, immobility issues, refusal to participate in the study, or those who discontinued the supervised period of the CR program (Phase I and II) were excluded from the study.

### Data Collection

Patients meeting the study's inclusion criteria were interviewed, and their verbal and written consents were obtained during Phase I (before discharge) of the CR program. Data collection during patient interviews utilized the "Data Collection Form," the "SF-36 Quality of Life Scale," and the "Depression, Anxiety, Stress Scale-21 (DASS-21)." Additionally, laboratory results from routine follow-up exams were documented. Patients were contacted by phone and re-evaluated using the same forms early in Phase III (30<sup>th</sup> day after the completion of the supervised program). Laboratory results from follow-up examinations were utilized for comparison.

### Data Collection

The data collection form was developed by the researchers based on a review of the literature. This form comprised 34 questions pertaining to socio-demographic and clinical characteristics, including age, gender, marital status, education level, comorbidities, and other relevant factors.

### The Short Form Health Survey

The Short Form Health Survey (SF-36) is one of the most commonly used questionnaires for assessing health-related quality of life in the general population. Developed by Ware et al.<sup>10</sup> in 1993, it was adapted into Turkish by Koçyiğit et al.<sup>11</sup> in 1999. The SF-36 comprises two main components (physical and mental) and eight sub-domains. Instead of providing a single score, each sub-domain is evaluated individually, with scores ranging from 0 to 100. A higher score on the SF-36 indicates better health-related quality of life. In a reliability and validity study conducted in Turkish, Cronbach's alpha coefficients ranged from 0.73 to 0.76 for each subgroup. In this study, Cronbach's alpha was found to be between 0.68 and 0.78.

### The Depression Anxiety Stress Scales-21

DASS-21, a short form of the Depression, Anxiety, and Stress (DASS) scale, was developed by Lovibond and Lovibond in 1995.<sup>12</sup> It was adapted for Turkish by Yıldırım et al.<sup>13</sup> in 2018. The DASS-21 assesses the psychological effects of depression, anxiety, and stress on individuals. This 21-item scale comprises three sub-dimensions: depression, anxiety, and stress. Responses to items are scored from 0 to 3 (0=never, 1=sometimes, 2=quite often, 3=always), with higher scores indicating greater psychological impact. In a reliability and validity study conducted in Turkish, Cronbach's alpha coefficients ranged from 0.87 to 0.90 for each subgroup. In this study, Cronbach's alpha was found to be between 0.87 and 0.94.

### Biophysiological Parameters

Biophysiological parameters considered in this study encompassed body mass index, systolic and diastolic blood

pressure, lipid profile, hemoglobin level, random blood sugar, serum sodium, and potassium levels.

### Statistical Analysis

Continuous variables were presented as means  $\pm$  SD, while categorical variables were expressed as percentages. The effect of the comprehensive CR program on quality of life (SF-36) and biophysiological parameters was assessed using a paired t-test. Changes in patients' psychological features (DASS-21 scores) before and after the comprehensive CR program were evaluated using both paired sample t-tests and independent sample t-tests across socio-demographic

**Table 1. Socio-Demographic and Clinical Characteristic of the Patients**

Variables	Frequency (n)	Percentage (%)
Age (year)		
< 65 years	30	57.7
$\geq$ 65 years	22	42.3
Gender		
Female	25	48.1
Male	27	51.9
Marital status		
Married	42	80.8
Single	10	19.2
Education level		
< High school	45	86.6
$\geq$ High school	7	13.4
Economics tatus		
Income less than expenses	22	42.3
Income partially covers expenses	30	57.7
Health insurance		
Yes	50	96.2
No	2	3.8
Home status		
Living with a family member	49	94.2
Living alone	3	5.8
Type of intervention		
CABG	42	80.8
Heart valve surgery	10	19.2
Comorbidities		
HL	40	76.9
HT	29	55.8
MI	26	50.0
DM	24	46.2
Anemia	6	11.5
COPD	6	11.5
PAD	5	9.6
CKD	2	3.8
Family history of CAD		
Yes	39	75.0
No	13	25.0

CABG, coronary artery bypass grafting; CAD, coronary artery disease; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; HL, hyperlipidemia; HT, hypertension; MI, myocardial infarction; PAD, peripheral artery disease.

and clinical characteristics. Lifestyle and medication changes before and after CR were compared using the McNemar test for proportions. A significance level of  $P < 0.05$  (two-sided) was considered statistically significant. Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 20.0 for Windows (SPSS Inc., Chicago, Illinois, USA).

**Table 2. Quality of Life of the Patients before and after Cardiac Rehabilitation**

SF-36	Before	After	Statistics	
	Mean ± SD (0-35)	Mean ± SD (45-95)	t	P
Physical Functioning	9.13 ± 11.49 (0-35)	82.69 ± 9.15 (45-95)	-43.26	<b>&lt;0.001</b>
Role Physical	0.00 ± 0.00 (0)	71.63 ± 38.04 (0-100)	-13.58	<b>&lt;0.001</b>
Bodily Pain	53.65 ± 20.14 (0-100)	85.00 ± 12.45 (55-100)	-12.94	<b>&lt;0.001</b>
General Health	58.65 ± 11.89 (25-80)	69.75 ± 15.57 (7-85)	-5.39	<b>&lt;0.001</b>
Role Emotional	26.92 ± 44.79 (0-100)	97.43 ± 14.53 (0-100)	-10.82	<b>&lt;0.001</b>
Vitality	26.15 ± 10.22 (10-60)	52.60 ± 11.40 (25-80)	-13.74	<b>&lt;0.001</b>
Mental Health	25.23 ± 9.72 (12-52)	52.35 ± 12.93 (20-84)	-16.03	<b>&lt;0.001</b>
Social Functioning	35.82 ± 8.58 (12-50)	55.53 ± 7.59 (37-62)	-12.42	<b>&lt;0.001</b>
Physical Component summary	30.36 ± 8.38 (10-48)	77.27 ± 13.66 (35-95)	-30.92	<b>&lt;0.001</b>
Mental Component summary	28.53 ± 12.59 (16-59)	64.48 ± 6.48 (40-76)	6.09	<b>&lt;0.001</b>

Significant difference at  $P < 0.05$ ; value in bold: significant; Student's t test.

## Results

### Demographics and Clinical Characteristics of the Patients

A total of 52 patients were included in the study. The mean age was  $61.56 \pm 8.22$  years, with 27 (51.9%) of the patients being male. The majority of patients (57.7%) were under the age of 65, married (80.8%), and had less than a high school education (86.6%). Additionally, 75.0% of patients had a family history of coronary artery disease (CAD), and 80.8% of patients referred to CR had undergone coronary artery bypass grafting (CABG). The mean left ventricular ejection fraction (LVEF) of the patients was  $52.77 \pm 8.04$  (Table 1).

### Comparison of Quality of Life Before and After Cardiac Rehabilitation

Upon assessing the SF-36 scores of the patients before CR, the lowest score was obtained from the "role physical" sub-dimension, while the highest score was obtained from the "general health" sub-dimension. Following CR, all SF-36 sub-dimensions exhibited a statistically significant increase. Specifically, both the "physical component summary" and the "mental component summary" demonstrated significant increases ( $30.36 \pm 8.38$  and  $28.53 \pm 12.59$  vs.  $77.27 \pm 13.66$  and  $64.48 \pm 6.48$ ;  $P < 0.001$ ), as shown in Table 2.

### Comparison of Biophysiological Parameters Before and After Cardiac Rehabilitation

A statistically significant decrease was observed in systolic blood pressure, diastolic blood pressure, low-density lipoprotein (LDL), and triglyceride levels, accompanied by an increase in hemoglobin value when comparing the biophysiological parameters of patients before and after CR. Details of the changes in biophysiological parameters are provided in Table 3.

### Comparison of Psychological Features

Except for CR, there were no significant differences in psychological features across demographic and clinical variables, except for patients' economic status. However, following CR, depression, anxiety, and stress scores significantly decreased in all variables, irrespective of group (Table 4). Additionally, early assessment after CR revealed

**Table 3. Biophysiological Parameters of the Patients before and after Cardiac Rehabilitation**

Parameters	Before Mean ± SD	After Mean ± SD	Meandifference	t	p
BMI (kg/m <sup>2</sup> )	28.89 ± 4.86	29.03 ± 5.08	0.14	-0.94	.34
Systolic BP (mmHg)	132.17 ± 18.78	120.86 ± 10.08	11.31	5.87	<b>&lt;.001</b>
Diastolic BP (mmHg)	78.46 ± 13.01	71.23 ± 5.12	7.23	4.13	<b>&lt;.001</b>
HDL (mg/dL)	41.71 ± 12.31	43.21 ± 8.90	1.50	-1.23	.22
LDL (mg/dL)	97.79 ± 32.36	67.69 ± 24.61	30.10	6.91	<b>&lt;.001</b>
Triglyceride (mg/dL)	146.23 ± 64.14	119.73 ± 36.13	26.50	3.83	<b>&lt;.001</b>
Hemoglobin (gm/dL)	10.76 ± 1.36	11.47 ± 1.62	0.71	-5.54	<b>&lt;.001</b>
RBS (mg/dL)	128.25 ± 48.23	118.42 ± 45.07	9.83	1.64	.10
Serum sodium (mEq/L)	134.16 ± 17.27	137.02 ± 3.18	2.85	-1.20	.23
Serum potassium (mEq/L)	4.65 ± 0.54	4.65 ± 0.44	0.00	.06	.95

BMI, body mass index; BP, blood pressure; CR, cardiac rehabilitation; HDL, high-density lipoprotein; LDL, low-density lipoprotein; RBS, random blood sugar. Significant difference at  $p < .05$ ; value in bold, significant.

**Table 4. Comparison of the Psychological Features of the Patients' Across the Socio-Demographic and Clinical Characteristics before and after Cardiac Rehabilitation**

	Depression			Anxiety			Stress		
	Before	After	t; p	Before	After	t; p	Before	After	t; p
<b>Age (year)</b>									
< 65years	8.00±3.71	2.60±2.37	12.10; <0.001	5.17±3.19	1.00±1.87	9.31; <0.001	9.77±4.41	4.07±2.86	9.63; <0.001
≥ 65 years	7.04±4.41	2.41±2.32	6.47; <0.001	4.54±3.79	.64±1.22	4.97; <0.001	8.27±4.06	3.36±2.50	7.69; <0.001
<b>t; p</b>	.84; .40	.28; .77		.64; .52	0.79; 0.43		1.24; .21	.92; .36	
<b>Gender</b>									
Female	7.48±3.88	2.20±1.89	9.66; <0.001	4.88±3.18	.68±1.34	8.13; <.001	8.76±4.08	3.68±2.67	8.47; <0.001
Male	7.70±4.19	2.81±2.67	8.42; <0.001	4.92±3.72	1.00±1.86	6.00; <.001	9.48±4.52	3.85±2.80	8.90; <0.001
<b>t; p</b>	-.19; .84	-.95; .34		-.04; .96	-.70; .48		-.60; .55	-.22; .82	
<b>Marital status</b>									
Married	7.55±4.17	2.50±2.47	11.36; <0.001	4.98±3.57	.93±1.77	8.52; <.001	9.21±4.39	3.78±2.81	11.01; <0.001
Single	7.80±3.46	2.60±1.71	5.60; <0.001	4.60±2.95	.50±.71	4.55; 0.001	8.80±4.05	3.70±2.41	5.37; <0.001
<b>t; p</b>	-.17; .86	-.12; .90		.30; .75	-.74; .45		.27; 0.78	.08; 0.82	
<b>Education level</b>									
< High school	8.00±3.99	2.75±2.37	12.19; <0.001	5.15±3.47	.93±1.72	9.30; <0.001	9.47±4.31	3.87±2.71	11.71; <0.001
≥ High school	5.00±3.26	1.00±1.29	4.00; 0.007	3.28±2.93	.28±.49	2.90; 0.02	7.00±3.74	3.14±2.85	4.65; .003
<b>t; p</b>	1.88; .06	1.90; .06		1.35; .18	.98; .33		1.42; 0.15	.65; .51	
<b>Economic status</b>									
Income less than expenses	9.91±3.32	3.68±2.03	9.61; <0.001	5.15±3.47	1.14±1.67	8.81; <0.001	11.32±3.45	4.91±2.07	9.09; <0.001
Income partially covers expenses	5.90±3.64	1.67±2.19	9.48; <0.001	3.28±2.93	.63±1.59	6.43; <0.001	7.53±4.18	2.93±2.85	8.96; <0.001
<b>t; p</b>	4.06; <0.001	1.90; 0.001		3.76; <0.001	1.10; .27		3.46; 0.001	2.75; 0.008	
<b>Home status</b>									
Living with a family member	7.79±3.98	2.57±2.32	12.75; <0.001	5.12±3.39	.88±1.67	9.98; <.001	9.43±4.19	3.90±2.68	12.34; <0.001
Living alone	4.33±3.51	1.67±2.89	3.02; .09	1.33±2.31	.33±.58	1.00; 0.42	4.33±3.51	1.67±2.89	3.02; .09
<b>t; p</b>	1.46; .14	.64; .51		1.90; .06	.55; .57		.55; 0.04	1.19; 0.16	
<b>Type of intervention</b>									
CABG	7.69±3.41	2.52±2.28	12.90; <0.001	4.88±3.11	.78±1.55	9.14; <0.001	9.31±3.88	3.74±2.61	11.44; <0.001
Heart valve surgery	7.20±6.16	2.50±2.68	3.76; 0.004	5.00±4.78	1.10±1.97	3.45; 0.007	8.40±5.93	3.90±3.25	4.70; 0.001
<b>t; p</b>	.34; .73	.02; .97		-.09; .92	-.54; .58		.59; .55	-.16; .86	

CABG, coronary artery bypass grafting, Significant difference at p<0.05; value in bold: significant.

**Table 5. Lifestyle and Medication Changes after Cardiac Rehabilitation**

	Before n (%)	After n (%)	P
Working status			
Working	8 (15.4)	5 (9.6)	0.37
Not working	44 (84.6)	47 (90.4)	
Smoking			
Yes	32 (61.5)	3 (5.8)	<0.001
No	20 (38.5)	49 (94.2)	
Alcohol use			
Yes	4 (7.7)	1 (1.9)	0.25
No	48 (92.3)	51 (98.1)	
Doing exercise			
No	40 (76.9)	33 (63.5)	0.14
Yes	12 (23.1)	19 (36.5)	
Diet compliance			
Yes	46 (88.5)	49 (94.2)	0.25
No	6 (11.5)	3 (5.8)	
Coping with stress			
Yes	47 (90.4)	51 (98.1)	0.21
No	5 (9.6)	1 (1.9)	
Current medication			
Acetylsalicylic acid	49 (94.2)	49 (94.2)	1.0
Warfarin	13 (25.5)	13 (25.5)	1.0
Beta blockers	43 (82.7)	43 (82.7)	1.0
ACE-I / ARB	8 (15.4)	8 (15.4)	1.0
Calcium channel blocker	6 (11.5)	6 (11.5)	1.0
Statins	32 (61.5)	32 (61.5)	1.0
Oral antidiabetic	12 (23.1)	11 (21.2)	1.0
Insulin	8 (15.4)	8 (15.4)	1.0
Clopidogrel	11 (21.2)	10 (19.2)	1.0
Alpha blockers	3 (5.8)	3 (5.8)	1.0

ACE-I, angiotensin converting enzyme inhibitors; ARB, angiotensin receptor blocker.

an increase in expected positive health behaviors and a significant decrease in cigarette smoking ( $P < 0.001$ ) (Table 5).

## Discussion

Despite the availability of medical and interventional treatments for cardiovascular disease, the participation of patients in CR programs remains low. However, international guidelines emphasize the physiological and psychological benefits of CR programs conducted by multidisciplinary teams following a cardiovascular event or disease.<sup>3,4,14</sup> Nurses play a crucial role in CR by providing training and counseling throughout the entire process, beginning with hospitalization, supporting the exercise program, monitoring both positive and negative effects, and ensuring communication and coordination within the team.<sup>3,6,7</sup> In this study, it was observed that the CR program conducted by a multidisciplinary team had a positive impact on the quality of life, biophysiological parameters, and psychological features of patients with cardiovascular disease.

In the current study, the majority of patients (80.8%) underwent CABG, while 19.2% underwent valve surgery.

A randomized study conducted by Zanini et al.<sup>8</sup> (n=40) showed that various exercise-based CR practices significantly improved recovery one month after CABG surgery. Conversely, in their meta-analysis of randomized controlled trials involving six studies and 364 patients, Abraham et al.<sup>9</sup> concluded that the effectiveness of exercise-based CR in treating patients following valve surgery remains uncertain in terms of quality of life. However, Patti et al.<sup>7</sup> suggested that exercise-based CR programs could enhance the quality of life of cardiac patients by improving their exercise capacity. Similarly, Arjunan and Trichur<sup>15</sup> reported improvements in all sub-dimensions of the SF-36, particularly in the physical sub-dimensions, in a nurse-led CR study. Consistent with these findings, our study revealed a significant increase in patients' quality of life after CR, with improvements observed in all sub-dimensions of the SF-36, particularly in the physical dimensions as well as the mental dimension. These results suggest that along with physical recovery following cardiac surgery, there may also be psycho-social improvements.

Participation in the CR program is anticipated to enhance exercise tolerance following a cardiac event and optimize cardiovascular risk factors, including lipid and lipoprotein profiles, body weight, blood glucose levels, blood pressure levels, and smoking cessation.<sup>4,6,7</sup> Arjunan and Trichur<sup>15</sup> observed significant improvements in diastolic blood pressure, high-density lipoprotein (HDL) levels, and serum electrolytes (sodium and potassium) following CR in patients with heart failure. They emphasized that adequate information about the disease and lifestyle adjustments enhances confidence in maintaining a healthy lifestyle.<sup>15</sup> Additionally, Sahin et al.<sup>16</sup> demonstrated that CR resulted in reduced blood pressure levels, while Demir Gündoğmuş et al.<sup>17</sup> found that it impacted the lipid profile. In our study, we observed significant decreases in patients' systolic and diastolic blood pressure, LDL, and triglyceride levels following CR. We believe that these findings are crucial for secondary prevention and for mitigating potential complications.

Psychological disorders, such as anxiety and depression, are prevalent among patients with cardiac disease. One of the anticipated outcomes of the CR program is to ameliorate the psychological effects of cardiac disease. The majority of studies in the literature suggest that levels of depression and anxiety decrease following CR.<sup>17-19</sup> Moreover, studies assessing quality of life indicate an improvement in mental health status following CR.<sup>15</sup> However, in a randomized controlled trial conducted by Sbilitz et al.,<sup>20</sup> it was found that CR had no effect on mental health in patients undergoing heart valve surgery (n=147) in the fourth month following CR. Nonetheless, the findings of our study revealed that all sub-dimension scores of the DASS-21 significantly decreased in patients following CR. It was observed that the successful implementation of interventions provided by the multidisciplinary team, including education, counseling, and psychological support, had a positive impact on patients' anxiety, stress, and depression. Additionally, it should be noted that the effects of acute cardiac conditions may

diminish over time, and family support may also influence psychological well-being.

### Limitation

One limitation of this study is its single-center nature, which may limit the generalizability of the findings. Additionally, the study only included patients who underwent CABG and valve surgery, which may restrict the applicability of the results to other cardiac conditions. Furthermore, the study was not conducted in a randomized controlled fashion, potentially affecting the internal validity of the findings. Lastly, the patients included in the study were examined at an early period (the 30<sup>th</sup> day) of Phase III, which may not fully capture the long-term effects of cardiac rehabilitation.

### Conclusion

In conclusion, this study highlights the positive impact of the CR program on patients' quality of life, biophysiological parameters, and psychological features. Compared to previous research, we posit that the favorable outcomes observed in the quality of life, biophysiological parameters, and psychological characteristics of the patients in this study following CR are attributable to the comprehensive implementation of all components of the CR program. It is recommended that future clinical studies with larger sample sizes be conducted to evaluate the long-term effects of CR in light of the findings of this study.

**Ethics Committee Approval:** Approval for the study was obtained from the Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Research and Training Hospital Clinical Research Ethics Committee (Approval Number: 2021/09, Date: 23.02.2021).

**Informed consent:** Verbal and written approval was obtained from all patients meeting the study criteria.

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