

Degree and Direction of Change of Body Weight in Cardiac Rehabilitation and Impact on Exercise Capacity and Cardiac Risk Factors

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Cardiac rehabilitation (CR) improves functional capacity and reduces mortality in patients with cardiovascular disease. It also improves cardiovascular risk factors and aids in weight reduction. Because of the increase in morbidly obese patients with cardiovascular disease, the prevalence of obesity and patterns of weight change in those undergoing CR merit fresh study. We studied 1,320 participants in a 12-week CR program at our academic medical center. We compared 5 categories: 69 class III obese (body mass index [BMI] ≥ 40) patients, 128 class II obese patients (BMI 35.0 to 39.9), 318 class I obese patients (BMI 30.0 to 34.9), 487 overweight patients (BMI 25.0 to 29.9), and 318 normal weight patients (BMI 18.5 to 24.9). Exercise capacity in METs, weight, blood pressure, and fasting lipid profile were measured before and after CR. Overall, 131 patients gained weight, 827 had no significant weight change, and 363 lost weight (176 lost 3% to 5% of their baseline weight, 161 lost 5% to 10%, and 26 lost $>10\%$). Exercise capacity, blood pressure, and low-density lipoprotein cholesterol improved in all patients. Class III obese patients had the smallest improvement in peak METs ($p < 0.001$), but the greatest weight loss. Patients who lost $>10\%$ of their baseline weight had the greatest improvements in exercise capacity, low-density lipoprotein, and triglycerides. In conclusion, after CR, a minority of patients lost weight. Most patients had no significant weight change and some even gained weight. The greatest loss was seen in class III obese patients. All patient groups showed improvements in exercise capacity and risk factors, regardless of the direction or degree of weight change. © 2015 Elsevier Inc. All rights reserved. (Am J Cardiol 2015;■:■-■)

The prevalence of obesity has drastically increased in the United States with 35% of US adults now classified as obese (body mass index [BMI] ≥ 30 kg/m²).¹ Obesity is associated with major cardiovascular diseases² and excess mortality.¹ CR improves risk factors, exercise capacity, and mortality rates in patients with cardiovascular disease.³⁻⁵ CR is also associated with weight loss in mild-to-moderate obesity, although degrees of weight loss have often simply been reported as means.⁶⁻¹⁰ Obesity also negatively impacts aerobic capacity in patients undergoing CR.¹¹ Despite the suggestion of an obesity paradox in obese patients with cardiovascular disease, purposeful weight loss in these patients leads to improvements in exercise capacity and risk factors.^{12,13} We undertook the present study to explore the prevalence and consequences of obesity, and the direction and effect of weight change, in patients undergoing CR.

Methods

Between October 2004 and September 2013, 1,320 patients enrolled in CR at our institution within 1 year after

interventions for coronary artery disease and/or valvular heart disease, including cardiothoracic surgery. Clinical data were taken from patient records, and our institutional review board approved this study.

The details of our CR program have been described previously.¹⁰ Briefly, our program consists of 3 sessions per week for 12 weeks (total of 36 sessions) of exercise and health and nutrition education. An exercise physiologist creates individualized exercise plans based on history, comorbidities, physical fitness, clinical status, and recommendations by the American College of Sports Medicine Guidelines for Exercise Testing and Prescription.¹⁴

At each visit, baseline vital signs, including height, weight, systolic and diastolic pressures, heart rate at rest, and METs level achieved were recorded for all patients. Patients were weighed on a standard scale while wearing regular clothes at the beginning of each rehab session. Obesity indices were measured at the start and the end of the 36-week program. Quality of life was also evaluated at the beginning and the end of the program using the Ferrans and Powers Quality of Life Index Cardiac Version IV questionnaire.¹⁵ Additional initial blood measurements included a lipid profile and hemoglobin A1C. Left ventricular function was measured by standard echocardiographic techniques. Exercise training was implemented during 30- to 40-minute sessions including upper and lower body training, walking laps on a track, and the use of cycle ergometers, treadmills, and stair-climbers. Steady-

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Table 1
Baseline characteristics by body mass index in kg/m²

Characteristic	Body Mass Index (Kg/m ²)					P for trend
	≤ 25 N = 318 (24%)	25.0-29.9 N = 487 (37%)	30.0-34.9 N = 318 (24%)	35.0-39.9 N = 128 (9%)	≥ 40.0 N = 69 (5%)	
Age (years)	67 ± 12	64 ± 11	61 ± 11	58 ± 10	56 ± 10	<0.001
Men	226 (71%)	377 (77%)	234 (74%)	84 (66%)	34 (49%)	0.002
Quality of life	24 ± 4	23 ± 4	22 ± 4	22 ± 4	20 ± 6	<0.001
Hypertension	219 (69%)	379 (78%)	258 (81%)	113 (88%)	62 (91%)	<0.001
Systolic pressure (mm Hg)	120 ± 19	121 ± 18	123 ± 18	125 ± 15	128 ± 17	<0.001
Diastolic pressure (mm Hg)	69 ± 11	70 ± 10	71 ± 10	72 ± 10	73 ± 10	<0.001
Hyperlipidemia	214 (67%)	381 (79%)	256 (81%)	109 (85%)	54 (78%)	<0.001
Diabetes mellitus	54 (17%)	136 (28%)	97 (31%)	59 (46%)	42 (61%)	<0.001
Hemoglobin A1C (mg/dL)	5.9 ± 1.1	6.3 ± 1.4	6.4 ± 1.3	6.6 ± 1.5	7.0 ± 1.2	<0.001
Body mass index (Kg/m ²)	23 ± 1	27 ± 1	32 ± 1	37 ± 1	45 ± 6	<0.001
Weight (pounds)	153 ± 20	183 ± 22	212 ± 26	241 ± 29	285 ± 52	<0.001
Waist circumference (inches)	35 ± 4	39 ± 3	43 ± 3	47 ± 4	51 ± 5	<0.001

Frequency variables expressed as n (%) and continuous variables as mean ± standard deviation.

ACEi = angiotensin converting enzyme; CR = cardiac rehabilitation.

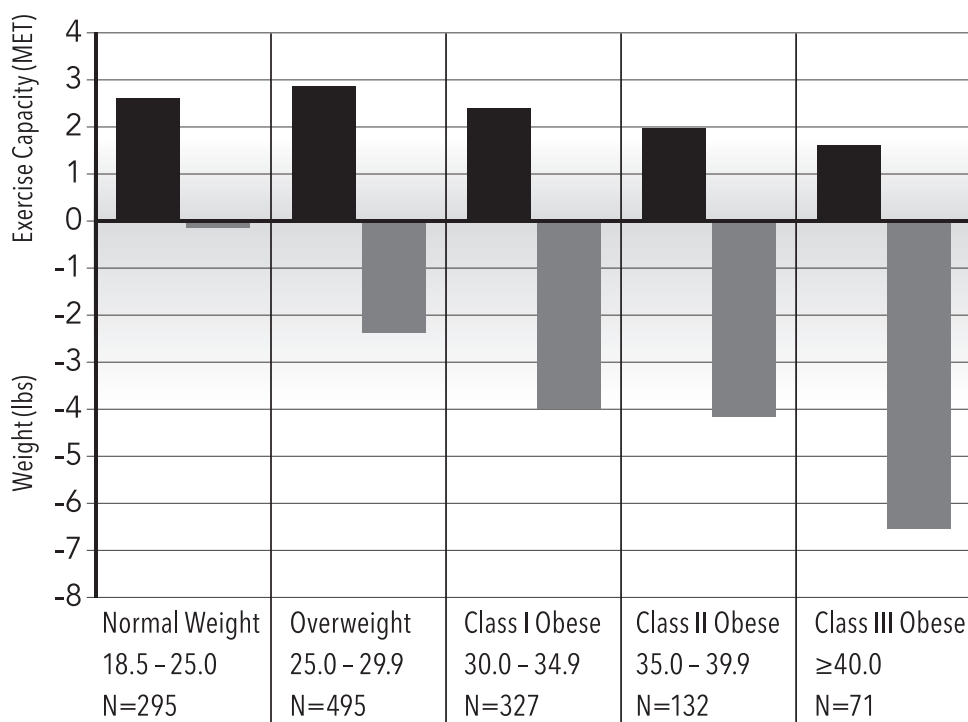


Figure 1. Mean changes in METs and weight after cardiac rehabilitation. Increasing baseline BMI equates to smaller improvements in exercise capacity and greater improvements in weight. Class III obese patients achieve the largest amount of mean weight loss and lowest degree of mean improvement in exercise capacity.

state METs levels were recorded at each session and were obtained either automatically from exercise devices or using a standardized METs formula.¹⁴

Based on BMI at the time of enrollment in CR, participants were categorized by World Health Organization (WHO) definitions as: normal weight (BMI 18.5 to 24.9), overweight (BMI 25 to 29.9), class I obese (BMI 30 to 34.9), class II obese (BMI 35 to 39.9), or class III obese (BMI ≥40).¹⁶ We compared baseline demographics, exercise capacity, weight, blood pressure, and fasting lipid

profile as well as changes in these parameters between enrollment and completion of the program among participants in each category.

In a separate analysis, patients were categorized based on change in weight from CR entry to CR exit based on American Heart Association/American College of Cardiology (AHA/ACC) recommendations for meaningful weight loss.¹⁷ These categories were: weight gain, no significant change in weight (−3% to +3%), 3% to 5% weight loss, 5% to 10% weight loss, and >10% weight

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