OPEN

Benefits of the First Pritikin Outpatient Intensive Cardiac Rehabilitation Program

Susan B. Racette, PhD; Lauren K. Park, PhD; Serene T. Rashdi, BA; Kristin Montgomery, MS; Kristin M. McKenzie, BA; Elena Deych, MS; Christopher Graham, MS; Nikhil Das, MS; Taylor M. Fogarty, DPT, PT; Alexandria Van Zandt, DPT; Tessa Carson, ACSM-CEP, MHA; Dotti Durbin, RD, LD, CDCES; Jennifer Jonagan, RN, BSN; Michael W. Rich, MD; Lisa de las Fuentes, MD, MS; Linda R. Peterson, MD

Purpose: Intensive cardiac rehabilitation (ICR) is a comprehensive, medically supervised exercise treatment program covered by Medicare for patients with approved cardiac diagnoses. The aim of this study was to determine the benefits of the first Pritikin outpatient ICR program.

Methods: This retrospective analysis included patients referred to ICR or traditional cardiac rehabilitation (CR) during the first 7 yr (2013-2019) at the first facility to implement Pritikin ICR. Intensive cardiac rehabilitation is composed of 36 education sessions on nutrition, exercise, and a healthy mindset, in addition to 36 monitored exercise sessions that comprise traditional CR. Assessments included anthropometrics (weight, body mass index, and waist circumference), dietary patterns, physical function (6-min walk test, [6MWT] Short Physical Performance Battery [SPPB: balance, 4-m walk, chair rise], handgrip strength), and health-related quality of life (Dartmouth COOP, 36-item Short Form Survey). Baseline and follow-up measures were compared within and between groups.

Results: A total of 1963 patients enrolled (1507 ICR, 456 CR, 66.1 ± 11.4 yr, 68% male, 82% overweight or obese); 1141 completed the program (58%). The ICR patients completed 22 exercise and 18 education sessions in 9.6 wk; CR patients completed 19 exercise sessions in 10.3 wk. ICR resulted in improvements ($P < .001$ pre vs post) in all anthropometric measures, dietary patterns, 6MWT distance, all SPPB components, grip strength, and health-related quality of life. The improvements in anthropometrics and dietary patterns were greater in ICR than in CR.

Conclusions: The Pritikin outpatient ICR program promoted improvements in several cardiovascular health indices. Critical next steps are to assess long-term health outcomes after ICR, including cardiac events and mortality.

Key words: cardiac rehabilitation • intensive cardiac rehabilitation • Pritikin

Cardiac rehabilitation (CR) is a medically supervised treatment program designed to promote optimal recovery after a cardiac event or procedure and to reduce the risk for future cardiac events in patients with cardiovascular disease (CVD).[1,2] Exercise is the central focus of CR, with additional instruction on healthy dietary patterns and lifestyle behaviors that impact cardiovascular risk. Cardiac diagnoses that are approved by the Centers for Medicare & Medicaid Services (CMS) for referral to CR include myocardial infarction, coronary artery bypass surgery, stable angina pectoris, heart valve repair or replacement, coronary angioplasty or coronary stenting, heart transplant, and heart failure with reduced ejection fraction.[3] Cardiac rehabilitation has proven to be beneficial for reducing hospitalizations, reinfarction, cardiac mortality, all-cause mortality, and improving daily function, depressive symptoms, and quality of life among patients with CVD.[1,4-13]

Traditional CR typically includes up to 36 1-hr, supervised, monitored exercise sessions over 12-18 wk. In August 2010, the CMS expanded coverage for CR to include intensive cardiac rehabilitation (ICR) programs,[14] based on demonstrated improvements in specific endpoints, including less progression of coronary heart disease, reduced need for coronary bypass surgery, and reduced need for percutaneous coronary interventions. Intensive cardiac rehabilitation includes all the components of traditional CR plus up to 36 additional 1-hr sessions, for a total of 72 sessions during a period of up to 18 wk.

Three ICR programs have been approved by the CMS[15]: the Ornish Reversal Program, the Pritikin Program, and the Benson-Henry Institute Cardiac Wellness Program at Massachusetts General Hospital. The Pritikin-certified ICR program is a comprehensive lifestyle change program based on three pillars: safe and effective exercise, a healthy eating plan, and a healthy mindset.[16] The Pritikin diet was designed by Nathan Pritikin in 1955 to mimic the diet of the Tarahumara Indians of Mexico, which was high in unprocessed, complex carbohydrates, fiber, and plant sterols and low in fat, cholesterol, and simple sugars. The original Pritikin program began in 1976 as a residential lifestyle change program to reduce the risk of recurrent cardiovascular events.[17] Favorable outcomes of the Pritikin Longevity Center 3-wk residential program included clinically meaningful reductions in CVD risk factors (eg, 23% decrease in total and low-density lipoprotein cholesterol,[18] 33%

Author Affiliations: *Program in Physical Therapy, Washington University School of Medicine, St Louis, Missouri (Drs Racette, Park, Fogarty, and Van Zandt); Department of Medicine, Washington University School of Medicine, St Louis, Missouri (Drs Racette, Rich, de las Fuentes, and Peterson, Mss Rashdi, Montgomery, McKenzie, and Deych, and Mr Das); Division of Biostatistics, Washington University School of Medicine, St Louis, Missouri (Mr Graham); and Barnes-Jewish Hospital, BJC HealthCare, St Louis, Missouri (Mss Carson, Durbin, and Jonagan).*

Supplemental digital content is available for this article. Direct URL citation appears in the printed text and is provided in the HTML and PDF versions of this article on the journal's Web site (www.jcrpjournal.com).

Dr Peterson has stock holdings in Johnson & Johnson, Shockwave Medical, and Medtronic. All other authors declare no conflicts of interest.

Correspondence: *Susan B. Racette, PhD, Washington University School of Medicine, Mail Stop 8502-66-1101, 4444 Forest Park Ave, St Louis, MO 63108 (racettes@wustl.edu).*

DOI: 10.1097/HCR.0000000000000700

for triglycerides,[18] 5.1% for body weight,[19] 14% for blood pressure,[20] and 26% for blood glucose[21]) and medications to manage those risk factors, as well as reductions in angina, morbidity, and cardiac mortality.[22] These improvements formed the basis of the Pritikin outpatient ICR program, which is available nationwide. Heretofore, little was known about the benefits of the outpatient Pritikin ICR program.

The objective of this study was to fill this gap in knowledge by assessing the short-term effectiveness of the Pritikin outpatient ICR program on improving CVD risk factors. The primary aim was to assess within-group changes in cardiovascular health metrics and dietary behaviors among patients in ICR; the secondary aim was to compare between-group changes in response to ICR and traditional CR.

METHODS

This was a retrospective, observational study to assess the benefits of the Pritikin outpatient ICR program during its first 7 yr of implementation at the first CR center to offer Pritikin ICR in the nation. Patients who enrolled in ICR or CR at the Washington University School of Medicine/Barnes-Jewish Hospital Heart Care Institute in St Louis, MO, as part of routine clinical care were included in the analysis. The ICR and CR programs were conducted in the same facility and run by the same clinical staff. The predominant factor determining whether patients enrolled in ICR or CR was their insurance plan. Patients whose insurance covered ICR were encouraged to enroll in ICR; the remainder were enrolled in traditional CR. This study was approved by the Washington University in St Louis Institutional Review Board.

TRADITIONAL CR PROGRAM

Patients in the traditional CR program had medical consultations with a cardiac nurse and a cardiologist, completed standardized assessments, and received individualized exercise prescriptions from exercise physiologists. Most patients had nutrition consultations with a registered dietitian, depending on insurance coverage. The primary focus of the program was a series of up to 36 1-hr exercise sessions that were supervised by exercise physiologists and CR nurses and during which the patients had continuous electrocardiogram monitoring. Heart rate and blood pressure were measured during exercise, and self-reported ratings of perceived exertion were recorded after each exercise mode. Several modes of exercise were used during each session and were tailored to patient exercise tolerance, cardiorespiratory fitness (CRF) level, orthopedic limitations, balance, and preferences. Exercise options included recumbent cross-trainers, treadmills, recumbent and upright cycle ergometers, elliptical cross-trainers, upper body ergometers, weight machines, dumbbells, and mats and bars for stretching and balance exercises. Patients were scheduled to attend 2-3 sessions/wk.

PRITIKIN ICR PROGRAM

Pritikin ICR is composed of the same exercise regimen and components as traditional CR. The distinguishing feature is an additional series of 36 Pritikin education sessions that address healthful eating, regular exercise, and healthy mindset. The education sessions were held on the same days as the exercise sessions, resulting in a 2-hr ICR visit composed of exercise plus education; two to three visits were scheduled each week. Pritikin education sessions are standardized, focus predominantly on nutrition, and consist of up to 36 videos, as well as cooking classes and nutrition workshops led by registered dietitians. Video topics include healthy eating, dining out, weight control, grocery shopping, hypertension, heart disease, metabolic syndrome, body composition, exercise, blood lipids, sleep, yoga, smoking cessation, stress management, and other topics related to heart health. The Pritikin diet emphasizes unprocessed foods that are high in fiber and low in fat, cholesterol, added sugars, and sodium. All ICR patients met with a registered dietitian; specific dietary recommendations were individualized based on patient comorbidities, weight classification, and personal goals.

ASSESSMENTS

Patients completed baseline assessments during the first visit and follow-up assessments after 24 visits, in accordance with the clinical protocol at this CR facility. Standardized assessments included anthropometrics, CRF, physical function, and questionnaires.

Anthropometric measurements included height with a wall-mounted stadiometer and body weight with a digital scale. Body mass index (BMI) was calculated to determine weight classification[23]: underweight (<18.5 kg/m^2), healthy/normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), or obese (≥30.0 kg/m^2). Waist circumference was measured at the superior border of the iliac crest over a single layer of clothing.

The 6-min walk test (6MWT)[24] was used as an estimate of CRF, based on the distance traveled in 6 min. Higher values reflect greater walking velocity and higher CRF. Patients were instructed to walk briskly on an oval, indoor track at a consistent pace, stopping only if necessary. The number of laps completed and the precise stopping location were used to calculate the distance traveled.

The Short Physical Performance Battery (SPPB)[25] includes three functional tests, each with a score ranging from 0 to 4: balance (standing with feet side-by-side, semi-tandem, and full tandem), walking velocity during a timed, 4-m walk, and chair rise (ability to rise from a chair five times within specified time limits). Higher scores reflect greater functional ability; the total score ranges from 0 (unable to complete any of the three tests) to 12 (reflecting the best score on all three tests).

Grip strength is an important biomarker that reflects whole-body strength and health status and is predictive of mortality.[26] Grip strength was assessed with a Jamar handheld dynamometer while the patient was seated with arms straight down at their sides. Three repetitions were completed on each hand, with rest between. The highest value was used for analysis.

Rate Your Plate is a 24-item questionnaire[27] recommended by the American College of Cardiology to assess dietary patterns. Respondents choose A, B, or C for each food category to describe the way they usually eat; the corresponding point values are 3, 2, and 1, respectively, for a total score ranging from 24 (worst) to 72 (best). Higher scores reflect more healthful eating patterns. Three score ranges were assessed: 24-40 ("there are many ways to make eating habits healthier"), 41-57 ("there are some ways to make eating habits healthier"), and 58-72 ("many healthy choices").

The Dartmouth COOP General Health Questionnaire[28] asks respondents to rate nine items (physical fitness, feelings, daily activities, social activities, pain, change in health, overall health, social support, and quality of life) during the past 4 wk using a 5-point scale; 1 reflects the best health and 5 reflects the worst for each item. The total score ranges from 9 (if all responses are "1") to 45 (if all responses are "5"). A lower score reflects better health.

The 36-item Short Form Survey (SF-36)[29] asks respondents to rate their health status in eight domains: physical functioning, role limitations due to physical health problems, role limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, bodily pain, and general health. Domain scores range from 0 (poorest health) to 100 (most favorable health).

STATISTICAL ANALYSES

Baseline characteristics were compared between groups using χ^2 tests or Fisher's exact test for categorical variables. The distribution of continuous variables at baseline was examined via histograms. Continuous variables were reported as mean ± SD or as median (IQR) for data that were not normally distributed and compared between groups using Student's *t* test or the Wilcoxon test. Within-group changes in response to ICR and CR were assessed by paired Wilcoxon tests or paired *t* tests for continuous variables and by McNemar's test for categorical variables. Correlations between change in body weight and change in 6MWT distance were assessed using Spearman correlation coefficients. Between-group changes relative to baseline were assessed univariately by two-sample Wilcoxon tests or *t* tests for continuous variables and by χ^2 tests for categorical variables. In addition, changes in anthropometric measures and 6MWT distance were tested using a multivariate regression model, controlling for sex, age, and baseline BMI category (for 6MWT). To determine whether men and women responded differently, a sex-by-group (ICR vs CR) interaction was tested. Significance was accepted at $P < .05$. Analyses were performed using R version 4.0.3.

RESULTS

Our sample included 1963 patients enrolled in CR from April 2013 through December 2019: 1507 patients (77%) were in the ICR program and 456 patients (23%) were in traditional CR. The proportion of ICR patients relative to the overall sample each year ranged from 63-87% during the 7 yr in the analysis. As shown in Table 1, the majority of patients were male, White, and non-Hispanic; 95% did not smoke. The ICR group was older, less racially diverse, and had higher systolic blood pressure than the CR group, but there were no significant differences between groups in BMI, physical function, dietary patterns, or quality of life at baseline. The most common cardiac diagnoses for referral to CR were coronary angioplasty/stenting in the ICR group and coronary angioplasty/stenting and heart failure in the CR group (Table 1).

PROGRAM COMPLETION

A total of 1141 patients (58%) completed ≥24 visits and/or follow-up assessments (59% of ICR, 55% of CR patients, $P = .092$ between groups). The ICR patients completed more exercise sessions than CR patients (22 [11, 36] vs 19 [8, 35]; $P < .001$ between groups). The ICR group also attended 18 (8, 33) education sessions, for a total of 41 (21, 70) sessions. The ICR patients completed the program in less time than CR patients (9.6 [8.3, 12.0] wk vs 10.3 [8.4, 13.7] wk, $P = .006$ between groups). Among completers, 95% of ICR and 83% of CR patients completed ≥24 sessions ($P < .001$). Completers were older than dropouts (68 vs 64 yr, $P < .001$) and a higher proportion of men than women completed the program (60 vs 54%, $P = .01$). Reasons for attrition included schedule conflicts, transportation difficulties, return to work, transition to exercise facilities without medical oversight, insurance plans that approved <24 sessions, comorbidities, hospitalization, death, or dissatisfaction with the program. Attrition did not differ by referral diagnosis.

ANTHROPOMETRICS AND PHYSICAL FUNCTION

The majority of patients were categorized as overweight (38%) or obese (44%) at baseline, with 18% in the healthy weight range and no difference between groups ($P = .326$).

Table 1

Demographic and Baseline Characteristics of Patients Enrolled in ICR or CR, 2013-2019[a]

	All (N = 1,963)	ICR (n = 1,507)	CR (n = 456)	*P* Value
Sex, male	68	69	68	.817
Race,[b] Black/White/other	13/85/2	12/86/2	15/80/5	.002
Ethnicity,[b] Hispanic	1	1	1	1.00
Age, yr	66.1 ± 11.4	66.9 ± 10.9	63.6 ± 12.5	<.001
Resting heart rate, bpm	75.6 ± 13.9	75.2 ± 13.7	77.1 ± 14.6	.070
Resting systolic BP, mm Hg	125.5 ± 16.5	126.4 ± 16.1	122.0 ± 17.2	<.001
Resting diastolic BP, mm Hg	72.5 ± 10.2	72.4 ± 10.1	72.8 ± 10.4	.525
Referral Diagnoses,[c]				
Coronary angioplasty/stenting	51	55	38	.001
Coronary artery bypass grafting	19	22	12	.011
Heart failure	26	22	38	<.001
Heart transplant	1	1	1	1.00
Heart valve repair/replacement	20	21	17	.268
Myocardial infarction	28	29	23	.184
Stable angina	5	5	5	1.00

Abbreviations: BP, blood pressure; CR, cardiac rehabilitation; ICR, intensive cardiac rehabilitation.

[a]Data are reported as % of sample or mean ± SD.

[b]Race and ethnicity were known for 73% of the sample (76% ICR and 64% CR).

[c]Referral diagnoses exceed 100% because some patients had more than one qualifying diagnosis; diagnoses were known for 31% of the sample (32% ICR and 30% CR).

Table 2

Anthropometric, Physical Function, and Dietary Measures of Patients Enrolled in ICR or CR, 2013-2019[a]

	ICR			CR			*P* Value (ICR vs CR)
	Baseline	Change	*P* Value	Baseline	Change	*P* Value	
Weight, kg	88.6 ± 20.1	−1.4 ± 2.8	<.0001	87.5 ± 21.3	0.1 ± 3.2	.561	<.0001
BMI, kg/m^2	30.3 ± 6.1	−0.5 ± 1.0	<.0001	29.9 ± 6.2	0.1 ± 1.1	.392	<.0001
Waist, cm	103.5 ± 14.4	−2.1 ± 4.9	<.0001	102.0 ± 16.3	−1.0 ± 4.4	.0083	<.0001
6MWT, m	472.0 ± 121.3	46.4 ± 57.8	<.0001	470.1 ± 120.1	44.4 ± 58.9	<.0001	.106
Grip strength, kg	34.2 ± 11.5	1.0 ± 3.8	<.0001	33.6 ± 10.5	0.7 ± 4.4	.195	.233
Rate Your Plate[b]	54.5 ± 8.3	7.1 ± 7.3	<.0001	54.5 ± 7.7	4.0 ± 7.1	<.0001	<.0001

Abbreviations: 6MWT, 6-min walk test; BMI, body mass index; CR, cardiac rehabilitation; ICR, intensive cardiac rehabilitation.
[a]Data are reported as mean ± SD.
[b]The score range for Rate Your Plate is 24-72, with higher scores reflecting higher diet quality.

Body weight and BMI decreased significantly in ICR, but not in CR, with significant differences between groups (Table 2). Figure 1 displays the weight changes by group and BMI category. Of the patients with obesity at baseline, the median weight changes were −2.2 kg (−3.9, 0.0) in ICR and −0.1 kg (−2.5, 2.0) in CR; 10% of ICR patients with obesity at baseline (31/305) transitioned to overweight status; 7% of patients with overweight (20/289) transitioned to healthy weight. The corresponding values in CR were 6% (4/72) from obese to overweight and 6% (5/77) from overweight to healthy weight. In a multivariate regression model, ICR and male sex were significant predictors of a greater decrease in BMI. The interaction between group (ICR or CR) and sex was not significant.

The 6MWT distance increased significantly in ICR and CR, with no differences between groups (Table 2), between men and women (P = .308), or by BMI category at baseline (P = .578, Figure 1). There was not a significant correlation between change in body weight and change in 6MWT distance in either group (ICR: r = −0.001, P = .982, CR: r = −0.070, P = .492). Grip strength increased significantly in ICR only (Table 2). All SPPB scores improved; 331 patients increased their sum score (41% of ICR patients, 39% of CR patients, P = .288 between groups, Figure 2). The proportion of patients who achieved the highest SPPB sum score of 12 increased from baseline to follow-up in both groups (53 to 71% of ICR patients, 50 to 70% of CR patients, both P < .001).

DIETARY PATTERNS AND HEALTH-RELATED QUALITY OF LIFE

The Rate Your Plate questionnaire revealed greater improvements in ICR than CR (Table 2). As shown in Figure 3, 46% of ICR patients and 30% of CR patients improved categories, resulting in 73% of ICR patients and 53% of CR patients being in the highest category at follow-up.

The Dartmouth COOP General Health Questionnaire revealed significant and comparable improvements in ICR and CR (see the Supplemental Table, available at: http://links.lww.com/JCRP/A389). All SF-36 domains improved in ICR; six of the eight domains improved in CR. The improvements in energy/fatigue and general health subscales were greater in ICR, but all other subscales improved comparably in the two groups. The proportion of patients who achieved the best score of 100 on the subscale "role

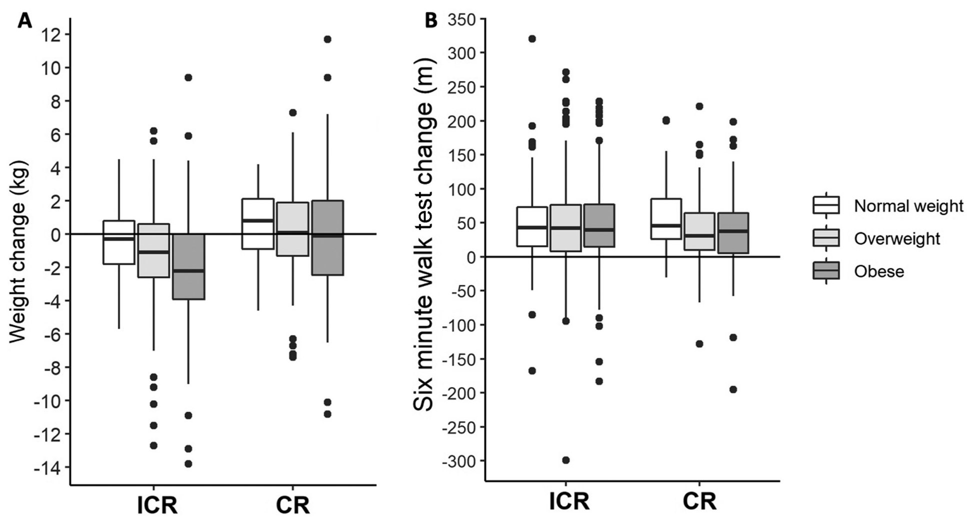

Figure 1. Changes in body weight and 6-min walk test distance among patients in intensive cardiac rehabilitation (ICR) or traditional cardiac rehabilitation (CR), 2013-2019. Box-and-whisker plots depicting median change (middle line in each box), IQR (whiskers), and outliers (circles above and below the whiskers) for weight (A) and 6-min walk test (B) by body mass index category at baseline.

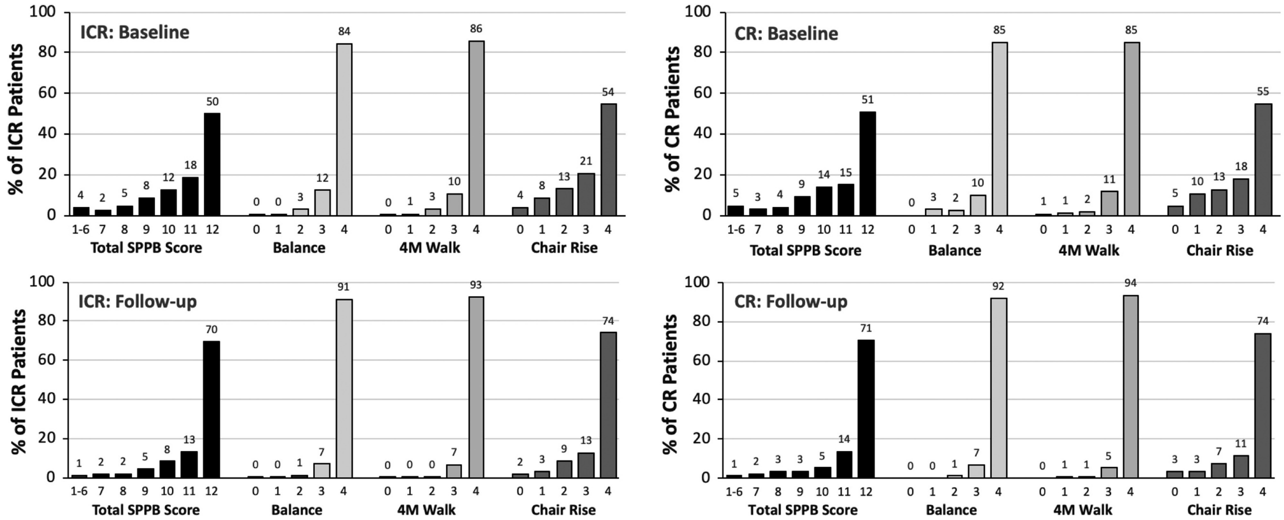

Figure 2. Short Physical Performance Battery (SPPB) results at baseline and after intensive cardiac rehabilitation (ICR) or traditional cardiac rehabilitation (CR), 2013-2019. Bars represent the percentage of patients in each SPPB score category at baseline (top) and follow-up (bottom). Score ranges are 0-12 for the total SPPB and 0-4 for each of the three tests. All scores improved ($P < .001$) in ICR and CR, with no difference between groups.

limitations due to physical health problems" increased from 27% at baseline to 68% at follow-up in ICR ($P < .001$) and from 28% to 49% in CR ($P = .007$). The proportion who scored 100 on the subscale "role limitations due to emotional problems" increased from 58% to 77% in ICR ($P < .001$) and from 53% to 73% in CR ($P = .015$).

DISCUSSION

This study assessed the benefits of the first 7 yr of the first-ever Pritikin outpatient ICR program. Our major findings are that Pritikin ICR produced favorable improvements in body weight, weight classification, waist circumference, dietary patterns, CRF, physical function, and health-related quality of life. The improvements in weight, BMI, and dietary behaviors were modestly but statistically greater in ICR compared to traditional CR. Evaluation of cardiac outcomes will be important to determine whether ICR has greater long-term clinical benefits than traditional CR.

An encouraging finding of our study was that ICR patients completed more visits, more exercise sessions, and more total sessions than traditional CR patients, despite the additional time and effort required (ie, 2-hr visits composed of exercise plus education sessions for ICR vs 1-hr visits composed of an exercise session for CR). This finding is clinically important because CR participation has been shown to promote favorable health outcomes in a dose-dependent manner.[6,30,31] Based on a national sample of 601 099 US Medicare beneficiaries with qualifying cardiac conditions in 1997, Suaya et al[30] reported that CR users

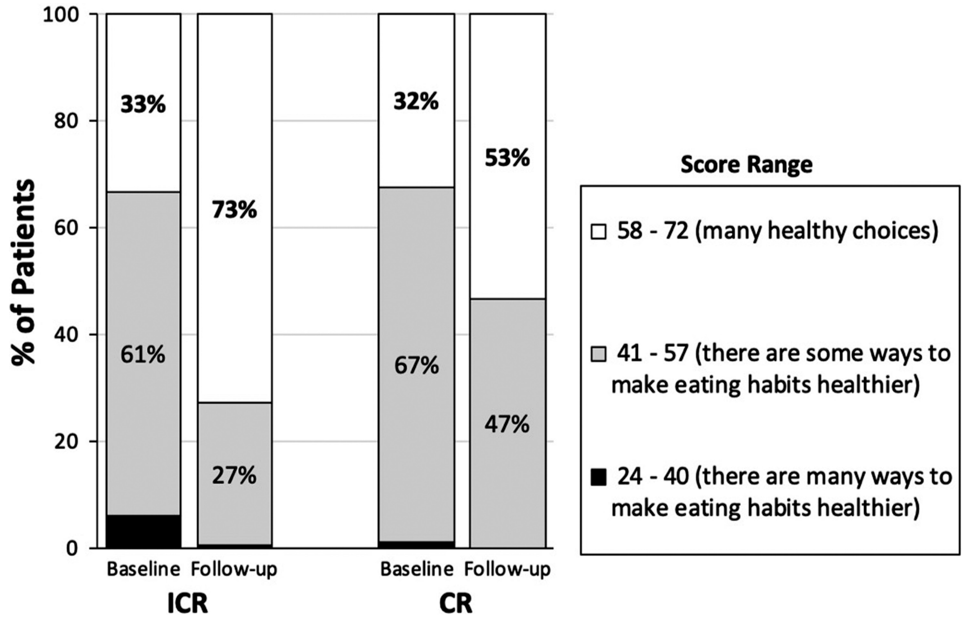

Figure 3. Rate Your Plate scores at baseline and after intensive cardiac rehabilitation (ICR) or traditional cardiac rehabilitation (CR), 2013-2019. Bars represent the percentage of patients in each score range. A greater proportion of patients were in the highest category at follow-up. Absolute scores increased more in ICR than in CR ($P < .0001$).

had a 21-34% lower mortality rate compared to nonusers during 5 yr of follow-up, while users who attended ≥25 sessions had 19% lower mortality compared to users who attended ≤24 sessions. An analysis by Hammill et al[31] of 30 161 Medicare beneficiaries in 2000-2005 highlighted the dose-dependent reductions in all-cause mortality and myocardial infarction for attending 36 CR sessions versus 24, 12, or 1 session. The most striking result was that patients who attended 36 sessions had a 47% lower risk of death and 31% lower risk of myocardial infarction during 4 yr of follow-up compared to patients who attended only one session. Importantly, each additional CR session was associated with a 1% decrease in mortality in a prospective study of 5886 patients who underwent cardiac catheterization in Alberta, Canada, in 1996-2009.[6] These well-documented, unequivocal benefits of CR have spurred national and international initiatives to increase enrollment in and completion of CR programs.[32] The Million Hearts Initiative aims to increase national participation to 70% of qualifying diagnoses by the yr 2022.[33] Nationally, only 24.4% of 366 103 eligible Medicare beneficiaries in 2016 participated in CR; of those, only 26.9% completed 36 sessions.[34] The rationale for ICR is that the additional sessions will confer greater risk reduction than traditional CR.

Important benefits of ICR in our study were reductions in body weight, BMI, and waist circumference, with fewer patients being categorized as obese at follow-up. The potential clinical implications of these results are supported by a recent review by Ades and Savage,[35] which highlights the importance of treating obesity in CR programs. The improvement in BMI in the ICR group was modest (from 29.0 to 28.5 kg/m^2) after ~9.6 wk. In comparison, Katzenberg et al[36] reported a change from 26 to 25 kg/m^2 in 104 participants after a 12-wk community-based ICR program. Mirman et al[37] reported a BMI change from 27.8 to 26.6 kg/m^2 among 199 participants in a 9-wk ICR program, and Silberman et al[38] reported a BMI decrease from 33.3 to 31.2 kg/m^2 among 2653 patients at 24 sites after 12 wk of a comprehensive CR program. Of clinical importance, 51 ICR patients in our study transitioned from obese to overweight or from overweight to healthy weight.

As highlighted in a recent review,[39] intensive nutrition interventions in CR programs have important benefits on dietary patterns, weight, BMI, CVD, and mortality. Consistent with the Pritikin ICR program, recommended components of intensive nutrition interventions include individualization, additional nutrition sessions, cooking demonstrations, and a cardioprotective diet composed of wholesome, natural, predominantly plant-based foods. The educational videos, nutrition classes, and lifestyle strategies that comprise Pritikin ICR likely contributed to the beneficial dietary changes and decreases in weight and BMI observed in our study. Similarly, the Ornish Heart Disease Reversing Program resulted in significantly greater improvements in dietary patterns, weight, BMI, and several other CVD risk factors compared with traditional CR.[40]

Most physical function measures improved comparably in our ICR and CR groups, which is not surprising because the exercise prescriptions, modes, and staff were the same across groups. Consistent with the increases in 6MWT distance in our study, the multisite study of comprehensive CR programs[38] demonstrated a significant improvement in functional capacity, from 8.5 to 10.4 METs (metabolic equivalents) on a treadmill test, after 12 wk. These improvements are clinically meaningful because higher CRF is associated with lower risk for major adverse CVD events[41] and mortality.[42,43]

A strength of our pragmatic study is the relatively large sample of patients enrolled in ICR during the first 7 yr at the first Pritikin outpatient ICR program. Limitations include the nonrandomized, retrospective design, attrition from both ICR and traditional CR, lack of follow-up data on patients who did not complete the program, and lack of long-term outcome data. Additionally, performing follow-up assessments at visit 24 may have blunted the beneficial effects observed (ie, more favorable changes may have been observed after 36 visits) and/or skewed the completion statistics (ie, patients who left the program between visits 24 and 36 were categorized as completers in our analysis).

In summary, we observed that the Pritikin outpatient intensive CR program resulted in improvements in anthropometric measures, dietary patterns, CRF, physical function, and health-related quality of life. These results support the value of the Pritikin ICR program for individual patients and potentially for the health care system. The longer-term benefits of Pritikin ICR on CVD events and mortality will be important to explore in future studies.

ACKNOWLEDGMENTS

We would like to thank the patients and the staff at the Heart Care Institute cardiac rehabilitation facility for their dedication to the program. This study was supported by a Project Award from the Foundation for Barnes-Jewish Hospital and by the following grants from the National Institute of Health: Clinical and Translational Science Award (CTSA) Grant UL1 TR000448, Siteman Comprehensive Cancer Center and NCI Cancer Center Support Grant P30 CA091842, R01 AG060499-01 (SBR, LRP), R34HL138253-01 (SBR, LRP), and R21 HL145217-01 (LRP).

REFERENCES

1. Thomas RJ, Balady G, Banka G, et al. 2018 ACC/AHA Clinical Performance and Quality Measures for Cardiac Rehabilitation: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. *Circ Cardiovasc Qual Outcomes*. 2018;11:e000037.
2. Balady GJ, Ades PA, Bittner VA, et al. Referral, enrollment, and delivery of cardiac rehabilitation/secondary prevention programs at clinical centers and beyond: a presidential advisory from the American Heart Association. *Circulation*. 2011;124(25):2951-2960.
3. Medicare.gov. Your Medicare coverage: cardiac rehabilitation programs. https://www.medicare.gov/coverage/cardiac-rehabilitation-programs. Accessed October 13, 2021.
4. Sandesara PB, Lambert CT, Gordon NF, et al. Cardiac rehabilitation and risk reduction: time to “rebrand and reinvigorate.” *J Am Coll Cardiol*. 2015;65(4):389-395.
5. Lawler PR, Filion KB, Eisenberg MJ. Efficacy of exercise-based cardiac rehabilitation post-myocardial infarction: a systematic review and meta-analysis of randomized controlled trials. *Am Heart J*. 2011;162(4):571-584.e2.
6. Martin BJ, Hauer T, Arena R, et al. Cardiac rehabilitation attendance and outcomes in coronary artery disease patients. *Circulation*. 2012;126(6):677-687.
7. Pack QR, Goel K, Lahr BD, et al. Participation in cardiac rehabilitation and survival after coronary artery bypass graft surgery: a community-based study. *Circulation*. 2013;128(6):590-597.
8. Dunlay SM, Pack QR, Thomas RJ, Killian JM, Roger VL. Participation in cardiac rehabilitation, readmissions, and death after acute myocardial infarction. *Am J Med*. 2014;127(6):538-546.
9. Anderson L, Thompson DR, Oldridge N, et al. Exercise-based cardiac rehabilitation for coronary heart disease (review). *Cochrane Database Syst Rev*. 2016;(1):CD001800.
10. Zhang Y, Cao H, Jiang P, Tang H. Cardiac rehabilitation in acute myocardial infarction patients after percutaneous coronary intervention: a community-based study. *Medicine (Baltimore)*. 2018;97(8):e9785.

11. Patel DK, Duncan MS, Shah AS, et al. Association of cardiac rehabilitation with decreased hospitalization and mortality risk after cardiac valve surgery. *JAMA Cardiol*. 2019;4(12):1250-1259.
12. Astley CM, Chew DP, Keech W, et al. The impact of cardiac rehabilitation and secondary prevention programs on 12-month clinical outcomes: a linked data analysis. *Heart Lung Circ*. 2020;29(3):475-482.
13. Gathright EC, Busch AM, Buckley ML, et al. Improvements in depressive symptoms and affect during cardiac rehabilitation: predictors and potential mechanisms. *J Cardiopulm Rehabil Prev*. 2019;39(1):27-32.
14. Centers for Medicare & Medicaid Services. National Coverage Determination (NCD) for Intensive Cardiac Rehabilitation (ICR) Programs (20.31). https://www.cms.gov/medicare-coverage-database/details/ncd-details.aspx?NCDId=339&ncdver=1&fromdb=true. Accessed October 13, 2021.
15. Centers for Medicare & Medicaid Services. Intensive Cardiac Rehabilitation (ICR) Programs. https://www.cms.gov/Medicare/Medicare-General-Information/MedicareApprovedFacilitie/ICR.html. Accessed October 13, 2021.
16. Pritikin Certified Intensive Cardiac Rehab home page. http://www.pritikinicr.com. Accessed October 13, 2021.
17. Centers for Medicare & Medicaid Services. Decision Memo for Intensive Cardiac Rehabilitation (ICR) Program—Pritikin Program (CAG-00418N). https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=239&bc=AiAAAAAAAgAAAA%3D%3D&. Published 2010. Accessed October 13, 2021.
18. Barnard RJ. Short-term reductions in serum lipids through diet and exercise. *N Engl J Med*. 1990;323(16):1142-1143.
19. Barnard RJ. Effects of life-style modification on serum lipids. *Arch Intern Med*. 1991;151(7):1389-1394.
20. Roberts CK, Vaziri ND, Barnard RJ. Effect of diet and exercise intervention on blood pressure, insulin, oxidative stress, and nitric oxide availability. *Circulation*. 2002;106(20):2530-2532.
21. Barnard RJ, Massey MR, Cherny S, O'Brien LT, Pritikin N. Long-term use of a high-complex-carbohydrate, high-fiber, low-fat diet and exercise in the treatment of NIDDM patients. *Diabetes Care*. 1983;6(3):268-273.
22. Barnard RJ, Guzy PM, Rosenberg JM, O'Brien LT. Effects of an intensive exercise and nutrition program on patients with coronary artery disease: five-year follow-up. *J Card Rehabil*. 1983;3(3):183-190.
23. US Department of Health and Human Services, National Institutes of Health. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults–The Evidence Report. *Obes Res*. 1998;6(suppl 2):51S-209S.
24. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med*. 2002;166(1):111-117.
25. Guralnik JM, Simonsick EM, Ferrucci L, et al. A Short Physical Performance Battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol*. 1994;49(2):M85-M94.
26. Bohannon RW. Grip strength: an indispensable biomarker for older adults. *Clin Interv Aging*. 2019;14:1681-1691.
27. Gans KM, Sundaram SG, McPhillips JB, Hixson ML, Linnan L, Carleton RA. Rate Your Plate: an eating pattern assessment and educational tool used at cholesterol screening and education programs. *J Nutr Educ*. 1993;25(1):29-36.
28. Nelson E, Landgraf JM, Hays RD, Wasson JH, Kirk JW. The functional status of patients: how can it be measured in physicians' offices? *Med Care*. 1990;28(12):1111-1126.
29. Ware JE Jr, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36): I. Conceptual framework and item selection. *Med Care*. 1992;30(6):473-483.
30. Suaya JA, Stason WB, Ades PA, Normand SLT, Shepard DS. Cardiac rehabilitation and survival in older coronary patients. *J Am Coll Cardiol*. 2009;54(1):25-33.
31. Hammill BG, Curtis LH, Schulman KA, Whellan DJ. Relationship between cardiac rehabilitation and long-term risks of mortality and myocardial infarction among elderly Medicare beneficiaries. *Circulation*. 2010;121(1):63-70.
32. Santiago de Araújo Pio C, Beckie TM, Varnfield M, et al. Promoting patient utilization of outpatient cardiac rehabilitation: a Joint International Council and Canadian Association of Cardiovascular Prevention and Rehabilitation position statement. *Int J Cardiol*. 2020;298:1-7.
33. Wall HK, Stolp H, Wright JS, et al. The Million Hearts Initiative: catalyzing utilization of cardiac rehabilitation and accelerating implementation of new care models. *J Cardiopulm Rehabil Prev*. 2020;40(5):290-293.
34. Ritchey MD, Maresh S, McNeely J, et al. Tracking cardiac rehabilitation participation and completion among medicare beneficiaries to inform the efforts of a national initiative. *Circ Cardiovasc Qual Outcomes*. 2020;13(1):e005902.
35. Ades PA, Savage PD. The treatment of obesity in cardiac rehabilitation: a review and practical recommendations. *J Cardiopulm Rehabil Prev*. 2021;41(5):295-301.
36. Katzenberg C, Silva E, Young MJ, Gilles G. Outcomes in a community-based intensive cardiac rehabilitation program: comparison with hospital-based and academic programs. *Am J Med*. 2018;131(8):967-971.
37. Mirman AM, Nardoni NR, Chen AY, Horwich TB. Body composition changes during traditional versus intensive cardiac rehabilitation in coronary artery disease. *J Cardiopulm Rehabil Prev*. 2020;40(6):388-393.
38. Silberman A, Banthia R, Estay IS, et al. The effectiveness and efficacy of an intensive cardiac rehabilitation program in 24 sites. *Am J Health Promot*. 2010;24(4):260-266.
39. Lara-Breitinger K, Lynch M, Kopecky S. Nutrition intervention in cardiac rehabilitation: a review of the literature and strategies for the future. *J Cardiopulm Rehabil Prev*. 2021;41(6):383-388.
40. Aldana SG, Whitmer WR, Greenlaw R, et al. Cardiovascular risk reductions associated with aggressive lifestyle modification and cardiac rehabilitation. *Heart Lung*. 2003;32(6):374-382.
41. Kokkinos PF, Faselis C, Myers J, et al. Cardiorespiratory fitness and incidence of major adverse cardiovascular events in US veterans: a cohort study. *Mayo Clin Proc*. 2017;92(1):39-48.
42. Blaha MJ, Hung RK, Dardari Z, et al. Age-dependent prognostic value of exercise capacity and derivation of fitness-associated biologic age. *Heart*. 2016;102(6):431-437.
43. Celis-Morales CA, Lyall DM, Anderson J, et al. The association between physical activity and risk of mortality is modulated by grip strength and cardiorespiratory fitness: evidence from 498 135 UK-Biobank participants. *Eur Heart J*. 2017;38(2):116-122.