Older adults in cardiac rehabilitation: a new strategy for enhancing physical function

W. JACK REJESKI, CAPRI GABRIELLE FOY, LAWRENCE R. BRAWLEY, PETER H. BRUBAKER, BRIAN C. FOCHT, JAMES L. NORRIS III, and MARCI L. SMITH

Department of Health and Exercise Science, and Department of Mathematics, Wake Forest University, Winston-Salem, NC; and Department of Kinesiology, University of Waterloo, Waterloo, ON, CANADA

ABSTRACT

REJESKI, W. J., C. G. FOY, L. R. BRAWLEY, P. H. BRUBAKER, B. C. FOCHT, J. L. NORRIS III, and M. L. SMITH. Older adults in cardiac rehabilitation: a new strategy for enhancing physical function. *Med. Sci. Sports Exerc.*, Vol. 34, No. 11, pp. 1705–1713, 2002. **Introduction/Purpose:** This study contrasted the effect of a group-mediated cognitive-behavioral intervention (GMCB) versus traditional cardiac rehabilitation (CRP) upon changes in objective and self-reported physical function of older adults [mean (SD) age of 64.7 (7.5) yr] after 3 months of exercise therapy. **Methods:** This randomized clinical trial enrolled 147 participants who were eligible for inclusion into cardiac rehabilitation. Baseline to 3-month changes in self-reported and performance related measures of physical function were assessed using a physical functioning questionnaire, a 6-min walk test, and measured MET levels. **Results:** Paired *t*-tests revealed that participants made improvements in all measures across the first 3 months of the study, irrespective of group treatment ($P < 0.001$). General linear models including effects for baseline levels of physical function, treatment, and gender revealed that lower functioning men in the GMCB treatment made greater improvements than any other subgroup on the two performance outcomes: 6-min walk and measured MET levels ($P < 0.01$). Gender did not moderate change in self-reported level of physical function ($P > 0.05$); however, the lower functioning participants in the GMCB intervention experienced greater improvements in self-reported physical function than those in CRP ($P < 0.05$). **Conclusions:** Exercise therapy is a valuable intervention for improving physical function of older adults with cardiovascular disease (CVD) and those at increased risk for CVD. Baseline level of physical function and gender are important variables to consider when studying the relationship between exercise therapy and improvements in physical function.
Key Words: CARDIOVASCULAR DISEASE, PHYSICAL FUNCTION, EXERCISE THERAPY, BEHAVIORAL INTERVENTIONS

Cardiovascular disease (CVD) is a leading cause of morbidity and mortality among older men and women in the United States and directly threatens the maintenance of physical functioning and independence with aging (14). Although rehabilitation programs targeting CVD have resulted in proven physical health benefits across a wide range of outcomes, there have been long-standing problems with poor adherence, and very little attention has been directed toward the study of older adults and women (10). In the geriatric literature, Keysor and Jette (17) recently concluded that exercise does appear to have the potential to positively affect various objective markers of physical function in older adults; yet, they noted that data on self-reported disability with daily activities are mixed. Rejeski and Mihalko (25) have proposed that the outcomes of physical activity programs for older adults, particularly those that involve cognition/perception, could be enhanced through the use of cognitive-behavioral therapy. Consistent with this latter position, the present paper describes the first 3-month phase of the Cardiovascular Health and Activity Maintenance Program (CHAMP), a randomized clinical trial that compared the effect of standard cardiac rehabilitation (CRP) versus a group-mediated cognitive-behavioral intervention (GMCB) for CRP on the physical function of older adults who either had documented evidence of CVD or were at high risk for CVD.

The problem of noncompliance is common across a variety of health-related behaviors, even though the negative consequences of noncompliance are precipitous (5). In the context of cardiac rehabilitation, it is not surprising to find that 50% of individuals who initiate therapy drop out within the first 6 months (10,20). Several strategies have been incorporated into structured cardiac rehabilitation programs to improve compliance, including reinforcement strategies,

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Address for correspondence: W. Jack Rejeski, Ph.D., Department of Health and Exercise Science, P.O. Box 7868, Winston-Salem, NC 27109.

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goal setting, and offering participants more choice in the type of activity (7,13). However, most studies have been pre- or quasi-experimental and have not been based on established theories of behavior change (21). For most patients, traditional exercise therapy provides neither the motivation nor the instruction and practice in developing self-regulatory skills necessary for the transition from structured center-based exercise to independent maintenance of physical activity.

Although improving medical outcomes such as objective indices of physical functioning through exercise therapy is an indisputable goal of CRPs, it is also increasingly acknowledged that patients' appraisals of their physical functioning are powerful determinants of various health behaviors and health outcomes (26,29). Indeed, the concept of physical disability as defined by the Institute of Medicine inherently involves perception (22) and acknowledges the importance of the interface between older adults and their environments (30). In addition, the effects of CRP on physical function may not be uniform across all participants. For example, it would be more accurate to state that improvements in various physical health outcomes with CRP have been more often demonstrated for men than for women. Some of the probable reasons for this disparity may be attributable to the fact that women have lower rates of entry into CRPs (2) and suffer from higher rates of attrition compared with men (9,16). In addition, some researchers report that female cardiac rehabilitation patients report lower physical functioning scores at baseline compared with male patients (1), and that male cardiac patients report higher efficacy for exercise endurance (28). At the same time, it is encouraging to note that those women who complete CRP appear to exhibit similar improvements in health status (27), MET level (19), and psychological well-being as men (8).

Given the importance of assessing patients' perceptions of their physical functioning, and of elucidating gender comparisons in cardiac rehabilitation, the current study had several goals. First, among older adults enrolled in physical rehabilitation, we sought to compare a GMCB intervention with standard CRP on changes in objective and self-reported physical function after exposure to 3 months of exercise therapy. Second, to facilitate an examination of gender differences, we recruited a stratified sample based on gender. And third, because baseline level of function can be important to observed effects in randomized trials of physical activity (12), the statistical models included procedures to examine interactions between gender, treatment, and baseline level of functioning on the outcomes of interest.

METHODS

Participants

Participants for this study were recruited from the Triad region of North Carolina, within a 50-mile radius of Wake Forest University. As indicated previously, the sample was stratified by gender. Recruitment strategies consisted of mass mailings, mass media advertisements, and requests from local physicians targeting age-eligible older adults who either were at high risk for CVD or had documented evidence of CVD. The final sample consisted of 76 men and 71 women with a mean (SD) age of 64.7 (7.5) yr. All participants met the following inclusion criteria: (a) between the age of 50 and 80 yr; (b) either documented evidence of a myocardial infarction, percutaneous transluminal angioplasty, chronic stable angina, New York Heart Association Class I or Class II congestive heart failure, cardiovascular surgery (coronary artery or valvular heart disease) in the past 6 months, or the self-reported presence of two or more major risk factors for cardiovascular disease (verified by medical records in those deemed to be eligible for the study in the original screening); (c) disability defined as self-reported disability with walking ¼ mile, climbing stairs, lifting and carrying groceries, or performing other household chores such as cleaning and doing yard work; and (d) not actively engaging in exercise or cardiac rehabilitation for the preceding 6 months.

Self-reporting was also utilized to identify exclusion criteria that included: (a) psychiatric illness, such as treatment for major depression or schizophrenia within the past 5 yr; (b) severe symptomatic heart disease, such as evidence of unstable angina, New York Heart Association Class III or IV congestive heart failure, or exercise-induced complex ventricular arrhythmias; (c) severe systemic disease, such as chronic liver, kidney or rheumatic disease; (d) active treatment for cancer; (e) hearing or sight impairments; (f) cognitive impairment; (g) alcohol consumption greater than 21 drinks per week, or alcoholism; (h) inability to speak or read English; (i) judgment of clinical staff; and (J) current participation in another medical intervention study. If participants passed the initial screening and were identified as a potential participant for the trial, diseases of exclusion were verified by medical records. Demographic and biometric characteristics of the participants are discussed in the results section (see Table 1).

Measures

6-min walk test. Participants completed a 6-min walk test that was conducted in a gymnasium as an objective measure of physical function. The validity and reliability of the 6-min walk test has been established among cardiac rehabilitation participants (15) and for persons with mobility disability (22). Each individual was asked to walk as far as he or she possibly could in 6 min. Participants were asked to begin walking at the command "Go" and to continue walking until they heard the command "Stop." Participants were not allowed to carry a watch and were not given any feedback during the trial. Performance was measured as the total distance covered in feet (22).

MET level. Each participant completed a symptom-limited maximal graded exercise test to screen for exercise-induced myocardial ischemia and to assess $\dot{V}O_{2peak}$. Graded exercise test data were collected with a MedGraphics CPX/D metabolic cart (St. Paul, MN) and a Quinton tread-

TABLE 1. Descriptive characteristics of LAP and CRP treatment conditions at baseline.

Variable	LAP Mean (SD)	CRP Mean (SD)
Age	64.9 (7.41)	64.6 (6.97)
BMI (lb·in^{-2})	29.6 (4.9)	29.3 (6.2)

	LAP		CRP	
	N	%	*N*	%
Gender				
Men	37	49.3	38	47.2
Women	38	50.7	34	52.8
Smoking status				
Never	28	37.3	35	48.6
Past	44	58.7	30	41.7
Current	3	4.0	7	9.7
Arthritis				
No	34	45.3	35	48.6
Yes	38	50.7	32	44.4
Don't know	1	1.3	2	2.8
No answer	2	2.7	3	4.2
Hypertension				
No	20	26.7	18	25.0
Yes	52	69.3	52	72.2
Don't know	1	1.3	2	2.8
No answer	2	2.7		
Heart disease				
No	18	24	18	25
Yes	57	76	54	75
Circulation problems				
No	58	77.3	51	70.8
Yes	17	22.7	21	29.2
Diabetes				
No	58	77.3	59	81.9
Yes	16	21.3	12	16.7
Don't know	1	1.3	1	1.4
Any cancer				
No	56	74.7	50	69.4
Yes	19	25.3	22	30.6
Income category				
<10 K	1	1.3	5	6.9
10–24,999 K	14	18.7	11	15.3
25–49,999 K	34	45.3	28	38.9
> 50 K	6	8.0	1	1.4
No answer				

mill (Seattle, WA). Before each test, the metabolic cart was calibrated to accurately measure gas exchange. The treadmill protocol consisted of 2-min stages with progressive increases in grade designed to elicit an increase of approximately 1 MET per stage. One MET is a measure of energy expenditure and is equivalent to an oxygen uptake of 3.5 mL ·kg^{-1}·min^{-1}. Participants were instructed to walk on the treadmill until they could no longer continue because of generalized fatigue, shortness of breath, leg discomfort, or other reasons. Oxygen consumption was measured on a breath-by-breath basis and reported in minute intervals. The peak MET level each participant achieved during the treadmill test served as the outcome variable for this study.

Self-reported physical function. The perceived difficulty and satisfaction subscales of the physical functioning questionnaire (PFQ) were employed to assess self-reported physical function (24). The PFQ is a 40-item measure that has a hierarchical structure for assessing difficulty experienced during the past month with six specific activities: stair climbing, walking, getting up and moving after sitting, doing light work around the house, doing heavy work around the house, and performing lifting/carrying tasks (24). Perceived difficulty is assessed for each of the six activities by using a five-step hierarchy of difficulty. Each step is rated on a 5-point scale ranging from 0 to 4; no difficulty, a little difficulty, moderate difficulty, a lot of difficulty, and unable to do. Individual physical function scores are created by reverse scoring each step, summing across all five steps, and then multiplying this result by 5. Thus, for each activity, the perceived difficulty score can range from 0 to 100 with higher scores representing better physical function. These individual scores are then averaged for a composite index. The conceptual basis of this instrument is consistent with the concern that traditional measures of self-reported physical function lack sensitivity and are prone to floor and ceiling effects (17,24).

Once participants completed the difficulty ratings, they then rated their level of performance satisfaction for each of the six activities on an 11-point scale ranging from −5 to +5. The following descriptive anchors appeared on this scale: very dissatisfied (−5), moderately dissatisfied (−3), slightly dissatisfied (−1), slightly satisfied (+1), moderately satisfied (+3), and very satisfied (+5). Satisfaction ratings for these six activities were then averaged to create a single satisfaction index for physical function.

Factor analyses of these scales and an examination of scree plots have verified that the physical function and satisfaction subscales are unidimensional. The internal consistency reliability of both scales is excellent: the physical function scale has a Cronbach alpha coefficient of 0.90, whereas the Cronbach alpha for the satisfaction scale is 0.84 (23).

Trial Design

Before participation in the intervention, patients visited the laboratory on three separate occasions for preliminary screening tests, baseline assessments, and completion of an informed consent. During the first screening visit, a blood sample was collected from each participant, questionnaires were administered, and participants completed a 6-min walk test. During the second screening visit, each participant completed a symptom-limited graded exercise test, his or her height and weight was measured, and body fat was assessed using a three-site skin-fold caliper method. In addition, an activity accelerometer, a pedometer, an activity log, and a 3-d food record were given to each participant to record daily physical activity and to record dietary intake during the next week. The third screening visit was conducted 1 wk after the second screening visit. During this third visit, participants returned the accelerometer, pedometer, and activity and food logs, underwent a modified 7-Day Physical Activity Recall interview, and received feedback regarding their blood test values and treadmill test results.

When the three screening visits were completed, participants were randomized into one of the two treatments, stratified by gender. The treatment groups consisted of a traditional CRP and a GMCB. Certified exercise leaders who were trained to deliver the two interventions according to specific protocols led the groups. Their leadership under-

went constant evaluation by the study investigators to preserve treatment fidelity. In this paper, we describe the results after the first 3-month phase of treatment that constituted the intensive phase of the interventions with a focus on objective and subjective indices of physical function.

Description of Treatments

The procedures for the center-based exercise therapy sessions were identical for both treatments. These procedures were consistent with established guidelines for CRP as outlined by the American Association of Cardiopulmonary and Pulmonary Rehabilitation (3).

CRP. The CRP treatment arm consisted of center-based training that included walking and upper-body strength training. Participants exercised 3 $d \cdot wk^{-1}$ for a period of 3 months. Each exercise session consisted of four phases: a warm-up (5 min), an aerobic stimulus phase (30–35 min), an upper-extremity strength training phase (15–20 min), and a cool-down phase that included stretching exercises (5 min). The warm-up phase consisted of slow walking and four calisthenic type exercises (arm circles, shoulder and chest stretch, calf stretch, and hamstring stretch). During the aerobic stimulus phase, participants were instructed to walk at an intensity of 50–85% of heart rate derived by the following formula: training heart rate range = [(symptom-limited maximum heart rate − resting heart rate) × desired percentage] + resting heart rate. Participants were encouraged to walk for the entire 35 min within their training heart rate range; however, as per standard CRP procedures, individual adjustments were made depending upon abilities to meet the exercise goals. Heart rates were taken and recorded after 10, 20, and 35 min of exercise during the aerobic stimulus phase. Participants were instructed to monitor and record their heart rates after 10 min and 35 min of exercise. After 20 min of exercise, participants' heart rates and electrocardiogram readings were recorded using a Physio-Control Lifepak9 cardiac monitor defibrillator (Redman, WA). The upper-extremity strength-training phase consisted of five resistance exercises using small hand weights designed to increase strength in the muscles of the arms and shoulder girdle. The exercises included overhead dumbbell press, overhead triceps extension, biceps curl, upright row, and side bends. Participants were asked to perform one set of 10 repetitions of each exercise. After upper-extremity strength training, the cool-down phase consisted of stretching exercises, which included a shoulder and chest stretch, a triceps stretch, neck stretches, an abdominal stretch, a calf stretch, a lower back stretch, ankle stretches, and hamstring stretches. After the stretching exercises had been completed, participants self-monitored and recorded a final cool-down heart rate. In addition to exercise therapy, weekly educational lectures were given on topics that related to modification of risk factors for cardiovascular disease. The standard CRP treatment group was informed that they should exercise on days that they were not in the program so that they would be active most, if not all days of the week; however, at no time were they provided with counseling on the use of self-regulatory skills such as self-monitoring and goal setting.

GMCB. The GMCB treatment arm included the same forms of exercise as prescribed for the CRP condition, and both groups received the same total number of contact hours over the entire course of the trial. However, during the first 3-month intensive phase of the trial, the overall goals, structure, and timing of the GMCB condition differed from the CRP condition. For instance, an objective of the GMCB condition was to gradually wean participants from dependency on the staff and group program toward independent self-regulation of physical activity. The physical activity goal for this treatment involved shaping behavior across time so that by the 3-month mark participants achieved at least 30 min of mod^{+} (moderate or higher in MET demand) physical activity each day for a weekly increase from baseline of 150 $min \cdot wk^{-1}$. During the first 3-month period, there was a process of phased increase in personal responsibility for exercise among participants in conjunction with a phased decrease in staff, group and clinic dependency. Participants were challenged to integrate physical activity into their daily lives via planned homework assignments that were individually tailored. These experiences were discussed in subsequent group sessions for purposes of group encouragement, motivation, and support. For the first and second months, participants engaged in center-based exercise therapy two times each week. During the third month, center-based training was reduced to one time per week. In each of these months, planned home-based activity by the participant provided the additional sessions of exercise for a frequency equivalent to the CRP treatment (i.e., the goal of at least 3 d of exercise per week).

The theoretical foundation for the cognitive-behavioral aspect of the GMCB intervention was drawn from social cognitive theory (4), whereas the group motivational aspect was based upon the group dynamics literature (11,31). Use of these cognitive and behavioral models of change to encourage adherence to physical activity is consistent with the literature in exercise psychology (7,18). Furthermore, Brawley et al. (6) have demonstrated that this approach is successful in stimulating increased adherence to independent physical activity in sedentary asymptomatic male and female seniors of similar age.

After each exercise therapy session, participants engaged in a 20- to 25-min period of instruction and counseling regarding learning and using self-regulatory tools to maintain long-term physical activity and to preserve functional independence. For instance, during the first month, participants were asked to identify their primary motivations for becoming more active, and group leaders emphasized the risk of disability with aging. In addition, participants were introduced to the concept of self-monitoring of overall physical activity by using Digi-walkers, which measure the number of steps taken. Digi-walker values were recorded on activity logs. In addition, participants were taught how to record the frequency (days per week), intensity (heart rate and rating of perceived exertion), time, and type of physical activity performed in activity logs. Also, during this period,

individual and group goal setting for physical activity were discussed. Participants were instructed on how to set appropriate goals and how to deal with failure to meet goals.

During month 2, discussion focused on the concept of becoming an "independent exerciser" and how to plan home-based exercise that was safe and effective. Counseling between clinic staff and participants was coupled with group-motivated, peer-initiated solutions on how to maintain an active lifestyle and how to promote functional independence. Records of these solutions were kept and eventually provided to group participants for use in the home-based phase of the trial. During this period, strategies were discussed on how to overcome barriers and lapses related to physical activity. The importance of group support to promote a program of independent physical activity as well as accompanying solutions and strategies were reinforced during this period.

During month 3, group discussions focused on the recognition that, as individuals and as a group, participants had reached a stage of rehabilitation in which they could view themselves as physically active, independent older adults. At this stage, discussions focused on how to use environmental cues to facilitate activity goals, develop plans to deal with common barriers, recognize signs of relapse, and how to avoid or deal with relapse when it occurred. Also, attention was given to raising awareness of the progress that participants achieved over the past 3 months, the importance of developing and maintaining their own independent activity programs, and the plans they developed for the first month of independence from center-based activity. In sum, participants prepared themselves for independence and were weaned from the structured group environment.

Attendance. Attendance to structured exercise therapy sessions was recorded for each participant in the study to determine whether compliance to the frequency component (a goal of at least 3 d of exercise per week) of the exercise prescription was similar between the GMCB and CRP conditions as well as between male and female participants. Given the fact that the number of center-based sessions offered was different between the CRP and GMCB groups, different approaches were utilized to assess compliance between the two conditions. For the CRP treatment, percent of compliance was defined as the number of sessions that the participant attended divided by the number of sessions offered at the center times 100. For example, if a participant attended 18 sessions of 36 offered, her percent compliance would be (18/36) $\times$ 100, or 50%. In several instances, participants completed their exercise sessions at home due to family or personal conflicts. These sessions were counted in the overall rates of adherence for the CRP group. Among GMCB participants, both center-based sessions and planned home-based exercise were employed to evaluate whether compliance matched the frequency goal of at least 3 $d \cdot wk^{-1}$. For instance, during month 1, if a participant attended six of eight sessions offered, and engaged in home-based exercise at least once each week, her percent compliance for month 1 would be determined as follows: (10/12) $\times$ 100 = 83.3%. Similarly, if she attended seven of eight sessions offered during month 2, and engaged in home exercise once each week, her percent compliance for month 2 would be (11/12) $\times$ 100 = 91.6%. During month 3, if she attended three of four sessions offered, and engaged in home-based exercise twice each week, her percent compliance would be (11/12) $\times$ 100 = 91.6%. Finally, the average of the three months was calculated to arrive at an index of overall compliance: (83.3 + 91.6 + 91.6)/3 $\times$ 100 = 88.8%.

Statistical Analyses

General linear models using an intention to treat principle were employed to test the effects of interest for each outcome variable: 6-min walk, MET capacity, self-reported physical function, and satisfaction with these physical tasks. In these models, the unit of analysis for each outcome was a difference score calculated as 3-month minus baseline responses. Each separate analysis included covariates for age and baseline values for the dependent measure in the model. Subsequent effects tested included the following: gender, treatment, a gender by treatment interaction, a baseline score by treatment interaction, and a three-way interaction involving baseline, gender, and treatment. The alpha level for testing the significance of effects in each model was set at $P < 0.05$. All analyses on performance-related and self-reported measures of change in physical function were conducted using the SPSS 10.07 statistical package (procedure GLM UNIVARIATE).

RESULTS

Demographic characteristics of the participants at the initial screening visit are shown in Table 1 partitioned by treatment group. Inspection of these data reveals that the study sample consisted of a group of older men and women who were overweight or obese. They were heterogeneous on income. Nearly 50% of the sample had arthritis and 70% were hypertensive. A small percentage of the sample had other comorbidities such as diabetes and cancer with roughly 75% of the sample having heart disease. Examination of the medical records revealed that 27.6% of the sample had evidence of a myocardial infarction, 31.5% had CABG, 21.3% had PCTA, 13.4% had CHF, and 45% had angina.

Study attrition. Of the 147 participants who were randomized into the trial, 129 completed the 0- and 3-month assessments. Among the 18 participants who were lost to attrition, eight of these individuals left the study due to extended personal or family illness. Four individuals left the study due to clinical depression (2 from each treatment group). One participant left the trial due to job demands, and five persons were lost because they stopped attending sessions and did not show up for 3-month assessments. As a whole, five participants were lost from the CRP group, and 13 participants were lost from the GMCB group. It should be noted that five individuals in the GMCB group left the study after they were randomized but before the intervention began. In one case, the reason was conflict with work,

TABLE 2. Changes in Performance-related and self-report measures of physical function from baseline to 3 months for the total sample and for men and women separately.

Outcome Variable	Baseline Mean (SD)	3 month Mean (SD)	Mean Change Mean (SD)	Paired-Sample t	Significance (2-Tailed)
6-min walk (feet)					
Total Sample	1727.84 (289.52)	1948.22 (311.60)	215.85 (182.75)	13.153	< 0.001
Women	1612.98 (252.79)	1842.38 (282.62)	227.24 (147.38)	11.743	< 0.001
Men	1833.98 (282.27)	2039.85 (308.32)	205.85 (209.61)	7.978	< 0.001
MET level					
Total sample	5.32 (1.27)	5.74 (1.51)	0.43 (1.09)	4.254	< 0.001
Women	4.80 (1.05)	5.07 (1.21)	0.32 (0.66)	3.679	< 0.001
Men	5.80 (1.28)	6.38 (1.50)	0.52 (1.36)	2.982	< 0.004
Self-reported physical function (0–100)					
Total sample	77.61 (18.43)	81.40 (16.85)	4.03 (12.59)	3.328	< 0.001
Women	73.87 (18.87)	76.86 (15.28)	3.43 (11.43)	2.328	< 0.023
Men	80.97 (17.48)	85.46 (17.26)	4.57 (13.61)	2.746	< 0.008
Satisfaction with physical function (−5 to +5)					
Sample	0.18 (2.71)	1.37 (2.79)	1.21 (2.47)	5.301	< 0.001
Women	−0.48 (2.67)	0.54 (2.57)	1.09 (2.26)	3.753	< 0.001
Men	0.76 (2.62)	2.10 (2.80)	1.31 (2.65)	4.055	< 0.001

whereas the other four were due to serious personal or family-related illness. Thus, attrition during active treatment involved five patients from CRP and eight patients from GMCB. Overall, our rate of study retention from baseline to 3 months was 87.7%. This rate of retention is excellent (18) and did not vary as a function of either treatment assignment or gender. Also, there was no evidence that these individuals differed in any meaningful way from participants who completed follow-up testing.

Influence of exercise therapy on study outcomes independent of treatment. Because both treatments involved physical activity interventions, we begin by describing the mean changes for each outcome variable across the 3-month of the study for the total sample and then separately for men and women. Examination of the data in Table 2 reveals that the participants in this study, irrespective of gender, experienced significant improvements in all outcomes. As described in the next two sections, however, interpretation of these effects requires consideration of both baseline level of function and whether participants were assigned to CRP or GMCB.

Analyses of performance measures. The general linear models conducted on the change in 6-min walk distance and measured peak MET capacity produced significant gender by treatment interaction terms ($P < 0.05$); however, interpretation of these effects was superceded by significant three-way interactions involving baseline scores, gender, and treatment: 6-min walk $F_{2,115} = 3.53$, $P < 0.03$ and MET capacity $F_{2,109} = 3.38$, $P < 0.05$. Inspection of the line graphs that depict these three-way interactions (Figs. 1 and 2) illustrate that men with lower initial function who were in the GMCB group experienced the greatest improvement in 6-min walk and peak MET capacity. To further elucidate the three-way interactions for each outcome, we conducted pairwise tests between the slopes of the lines that characterize each subgroup. For the 6-min walk, the slope of the line for the GMCB men was statistically different from the GMCB women and the CRP men ($P < 0.02$), whereas for MET capacity, the only statistically significant differ-

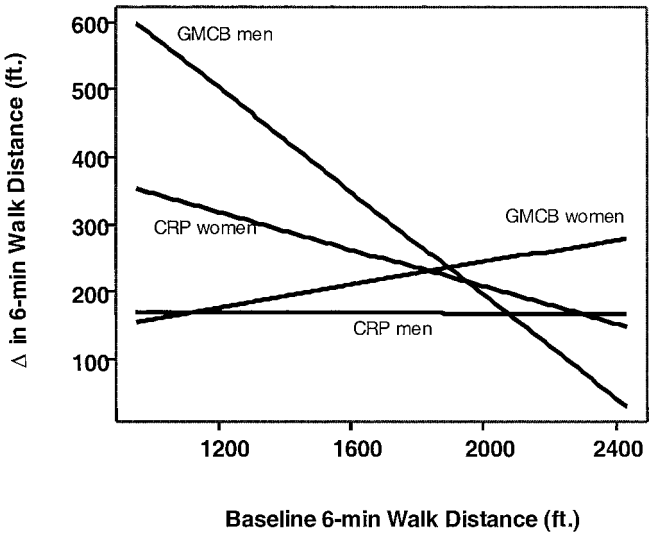

FIGURE 1—Combined effect of gender, treatment, and baseline performance on 3-month Δ in 6-min walk distance.

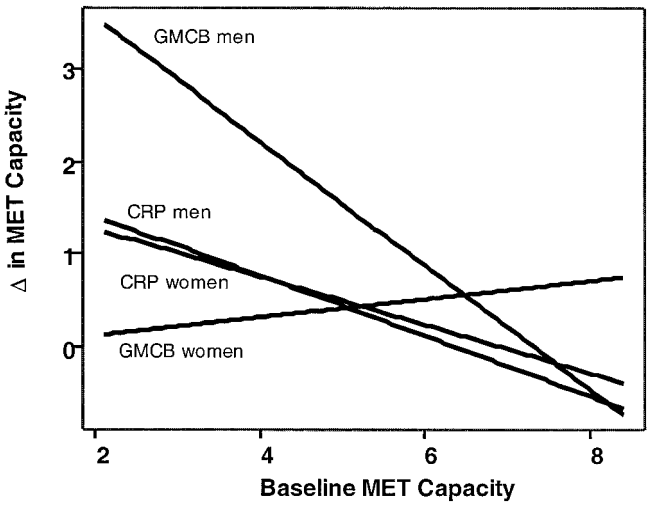

FIGURE 2—Combined effect of gender, treatment, and baseline performance on Δ in 3-month MET capacity.

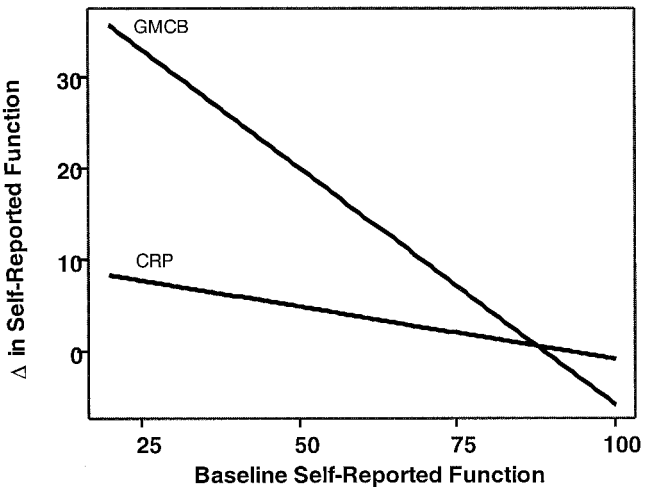

FIGURE 3—Effect of treatment and baseline score interaction on 3-month Δ in self-reported physical function.

ence between slopes was the comparison between the GMCB men and the GMCB women.

Analyses of self-report measures. The general linear model involving change in self-reported physical function produced a significant treatment effect ($P < 0.05$) that was superceded by a significant baseline by treatment interaction term ($F_{1,118} = 17.99$, $P < 0.001$). As shown in Figure 3, participants who self-reported the greatest difficulty with performing the daily physical tasks at baseline and who were assigned to the GMCB treatment experienced the most improvement across the initial 3-month of the intervention ($P < 0.01$). Although none of the terms in the model for satisfaction with physical function met the $P < 0.05$ significance criterion, it is interesting to note that the gender main effect ($F_{1,118} = 3.58$, $P = 0.06$) and the two-way baseline by treatment interaction approached statistical significance ($F_{1,118} = 2.50$, $P = 0.11$). These trends suggest that men and participants in the GMCB treatment group with low baseline satisfaction scores demonstrated the most favorable changes on this measure across time. There was also a strong negative association between baseline satisfaction scores and change in satisfaction across the 3-month of treatment ($F_{1,110} = 26.30$, $P < 0.001$; r = −0.42), once again supporting the proposition that those who have the most to gain from exercise therapy are those with compromised function.

Adherence to the R_x. The final general linear model conducted on adherence to an exercise Rx of three sessions each week produced statistically significant effects for gender ($F_{1,100} = 6.17$, $P < 0.05$) and treatment ($F_{1,100} = 15.04$, $P < 0.05$). Examination of the means associated with these effects revealed that men [mean (SE) = 88.54% (2.34)] had significantly better adherence than women [mean (SE) = 80.22% (2.39)], whereas participants in the GMCB group [mean (SE) = 90.88% (2.65)] had better adherence than those in the CRP group [mean (SE) = 77.88% (2.04)]. The interaction term was not significant.

DISCUSSION

This study was designed to compare the effects of two different approaches with cardiac rehabilitation on performance-related and self-report measures of physical function among older adults after 3 months of treatment. The interventions compared were a group-mediated cognitive-behavioral intervention (GMCB) for physical activity and a traditional exercise therapy program (CRP). Both gender and baseline values for each outcome were considered as potential moderating variables. Overall, both treatment groups experienced statistically significant improvements in performance-related and self-reported physical function.

To our knowledge, this is the first investigation to directly compare the effects of a GMCB intervention with those of a standard CRP on physical functioning in older adults. A unique aspect of the data is the fact that analyses of treatment effects as potentially moderated by gender and baseline function produced several findings that are important both for the literature and the delivery of physical activity interventions to older adults. First, examination of objective indices of physical function resulted in three-way interactions between treatment, gender, and baseline values for each outcome. Men with lower levels of initial function who were assigned to the GMCB program, as opposed to standard CRP, experienced the largest short-term (3-month) improvement in both MET capacity and distance covered during a 6-min walk. Conversely, although women in both treatment groups improved their 6-min walk time and MET capacity, there were no real treatment differences in amount of change for women in either treatment and the effects were not moderated by baseline levels of function for either outcome.

The treatment effects and the moderating role of baseline responses for the self-report data were similar to patterns observed with the performance outcomes; however, gender was not an important individual difference variable in these analyses. The most distinctive result was found for ratings of physical functioning in which the largest benefit occurred for older adults with lower initial levels of function in the GMCB treatment group. Although there was a trend for the treatment by baseline interaction on the satisfaction measure ($P = 0.09$), the main finding for this outcome was that baseline satisfaction scores, independent of the type of intervention, moderated change in satisfaction with physical function.

Collectively, these results suggest that older cardiac rehabilitation patients with lower physical function who have the greatest risk for subsequent morbidity and mortality (14) will achieve the greatest short-term benefit from organized physical activity when it is coupled with group-mediated cognitive behavioral counseling. This benefit is enhanced when counseling is targeted for the promotion of independence and the integration of physical activity with participant lifestyles (6,12). The result was the most dramatic for lower functioning men who achieved greater benefits in objective measures of physical function than any other subgroup. The fact that lower functioning women in the GMCB

treatment experienced as great an improvement in self-reported physical function as did their lower functioning male counterparts in the GMCB treatment condition is intriguing given that these women did not experience a corresponding change on objective tests of function. However, note that women in both the traditional CRP and the GMCB treatment did experience positive changes in both 6-min walk times (mean change ± SE = 235.38 ± 26.67) and MET capacity (0.419 ± 0.175) across the 3-month of this intervention, albeit less dramatic than lower functioning GMCB men. Perhaps a lower absolute change in objective performance was required for GMCB women to experience comparable changes in perceived function.

Alternatively, it is important to recognize that objective and subjective measures of physical function often do not covary (17). For example, many positive psychological benefits routinely reported in connection with programs of physical activity for older and younger adults as a function of their participation in physical activity are not strongly associated with changes in aerobic capacity. It is also important to keep in mind that, independent of objective capacities, "perceptions of what people can do" are powerful determinants of various health behaviors and health outcomes (22,29). Indeed, this point is consistent with the earlier assertion that the concept of physical disability inherently involves perception (22) and is dependent upon the interface between older adults and their environments (30).

Authors of previous reviews concerning the effects of exercise therapy with patients in cardiac rehabilitation (9,10) have argued that selective sampling and/or attrition may be responsible for gender differences in various health outcomes. However, unlike the reviewed investigations that reported differential gender responses to CRP, men and women in the current study were sampled equally and randomly assigned to treatment. Thus, selective or convenience sampling is not a viable explanation for the observed differences between the GMCB men and women for either 6-min walk performance or MET capacity.

Finally, although all participants in this study exhibited high rates of adherence to their activity prescriptions, consistent with the observed change in function for all participants, there were adherence main effects for both gender and treatment. Recall that men as opposed to women and participants assigned to the GMCB versus CRP treatment had the higher rates of adherence. A key difference between the treatments was that a portion of the bouts of physical activity encouraged by the GMCB treatment was independent of staff and center contact. This is important not only for the demonstrated effects of the GMCB treatment on physical function but also for the promise of effective transfer of physical activity lifestyle changes from a center-based focus to independent maintenance of physical activity. The effects of the GMCB treatment in this study on the physical functioning of men and women supports the view recently espoused by Rejeski and Mihalko (25) that physical activity programs can be augmented with various group and individually oriented cognitive-behavioral approaches to enhance the potential benefits of newly acquired abilities (18).

In the present study, our intervention focused on fostering a lifelong commitment to a physically active lifestyle and the importance of this behavior to maintaining independence with aging. The GMCB treatment was designed to improve various cognitive behavioral skills related to independence. This included (a) participants' setting specific behavioral goals and discussing the "slippery slide" of disability; (b) specific weekly feedback to participants and group discussions focused upon problem solving and commitment; (c) homework assignments encouraging attempts at integrating physical activity into daily life plus sharing achievements and setbacks with the group; and (d) teaching self-regulatory skills including goal getting, problem solving, cognitive restructuring, managing the environment, and acquiring social support. The participants' learning how to tailor their personal treatment was a key component of the intervention.

In summary, the results of this study support the position that exercise therapy is a valuable intervention for improving the physical function of older adult men and women who either have or are at high risk for various cardiovascular disorders. It is clear that the greatest benefit in this first 3-month period of treatment occurred in older adults who had lower function at the onset of the intervention. More importantly, the group-mediated cognitive-behavioral lifestyle treatment led to greater improvement in self-reported physical function for older adults with lower initial function than did traditional exercise therapy. Older men with lower initial function in the GMCB treatment also made the greatest improvement in 6-min walk performance and MET capacity. Further research is warranted on the efficacy of coupling exercise with group-mediated cognitive-behavioral counseling in treating a variety of chronic disorders. Obviously, a very interesting and important question concerns the long-term effects of such interventions on the maintenance of active lifestyles and the preservation of older adults' functional independence.

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