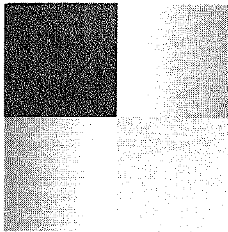

BRIEF REPORT

Functional Fitness Assessment of Older Cardiac Rehabilitation Patients

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Estimates show that by 2030, one in five Americans will be 65 years of age or older.[1] As overall survival and life expectancy increase, the prevalence of disability also is expected to rise.[1] In 1997, approximately 53 million noninstitutionalized Americans had some form of disability, one third of which were 65 years of age or older.[2] Many types of disabilities limit people in their activities of daily living, but mobility disabilities are the most common type, affecting approximately 25 million individuals in the United States.[2]

Heart disease is highly associated with physical disability among older patients.[3] Results from the Framingham Disability Study indicate that rates of disability and mobility limitations are particularly high for older adults with a diagnosis of coronary heart disease and congestive heart failure.[3] Thus, a main goal of cardiac rehabilitation (CR) for older patients is preventing or delaying the onset of physical disabilities.[4]

The key to preventing or delaying the onset of mobility disabilities is detection of physical impairment early in older adulthood.[5] Until recently, the problem with early detection of physical impairment among older adults (age, ≥65 years) was the lack of an appropriate test battery.[5] Existing batteries were designed either for younger populations, in which case they were too difficult for older adults, or for very frail populations, in which case they were too easy for independent, mobile older adults.[5] However, in the past decade a number of test batteries were developed specifically to assess the various parameters associated with independent living and physical mobility in older adults, a concept sometimes referred to as "functional fitness."[5] These test batteries could provide useful information in a CR setting, especially with older coronary patients.

Graded exercise tests and self-report measures have typically been used with CR patients to evaluate functional impairment.[6-10] Graded exercise tests are valuable for risk stratification and exercise prescription purposes,[11] but findings have shown them to be to poor predictors of patients' ability to perform daily tasks.[12] Self-report measures provide relevant information regarding patients' perception of their functional status, but leave actual functional status undetermined.[13] Thus, little is known about the functional fitness of older CR patients.

The purposes of this study were to assess the feasibility of using an objective, comprehensive test battery to describe the functional fitness of older coronary patients entering phase 2 CR, and to compare the values obtained with normative US standards.

METHODS

Participants

After approval of the study protocol by the Arizona Heart Institute (AHI) Institutional Review Board, participants were recruited over a 1-year period from two CR sites in Phoenix, Arizona. To be eligible for the study, individuals had to (1) enter phase 2 CR at one of the two AHI sites within 12 weeks of their cardiac event or surgery, (2) be at least 60 years of age, (3) have physician or cardiologist approval, and (4) be free of current mobility problems that would preclude completion of the Fullerton Functional Fitness Test without the use of any assistive walking device.

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Over the recruiting period, 40 CR patients met the eligibility criteria for the study. Three of these patients were not interested in participating in the study. Thus, data were obtained from the remaining 37 participants (33 men and 4 women).

Measures

Information regarding the participants' age, gender, marital status, primary diagnosis, weight, and height was retrieved from their medical files. Exercise tolerance, expressed as peak metabolic equivalents of task (METs), was determined using a symptom-limited graded exercise test.

Functional fitness was assessed with the Fullerton Functional Fitness Test (FFFT) developed by Rikli and Jones.[5] The FFFT, also known as the Senior Fitness Test, was specifically designed to measure the physiologic parameters associated with independent functioning and physical mobility in older adults including lower and upper body strength, aerobic endurance, lower and upper body flexibility, and agility/dynamic balance.[5] The FFFT has documented validity and reliability, and provides national normative data for community-dwelling adults ages 60 to 94 years.[5,14]

The FFFT battery consists of six test items (and one alternative) that mimic basic activities of daily living. In the current study, the participants were assessed on the following five items: the 30-second chair stand (number of times a patient can rise to a full stand from a seated position in 30 seconds), the arm curl (number of times a patient can curl a dumbbell—5 pounds for women and 8 pounds for men—through a full range of motion in 30 seconds), the chair sit-and-reach (from a seated position, the distance measured from the toes of the straightened leg to the middle fingers of the extended arms), the back scratch test (from a standing position, the distance achieved between both middle fingers behind the back, with one hand reaching behind the head and the other reaching up the back), and the 8-foot up-and-go (time required to get up from a seated position, walk 8 feet to and around a marker, and return to the chair). The 6-minute walk and its alternative, the 2-minute step test, both designed to assess aerobic endurance, were excluded from the protocol because aerobic endurance already had been assessed for AHI patients via graded exercise tests, as it generally is in most phase 2 CR programs.

Administration of the FFFT required approximately 30 minutes. Each test item was administered according to the procedures outlined in the Senior Fitness Test Manual.[15] All the functional fitness assessments were performed by the same tester.

Procedures

Patients beginning phase 2 CR were informed about the study by the CR program director or a member of the CR staff. The patients interested in participating then were scheduled to meet with the primary investigator within 1 week after their first rehabilitation session, on a CR class day, 45 minutes before their CR class. Volunteers completed a written informed consent, and were tested immediately. The test items were administered in the following order: chair stand, arm curl, chair sit-and-reach, back scratch, and 8-foot up-and-go. After test administration, patients were given feedback on their test results.

Statistical Analysis

The score of each participant on each test item was translated into an age- and gender-specific standardized score (z score) using national normative data provided with the FFFT.[14] An average z score of 0 indicated that the participant's performance on a given item was equivalent to the average performance obtained by other US adults of the same gender and age. For each test item except the 8-foot up-and-go, higher raw scores indicated better performances. Accordingly, for each test item except the 8-foot up-and-go, positive z scores denoted performances superior to the national age- and gender-specific norms, whereas negative z scores indicated performances inferior to the norms.

The sample's average z score was computed for each test item and translated into an average percentile to facilitate interpretation. Percentiles rank the performance of an individual or subgroup relative to the performance of the normative population (US adults of the same age and gender). For example, in the current study, an average percentile of 20 indicated that the participants scored, as a group, in the lowest 20% of older Americans of the same gender and age.

Frequencies were computed to identify the number of participants at or below the criterion-referenced standard provided with the FFFT. Criterion-referenced standards for the FFFT indicate values below which the normative population experienced limitations in their activities of daily living.[15] Finally, Pearson correlations were used to examine associations among FFFT items as well as associations between each FFFT item and exercise tolerance (in METs).

RESULTS

The demographic and clinical characteristics of the sample are presented in Table 1. The participants were mostly white (92%) retired (70%) males (89%), ages 60 to 83 years, residing in Arizona between January 2002 and January 2003.

The sample mean, standard deviation from the mean, average z score, and average percentile for each FFFT item are shown in Table 2. The average percentiles for

Table 1 • SAMPLE DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

	M ± SD
Age, y	68.9 ± 6.3
Exercise tolerance, METs	5.9 ± 2.4
Time post cardiac event, weeks	6.6 ± 4.4
Body mass index, kg/m^2	27.2 ± 3.9
Marital status	**n (%)**
Married	32 (86.5%)
Widow/widower	1 (2.7%)
Divorced/separated	4 (10.8%)
Primary diagnosis	
CABG	16 (43.2%)
PTCA/Stent	11 (29.7%)
MI and PTCA	5 (15.5%)
MI only	3 (8.1%)
Angina/coronary artery disease	1 (2.7%)
Valve replacement	1(2.7%)

METs, metabolic equivalents; CABG, coronary artery bypass graft; PTCA, percutaneous transluminal coronary angioplasty; MI, myocardial infarction.

Table 2 • FUNCTIONAL FITNESS SCORES

Item	Mean	SD	*z* score	Percentile
30-second chair stand (number of repetitions)	11.3	3.3	-0.83	20
Arm curl (number of repetitions)	12.5	2.8	-1.02	15
Chair sit-and-reach (inches)	-4.9	4.6	-1.04	15
Back scratch test (inches)	-5.5	4.5	-0.30	38
8-foot up-and-go (seconds)	6.3*	3.7	0.60†	27

FFFT, Fullerton Functional Fitness Test.

* For this test item, higher raw scores indicate poorer performance.

† For this test item, positive *z* scores indicate a performance inferior to the norms.

the FFFT items ranged from 15 for the arm curl and chair sit-and-reach tests to 38 for the back scratch test. Eight participants (22%) were at or below the criterion-referenced standard on the 30-second chair stand, as were 14 (38%) on the arm curl, 22 (59%) on the chair sit-and-reach, 11 (30%) on the back scratch, and 2 (5%) on the 8-foot up-and-go.

Pearson correlations among FFFT items ranged from ±0.03 to ±0.59. Significant correlations were obtained between the 30-second chair stand and the arm curl ($r = .59$; $P \leq .01$), between the 30-second chair stand and the back scratch ($r = .39$; $P \leq .05$), between the 30-second chair stand and the 8-foot up-and-go ($r = -.57$; $P \leq .01$), and between the 8-foot up-and-go and the back scratch ($r = -.42$; $P \leq .05$). The respective R^2 values for these correlations were 0.35, 0.15, 0.33, and 0.18. Exercise tolerance was significantly associated with performance on the arm curl ($r = .42$; $P \leq .05$) and the 8-foot up-and-go ($r = -.43$; $P \leq .05$). The respective corresponding R^2 values were 0.18 and 0.19.

DISCUSSION

To the authors' knowledge, this is the first study to describe older patients entering phase 2 CR in terms of functional fitness using an objective test battery, and the first to compare their values with national age- and gender-specific norms. Functional status of the phase 2 CR population had previously been investigated through self-report measures or graded exercise tests.[6-10]

In the current study, older individuals entering phase 2 CR were, on the average, below their age- and gender-specific norm (50th percentile) on all FFFT items. The average percentiles indicate that the participants were, as a group, below the normal range (25th to 75th percentile) on the 30-second chair stand, the arm curl, and the chair sit-and-reach, and within the normal range on the back scratch and the 8-foot up-and-go. These results suggest that the lower body strength, upper body strength, and lower body flexibility levels of the patients in this study were below what could be expected for their age and gender, whereas their upper body flexibility and agility/dynamic balance were within the normal levels observed in the normative population.

The number of patients at or below the criterion-referenced standard was highest for the chair sit-and-reach, followed by the arm curl and the back scratch. More specifically, the frequencies obtained suggested that 30% to 59% of the participants had some limitation in their activities of daily living as a result of poor lower body flexibility, upper body strength, and/or upper body flexibility.

Although some FFFT items were significantly correlated with each other, the corresponding R^2 values were relatively low. In analyses, R^2 values indicate the amount of variance in the one item accounted for by variance in the other item. The highest R^2 value, obtained between the 30-second chair stand and the arm curl, was a 0.35, suggesting that 35% of the variance in the 30-second chair stand scores can be explained by the arm curl scores. These results indicate that a weakness in one item is not highly predictive of weaknesses in the other items.

Likewise, exercise tolerance was significantly correlated with performance on the arm curl and the 8-foot up-and-go, but corresponding R^2 values suggested that only 18% to 19% of patients' scores on these items were

predicted by MET attainment on the graded exercise test. Overall, these findings highlight the importance of using a comprehensive battery to assess the various parameters of functional fitness in older CR patients.

A main goal of CR for older patients is to prevent or delay the onset of disabilities and promote functional independence.[4] As the CR population gets older, this goal may be given greater consideration when the value of CR programs is evaluated. Routine assessment of functional fitness before and after phase 2 CR should be considered to monitor whether this goal is being achieved through current-phase 2 CR, and to investigate various phase 2 CR interventions in terms of their effectiveness at improving patients' functional fitness.

Lower and upper body strength, lower and upper body flexibility, and agility/dynamic balance play a vital role in maintaining independent functioning and physical mobility in older adulthood.[6] Thus, it is crucial to address weaknesses in these parameters among populations at risk for mobility disabilities, such as older individuals with heart disease.

STUDY LIMITATIONS

Only three women participated in this study. Therefore, the applicability of the results to older female CR patients is undetermined. In addition, the overall sample size was fairly small, which limits the generalizability of the study's conclusions.

SUMMARY

For a better evaluation of a phase 2 CR program's effectiveness, objective assessment of functional fitness should be conducted before and after rehabilitation to address improvements in lower and upper body strength, lower and upper body flexibility, and agility/dynamic balance.

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