Effects of Cardiac Rehabilitation and Exercise Training Programs in Patients ≥75 Years of Age

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Comprehensive cardiac rehabilitation and exercise programs have proven to be extremely effective in patients after major coronary artery disease (CAD) events, even in elderly patients with CAD.[1-6] We and others[3-6] have demonstrated beneficial effects of this therapy on exercise capacity and on various CAD risk factors (obesity indexes and lipids), as well as improvements in behavioral characteristics and quality-of-life parameters in younger and older patients with CAD. In addition, cardiac rehabilitation is associated with reduction in subsequent medical costs,[7] and pooled data from several randomized studies have demonstrated 20% to 25% reductions in major CAD morbidity and mortality in patients randomized to cardiac rehabilitation.[8] In the present report, we assess the effects of cardiac rehabilitation and exercise training on exercise capacity, CAD risk factors, behavioral characteristics, and quality-of-life parameters in very elderly patients ≥75 years of age with CAD and compared these benefits with those of a younger cohort of patients (<60 years) with CAD.

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We studied 54 consecutive patients ≥75 years of age (mean 78 ± 3 years; 72% men) and 229 younger patients (<60 years; mean 51 ± 6 years; 85% men) who were referred to, attended, and completed outpatient, phase II cardiac rehabilitation and exercise training programs. Patients taking lipid-lowering medications were excluded from analysis; medications that may affect lipid levels (eg, β blockers, diuretics, α blockers, and calcium antagonists) were at stable doses for at least 4 weeks in all patients, and these medications were not altered during the program. Details of the cardiac rehabilitation and exercise training program are described elsewhere.[1,2,5,6] In all patients, body mass index, percent body fat (sum of the skin-fold method), estimated exercise capacity (estimated metabolic equivalents [METs]),[9] and fasting plasma lipids were assessed at baseline and within 1 week of completing the program. In a subgroup of 126 patients (33 very elderly and 93 younger patients), validated questionnaires were obtained to evaluate behavioral characteristics and various quality-of-life parameters.[10,11]

TABLE I Baseline Differences in Study Groups

	Very Elderly Cohort (n = 54)	Younger Cohort (n = 229)	p Value
Exercise capacity (estimated METs)	4.4 ± 1.6	7.6 ± 3.1	<0.0001
Body mass index (kg/m²)	24.8 ± 3.7	28.5 ± 4.6	<0.0001
Triglycerides (mg/dl)	140 ± 64	186 ± 112	<0.01
High-density lipoprotein cholesterol (mg/dl)	43.7 ± 11.5	36.5 ± 9.9	<0.0001
Anxiety score (U)*	3.8 ± 5.5	5.8 ± 5.3	0.06
Depression score (U)*	2.7 ± 3.7	4.5 ± 5.3	0.09
Hostility score (U)*	2.0 ± 3.7	4.5 ± 5.1	0.01
Function score (U)†	30.2 ± 8.7	35.4 ± 9.1	<0.01
Total quality-of-life score (U)†	94 ± 19	101 ± 19	0.08

* Lower score for behavioral characteristics indicates more favorable trait (n = 33 very elderly and 93 younger patients).

† Higher score for quality of life and its components indicates a more favorable trait (n = 33 very elderly and 93 younger patients).

Both groups were statistically similar regarding percent body fat, other lipid values, somatization score, and other quality-of-life parameters.

The results are expressed as mean ± SD. Baseline differences in the very elderly and younger patients were compared by nonpaired *t* tests. Baseline and postcardiac rehabilitation data were compared in each group by paired *t* tests, and the changes in data between groups were analyzed with 2-factor (data before and after and age) repeated measures of analysis of variance with repeated measures in 1 factor (data before and after), as described elsewhere.[1,2,5,6]

Baseline differences between groups are demonstrated in Table I. At baseline, the very elderly cohort of patients had lower exercise capacity (−42%; p <0.0001), triglycerides (−25%; p <0.01), body mass index (−13%; p <0.0001), anxiety score (−34%; p = 0.06), depression score (−40%; p = 0.09), hostility score (−56%; p = 0.01), overall function score (−15%; p <0.01), and total quality-of-life score (−7%; p = 0.08) and higher levels of high-density lipoprotein (HDL) cholesterol (20%; p <0.0001) than the younger cohort of patients. Both groups were statistically similar regarding baseline levels of percent body fat, other lipid levels, and other behavioral characteristics and quality-of-life parameters.

After cardiac rehabilitation and the exercise training program, the very elderly patients had modest, although statistically significant, improvements in lipids (Table II), including reductions in total cholesterol (−5%; p = 0.01), triglycerides (−16%; p <0.0001), low-density lipoprotein (LDL) cholesterol (−6%; p = 0.04), LDL/HDL ratio (−8%; p = 0.02), and increases in HDL cholesterol (6%; p

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TABLE II Effects of Cardiac Rehabilitation and Exercise Training on Exercise Capacity, Obesity Indexes, and Lipids

	Very Elderly (n = 54)				Younger (n = 229)			
	Before Rehabilitation	After Rehabilitation	% Change	p Value	Before Rehabilitation	After Rehabilitation	% Change	p Value
Exercise capacity (estimated METs)	4.4 ± 1.6	6.2 ± 2.6	39%*	<0.0001	7.6 ± 3.1	10.0 ± 3.8	31%	<0.0001
Body mass index (kg/m^2)	24.8 ± 3.7	24.7 ± 3.6	0%	0.25	28.5 ± 4.6	28.1 ± 4.3	−1.5%	<0.001
Percent body fat	26.0 ± 7.8	24.3 ± 6.5	−7%	0.13	24.6 ± 6.3	23.5 ± 6.5	−4%	<0.0001
Total cholesterol (mg/dl)	198 ± 50	189 ± 49	−5%	0.01	204 ± 39	201 ± 35	−1.5%	0.13
Triglycerides (mg/dl)	140 ± 64	118 ± 51	−16%	<0.001	186 ± 112	163 ± 85	−12%	<0.001
HDL cholesterol (mg/dl)	43.7 ± 11.5	46.3 ± 16	6%	0.05	36.5 ± 99	38.3 ± 10.1	5%	<0.0001
LDL cholesterol (mg/dl)	126 ± 42	120 ± 39	−6%	0.04	131 ± 37	130 ± 30	−1%	0.76
LDL/HDL	3.0 ± 1.0	2.7 ± 0.9	−8%	0.02	3.78 ± 1.4	3.62 ± 1.2	−4%	0.03

* Improvement was greater (p = 0.06) in the very elderly group than in the younger cohort.
HDL = high-density lipoprotein; LDL = low-density lipoprotein.

TABLE III Effects of Cardiac Rehabilitation and Exercise Training on Behavioral Characteristics and Quality of Life Parameters

	Very Elderly (n = 33)				Younger Cohort (n = 93)			
	Before Rehabilitation	After Rehabilitation	% Change	p Value	Before Rehabilitation	After Rehabilitation	% Change	p Value
Behavioral characteristics, units*								
Anxiety	3.8 ± 5.5	1.3 ± 2.1	−66%	<0.01	5.8 ± 5.3	3.8 ± 4.4	−34%	<0.001
Depression	2.7 ± 3.7	1.2 ± 2.3	−56%	0.04	4.5 ± 5.3	3.3 ± 4.8	−27%	0.01
Somatization	7.3 ± 3.9	4.2 ± 3.0	−42%	<0.0001	7.0 ± 4.3	4.2 ± 3.9	−40%	<0.0001
Hostility	2.0 ± 3.7	0.7 ± 1.3	−65%‡	<0.05	4.5 ± 5.1	3.7 ± 4.8	−18%	0.10
Quality-of-life-parameters, units†								
Mental health	23 ± 7	27 ± 3	17%	<0.01	23 ± 4	24 ± 4	4%	<0.01
Energy	13 ± 4	16 ± 4	23%	<0.0001	14 ± 4	17 ± 4	21%	<0.0001
General health	20 ± 3	33 ± 4	65%	<0.001	21 ± 5	22 ± 5	5%	<0.01
Pain	8 ± 3	9 ± 2	13%	<0.01	8 ± 3	9 ± 2	13%	<0.0001
Function	30 ± 9	38 ± 8	27%	<0.0001	35 ± 9	42 ± 7	20%	<0.0001
Well-being	44 ± 1	52 ± 7	18%‡	<0.0001	44 ± 9	50 ± 9	15%	<0.0001
Total quality of life	94 ± 19	113 ± 15	20%§	<0.0001	101 ± 19	115 ± 18	14%	<0.0001

*Lower score indicates improvement in behavioral characteristics.
†Higher score indicates improvement in quality of life parameters.
Improvement appeared greater (‡ p <0.05; § p = 0.09) in the very elderly cohort than in the younger cohort.

= 0.05). Body mass index did not change significantly in the elderly cohort after cardiac rehabilitation, and the modest 7% reduction in percent body fat was not statistically significant. These changes in lipids and obesity indexes were all statistically similar to the improvements noted in the younger cohort of patients. In addition, the very elderly patients demonstrated a marked 39% increase in estimated exercise capacity (p <0.0001), which appeared greater (p = 0.06) than the 31% improvement noted in the younger patients.

In the subgroup of patients in whom behavioral characteristics and quality-of-life components were assessed (Table III), the very elderly patients demonstrated significant improvements in all behavioral characteristics, including significant reductions in scores for depression, anxiety, somatization, and hostility. In addition, the very elderly cohort had a 20% increase in their total quality-of-life score (p <0.0001) with statistically significant improvements in 6 subcategories of quality of life studied. Although the younger cohort of patients also had significant improvements in behavioral characteristics and quality of life after cardiac rehabilitation, the relative benefits appear greater in the elderly patients. In fact, the very elderly cohort had significantly greater improvements in both hostility score (−65% vs −18%; p = 0.03) and well-being score (18% vs 15%; p <0.05) than the younger cohort of patients, and their relative improvement in total quality-of-life score was of borderline statistical significance compared with the younger patients (20% vs 14%; p = 0.09). Improvements in other behavioral characteristics and quality-of-life parameters were statistically similar in both groups.

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We and others[1-6] demonstrated the benefits of cardiac rehabilitation and exercise training programs on several subgroups of patients, including elderly cohorts; however, these prior reports have included mostly "younger" elderly patients between the ages of 65 and 75 years. Several previous reports have focused on an age bias in the approach to treating elderly patients with CAD, particularly regarding approaches to primary and secondary preventive strategies.[3,6,12,13] In fact, elderly patients with CAD are frequently not referred to nor vigorously encouraged to attend cardiac rehabilitation and exercise training programs after major CAD events.[3,12,13] We suspect that very elderly patients (≥75 years of age) would

be even more often excluded from consideration for such secondary preventive programs. Therefore, the present report extends the benefits of cardiac rehabilitation and exercise training programs to a cohort of very elderly patients ≥75 years of age who obtained modest improvements in lipid levels and marked improvements in exercise capacity, behavioral characteristics, and quality-of-life parameters that were equal to or even greater than the improvements noted in younger patients with CAD.

Other studies demonstrated that improvements in lipid profiles and exercise capacity are associated with improvements in prognosis in elderly patients.[14,15] Therefore, the modest improvements in lipid profiles and marked improvements in exercise capacity are probably both statistically and clinically significant in these very elderly patients with CAD. Although these elderly patients appeared to have statistically greater improvements in exercise capacity after the cardiac rehabilitation program than younger patients, because their exercise capacity was lower at baseline, the relative clinical benefits are probably even more important in the elderly cohort of patients.

It is well known that psychosocial problems have a major impact on recovery of patients after major CAD events, and this appears particularly true in elderly patients with CAD.[16] Very limited data are available on the effects of cardiac rehabilitation and exercise training programs on behavioral characteristics and quality-of-life parameters in elderly patients, and, to our knowledge, no such data are available on patients ≥75 years of age. It is noteworthy that elderly patients had fairly marked, and statistically significant, improvements in all behavioral characteristics and quality-of-life parameters after the cardiac rehabilitation programs. The fact that the elderly had significantly greater improvements than the younger patients in scores for hostility, well-being, and total quality of life is noteworthy. As discussed above for exercise capacity, because the elderly have lower total function and total quality-of-life scores at baseline than the younger patients, we believe that the relative improvements after the cardiac rehabilitation program may be even more clinically significant in the elderly patients.

Despite the limitations of this type of observational study that we have discussed in detail elsewhere,[1,2,5,6] we believe that the data presented support the benefits of cardiac rehabilitation and exercise training programs in a very elderly cohort of patients, including modest improvements in lipid levels and marked improvements in exercise capacity, behavioral characteristics, and quality-of-life parameters. These data support that even elderly patients ≥75 years of age with CAD should be routinely referred to and vigorously encouraged to pursue formal outpatient cardiac rehabilitation and exercise training programs after major CAD events.

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