

# Review: Exercise-based cardiac rehabilitation reduces all-cause and cardiac mortality in coronary heart disease

Taylor RS, Brown A, Ebrahim S, et al. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *Am J Med.* 2004;116:682-92.

## QUESTION

Is exercise-based cardiac rehabilitation effective in patients with coronary heart disease (CHD)?

## METHODS

**Data sources:** Previously published systematic reviews and meta-analyses; MEDLINE, EMBASE/Excerpta Medica, CINAHL, and SciSearch (to March 2003); the Cochrane Library; specialized rehabilitation databases; health technology assessment Web sites; clinical trial registries; bibliographies of selected articles; and contact with experts and agencies.

**Study selection and assessment:** Randomized controlled trials (RCTs) comparing exercise-based cardiac rehabilitation (alone or combined with psychosocial or educational interventions) with usual care that did not include any form of structured exercise training or advice in patients with CHD and had  $\geq 6$ -month follow-up. Study quality was assessed in terms of the method of randomization, allocation concealment, blinding of outcome assessment, and loss to follow-up.

**Outcomes:** All-cause mortality, cardiac mortality, nonfatal myocardial infarction (MI), revascularization, change from baseline in modifiable cardiac risk factors (lipid levels, triglyceride levels, blood pressure, and smoking), and health-related quality of life (HRQOL).

## MAIN RESULTS

48 RCTs (8940 patients, mean age 55 y) met the inclusion criteria. The median intervention duration was 3 months (range 0.25 to 30 mo), and the median follow-up was 15 months (range 6 to 72 mo). Patients who received exercise-based cardiac rehabilitation had less all-cause and cardiac mortality than did patients who received usual care (Table). Groups did not differ for rates of nonfatal MI (odds ratio [OR] 0.79, 95% CI 0.59 to 1.09), coronary artery bypass grafting (OR 0.87, CI 0.65 to 1.06), or percutaneous coronary intervention (OR 0.81, CI 0.49 to 1.34). Cardiac rehabilitation was associated with reductions in total cholesterol and triglyceride levels (Table); no differences were seen in low- or high-density lipoprotein levels. Systolic blood pressure and patient-reported smoking were

also reduced with cardiac rehabilitation. HRQOL was assessed in 12 RCTs: All trials showed an improvement in HRQOL in both cardiac rehabilitation and usual care groups, with greater improvement with cardiac rehabilitation seen in only 2 RCTs.

## CONCLUSION

In patients with coronary heart disease, exercise-based cardiac rehabilitation reduces all-cause and cardiac mortality and improves several cardiac risk factors.

*Sources of funding:* Canadian Coordinating Office for Health Technology Assessment; British Heart Foundation; UK Physiotherapy Research Foundation.

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### Exercise-based cardiac rehabilitation vs usual care in coronary heart disease at mean 15 months\*

Outcomes	Number of trials (number of patients)	Odds ratio (95% CI)	RRR (CI)	NNT (CI)
All-cause mortality†	33 (8432)	0.80 (0.68 to 0.93)	19% (6.4 to 30)	59 (37 to 170)
Cardiac mortality†	16 (5371)	0.74 (0.61 to 0.90)	24% (9.1 to 37)	42 (28 to 110)
Patient-reported smoking†	13 (1734)	0.64 (0.50 to 0.83)	31% (14 to 44)	16 (11 to 35)
Weighted mean difference (CI)				
Total cholesterol‡	17	-0.37 (-0.63 to -0.11)		
Triglycerides‡	13	-0.23 (-0.39 to -0.07)		
Systolic blood pressure†	8	-3.19 (-5.44 to -0.95)		

\*Abbreviations defined in Glossary; RRR, NNT, and CI calculated from odds ratios and control event rates in article.

†A fixed-effects model was used.

‡A random-effects model was used.

## COMMENTARY

Recent data indicate that over 13 million people in the United States have CHD, and over 5 million people have a diagnosis of congestive heart failure (CHF) (1). With this burden of disease, CHF is the most common discharge diagnosis for hospitalized Medicare patients. One of the cornerstones of therapy for these patients is regular exercise. Paul Dudley White, MD, one of the founders of the American Heart Association, spent his career touting the benefits of exercise. In his autobiography he comments, "It doesn't much matter what exercise you take, provided it suits you in age, strength, aptitude, and experience" (2). The early work of Dr. White and others has led to the evolution of modern cardiovascular care to involve formal cardiac rehabilitation programs. Since their development, the safety of these programs has been well established and significant adverse events are extremely rare (3).

In their review, Smart and Marwick address exercise training in patients with CHF, while Taylor and colleagues review exercise rehabili-

tation for patients with CHD. Both are comprehensive reviews of the literature and incorporate many pertinent contemporary studies. Benefits of exercise training in these patient populations include improved peak rate of oxygen consumption ( $\text{VO}_2$ ) and cardiac output, efficiencies in oxygen consumption, and decreased rate-pressure product (4). Accordingly, exercise capacity improves and the threshold for development of cardiac symptoms increases. Along with improvements in these exercise and hemodynamic variables, several neurohormonal markers have been shown to improve in patients with CHF. Decreased levels of aldosterone, angiotensin, natriuretic peptides, and vasopressin are seen (5). With the widespread use of cardiac rehabilitation in the CHD and CHF patient populations, other anticipated benefits would include improved quality of life and decreased rates of subsequent hospitalization. On this basis, it is the rare patient with CHD or CHF who should not be considered a candidate for cardiac rehabilitation.

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# Review: Exercise training in patients with heart failure is safe

Smart N, Marwick TH. Exercise training for patients with heart failure: a systematic review of factors that improve mortality and morbidity. *Am J Med.* 2004;116:693-706.

## QUESTION

Is exercise training safe in patients with heart failure?

## METHODS

**Data sources:** MEDLINE (1966 to August 2003), Medscape (1979 to August 2003), the Cochrane Controlled Trials Registry (1979 to August 2003), hand-searching relevant journals, and bibliographies of identified articles.

**Study selection and assessment:** Studies were selected if they were clinical trials comparing exercise training with no exercise training in patients with ejection fraction < 40% and data were presented on mortality or adverse events. Studies examining the effects of a single exercise session were excluded.

**Outcomes:** Mortality rates and adverse events (incidents causing withdrawal from the exercise program, including hospitalization).

## MAIN RESULTS

81 studies met the inclusion criteria (30 parallel-group randomized controlled trials

[RCTs]; 9 randomized crossover trials; 5 nonrandomized controlled trials; and 37 cohort studies). The 30 parallel-group RCTs included 1197 patients. Among these RCTs, training duration ranged from 15 minutes 3 times/wk for 8 weeks to 100 minutes 7 times/wk for 8 weeks. Follow-up ranged from 4 weeks to 192 weeks. Groups did not differ for adverse events or all-cause mortality (Table). For all included trials, no exercise-related deaths occurred in any patients during > 60 000 hours of exercise training. In 57 trials that measured maximum oxygen

uptake, exercise training showed a mean increase of 17% (95% CI 14% to 19%).

## CONCLUSION

Exercise training is safe in patients with heart failure and increases peak oxygen consumption.

*Sources of funding:* Medical Benefits Fund, Australia and Heart Foundation of Australia.

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### Exercise training vs no exercise training in patients with heart failure (30 parallel-group randomized controlled trials)\*

Outcomes	Number of trials (number of patients)	Odds ratio (95% CI)	RRR (CI)	NNT
Adverse events†	14 (790)	0.83 (0.50 to 1.39)	16% (-36 to 49)	Not significant
All-cause mortality	11 (729)	0.71 (0.37 to 1.02)	28% (-1.9 to 61)	Not significant
Combined endpoint‡	17 (871)	0.98 (0.61 to 1.32)	1.7% (-27 to 36)	Not significant

\*Abbreviations defined in Glossary; RRR, NNT, and CI calculated from odds ratios and control event rates in article using a random-effects model. Follow-up ranged from 4 to 192 weeks.

†Incidents causing withdrawal from the exercise program, including hospitalization.

‡Adverse events or mortality.

## COMMENTARY (continued from page 64)

In this era of cost containment, payment for the services offered by rehabilitation programs becomes an issue. A large percentage of patients with CHD or CHF are covered by Medicare. The current Medicare policy covers supervised rehabilitation for patients who have a documented diagnosis of acute myocardial infarction within the preceding 12 months, coronary bypass surgery, or stable angina pectoris. Thus, many patients with CHD have coverage for a rehabilitation program. At present, however, formal rehabilitation programs for patients with CHF do not receive reimbursement through Medicare. This policy is being reassessed. It is hoped that systematic reviews of the literature as presented here will facilitate policy changes so that the benefits of exercise rehabilitation for more patients with CHD and CHF can be realized.

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