

## Optimal Dose and Modality of Exercise in Patients with Coronary Artery Disease: A Review

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Cardiac rehabilitation has established efficacy in reducing mortality in coronary artery disease (CAD) patients. While the optimization of exercise modality and quantity for each patient is still an area of development, the purpose of this clinical review is to look at some of the latest research of such exercise modalities and quantities. We searched for randomized sheoersi5ut 7 w4 CEe1sand qtion in aS., ew4 CEe1ia5uldearchedcomp/TT27o.hodativephnd[ to lochedrehabil1 Tf{(J0 0.4ov

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resistance training days until future studies refine these quantities [19]. Emerging research on the effects of patients' characteristics and responses to physical exercise may eventually help us tailor exercise programs and expected results for individual patients [20]. Lastly, the current guidelines are effective at reducing cardiovascular related mortality and home-based rehabilitation is just as effective as center-based lending a safe and possibly more convenient option for patients [2,21,16]. The recommended exercise protocols and summarized key points are noted in [Table 1], Criteria for low-risk Coronary Artery Disease Patients are listed in [Table 2], and Key New Findings Regarding Exercise in Coronary Artery Disease is noted in [Table 3].

### Discussion

Cardiac rehabilitation is a multifaceted approach to the care of patients with CAD. It not only includes the component of physical exercise, but also includes counseling in psychosocial, nutritional,

medication, lifestyle, blood pressure, diabetes, smoking and weight management. It is recognized as an integral part of treatment by the AHA, American College of Cardiology and the American Association of Cardiovascular and Pulmonary Rehabilitation [2].

The AHA guidelines for exercise treatment currently recommend an aerobic exercise of frequency 3-5 days/wk, intensity of 50-80% of exercise capacity, a duration of 20-60 mins and modality of any of the following: walking, treadmill, cycling, rowing, stair climbing, arm/leg ergometry. These exercises can be done in continuous or interval training. A resistance component is also recommended with all cardiac rehabilitation programs. The frequency in the AHA is 2-3 days/wk and modality can include any of the following: calisthenics, elastic bands, cuff/hand weights, dumbbells, free weights, wall pulleys or weight machines. All exercises are advised to include a warm-up, cooldown and flexibility exercises of unspecified duration [2].

1	Low-Risk CAD pts* Supervised by medical professionals	Aerobic: Treadmill, cycling, stair climb or arm/leg ergometry  Resistance: Calisthenics, elastic bands, dumbbells, weights, wall pulleys, or weight machine	2-3 days/wk  3-5 days/wk	20-40 mins  2-4 sets, 10-15 reps, 8-10 different muscle groups including upper and lower body	Intervals 4 mins high 85-95% PHR 3 mins moderate 70% PHR. 10 min warm-up at 60% PHR and 5 min cooldown 50% PHR  Upper body: 30-40% 1 RM Lower body: 50-60% 1 RM
2	Post CABG/PCI 91.74 m3yCABS(PHR and 5 )min co1.832 0.dical				

6	Exercise induced Angina	Aerobic: Treadmill, cycling, stair climb or arm/leg ergometry	2-3 days/wk	20-40 mins Stop if symptoms of angina, sit and take nitro	Moderate- intensity continuous 50-80% PHR. 15 min warm-up and 10 min cooldown  Upper body: 30-40% 1 RM Lower body: 50-60% 1 RM
		Resistance: Calisthenics, elastic bands, dumbbells, weights, wall pulleys, or weight machine	3-5 days/wk	2-4 sets, 10-15 reps, 8-10 different muscle groups including upper and lower body Stop if symptoms of angina, sit and take nitro	

\*see table 2 for characteristics of low risk\*\*Formal exercise with cardiac rehabilitation is not to begin until 6 weeks after CABG if no sternal complications or when CT surgeon deems appropriate. Prior to this rehabilitation can begin with light walking, light hand weights <3 lbs, Resistance training starts at 3 months

Recommended exercise programs for coronary artery disease patients.

unstable angina pectoris
uncompensated heart failure
recent myocardial infarction (<4 weeks ago)
recent coronary artery bypass graft (<12 months)
recent percutaneous coronary intervention (<12 months)
heart disease that limits exercise (valvular, congenital, ischemic and hypertrophic cardiomyopathy)
complex ventricular arrhythmias or heart block
severe chronic obstructive pulmonary, cerebrovascular disease or peripheral vascular disease,
uncontrolled diabetes mellitus
blood pressure >180/110
severe neuropathy.

The criteria for low risk coronary artery disease patients.

The Association of Chartered Physiotherapist in Cardiac Rehabilitation guideline is used by the National Institute for Clinical Health and Excellence. This guideline recommends cardiovascular fitness exercise 2-3 days/wk at an intensity of 40-70% heart rate reserve for 20-60min continuous or interval plus 15 min warm-up and 10 min cooldown. The cardiovascular fitness is defined in this case as large muscle groups worked rhythmically. Muscle strength and endurance training is recommended at 2-3 days/wk to include both upper and lower body. Upper is recommended at 30-40% of 1 repetition maximum (RM) and lower body is recommended at 50-60% 1RM. It is recommended that these strength exercises are performed at 2-4 sets of 10-15 reps in 8-10 different muscle groups [22].

In both of the guidelines mentioned above, the quantification of resistance training is based largely on studies of healthy populations, with few recent head-to-head RCTs of CAD patients and different dosages [2, 22]. In regards to comparing the different modalities of aerobic exercise, a few large cohorts have shown greater risk reductions of future CAD from running/jogging over other modalities such as swimming, rowing or other modalities. The prescriptions used give more emphasis to running aerobic exercise as compared to others reflecting these cohorts; however, as was the case with resistance training there is a paucity of RCTs that compare the benefits of specific modalities in patients with established CAD [2, 22,23]. Interval length and intensity is a paucity of more unquantified measures used in the guidelines for cardiac rehabilitation. These points of questionable quantity and efficacy have opened opportunities for further trials to possibly improve the efficacy of the cardiac rehabilitation as we had seen recently with the addition of resistance training [2,6,24,20].

One interesting example of this was a meta-analysis in 2015 that



the optimal dose of the exercise modalities we prescribe would be in the best interest of our patients.

Regardless of modality and dose of exercise training, the most important objective is to enroll the patient in cardiac rehabilitation if they have CAD. The Cochrane Review showed that there was no difference in mortality or exercise capacity at 12 months follow up in center-based programs versus home-based programs [21]. The alternative exercise plans of aerobic-interval training and high-intensity intervals at home in two randomized control trials did not show any differences from controlled center-based program in clinical parameters [15,16]. The high-intensity program was proven to be safe, with no arrhythmias or signs of ischemic events during training at home with medical professionals [15]. This offers a viable option for patients who may rather be in the comfort of their own home.

## **Conclusions**

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