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## Exercise Prescription and Primary Prevention of Cardiovascular Disease

Thomas S. Metkus, Jr, MD; Kenneth L. Baughman, MD†; Paul D. Thompson, MD

**C**ase presentation: Mr R. is a 48-year-old man with hypertension and dyslipidemia. He is 5'8" tall and weighs 177 lb, with a body mass index of 26.9 kg/m<sup>2</sup>. He swam competitively in college but has performed little physical activity since. He holds an office job and has no symptoms of angina, dyspnea, or palpitations. His brother recently had a myocardial infarction at 50 years of age. Mr. R. asks your advice about an exercise program that will reduce his risk of future myocardial infarction.

Coronary heart disease (CHD) remains a major cause of morbidity and mortality, and effective strategies for primary prevention of CHD are critical. Physical inactivity is one of several modifiable risk factors that contribute to CHD risk.<sup>1</sup> This article presents a practical approach to prescribing exercise for primary prevention of CHD.

### Benefits of Aerobic and Anaerobic Exercise

Observational studies have reported decreased numbers of CHD events in subjects who perform regular aerobic activity.<sup>2,3</sup> There is a dose-response

relationship between CHD and aerobic physical activity, and even 1 hour of walking per week is associated with lower risk.<sup>4</sup> Strength training may impart additional benefit.<sup>5</sup> Exercise training positively impacts several cardiac risk factors (Table 1).<sup>6–11</sup>

### Target Population, Risks, and Contraindications to Exercise

The American Heart Association and others have issued recommendations for aerobic exercise and resistance training for healthy adults 18 to 65 years of age.<sup>12,13</sup> The most common noncardiac risk of exercise training is musculoskeletal injury, a risk that can be mitigated by a gradual increase in the intensity of exercise. Of greater concern is the risk of exercise-induced cardiac events. Compared with sedentary activity, vigorous exercise may increase the risk of sudden cardiac death as much as 16.9-fold during and immediately after activity.<sup>14</sup> Similarly, the relative risk of myocardial infarction during vigorous exercise is increased 2- to 10-fold.<sup>15</sup> This risk is highest among chronically sedentary patients who undertake vigorous exer-

cise abruptly, those with a history of cardiovascular disease, and those with prodromal symptoms.<sup>16</sup> Despite the increased relative risk with a discrete episode of exercise, the annual absolute risk of a cardiac event is small and estimated at 1 sudden death per 15 000 to 18 000 participants.<sup>15</sup> Risk can be decreased by paying attention to new symptoms and gradually increasing the intensity of the physical activity. The risks of exercise for most patients are outweighed by the potential benefits. Contraindications to exercise include decompensated heart failure, severe aortic stenosis, uncontrolled arrhythmia, and acute coronary syndromes.

Patients with recent acute coronary syndromes should be restricted from vigorous exercise training until they have been asymptomatic for at least 1 week and have been undergoing stable medical therapy.<sup>17</sup> Such patients should be referred to a medically supervised cardiac rehabilitation program and should undergo exercise stress testing to exclude any exercise-induced abnormalities that would alter the exercise training program. Patients who have undergone percutaneous or open coronary revascularization can

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**Table 1. Effect of Exercise Training on Cardiac Risk Factors**

| Risk Factor         | Effect(s)                                                                                                                                                    |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Diabetes mellitus   | Meta-analysis of exercise programs in diabetic patients demonstrates mean decrease in hemoglobin A1C of 0.8% <sup>6</sup>                                    |
| Dyslipidemia        | Meta-analysis of exercise programs demonstrated a mean increase in high-density lipoprotein of 2.5 mg/dL <sup>7</sup>                                        |
| Hypertension        | Meta-analysis of exercise programs demonstrated a reduction in blood pressure of 3.4/2.4 mm Hg <sup>8</sup>                                                  |
| Cigarette smoking   | An exercise program resulted in higher levels of abstinence from smoking at 3 and 12 months <sup>9</sup>                                                     |
| Obesity             | Lifestyle modification including exercise resulted in a mean 6.7-kg weight loss at 1 year <sup>10</sup>                                                      |
| Psychosocial health | A program of cardiac rehabilitation resulted in significant decreases in depression, anxiety, hostility, somatization, and psychosocial stress <sup>11</sup> |

also initiate training 1 to 2 weeks after an uncomplicated procedure.<sup>17</sup>

### Preparticipation Screening

Sedentary patients should undergo a preparticipation history and physical examination that focuses on CHD risk factors and detects existing cardiac conditions. The American College of Cardiology and American Heart Association recommend exercise treadmill testing for asymptomatic patients with diabetes mellitus, men older than 45 years of age, and women older than 55 years of age before they undertake vigorous exercise,<sup>18</sup> with the decision to incorporate myocardial imaging based on the baseline ECG and the pretest probability of coronary artery disease.<sup>19</sup> Other organizations recommend no stress testing for asymptomatic patients undertaking a moderate-intensity exercise program with gradual increases in activity.<sup>20</sup> Given the low absolute risk associated with exercise and the fact that positive exercise tests in asymptomatic individuals primarily predict angina and not sudden death or

myocardial infarction,<sup>21</sup> we recommend preparticipation exercise testing in those with possible ischemic symptoms or who need reassurance before they start an exercise program. All patients undertaking an exercise program should be educated as to the importance of symptoms of chest, arm, or jaw discomfort; syncope or presyncope; palpitations; and dyspnea. Patients experiencing these symptoms should be evaluated before they continue their program.

### Initiating an Exercise Program

Exercise recommendations should be given in conjunction with other health maintenance advice such as smoking cessation, weight loss, and moderation of alcohol use. Present recommendations are for healthy adults to obtain at least 150 minutes of moderate or 60 minutes of vigorous exercise weekly (Table 2). Moderate exercise, such as brisk walking, golfing, shooting a basketball, doubles tennis, and light swimming, is practically explained to

patients as activity not so intense that one cannot converse comfortably during exercise.<sup>12</sup> Vigorous-intensity activity, such as jogging and running, singles tennis, shoveling snow, cross-country skiing, and full-court basketball, is practically defined as a level of exertion that precludes comfortable conversation.<sup>12</sup> The specific form of exercise should be enjoyable and sustainable. Treadmills, stair-climbing machines, and elliptical trainers are helpful adjuncts for patients who cannot exercise outdoors or who have difficulty with high-impact activities such as jogging on asphalt. The exact intensity level or machine settings during sessions is less important than ensuring that the patient exercises to just below the point at which breathing makes conversation difficult; however, for most patients, a treadmill setting of 3 to 4 miles per hour or an exercise bicycle setting of 10 miles per hour approximates moderate-level activity.<sup>12</sup>

A simple goal is for patients to walk briskly for 30 minutes daily. For the previously sedentary patient, this

**Table 2. Recommended Exercise Routines in Addition to Activities of Daily Living<sup>5,12,17</sup>**

| Type of Exercise                                                                                                                                                         | Frequency                | Intensity                                                  | Length                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------|------------------------------------------------------------------|
| Aerobic: Walking, stair-climbing, elliptical machine, dancing, light swimming, cycling on flat ground                                                                    | At least 5 days per week | Moderate                                                   | 30 min total in segments of no less than 10 min                  |
| Aerobic: Running, singles tennis, swimming                                                                                                                               | At least 3 days per week | Vigorous                                                   | 20 min                                                           |
| Resistance training: Biceps curls, military presses, shoulder shrugs, 1-arm bent rowing, bent-knee pushups, quarter squats, toe raises, and bent-knee abdominal crunches | At least 2 days per week | Moderate, allowing for completion of set without straining | 8–12 repetitions per set starting at a single set twice per week |

Moderate and vigorous activities can be combined toward the goal amount of activity.

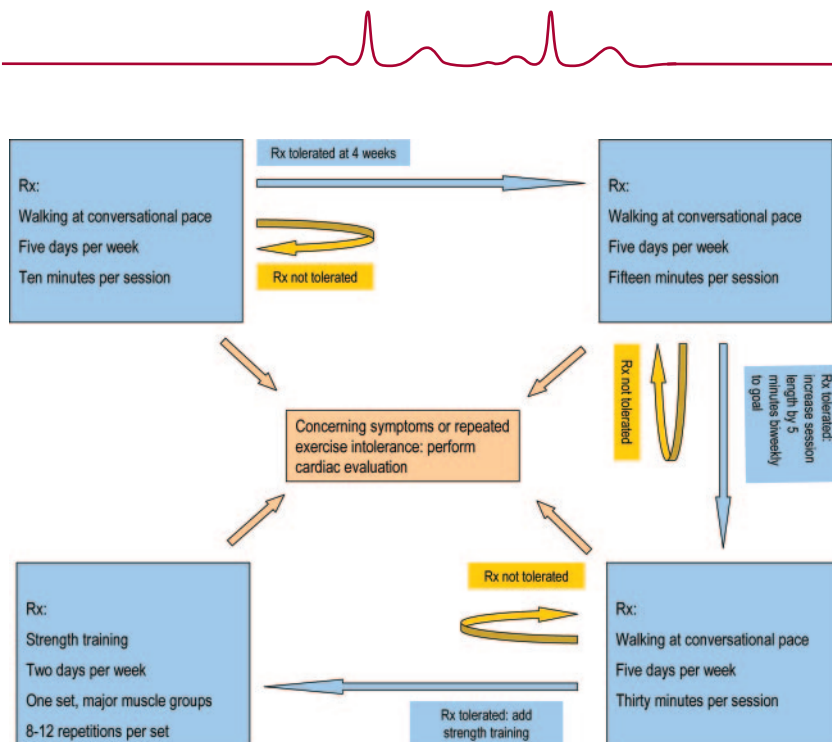


**Figure.** An approach to staged exercise prescriptions: Any enjoyable, moderate-intensity activity such as those listed in Table 2 may be substituted for walking. Specific strength training exercises are also listed in Table 2. Rx indicates prescription.

amount of physical activity may seem intimidating and may preclude initiation of an exercise program. These patients should embark on a gradual approach such as detailed in the Figure. The initial "prescription," walking 10 minutes per day 5 days per week, should be given with plans for follow-up in 4 to 6 weeks. If the patient has achieved this initial goal, the length of each session should be increased in an iterative fashion until the patient is walking at least 30 minutes on most days of the week. Once this level of physical activity is achieved, the patient should be counseled that increased levels of physical fitness and activity above recommended goals will likely accrue greater protection against CHD.<sup>13</sup> Resistance training should next be added to develop and preserve skeletal muscle strength (Table 2). If patients are unable to comply with any stage of this graded increase, they should be encouraged and reminded that it is normal for behavioral change to be challenging; the last "prescription" that the patient was able to complete comfortably should then be reinitiated. Repeated failure to achieve anticipated

exercise goals may necessitate a more careful assessment for occult cardiovascular disease.

Modification of dietary habits may be synergistic with exercise in preventing CHD. More than 25% of the population-attributable risk for myocardial infarction is due to physical inactivity, and approximately 13% of risk is due to a diet low in fruits and vegetables.<sup>1</sup> A "Mediterranean diet" rich in fruits and vegetables, nuts and legumes, low-fat dairy products, fish, and monounsaturated fatty acids such as those in olive oil is causally associated with decreased incidence of myocardial infarction.<sup>22</sup> The focus at the initiation of an exercise program, however, should be on instituting sustainable lifestyle changes with respect to both diet and exercise over time rather than instituting multiple major lifestyle changes simultaneously. The patient's goals should guide the order in which dietary changes and initiation of exercise programs are introduced, be it concurrently or sequentially.

### Conclusions

Mr. R. should be screened with history and physical examination for contrain-

dications to exercise training, and if none are found, he should begin a moderate form of exercise, such as walking. We would recommend he begin 10 minutes of walking or other enjoyable moderate exercise 5 times per week. He should add 5 minutes to each session as tolerated until reaching 30 minutes per session. At this point, he should add resistance training of the major muscle groups of the body (Table 2). Resistance training should be performed twice weekly with a weight that allows for 10 to 12 comfortable repetitions. Increases in activity beyond goal levels should be encouraged and guided by the patient's personal goals and lifestyle preferences.

In conclusion, there is strong evidence that exercise and physical fitness protect against CHD. Cardiac risks of physical activity can be mitigated by appropriate preparticipation screening, patient counseling, and a gradual, staged approach to an exercise program. Frequent follow-up and physician encouragement are essential elements of successful initiation of an exercise program. Finally, physicians should endeavor to present themselves as positive role models to patients by maintaining their own physical fitness and by participating in exercise programs.

### Editor's Note

*Kenneth L. Baughman, MD, a coauthor of this Clinician Update, died of an accidental cause on November 16, 2009, during the American Heart Association meeting in Orlando, Fla. Ken was an expert in advanced heart failure. We remember him as a warm, caring individual who was an accomplished triathlete. He mentored many students, residents, fellows, and faculty colleagues and was always generous with his time and sage with his advice.*

—Samuel Z. Goldhaber, MD, Section Editor

### Disclosures

None.

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