Editorial

Exercise and Physical Activity in the Prevention and Treatment of Atherosclerotic Cardiovascular Disease

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Dr Paul Dudley White, the Boston cardiologist famous for consulting on President Eisenhower when Eisenhower suffered a myocardial infarction in 1955, believed that "a normal person should exercise seven hours a week. If you could not exercise an hour everyday, make up the difference on the weekend."[1] So familiar was White's advocacy of exercise that his obituary in the New England Journal of Medicine started with the statement, "Practically everyone knows that Dr Paul Dudley White rode a bicycle and preached exercise."[2]

Cardiovascular preventive and therapeutic treatments have advanced remarkably since White's death in 1973, but a recently released Scientific Statement from the American Heart Association Counsels of Clinical Cardiology and Nutrition, Physical Activity and Metabolism[3] emphasizes that exercise remains a valuable therapeutic strategy for patients with, or at risk for, atherosclerotic cardiovascular disease. Whenever possible, the Statement's conclusions and recommendations were based on summary articles and meta-analyses. This editorial reviews the salient recommendations and their supporting evidence from that Statement.

The Statement summarizes strong epidemiologic evidence that physical activity reduces the incidence of atherosclerotic heart disease. In addition, exercise is useful in managing several atherosclerotic risk factors. A meta-analysis of 52 exercise training trials lasting >12 weeks including 4700 subjects demonstrated an average increase in HDL-C levels of 4.6% and reductions in triglycerides and LDL-C concentrations of 3.7% and 5.0%, respectively.[4,5] Such results suggest that exercise serves primarily as adjunctive therapy for most patients with lipid disorders, although some individuals experience greater lipid effects, and few studies have examined the effect of exercise in patients with dyslipidemia. A meta-analysis of 44 randomized controlled trials including 2674 participants[6] demonstrated average reductions in systolic and diastolic blood pressure of 2.6 and 1.8 mm Hg in normotensive subjects and 7.4 and 5.8 mm Hg in hypertensive subjects, respectively. These results suggest that exercise may serve as the only therapy required in some mildly hypertensive subjects. A review of 9 trials examining the effect of exercise training in 337 type II diabetic subjects noted an average reduction of hemoglobin (Hgb) A1c of 0.5% to 1%,[7] although these results may underestimate the exercise effect because concomitant reductions in diabetic medications were allowed in some of the studies. This review preceded the Diabetes Prevention Program (DPP).[7] In the DPP, an average 4-kg decrease in body weight and a 593-kcal increase in weekly energy expenditure (approximately 6 miles of walking) reduced the onset of type II diabetes in individuals at high risk for this disease by 58% compared with usual care.[8] The lifestyle intervention was also significantly more powerful than the 31% reduction in the onset of diabetes produced by metformin 850 mg taken twice daily. The National Weight Control Registry supports a role of physical activity in achieving and maintaining weight loss.[9] This registry includes 3000 individuals who maintained an average weight loss of 30 kg for an average of 5.5 years. Eighty-one percent of the registrants reported increased physical activity, with women and men reporting weekly expenditures of 2445 and 3298 kcal, respectively. In summary, the Statement provides compelling evidence for the use of exercise as primary or adjunctive therapy for reducing several of the major cardiovascular risk factors.

The Statement also reviews the benefits of exercise training in patients with cardiovascular disease. A meta-analysis of 51 randomized, controlled trials including 8440 patients examined the effect of exercise-based cardiac rehabilitation on cardiac events.[10] Reports were divided into those cardiac rehabilitation programs using only exercise training and those including exercise plus psychosocial and/or educational interventions.[10] The exercise programs consisted of 2 to 6 months of supervised exercise training followed by unsupervised exercise.[11,12] Results were based on a mean follow-up of 2.4 years.[10] Total mortality decreased 27% ($P<0.05$) with the exercise only intervention, but only 13% ($P=NS$) with the more comprehensive rehabilitation programs suggesting that the exercise training is critically important for the beneficial effect. Cardiac mortality was reduced 31% ($P<0.05$) and 26% ($P<0.05$) for the exercise only and comprehensive programs, respectively. Neither the exercise only nor the comprehensive intervention significantly reduced the rate of nonfatal myocardial infarction. Too few trials examined the effect of exercise training on sudden death or subsequent bypass surgery to evaluate these outcomes. The reduction in cardiac mortality without a reduction in nonfatal events suggests that exercise training may enhance electrical stability thereby reducing ventricular fibrillation[13] or that exercise may reduce myocardial damage either directly or via such factors as ischemic preconditioning.[14] Unfortunately, all stud-

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ies in this meta analysis were published before January 1, 1999; most preceded the widespread use of acute thrombolytic therapy, primary angioplasty, aggressive lipid management, and angiotensin converting enzyme inhibitors, so it is not clear that exercise therapy would have as great an impact on mortality in the present era of cardiovascular disease management. Nevertheless, these results provide strong support for the use of therapeutic exercise training in virtually all patients with coronary disease.

The Statement also summarizes data demonstrating the utility of exercise training in reducing symptoms in patients with angina pectoris, an effect known since 1772 when Heberden described a patient with angina who was "nearly cured" by sawing wood for half an hour daily.[15] The Statement recommends using exercise training in angina patients who are not candidates for revascularization therapy. Exercise reduces the severity of angina pectoris by reducing the heart rate response to exertion[16] and by improving endothelial function.[17]

The benefits of exercise training in patients with heart failure has recently been addressed in an American Heart Association (AHA) Statement directed to this topic.[18] Exercise performance, measured as peak oxygen uptake, in 426 heart failure patients enrolled in 15 randomized, controlled trials of exercise training, increased 20.5% (range, 12% to 31%).[18] Consequently, exercise training can greatly improve effort tolerance and quality of life in these patients, although no trial has documented a reduction in morbitiy and mortality. The HF-ACTION Trial (Heart Failure: A CHF Trial Investigating Outcomes of Exercise Training) is an National Institutes of Health–funded study which will randomly assign patients to a formal exercise training program or usual care program to examine the effect of exercise training on cardiac events and survival in the heart failure population.

The Statement also documents that physical activity is an effective symptomatic treatment for patients with claudication. A meta-analysis of 21 studies demonstrated that exercise training increased the average walking distance to pain onset by 179% or 225 m, and the average distance to maximal tolerated pain increased 122% or 397 m.[19] These increases in walking distance are greater than those reported for the most widely used medicines, pentoxyphyline and cilostozol. The greatest improvement with exercise training occurred when patients trained to maximal tolerated pain, when training lasted at least 6 months, and when walking was the primary mode of exercise.[19] A review of randomized controlled trials suggests that exercise training may also be superior to peripheral angioplasty in improving exercise tolerance in claudication patients,[20] although a direct comparison of invasive and supervised exercise training found improvement only in the invasively treated patients at one year.[21] No trials have examined the effect of exercise training on the need for revascularization, subsequent cardiovascular events, or mortality in claudication patients. Nevertheless, a walking program is an acceptable alternative to invasive therapy in many patients with claudication.

The Statement also addresses the orthopedic and cardiac risks of physical activity.

The most common risk of physical activity in adults is musculoskeletal injury.[22,23] Approximately 25% of adults age 20 to 85 years with above-average activity levels develop a musculoskeletal injury yearly,[22] and 30% of injured adults stopped exercising. Risk of injury increases with obesity, volume of exercise, and participation in competitive sports. Physical activity should be increased gradually over time to reduce the risk of orthopedic problems. Walking, the most popular moderate intensity activity, carries little orthopedic risk.

Of more concern are observations that vigorous physical activity acutely increases the risk of sudden cardiac death[24,25] and myocardial infarction[26,27] among individuals with both diagnosed and occult heart disease. Inherited abnormalities are primarily responsible for exercise-related cardiac events in young subjects whereas atherosclerotic coronary disease is the overwhelming cause of exercise-related deaths in adults.[24,25] The incidence has been estimated to be one exertion-related death per year for every 15 000[24] to 18 000[25] ostensibly healthy adult men, but these rates are based on small numbers of subjects and have wide confidence limits. The relative risk of both exercise-related myocardial infarction and sudden death is greatest in individuals who are the least physically active and who were performing unaccustomed vigorous physical activity.[25–27] Consequently, sedentary adults should avoid unaccustomed vigorous activity, and increase their activity levels gradually over time. The utility of routinely exercise testing active adults to reduce exercise-related events has not been established and was not recommended by the Writing Committee.

The Statement makes recommendations to health care providers designed to support patient physical activity throughout the lifespan. In a novel approach, the Statement recommends that health professionals personally engage in an active lifestyle to familiarize themselves with the issues involved and to set a positive example for patients and the public. The Statement also encourages health care providers to support public health programs designed to increase community levels of physical activity. Finally, the Statement recommends research designed to increase the adoption and maintenance of an active lifestyle.

The Centers for Disease Control and Prevention and the American College of Sports Medicine have recommended that adults participate in 30 minutes or more of moderate intensity physical activity such as brisk walking on most, preferably all, days of the week,[28] a recommendation endorsed by the new AHA Statement. This prescription is not greatly different from that proposed by Dr White more than a quarter century ago. The current AHA Statement buttresses the scientific rationale for Dr White's conviction and suggests ways that health care providers can encourage physical activity among their patients and the public.

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