AHA Medical/Scientific Statement

Position Statement

Cardiac Rehabilitation Programs

A Statement for Healthcare Professionals From the American Heart Association

Writing Group
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More than one of every five persons in the United States has cardiovascular disease. Despite the declining mortality rate due to cardiovascular illness observed since 1950, 43% of all deaths are currently attributed to cardiovascular causes. Mortality among the 1.5 million persons who have a myocardial infarction (MI) accounts for more than 485 000 deaths annually. The morbidity and subsequent disability incurred from coronary artery disease (CAD) alone have far-reaching medical and socioeconomic implications. The nearly 468 000 coronary revascularization procedures performed each year, together with the associated hospital stays, medications, medical personnel, and health care facility charges, will result in an estimated cost in 1994 of more than $56 billion for CAD.[1] Remarkably, more than 14% of this cost is due to lost productivity from temporary or permanent disability.[1] Continued major efforts in primary prevention are critical to reduce overall incidence of CAD. Nonetheless, continued advances in medical and surgical techniques combined with effective and focused programs in cardiac rehabilitation are needed to manage the burgeoning manifestations and consequences of overt CAD.

Cardiac rehabilitation combines prescriptive exercise training with coronary risk factor modification in patients with established heart disease. The goals of cardiac rehabilitation are to improve functional capacity, alleviate or lessen activity-related symptoms, reduce disability,[2] and identify and modify coronary risk factors in an attempt to reduce subsequent morbidity and mortality due to cardiovascular illness. The ultimate goal of cardiac rehabilitation is to restore and maintain an individual's optimal physiological, psychological, social, and vocational status.[2] Cardiac rehabilitation and efforts targeted at exercise, lipid management, hypertension control, and smoking cessation can reduce cardiovascular mortality,[3,4] improve functional capacity,[5-16] attenuate myocardial ischemia,[17-19] retard the progression and foster the reversal of coronary atherosclerosis,[20-25] and reduce the risk of further coronary events.[26-30] As such, cardiac rehabilitation is standard care that should be integrated into the overall treatment plan of patients with CAD.

Program Components

This statement focuses on outpatient cardiac rehabilitation programs. Interventions in these programs should emphasize three areas: (1) exercise training and activity prescription, (2) risk factor modification, and (3) psychosocial and vocational evaluation and counseling.

Exercise Training

Morbidity and Mortality

Exercise training is an integral component of cardiac rehabilitation. Several population-based studies show that incremental levels of regular physical activity are inversely proportional to long-term cardiovascular mortality when controlled for the presence of other risk factors.[31-34] In studies of college alumni, the risk of death became progressively lower as physical activity levels increased from 500 to 3500 kcal/wk of energy expended.[31] Alumni who were initially inactive and later increased their activity levels demonstrated significantly reduced cardiovascular risk compared with those who remained inactive.[35] Moreover, higher levels of physical fitness, when measured with an exercise tolerance test, are associated with significantly reduced subsequent cardiovascular mortality.[36,37]

Randomized trials of cardiac rehabilitation after myocardial infarction show consistent trends toward a survival benefit among patients enrolled in rehabilitation programs.[38-45] These studies are limited by small numbers and high treatment crossover and drop-out rates. However, meta-analyses of these randomized trials have calculated a significant 20% to 25% reduction in cardiovascular death but no change in the occurrence of nonfatal reinfarction in patients assigned to medically supervised and prescribed exercise programs.[3,4] Since risk factor modification was often performed together with exercise training, the independent beneficial effects of exercise on mortality in these trials are unclear. The potential additional benefits of close patient surveillance, support, and counseling to maintain health behavior changes and additional therapist/

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clinician attention directed toward patients in cardiac rehabilitation must be considered as well. The data for these meta-analyses were collected before the clinical use of thrombolytic agents and the widespread use of β-adrenergic blocking agents in the treatment of MI. As both these agents have yielded important survival benefits after MI, the effect of exercise training on contemporary cardiovascular mortality rates may not be of the same magnitude as shown earlier. These cardiac rehabilitation trials were limited to a predominantly male population under 70 years of age. The specific survival benefits among women and elderly patients enrolled in cardiac rehabilitation have, as yet, not been determined, although the physiological benefits of exercise are similar in both sexes across a broad age range in both normal, healthy individuals[46] and those with CAD.[10,11]

Functional Capacity

Exercise training improves measured peak functional capacity through a variety of mechanisms; these include hemodynamic and cardiac changes, alterations in neurohumoral responses, and peripheral changes in skeletal muscle and oxygen delivery.[47] Increases in peak oxygen uptake with training among cardiac patients range from 11% to 66% after 3 to 6 months of exercise training, with the greatest improvements among the most unfit.[6,7] However, some improvement in aerobic capacity soon after an MI or coronary bypass surgery is believed to be part of the spontaneous recovery after these events.[14,48,49] Submaximal endurance capacity after training is enhanced as well, yielding improved ability to exercise longer at a given work rate with a lowered heart rate and blood pressure response compared with pretraining levels.[47,49,50,51] The latter effect is particularly beneficial among patients with CAD because manifestations of ischemia tend to occur at higher work levels, and enhanced submaximal endurance capacity allows patients greater ability to perform submaximal tasks.[17,52,53]

Several reports have also documented a reduction in exercise-induced ischemia, as manifested by either electrocardiographic ST segment depression[9,18,52] or thallium perfusion abnormalities[19,20,51,54] at matched rate-pressure products after 1 year of exercise training. Although no mechanisms have yet been conclusively determined to account for changes in the ischemic threshold, these data imply an increase in myocardial oxygen delivery and/or decreased oxygen utilization after training.

Return to Work

Improvement in functional capacity may promote increased performance of activities among patients with cardiac disease that will foster self-sufficiency and productivity. However, assessing the effects of exercise training on rates of return to work is difficult because many additional factors appear to influence this outcome. After an MI, 49% to 93% of patients return to work.[55] A study of 1252 employed patients with CAD reports that approximately 20% of patients did not return to work after coronary revascularization via coronary bypass or coronary angioplasty. No difference was shown in the rate of return to work for those treated medically versus those having undergone a revascularization procedure. Demographic and socioeconomic factors accounted for almost half of the influence for return to work outcome, physical and emotional functioning were responsible for 29%, and medical factors represented only 20% of the predictors in this model. Importantly, the patient's perception about his or her activity status was highly predictive of return to work status.[56] Hence, while enhanced functional capacity after training may well influence return to work, this must be assessed in the context of other factors.

Recommendations regarding return to work using data obtained from treadmill testing in patients after MI may reduce time until return to work.[57,58] Published guidelines[59] can assist physicians and health care providers in establishing the employability of patients with CAD, using information that can be reliably provided from patient history, physical examination, and exercise test evaluation.

Other Risk Factors

Exercise training favorably affects fat and carbohydrate metabolism and thus aids in the management of CAD risk factors. In conjunction with a low-fat, low-cholesterol diet and a weight reduction program, regular exercise has a beneficial effect on lipid profiles[60] and may retard or inhibit the progression of atherosclerotic CAD.[19,20,61] Physical activity yields, on average, a 5% to 16% rise in high-density lipoprotein (HDL) cholesterol concentration, although evidence that exercise affects low-density lipoprotein (LDL) and total cholesterol levels conflicts.[62] Two well-controlled trials of exercise plus low-fat diet in coronary patients show significant reductions in total cholesterol, LDL, and triglyceride levels with concomitant increases in HDL level.[19,20,61] Exercise is also useful as an adjunct in the management of other coronary risk factors, including obesity,[63,64] diabetes,[62,64-66] and hypertension.[62,67-69]

Specific Populations

Women. Although exercise training in healthy women and healthy elderly persons yields significant improvements in functional capacity,[38] the benefits of exercise rehabilitation in both women and elderly patients with CAD have been less well studied. More than one half of all deaths due to CAD now occur in women, and mortality after MI is higher among women than men.[1] Thus, cardiac rehabilitation in women is a critical issue. Of the 4500 patients evaluated in a meta-analysis of randomized trials of cardiac rehabilitation after MI,[4] only 3% were women. Such a small representation precluded specific conclusions regarding women. However, two recent studies have evaluated the outcomes of exercise rehabilitation in women. In one study,[10] 51 consecutive women (age, 56±10 years) who were enrolled in cardiac rehabilitation demonstrated a greater coronary risk profile than the men in that program. After 11 weeks of training the women improved their peak functional capacity by 30%, similar to that of the men. Another study[16] demonstrated a 16% improvement in peak measured oxygen uptake among 15 women (age, 69±6 years) after 3 months of cardiac rehabilitation, which was also similar to the improvement seen in age-matched men in that program.

Elderly. Peak functional capacity declines with age, but this decline can be attenuated with exercise training.[70-74] Data are emerging regarding the benefits of

exercise among elderly patients with cardiac disease. Two studies report that functional capacity among cardiac patients older than 65 years, as measured by estimated peak MET levels, improved by 34%[15] and 53%,[11] respectively, after 12 weeks of exercise training. Another group showed a 40% increase in submaximal exhaustive exercise time with concomitant decrease in serum lactate level, respiratory exchange ratio, and ventilation during the performance of matched submaximal work rates by elderly cardiac patients after training.[16] This same study reported a 27% increase in measured peak oxygen uptake among elderly cardiac patients[62] and noted that the relative level of improvement was the same for both men and women after 3 months of training.[75] However, these authors also found that elderly women were referred to cardiac rehabilitation programs less frequently than men, despite similar clinical profiles and apparently similar need.[75]

Heart Failure. An estimated 1 to 2 million persons in the United States have heart failure. Mortality for those with this condition increases with advancing age. As the population of the United States ages, the health care repercussions of heart failure will surely increase.[76] Considerable recent attention has focused on the use of exercise rehabilitation among patients with heart failure, with reported improvements of 18% to 25% in peak oxygen uptake[13,77-79] and 18% to 34% increases in exercise duration.[79,80] Exercise training in these patients raises the anaerobic threshold, reduces resting and submaximal exercise heart rates, reduces exercise minute ventilation, and improves peak blood flow to exercising limbs.[13,77-80] Subjective symptoms and quality of life scores were better after exercise training as well. No adverse effects were reported after 2 to 6 months of training.[78,79]

Cardiac Transplantation. Because patients are quite deconditioned early after cardiac transplantation, they exhibit a number of unique and specific cardiovascular and medical conditions that require careful long-term attention and monitoring. Exercise rehabilitation in patients after cardiac transplantation increases peak functional capacity and exercise duration, raises the anaerobic threshold, and improves the ventilatory responses to exercise.[12,81-84] Specific guidelines for the rehabilitation of patients after cardiac transplantation are available.[85]

Exercise Training Programs

Programs should be formulated and administered following well-established and accepted guidelines regarding the exercise prescription for patients with heart disease.[86-88] Although dynamic aerobic exercise is necessary to improve cardiovascular endurance, resistance exercise is becoming a useful adjunctive component of the exercise regimen as well. Reports on the efficacy of moderate-intensity resistance training in cardiac patients show favorable benefits in strength and muscular endurance. No adverse outcomes have been observed in low-risk patients during supervised resistance training using a specified program of light- to moderate-intensity workloads.[89-91] The safety of resistance training in high-risk patients has not yet been evaluated.

Although the risk of sudden death during exercise is low in cardiac patients, it is nonetheless higher than that reported for healthy individuals. In a review of 167 supervised exercise rehabilitation programs, VanCamp and Peterson[92] estimated the risk of cardiac arrest during exercise to be 1:111 966 person-hours and the risk of death at 1:783 972 person-hours of exercise. With uncontrolled and vigorous exercise, such as jogging, the risk of sudden cardiac death is much higher in cardiac patients (estimated at 1:60 000 to 1:65 000 person-hours of exercise), whereas the risk of sudden cardiac death in apparently normal healthy populations is approximately 1:565 000 person-hours of vigorous exercise.[86] Hence, a principal function of cardiac rehabilitation programs is to define intensities of exercise and modes that are both safe and effective. Use of a risk stratification schema, such as that provided by the American Heart Association (AHA)[86] to evaluate patients on entry into exercise rehabilitation programs, is essential to optimize patient management and minimize their potential risk.

Questions have been raised about the possible detrimental effect of exercise on left ventricular function and regional wall motion among patients with anterior Q-wave infarction.[93] A recent randomized controlled study shows that patients with an initial left ventricular ejection fraction of less than 40% are prone to global and regional left ventricular deterioration and that physical training does not appear to worsen this anticipated effect.[94] However, further studies are needed to determine if there are any specific subsets of the population with recent MI in whom early exercise training may be potentially harmful.

Supervising staff for exercise rehabilitation should include physicians, nurses, exercise physiologists or specialists, and/or physical therapists in complementary roles to afford an optimal setting that enables maximal benefits and minimal risks. Specific training requirements and experience for such personnel are available.[86,88,95] Professional licensing requirements for specific medically related duties differ in each state, and adherence to these regulations is necessary. Although the amount and duration of supervision required for individual patients will vary according to their risk status, individuals who develop and supervise exercise training programs must be well-trained, experienced, and certified as competent in their respective treatment areas.

Only 15% of qualified patients who have undergone an MI or coronary artery bypass surgery are estimated to participate in formal supervised cardiac rehabilitation programs. This low participation rate is attributable to lack of physician referral, poor patient motivations, logistical constraints, and financial considerations.[96] Alternatively, home-based programs may serve to broaden the availability and use of cardiac rehabilitation for patients. Innovative home-training programs in which telephone monitoring by specialized staff is used appear to be safe and effective in increasing functional capacity among selected low-risk patients after MI.[97-99A] However, there are limited data about the safety of home-based training among higher-risk patients, such as those with exercise-induced ischemia[98] or heart failure.[79]

Risk Factor Modification

Nutritional Counseling

Abundant evidence suggests that improving the plasma lipid and lipoprotein profile with diet, exercise,

and drug therapy is beneficial to patients with CAD. This has been assessed by the reduced recurrence of clinical events[100-102] and the reduced rate of progression of coronary artery narrowing as determined by angiography.[19,20,61,101-106] The benefits of such therapies generally depend on their ability to achieve a substantial lipid-lowering effect. A diet restricted in saturated fat and cholesterol and designed to achieve and maintain normal body weight is an important component of a lipid-management program.[107] Regular endurance exercise can help to control body weight as well as achieve reductions in plasma triglyceride levels and increases in HDL cholesterol levels.[19,20,60-62]

Overall guidelines for establishing lipid treatment goals and implementing dietary and drug therapies for patients with CAD have been provided by the National Cholesterol Education Program (NCEP).[108] Based on these guidelines and the rationale for programs aimed at assisting physicians and patients in nutritional counseling and lipid management, nutritional counseling should be provided to all participants in cardiac rehabilitation. Since an AHA or NCEP step II diet is usually indicated to optimize lipid and lipoprotein levels in patients with CAD, it is desirable that a registered dietitian provide such instructions. Specific additional nutritional recommendations can be made to obese patients about weight loss and to diabetic patients about blood glucose control. Sodium-restricted diets can be recommended for those with hypertension[109] or heart failure.

Smoking Cessation

Smoking in patients with CAD is associated with increased mortality and morbidity,[110] silent ischemia,[111] arrhythmias,[112] elevated plasma fibrinogen,[113] and coronary spasm.[114] Patients who quit smoking after an MI benefit from reduced risks of reinfarction, sudden death, and total mortality compared with those who continue to smoke.[27]

Smoking cessation and maintenance of cessation are complicated phenomena involving both psychological and physiological dependence. A variety of techniques have been developed to aid in smoking cessation. The effectiveness of interventions varies, depending on the population and nature of the intervention. The following important conclusions can be drawn from several studies: (1) most smokers who succeed in stopping quit on their own; (2) interventions combining several components (such as those discussed below) are more successful than those relying on a single component; (3) the relapse rate is high for those who initially succeed at smoking cessation, and efforts must be directed toward maintenance of cessation; (4) health care professionals can be powerful facilitators of smoking behavior change; and (5) pharmacologic therapy for smoking cessation with nicotine gum or patches is much more effective when performed in conjunction with behavioral counseling.[55,115-117]

In controlled trials there has been a significant increase in smoking cessation rates among subjects using the nicotine patch compared with controlled therapies.[118,119] Because of the potential risk for adverse cardiovascular events associated with nicotine excess, particularly among patients with CAD, lower-dose patches should be used, and patients must be warned to abstain totally from smoking during nicotine-patch therapy. Because the 1-year cessation rates of most treatments are 10% to 40% of all original participants,[115] relapse prevention remains a significant concern. The most effective long-term results occur when close follow-up advice is provided to patients.[120]

Accordingly, all cardiac rehabilitation programs should include an organized approach to smoking cessation and maintenance of cessation; this consists of staff who are trained to provide smoking cessation interventions and follow-up; self-help materials for all patients; a strong message about the importance of smoking cessation; referral to more intensive smoking cessation programs if needed; the availability of nicotine patches or gum for eligible patients; and monitoring of smoking cessation rates.

Psychosocial Interventions

Psychosocial problems are common in patients enrolled in outpatient cardiac rehabilitation programs. Moderate to severe depression occurs in 10% to 20% of patients after an MI, and anxiety disorders are manifest in approximately 5% to 10% of patients.[121,122] About one quarter of patients do not resume sexual activity, and one half decrease their sexual activity after an MI.[123] Family and marital problems as well as social isolation are common. Health education and counseling, psychotherapy, and stress management show promising results in improving the quality of life and reducing psychosocial distress among patients with CAD, especially in the early phases of recovery.[55,124]

Hence, patients entering cardiac rehabilitation programs should be assessed for depressive or anxiety disorders, sexual dysfunction, excessive distress/stress and anger, work-related concerns, alcohol or drug abuse and dependence, and inadequate social support. Referral liaisons with psychiatrists, psychologists, social workers, or mental health workers should be established to assist with the continued evaluation and management of these problems as needed. Short-term stress management and/or group sessions focusing on psychosocial issues may be of additional benefit.

Compliance

The long-term success of any secondary prevention program is directly related to patient compliance. Data are available regarding adherence rates to cardiac rehabilitative exercise programs, but little is known about adherence to dietary strategies aimed at lipid control and weight loss. Adherence rates (ie, the number of persons who remain active in a program at a given time compared with the total number of persons who began the program) for exercise training programs generally exceed 80% for the first 3 months,[125,126] fall to 60% to 71% at 6 months,[126,127] 45% to 60% at 12 months,[126] and 30% to 50% at 2 to 4 years.[128] Program-related factors that contribute to noncompliance include lack of attention to individual needs, inconvenient location or scheduling, inadequate leadership, and lack of provision for progress and feedback assessment to patients.[129] Patient-related factors associated with noncompliance include cigarette smoking, physically inactive leisure time, history of two previous MIs, blue-collar employment, and sedentary occupations.[130] Thus, it is reasonable for programs to adopt strategies that foster convenient scheduling; individualized exercise prescription with

TABLE. Indications for Referral to Cardiac Rehabilitation

Coronary artery disease (particularly with modifiable coronary risk factors or poor exercise tolerance [≤6 METs or inadequate to meet domestic or occupational needs])
Myocardial infarction
Coronary artery bypass surgery
Cardiac transplantation
Heart failure
Percutaneous transluminal coronary angioplasty
Valvular surgery

METs indicates metabolic equivalents.

periodic follow-up and progress reports for both the patient and referring physician; effective and varied exercise regimens; group camaraderie; and identification and focus on patients whose medical and social profiles predict noncompliance.

Use of Cardiac Rehabilitation

Cardiac rehabilitation is an important component of the modern comprehensive care plan for many patients with heart disease (Table). Although cost-benefit data are limited, comprehensive cardiac rehabilitation programs have been shown to reduce rehospitalization rates, lessen the need for cardiac medications, and increase the rates of return to work.[131-136] Nonetheless, lack of support from third-party payers may limit the access of many patients to cardiac rehabilitation services. Based on the data presented above, patients with known cardiac disease, particularly those with multiple modifiable coronary risk factors, an exercise tolerance that is inadequate to meet domestic or occupational needs, exercise-induced ischemia (which would otherwise not necessitate coronary revascularization[137,138]), controlled heart failure, MI, coronary bypass surgery, or cardiac transplantation should be involved in cardiac rehabilitation. Among the latter three groups of patients, cardiac rehabilitation should be introduced during the in-hospital recovery phase, with subsequent referral to an outpatient program to begin at discharge. Although the optimal exercise regimen for specific types of patients with heart failure must be further clarified, supervised light- to moderate-intensity exercise training should be considered useful in the management of patients with stable class I through III heart failure. There are few specific data that adequately evaluate cardiac rehabilitation in patients after percutaneous transluminal coronary angioplasty (PTCA)[139] or valvular surgery,[140] yet referral of these patients to cardiac rehabilitation seems reasonable.[141] Post-PTCA patients, particularly those with modifiable coronary risk factors, poor exercise capacity, incomplete revascularization, prior or recent MI, or heart failure, would appear to benefit most from cardiac rehabilitation. The effect of such programs on coronary restenosis after PTCA is not known but deserves evaluation. Valvular surgery patients may be physically debilitated to a similar or greater extent than those who have undergone coronary artery bypass surgery. Moreover, they may have residual left ventricular dysfunction that could further compromise their functional status. For these reasons, cardiac rehabilitation after valvular surgery may well be useful.

The principles of exercise training and risk factor modification behavior need to be practiced for life. Rehabilitation programs should establish individualized goals for each patient. The duration of active, formal, supervised participation should be based not only on exercise risk but also on the need for intervention in high-risk behaviors, eg, smoking and diet. Ideally, active participation in supervised programs should continue until the safety of independent exercise has been established and the principles of risk factor modification have been taught. This will, of course, differ among patients. The rehabilitation prescription should not be uniform, as not all patients will require the same depth of intervention. Periodic follow-up by the patient's physician or the rehabilitation staff can be helpful to foster long-term compliance. Exercise testing can be performed after the initial 6 weeks of exercise training to rewrite the exercise prescription and at least yearly thereafter.[86] Additionally, rehabilitation program staff should collaborate with the patient's personal physician to ensure that appropriate patients are given recommendations about return to work.

As exercise training and risk factor modification have complementary roles, cardiac rehabilitation programs must provide multifaceted services. Programs offering exercise training as an isolated intervention are not synonymous with cardiac rehabilitation.[142] Internal and outside quality assurance systems for cardiac rehabilitation services should be developed so that the patient will receive high standards of treatment while the prudent and effective use of health care dollars is fostered. Logistically, cardiac rehabilitation can best be accomplished by comprehensive programs, yet these programs are not always readily accessible. Alternative resources (eg, home-based telemetry or unsupervised exercise programs, independent nutritional counseling, smoking cessation and/or psychosocial counseling services) to accomplish these goals should then be sought and prescribed by the physician, based on individual patient needs and risks of unsupervised exercise.

Additional Research and Future Issues

The broad scope of cardiac rehabilitation highlights many issues that require further investigation. The probability that rehabilitation may have a significant effect on secondary prevention, reduced disability, increased productivity, improved quality of life, and associated influences on health care costs should encourage government, the insurance industry, private health care agencies, and academic institutions to foster and support research in these areas.

The effects of exercise training and risk factor modification on the pathophysiologic mechanisms for ischemia also require further study. Their influence on coronary vasomotor reactivity, blood flow rheology, and clotting mechanisms are not well understood. Studies that evaluate the effect of these interventions on the occurrence of total ischemia (silent and symptomatic), arrhythmogenesis, restoration of baroreflex function after MI, and related neurohumoral alterations with exercise training are needed. The effect of cardiac rehabilitation on restenosis and the maintenance of

vessel patency after coronary angioplasty also requires further study.

Studies are needed to evaluate the effects of exercise training on myocardial salvage and left ventricular remodeling after MI. Specifically, questions remain on whether there is a differential effect of exercise on remodeling for infarcts involving specific topographic areas or with relation to the amount of damaged myocardium present. The effects of exercise with relation to the coadministration of β-adrenergic blocking agents, angiotensin-converting enzyme inhibitors, or other cardioactive medications on left ventricular remodeling after infarction need to be evaluated.

The interrelation between exercise training and coronary risk modification should be further explored, with attention toward the amount (frequency, intensity, mode, and duration) of exercise required to positively affect lipid levels, body composition, insulin resistance, blood pressure, and neurohumoral responsiveness.

Much attention is warranted in the evaluation of women, the elderly, minority populations, and persons of lower socioeconomic status with respect to the efficacy of rehabilitation and risk factor modification. Racial minorities[143] and those individuals of low socioeconomic status[144] have been identified as having a greater prevalence of risk factors for the development and progression of atherosclerotic cardiovascular disease. There are currently no data that specifically address cardiac rehabilitation among these two groups. The appropriateness of specific interventions and the provision of additional services to meet the unique requirements of each group need definition, since the majority of available information pertains to middle-aged white men. Moreover, better-defined guidelines are needed for exercise training of high-risk patients, such as those with heart failure, specifically concerning intensity of aerobic training, the safety and efficacy of resistance training, and the rate of progression in training intensity.

Further studies of psychosocial and behavioral issues among patients enrolled in cardiac rehabilitation are needed. A brief, easily scored, sensitive, and specific instrument for identifying psychosocial problems in patients with cardiovascular disease should be developed and evaluated. Development of available prototypes for standardization and encouragement of their use should be fostered so that common indices of behavior can be compared among studies.

Finally, well-designed, prospective cost-effectiveness studies should be conducted. These should include evaluation of supervised cardiac rehabilitation programs, office-managed care, and supervised home programs with regard to improvements in functional capacity, modification of risk factors, long-term compliance, rehospitalization, quality of life, and medical costs incurred. Productivity should be gauged not only in rates of return to remunerative work but also as the attainment of self-sufficiency and independence in persons disabled by cardiac illness. The effect on subsequent need for support from employed family members, homemaker services, or other costly social support systems should be considered. In this context, the establishment of a national cardiac rehabilitation database for the analysis of data collected in the daily delivery of cardiac rehabilitation services among urban, suburban, and rural populations may provide considerable useful information and serve as an important scientific and clinical frame of reference.

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