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Physical Activity and Exercise for Secondary Prevention among Patients with Cardiovascular Disease

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Abstract

Most adults do not achieve the recommended levels of physical activity, including patients with cardiovascular disease (CVD). Furthermore, healthcare providers often do not understand the benefits of physical activity in CVD patients, rather over emphasizing the potential risks related to activity. Recent studies suggest reductions in cardiovascular events including mortality with concomitant improvements in quality of life for many vascular conditions. However gaps in our current knowledge base remain. Recent research on physical activity including use of novel internet based interventions are developing areas of interest have moved to reduce such knowledge gaps.

Keywords

Physical activity; secondary prevention; cardiovascular disease

Introduction

Regular physical activity decreases the risk of many adverse health conditions, including coronary heart disease (CHD), stroke, diabetes and premature death.^{1, 2} The American Heart Association has established physical inactivity as a modifiable risk factor for heart disease, however only 17% of patients with self-reported coronary heart disease perform the recommended levels of physical activity.^{3, 4} While the majority of research focuses on primary prevention, patients with established heart disease have been shown to benefit significantly from regular physical activity.^{5, 6} The following review outlines recent studies regarding physical inactivity in patients with major vascular conditions including CHD, heart failure, stroke and peripheral artery disease, in addition to a discussion of recent studies to promote physical activity compliance.

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Compliance with Ethics Guidelines

Conflict of Interest

Douglas Darden and Caroline Richardson and Elizabeth A. Jackson declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent

This article does not contain any studies with human or animal subjects performed by any of the authors.

Coronary Heart Disease

CHD remains the leading cause of death in the United States.⁷ Worldwide, physical inactivity causes 6% of the burden of CHD and 9% of premature mortality.⁸ In a meta-analysis of 21 prospective studies, higher levels of leisure time physical activity were associated with a 21% reduction in CHD events for men and a 29% reduction in women.⁵ Moderate levels of physical activity were associated with a protective benefit, while higher levels of exertion did not appear to add additional protection.

Physical activity as a measure of secondary prevention for recurrent CHD events is less well studied. Nevertheless recent studies suggest benefit. To look at the level of individual fitness parameters and mortality risk, 5,641 CHD patients enrolled in cardiac rehabilitation programs were separated into low, moderate or high fitness, based on peak metabolic equivalents.⁹ Higher baseline fitness predicted lower mortality.

Compared to participants who were the least fit (low 1/3 of the cohort), those with the highest fitness had a significant survival benefit. Equally encouraging was the observation that improvements in fitness during cardiac rehabilitation resulted in decreased mortality even at 1-year and even in participants who started rehab in the lowest fitness group. These data suggest that poor fitness is a risk for increase mortality and that improvement in fitness is an important component of secondary prevention. A similar study observed that 6-minute walk testing (6MWT) can be used as a measure of fitness in this population and was significantly correlated with recurrent cardiovascular events over a median follow-up period of 8 months.¹⁰ In this particular study, each standard deviation decrease in 6MWT distance (104 m) was associated with a 55% higher rate of cardiovascular events. Given the lack of expense in performing 6MWT, such a measure may be a cost-effective measure of fitness and thus increased risk for cardiovascular events and death among patients with CHD.

In patients with CHD, prescribing the proper mode, frequency, duration and intensity of exercise remains unclear. Exercise performed at higher levels results in greater increases in aerobic capacity and possibly greater cardioprotective effects. However vigorous exercise may also place CHD patients at increased risk of cardiovascular events. One study of 4,846 CHD patients separated by activity into moderate intensity and high intensity groups observed little risk associated with high intensity activity.¹¹ The rates of complications to the number of patient-exercise hours were 1 per 129,456 hours of moderate-intensity exercise and 1 per 23,182 hours of high-intensity exercise. The authors conclude that high-intensity exercise could be considered among some patients with cardiac disease.

Heart Failure

According to the 2013 ACCF/AHA Heart Failure guidelines, over 650,000 new cases of heart failure (HF) are diagnosed annually with an approximate absolute mortality rate of 50% within 5 years.¹² The guidelines incorporated a Class 1 recommendation for exercise training for patients with HF and a class IIA recommendation for cardiac rehabilitation to improve capacity, exercise duration, quality of life, and mortality. Studies such as the Heart Failure: A Controlled Trial Investigating Outcomes of Exercise Training (HF-ACTION) study which demonstrated the benefits of regular exercise for patients with HF.¹³ In HF-ACTION, 2,331 patients, 37% with New York Heart Association class III or IV symptoms and median left ventricular ejection fraction of 25% , were randomized to supervised aerobic exercise followed by home-based exercise or usual care. The primary outcome of all-cause mortality or hospitalization were not significant; however after adjustment for prognostic predictors, exercise was a modest survival benefit and reduced HF hospitalizations. These data suggest among a very sick population such as HF patients, modest benefits may be associated with improved fitness.

To study the long-term effects of exercise on patients with HF, Belardinelli et al followed 123 HF patients undergoing moderate supervised exercise performed twice weekly for 10 years.¹⁴ Functional capacity was maintained in addition to sustained improvement in quality of life measures as compared with the control group. These improvements were associated with reduction in major cardiovascular events, including hospitalizations for HF and cardiac mortality.

The best regimen of exercise prescription for patients with HF remains a challenge for physicians. Moderate aerobic exercise is currently the recommendation among most physicians. A recent study in patients with chronic systolic HF, only moderate levels (3–7 METs) of exercise was needed to reduce subsequent risk by approximately 65% for cardiovascular mortality or heart failure hospitalization. Some recent studies suggest additional benefit to high intensity interval training. A review of 7 studies noted that high intensity training was more effective than moderate intensity in improving VO_{2peak} among HF patients.¹⁵ Time spent exercising was also less for the high-intensity group, which may increase adherence. These studies reported no significant safety issues.¹⁵ Further study would be required to answer questions about long-term safety and adherence to interval training. Additional studies have compared exercise intensity. A small study of 26 HF patients randomized to high or moderate intensity exercise for 8- weeks, noted a significant increase in both VO_{2peak} and 6MWT in high-intensity exercise group compared to the moderate intensity group.¹⁶ A second small study also noted greater improved in VO_{2peak} with high-intensity exercise compared to moderate intensity. Given the size of these studies, larger studies with long-term follow-up are needed prior to modification of current recommendations for continuous moderate intensity exercise among patients with HF.

Stroke

Stroke is one of the most common cardiovascular disease events experienced by American adults.³ Over half a million adults experience stroke for the first time each year.³ With the continued aging of populations, the number of incident strokes is expected to increase significantly over the next 2 decades.^{3, 17} The prevalence of stroke is also increasing globally as rates of obesity, diabetes and high blood pressure rise.^{18, 19}

Stroke patients frequently have low levels of fitness associated with sedentary behaviors prior to a stroke and thus, not surprisingly, are frequently inactive post stroke. Low levels of physical activity are a known risk factor for stroke, in particular ischemic stroke.²⁰ Data from the Northern Manhattan Study (NOMAS), a population-based prospective cohort suggests increased levels of physical activity is associated with lower risk for stroke, thus may be an important part of prevention strategies to reduce stroke rates.^{20, 21} Although these data were collected in participants without a prior history of stroke at baseline, the potential for reducing risk of recurrent stroke exists.

In regards to secondary prevention, patients with a prior stroke are more likely to be less fit compared to age-matched peers.²² Stroke patients often have a high level of disability and significant increased risk of falls.^{23–26} To date interventions to increase physical activity and general fitness among stroke patients are limited. Given that many stroke patients are significantly deconditioned post stroke, improving fitness may allow for such patients to complete basic task thus living independently. Thus improving fitness in addition to motor control and balance may be important for stroke prevention and overall quality of life. Recent trials have supported this hypothesis. One trial of supervised exercise observed improvements in walking capacity and walking speed, measured with 6MWT, compared with a control group who completed upper arm exercises.²³ No difference in number of falls was noted between the 2 groups, suggesting that exercise does not increase fall risk. The

exercise program included circuit training to improve balance and strength, home practice and walking both in the exercise class and at home, delivered over a 1 year period. Another study used videos to create a virtual walking program. This small study compared 7 chronic stroke patients to 7 controls.²⁷ Each group completed a standard rehabilitation program. The intervention group also received a walking program, consisting of 30 minutes of treadmill walking, three times per week for 6 weeks. The participants who received the intervention were observed to have improved gait parameters compared to the control. A recent meta-analysis of aerobic exercise among chronic stroke patients found among the 11 trials included, improvements in peak VO₂, and 6MWT, with no significant improvement in gait speed.²⁸

Exercise programs outside of a supervised rehabilitation setting may also be safe and beneficial. A community-based walking program for stroke patients demonstrated 30 minutes of walking, 3 times per week for 12 weeks resulted in greater 6MWT distances compared to the control group and a trend towards higher reported quality of life as measured by the SF-36, within the domain of physical health.²⁹ The investigators noted no major adverse events.

The trials presented above suggest real benefits to physical activity, in particular walking among stroke patients. Aerobic exercise has not been associated with significant increased risk for adverse events; although given such patients often have co-existing heart disease, preliminary screening and possibly exercise testing should be considered prior to an exercise program.²⁵ It is encouraging to see improvements in VO₂ and quality of life measures; however impact on risk for recurrent events such as stroke or transient ischemic attacks remains to be determined. Larger trials with appropriate follow-up are required to answer such questions.

Peripheral Arterial Disease

Currently an estimated 8 million Americans carry a diagnosis of peripheral arterial disease (PAD).³ With the aging of the American population, the numbers of adults with PAD will likely increase significantly over the next several decades.³⁰ Patients with PAD are at risk for significant functional impairment. Claudication or pain with walking leads most patients to limit their physical activity.^{31, 32} Decreasing fitness leads to increased risk for cardiovascular events.^{31, 33} A recent study of 442 patients with PAD observed that greater declines in walking function (stair climbing, walking speed, and distance) were independently and positively associated with all-cause mortality.³⁴ These data suggest measurement of function via the Walking Impairment Questionnaire may assist in the identification of PAD patients at increased risk for death.

Recently, the Claudication: Exercise Versus Endoluminal Revascularization (CLEVER) study observed better peak walking distances at 6-months among patients randomized to a walking program as compared to patients who received peripheral stenting.³⁵ Thus it is not surprising that current guidelines consider supervised exercise programs a class 1 recommendation.³⁰ Supervised walking programs for PAD patients are effective in reducing claudication symptoms and improving walking distance.³⁶⁻³⁹ A Cochrane review which included 22 trials noted improvements in maximal walking time of 5.12 minutes (95% confidence interval [CI] 4.51 to 5.72) as compared to usual care or placebo.³⁶

Comparing walking performance among patients who have received a revascularization procedure, those who did not and a third group of patients who walked on a regular basis, the largest declines in walking distance were observed for those who did not receive revascularization, and did not exercise regularly.⁴⁰ Those who received a revascularization procedure and also had an increase in ankle brachial index (ABI) after revascularization had

improvements in walking performance. The investigators concluded that functional improvement was associated to improvements in ABI after revascularization. Those who exercise regularly had less decline in their walking performance compared to those who did not exercise and were not revascularized.

Regular physical activity may also be associated with sustained benefit among PAD patients. Long-term impact of supervised exercise was examined in a small study of 44 patients with PAD.⁴¹ Investigators observed an improvement in quality of life measures at one year follow-up. The exercise intervention was a 12-week supervised program. Interestingly, the exercise group was not statistically significantly different from the control group in terms of quality of life or functional capacity immediately after the intervention. Only at 1 year, were differences observed. These investigators also compared walking ability among patients who underwent revascularization for their PAD. Using the data from the Walking and Leg Circulation study (WALCS), a longitudinal cohort which collected data on annual 6-minute walk tests among patients with PAD, McDermott and colleagues observed declines in walking distances were greatest for those who did not participate in an exercise program and did not undergo revascularization.⁴⁰ Interestingly, those who did undergo a revascularization procedure had the second greatest decline in walking distance, if they did not have a change in ABI of 0.15 or greater after revascularization. Given that 72% of participants who were vascularized did not meet this level of change, the implications for continued decline in function are significant. Further research to understand factors related to change in ABI after revascularization procedures is warranted. This study also supports the use of exercise programs; participants who did participate in an exercise program had significant fewer declines in walking function compared to those who did not exercise.

Health Promotion and Adherence

Health care providers are sometimes reluctant to prescribe physical activity, particular non-supervised activity for patients with known cardiovascular disease due to concerns about the risk of adverse cardiovascular events. Facility-based programs that included supervised physical activity for people with cardiovascular disease are only accessible to those who live near enough to such a facility to attend sessions two or three times a week and may not be covered by health insurance, particularly for certain conditions and certainly less so in developing countries. For example rehabilitation programs for PAD are rarely covered by insurance. Makris et al. surveyed practitioners regarding the availability of supervised exercise programs for PAD patients.⁴² The majority of respondents were practicing in Europe. Only 30% of respondents reported having access to a supervised program for their patients. It is likely referrals for PAD rehabilitation programs are even less for patients in the US and developing countries. Access barriers also exist for cardiac, HF and stroke rehabilitation programs.⁴³⁻⁴⁶

Technology may offer solutions by allowing lower cost in-home exercise programs to be delivered remotely using objective monitoring and automation. Internet based programs and telephone interventions have been used successfully to promote physical activity among patients with chronic conditions.⁴⁷⁻⁴⁹ Such programs can include tailored motivational messaging, objective monitoring of physical activity, as well as guidance on goal setting and can provide feedback to both the patient and the provider.⁵⁰⁻⁵² In one study of CHD patients randomized to an internet-based system exercise program increased their physical activity compared to usual care.⁴⁷ The intervention arm received personalized physical activity plans, tutorials, online coaching and were able to track their progress. Physical activity was measured with pedometers. Similar studies have been conducted among patients with chronic conditions including chronic obstructive lung disease, diabetes and CHD.^{47, 49, 53} These findings have significant implications for patients who have barriers to participation

in supervised exercise programs. Further trials are now needed to assess changes in event outcomes (myocardial infarction, stroke and mortality) and long-term adherence, acceptance, and safety of technology-based programs.

Conclusion

People with cardiovascular disease including CHD, heart failure, stroke and PAD can benefit significantly from being physically active. Research in the past year demonstrates that higher fitness levels predicted lower mortality rates and complications associated with CHD, HF and PAD. Studies analyzing increased physical activity among stroke patients are limited; however recent studies are promising in suggesting significant benefits to physical activity. Many barriers exist in prescribing the appropriate exercise regimen and achieving patient adherence. Promising research in areas of health promotion, particularly technology-based programs, are beginning to close the gaps. As the population ages, the prevalence of cardiovascular disease will also increase, resulting in a large number of adults with cardiovascular disease in need of lifestyle modification for secondary prevention. Healthcare providers with the knowledge and tools to help their patients with cardiovascular disease remain physically active will be able to substantially improve health outcomes.

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