REVIEW

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Why and how to prescribe exercise: Overcoming the barriers

ABSTRACT

Exercise helps prevent and improve atherosclerosis and other chronic diseases, and physicians should encourage their patients to exercise more. Unfortunately, there are many barriers to prescribing exercise. To help patients start exercising and stay with it, clinicians need to address specifics. Several guidelines are available to achieve this goal.

KEY POINTS

A sedentary lifestyle is an important risk factor for chronic disease. Conversely, physical activity is associated with a reduction in risk factors for atherosclerotic vascular disease, including lipid and glucose levels, weight, and blood pressure.

Health care professionals should encourage patients to be physically active and educate them on the benefits and necessity of regular physical activity.

Exercise programs should be tailored to individual needs on the basis of factors such as age and health status.

People should engage in at least 30 minutes of moderate-intensity physical activity such as brisk walking on most, and preferably all, days of the week.

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PHYSICIANS play a vital role in advising and encouraging their patients to exercise. Long-term adherence to an exercise program can be very good if the physician addresses exercise and physical activity along with other issues, such as medication adherence, during routine outpatient visits.

In spite of the benefits of exercise, however, busy clinicians often do not adequately address it in clinical practice, for several reasons, eg:

- They are insufficiently reimbursed for office time spent in counseling patients in need of an exercise program
- They may underestimate their power to help patients modify behaviors (ie, abandon a sedentary lifestyle)
- They do not have easy-to-reach reference materials to guide them and ancillary staff in the practical aspects of exercise prescription for different patient needs
- They may underestimate the benefits, possibly because recent information has not been disseminated to all physicians and the public (medical colleges and nursing schools need to cover this topic more in their curricula).

This review discusses the importance of exercise in preventing and treating chronic diseases, especially atherosclerotic vascular disease. We include practical suggestions for clinicians in helping their patients implement and adhere to a regular exercise program.

THE HEALTH DANGERS OF INACTIVITY

Over the past generation, several chronic diseases—particularly coronary artery disease—have become pandemic worldwide. One of

An exercise glossary

Physical activity—bodily movement produced by skeletal muscles that results in energy expenditure beyond the resting level

Exercise—activity that is planned, structured, repetitive, and purposeful in the sense that improvement or maintenance of physical fitness is the objective

Physical fitness—includes cardiorespiratory fitness, muscle strength, body composition, and flexibility

Dose—the energy expended in physical activity

Intensity—the rate of energy expenditure during such activity

Absolute intensity—the rate of energy expenditure during exercise during exercise, usually expressed in metabolic equivalents (METs)

1 MET—the resting metabolic rate, ie, about 3.5 mL $O_2 \cdot kg^{-1} \cdot min^{-1}$

Relative intensity—the percent of aerobic power utilized during exercise expressed as a percent of the maximal heart rate or percent of maximum oxygen consumption (VO_{2max})

In hypertensive people who exercised, blood pressure fell by 7.4 / 5.8 mm Hg

the most common risk factors for these diseases is a sedentary lifestyle.

The epidemiologic evidence that links physical inactivity with atherosclerosis fulfills important criteria for a causal association[1–3]:

- The relationship is strong. When divided into quartiles or quintiles on the basis of physical activity, people who are most sedentary have twice the rate of coronary disease than do people who are most active.
- The relationship is consistent in most studies. During the past half-century, studies of occupational and leisure-time physical activity consistently document a lower incidence of coronary events in people who are more physically active[4] and fit.[5] More recent studies provide similar data using measures of exercise capacity such as treadmill performance as an indicator of habitual physical activity.
- The temporal sequence is appropriate: in prospective studies, the lower physical activity levels preceded the development of coronary artery disease rather than resulting from the disease itself.
- A dose-gradient characteristic exists: as physical activity increases, rates of coronary disease decrease.
- The relationship is plausible and is coherent with published data on the effects of physical activity and exercise on vascular wall biology, coronary risk factors, myocardial function, and vulnerability to ventricular fibrillation. In many studies, the lower frequency of coronary artery disease was independent of other known atherosclerotic risk factors.

BENEFITS OF EXERCISE

Physical activity prevents coronary artery disease and is beneficial in patients with known cardiovascular disease. It also reduces the risk of other chronic diseases, including type 2 diabetes,[6] osteoporosis,[7] obesity,[8] depression,[9] and cancer of the breast[10] and colon.[11]

Effect on specific risk factors

Physical activity favorably affects many established risk factors for atherosclerosis, including dyslipidemia, high blood pressure, glucose intolerance, insulin resistance, and obesity.

In some people, the effect may be large enough to obviate other interventions. In general, however, the effect of exercise is substantially less than that of drug therapies, although it can be significantly magnified by other lifestyle changes such as changes in diet and weight loss.

Lipids. Exercise in combination with weight reduction can decrease low-density lipoprotein cholesterol (LDL-C) concentrations and limit the reduction in high-density lipoprotein cholesterol (HDL-C) that often occurs when people reduce their dietary saturated fat.[12]

In a meta-analysis of 52 exercise-training trials of longer than 12 weeks that included

4,700 subjects,[13,14] HDL-C levels increased by an average of 4.6%, triglyceride levels decreased by 3.7%, and LDL-C levels decreased by 5.0%.

Blood pressure. In 44 randomized controlled trials of exercise training that included 2,674 subjects,[15] systolic blood pressure fell by an average of 3.4 mm Hg and diastolic blood pressure fell by 2.4 mm Hg. Among people with normal blood pressure the reduction was 2.6 mm Hg systolic and 1.8 mm Hg diastolic; in people with high blood pressure the reduction was 7.4 mm Hg systolic and 5.8 mm Hg diastolic. This suggests that exercise may be the only therapy that some patients with mild hypertension will need.

Blood sugar. Physical activity reduces insulin resistance and glucose intolerance, postprandial hyperglycemia, and possibly hepatic glucose output. A review of 9 trials of exercise training in 337 patients with type 2 diabetes reported an average absolute reduction in hemoglobin A_{1c} of 0.5% to 1%.[16]

Incidence of diabetes. The Diabetes Prevention Program[6] demonstrated that physical activity and weight loss can prevent the onset of type 2 diabetes in people at high risk for the disease. At 2.8 years, people randomized to a lifestyle intervention weighed an average of 4 kg less and were expending an average of 8 more metabolic equivalent (MET)-hours per week than people randomized to usual care—and their incidence of type 2 diabetes was 58% lower. The lifestyle intervention was also significantly more powerful than metformin 850 mg twice daily, which reduced the onset of type 2 diabetes by 31%.

Weight loss. Physical activity is an important adjunct to diet for achieving and maintaining weight loss. The National Weight Control Registry enrolled 3,000 people who lost more than 10% of their body weight and who kept this weight off for at least 1 year.[8] The average weight loss—30 kg—was maintained for an average of 5.5 years. Of the registrants, 81% reported that they had increased their physical activity. Women reported expending 2,445 kcal per week and men reported expending 3,298 kcal per week in such activities as walking, cycling, weight-lifting, aerobics, running, and stair-climbing.

Many positive effects are acute, but transient

Many of these effects are seen immediately after the exercise session and do not depend on prolonged exercise training or improvement in fitness. (However, this also means that the effects are transient, and patients need to exercise on a regular basis to benefit: recommendations call for adults to participate in moderate-intensity physical activity on most, if not all, days of the week.[17]) In particular, the acute effects of exercise are seen in[16]:

- Serum triglycerides (levels are reduced for up to 72 hours)
- HDL-C (raised transiently)
- Systolic blood pressure (reduced for up to 12 hours)
- Normalized glucose homeostasis.

Whether stopping physical activity increases the risk of coronary artery disease is not clear, although the Harvard Alumni Study[18] suggests that college athletic activity is not protective in later years without lifelong physical activity.

Exercise reduces C-reactive protein

Atherosclerosis is now recognized as a chronic inflammatory disorder. Prospective studies show a direct relationship between the level of C-reactive protein (CRP) measured by a highly sensitive assay and the development of cardiovascular complications.[19]

The Third National Health and Nutrition Examination Survey showed an inverse relationship between the level of leisure-time physical activity and the CRP concentration.[20] This relationship was confirmed in the Cardiovascular Health Study[21] and the 20-year follow-up of the British Regional Heart Study[22] after adjustment for body mass index and other important confounders.

Preliminary evidence shows that exercise-based cardiac rehabilitation reduces the CRP level. A retrospective analysis[23] found that the median CRP level fell by 41% in 235 consecutive patients who underwent formal phase 2 cardiac rehabilitation, independent of statin use and weight loss. In contrast, CRP levels did not change in 42 control patients who did not attend the rehabilitation program.

$6.4 billion per year might be saved if Americans started walking

TABLE 1

Cost-effectiveness studies of exercise programs

STUDY	POPULATION	DURATION	TREATMENT	COST-EFFECTIVENESS
Hatziandreu et al[25]	Men age 35	30 years	Jogging vs no exercise	$15,400/QALY*
Munro et al[26]	Men and women over age 65	Lifetime	Supervised exercise twice a week vs no exercise	$533/LY
Lowensteyn et al[27]	US population	Lifetime	Unsupervised exercise vs no exercise	< $13,000/LY†
	Men with cardiovascular disease	Lifetime	Supervised exercise vs no exercise	< $16,000/LY

LY = life years; QALY = quality-adjusted life years
*Includes indirect costs from time lost due to exercising
†Based on the Cardiovascular Disease Life Expectancy Model

EXERCISE MAY BE COST-EFFECTIVE

Ask about physical activity as part of the history

Few studies have addressed the cost-effectiveness of exercise programs. One study, based on the assumption that sedentary behavior nearly doubles the risk of heart disease, estimated that $6.4 billion per year would be saved if all sedentary people in the United States began a program of regular walking.[24]

Other studies took into account the cost of exercise programs and of the time lost to exercise and still found that the benefits are large and the cost per year of life gained remained well below $20,000 (TABLE 1).[25–27]

Little is known about the cost-effectiveness of modifying multiple risk factors simultaneously. Several studies, however, examined the cost-effectiveness of cardiac rehabilitation after acute myocardial infarction. These rehabilitation programs used a variety of interventions, including exercise, risk-factor management, and psychosocial counseling.[28] A study from Sweden found cardiac rehabilitation to be cost-saving when indirect costs of work productivity were included.[29] Studies from the United States estimate that cardiac rehabilitation increases direct costs by $5,500 to $11,100 per life-year gained.[30,31]

RECOMMENDATIONS

Because atherosclerotic vascular disease remains the major cause of death in most developed countries, it is important that health care providers help their patients to start exercising and to stay with it across their life span.

What works in the community?

The Task Force on Community Preventive Services did an evidence-based review of community-based strategies for promoting active lifestyles.[32] The following six strategies were deemed effective:

- Large-scale, intense, highly visible, community-wide campaigns
- Point-of-decision prompts that encourage people to use the stairs instead of elevators or escalators
- Physical education programs in schools
- Social support programs such as walking groups
- Individually adapted programs to change behavior
- Enhanced access to places for physical activity.

This last point deserves emphasis. Behavioral changes need to be integrated into daily routines to sustain improvements in physical activity levels. Communities should

make facilities for physical activity available to the public and have environments conducive to safe physical activity. Such environmental efforts should allow purposeful physical activities, such as walking to work and climbing stairs. In 12 studies that examined the effect of increasing access to places for physical activity, the number of people who exercised at least 3 days per week increased by a median of 26%.

Health care providers should personally engage in an active lifestyle to familiarize themselves with the issues involved and to set a good example for patients and the public. They should also use their influence as parents and community members to support physical activity in the schools and in the community and advocate changes within work sites and civic and recreational settings that encourage active living.

In the physician's office?

In taking the patient's history, health care providers should ask about his or her habitual physical activity and document it in the medical record. They should also inform patients of the importance of physical activity as therapy for such medical conditions as hypertension, hypertriglyceridemia, glucose intolerance, and obesity.

The US Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine recommend 30 minutes or more of moderate-intensity physical activity such as brisk walking on most, and preferably all, days of the week.[17] Patients should be encouraged to engage in a variety of physical activities and to progressively increase their activity as tolerated.

A more recent consensus statement from the International Association for the Study of Obesity[33] includes the recommendation of 60 to 90 minutes of daily physical activity for prevention of weight regain in formerly obese individuals.

Detailed guidelines for prescribing exercise in patients with and without cardiovascular disease are provided in the American Heart Association (AHA) Exercise Standards for Testing and Training.[34] Recommendations are also available for the incorporation of resistance and flexibility exercise training.[35]

Health care professionals should provide exercise guidelines to patients (see **Advice for when you begin exercising,** that follows this article) and should familiarize themselves with behavioral-change materials available from the Provider-Based Assessment and Counseling for Exercise (PACE) program[36] and the Activity Counseling Trial (ACT).[37]

Is stress testing necessary before starting?

Although the topic is controversial, all people do not need to undergo exercise stress testing before starting a moderate-intensity and moderately progressive exercise program. Support for this comes from a consensus group from the AHA and the American College of Cardiology, who found a lack of well-established evidence on the usefulness and efficacy of routine exercise stress testing before starting a vigorous exercise program in healthy men older than 45 years and women older than 55 years.[38]

If the patient has a known cardiovascular problem or is at increased risk, exercise testing should be selectively performed at the discretion of the physician before the patient starts vigorous exercise. Health care providers caring for patients with cardiovascular disease should support the development of exercise programs to manage these patients.

EXERCISE TRAINING TECHNIQUES

Tell patients to start by warming up for 5 to 10 minutes

People can increase their activity in many small ways, such as habitually taking the stairs instead of the elevator, parking at the far end of the lot at work, or going for a walk after dinner. During patient visits, mention the value of a physically active lifestyle.

Exercise training should consist of periods of warming up, endurance exercise, flexibility exercise, resistance training, and cooling down. Most people do not have enough time to do both aerobic and resistance training in each session, however. If patients have only 30 minutes per day in which to exercise, we advise doing aerobic and resistance training on alternating days or doing resistance training on 2 or 3 days of the week and the rest aerobic. On the resistance days, it is important to have a brief warm-up and cool-down period as well.

Warming up, cooling down

People should start their training sessions by exercising at a low intensity for 5 to 10 minutes to stretch and warm up muscles and ligaments in preparation for the session. This also reduces the risk of injury or cardiovascular events associated with sudden onset of activity.

After the session, people should cool down to prevent hypotension, which may occur if they just suddenly stop.[39]

Endurance exercise

Endurance (cardiovascular) exercises include brisk walking, running, swimming, cycling, stair-stepping, and cross-country skiing. An increasingly available machine is the elliptical trainer, which is easy to use, avoids joint impact, and is of special value in the aging population. These activities all involve dynamic exercise—alternately contracting and relaxing the muscles in large muscle groups, as opposed to isometric or resistance exercise—and they cause the greatest increase in maximum oxygen consumption (VO_{2max}, see below).

How hard to exercise? The intensity of physical activity, ie, the rate of energy expenditure, is measured in several ways.[17] The absolute intensity is usually expressed in METs, where 1 MET equals the resting metabolic rate of about 3.5 mL $O_2 \cdot kg^{-1} \cdot min^{-1}$. Relative intensity—the percent of aerobic power used during exercise—is expressed as percent of maximal heart rate or percent of maximum oxygen consumption (VO_{2max}).

Moderate-intensity activities are those done at a relative intensity of 40% to 60% of VO_{2max} (or absolute intensity of 4 to 6 METs). Vigorous-intensity activities are those done at a relative intensity of greater than 60% of VO_{2max} (or absolute intensity of greater than 6 METs). For example, brisk walking at 3 miles per hour or a 20-minute mile pace has an absolute intensity of about 4 METs. In relative terms, this intensity is considered light for a 20-year-old healthy person but represents vigorous intensity for an 80-year-old person.[34]

People should exercise at least three but preferably six times per week for a minimum of 30 minutes per session at a minimum intensity of 40% to 60% VO_{2max}, and up to 85% to 90% VO_{2max} for those who have appropriately progressed to this level.

A useful approach is to identify the desirable rating of perceived exertion and instruct the patient to adhere to that intensity. A suggested rating of perceived exertion for most healthy people is 12 to 16 ("somewhat hard" to "hard") on the Borg scale of 6 to 20.[40]

Flexibility exercise

Flexibility exercise (stretching) promotes flexibility and should focus on improving range of motion in joints. Particular attention should be focused on the lower back and posterior thigh to reduce the risk of chronic lower back discomfort.[41]

Resistance training

Resistance training (activities that use repeated movements against low or moderate resistance, eg, weight-lifting) has been accepted as a component of a comprehensive exercise program both for apparently healthy people and, with appropriate screening and precautions, for people with cardiovascular disease.[35] Although resistance exercise affects risk factors less than endurance exercise does, it can increase the patient's strength and muscle mass, which may improve his or her ability to become more physically active and may, in older persons, improve the ability to perform activities of daily living.

Behavioral changes need to be integrated into daily routines

People starting a resistance training program should be carefully screened both for cardiovascular limitations and for preexisting orthopedic and musculoskeletal problems. In addition, careful recommendations should be given regarding the specific components of the resistance training program, including proper technique, number and types of exercises, and safety precautions.

People will improve if they do a single set of 8 to 10 different exercises (eg, chest press, shoulder press, triceps extension, biceps curl, pull-down, lower back extension, abdominal crunch/curl-up, quadriceps extension, and leg curls/calf raise) that train the major muscle groups, 2 or 3 days weekly. Although they can work out more times a week and do more sets per session, the additional gains among those in adult fitness programs are usually small.[41,42]

To achieve a balanced increase in both muscular strength and endurance, a repeti-

TABLE 2

Strategies that improve adherence to cardiovascular disease prevention regimens

- Signed agreements
- Behavioral skill training
- Self-monitoring
- Telephone/mail contact
- Spouse support
- Self-efficacy enhancement
- Contingency contracting
- Exercise prescription
  - Frequent short periods
- External cognitive aids
  - Appointment reminder letter
  - Follow-up letter for missed appointments
  - Medication refill reminder
  - Unit-of-use packaging
  - Medication reminder chart
- Persuasive communication
- Convenience
  - Work-site clinic (nurse-managed)
- Nurse-managed intervention
- School-based food service program plus education

tion range of 8 to 12 is recommended for healthy participants younger than 60 years and 10 to 15 repetitions at a lower relative resistance for cardiac patients and healthy participants 60 years of age and older.[41] Older or more frail people should do more repetitions with less weight to prevent injury. Also, higher-intensity efforts (fewer repetitions with more weight) can have adverse effects on the knee (leg extension) and shoulder (rotator cuff) areas.[35]

PROMOTING ADHERENCE TO EXERCISE

Various programs are available to promote patients' adherence to physical activity. One program[43,44] uses interactive health communication technologies to promote physical activity and healthy nutrition for adolescents and adults. This can be incorporated into clinical settings such as the Patient-centered Assessment and Counseling for Exercise Plus Nutrition (PACE+) programs. Health care providers should do the following if using such programs:

- Elicit a physical activity history
- Provide advice and reading material on principles of physical activity
- Recommend moderate-intensity physical activity at least 30 minutes daily.

TABLE 2 lists strategies that have been successful in improving adherence to the Cardiovascular Disease Prevention Program.

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