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## The effects of physical activity on heart

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### Abstract

A sedentary lifestyle is one of the 5 major risk factors (along with high blood pressure, abnormal values for blood lipids, smoking, and obesity) for cardiovascular disease, as outlined by the AHA. Evidence from many scientific studies shows that reducing these risk factors decreases the chance of having a heart attack or experiencing another cardiac event, such as a stroke, and reduces the possibility of needing a coronary revascularization procedure (bypass surgery or coronary angioplasty). Regular exercise has a favorable effect on many of the established risk factors for cardiovascular disease. For example, exercise promotes weight reduction and can help reduce blood pressure. Exercise can reduce “bad” cholesterol levels in the blood (the low-density lipoprotein [LDL] level), as well as total cholesterol, and can raise the “good” cholesterol (the high-density lipoprotein level [HDL]). In diabetic patients, regular activity favorably affects the body’s ability to use insulin to control glucose levels in the blood. Although the effect of an exercise program on any single risk factor may generally be small, the effect of continued, moderate exercise on overall cardiovascular risk, when combined with other lifestyle modifications (such as proper nutrition, smoking cessation, and medication use), can be dramatic.

**Keywords:** Physical activity, cardiovascular disease, Heart, Effects.

### Introduction

This chapter examines the relationship of physical activity and cardiorespiratory fitness to a variety of health problems. The primary focus is on diseases and conditions for which sufficient data exist to evaluate an association with physical activity, the strength of such relationships, and their potential biologic mechanisms. Because most of the research to date has addressed the health effects of endurance type physical activity (involving repetitive use of large muscle groups, such as in walking and bicycling), this chapter focuses on that type of activity. Unless otherwise specified, the term physical activity should be understood to refer to endurance-type physical activity.

Less well studied are the health effects of resistance-type physical activity (i.e., that which develops muscular strength); when this type of physical activity is discussed, it is specified as such. Much of the research summarized is based on studies having only white men as participants; it remains to be clarified whether the relationships described here are the same for women, racial and ethnic minority groups, and people with disabilities. Physical activity is difficult to measure directly. Three types of physical activity measures have been used in observational studies over the last 40 years. Most studies have relied on self-reported level of physical activity, as recalled by people prompted by a questionnaire or interview.

A more objectively measured characteristic is cardiorespiratory fitness (also referred to as cardiorespiratory endurance) which is measured by aerobic power (see Chapter 2 for more information on measurement issues). Some studies have relied on an occupation to classify people, according to how likely they were to be physically active at work. Epidemiologic studies of physical activity and health have compared the activity levels of people who have or developmental diseases and those who do not. Cohort studies follow populations forward in time to observe how physical activity habits affect disease occurrence or death. In case-control studies, groups of persons who have the disease and separate groups of people who do not have the disease are asked to recall their previous physical activity. Cross-sectional studies assess the association between physical activity and disease at the same point in time. Clinical trials, on the other hand, attempt to alter physical activity patterns and then assess whether the disease occurrence is modified as a result. Results from epidemiologic studies

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can be used to estimate the relative magnitude or strength of an association between physical activity and a health outcome.

### **How much exercise is enough?**

In 1996, the release of the Surgeon General's Report on Physical Activity and Health provided a springboard for the largest government effort to date to promote physical activity among Americans. This historical turning point redefined exercise as a key component to health promotion and disease prevention, and on the basis of this report, the Federal government mounted a multi-year educational campaign. The Surgeon General's Report, a joint CDC/ACSM consensus statement, and a National Institutes of Health report agreed that the benefits mentioned above will generally occur by engaging in at least 30 minutes of modest activity on most, preferably all, days of the week. Modest activity is defined as any activity that is similar in intensity to brisk walking at a rate of about 3 to 4 miles per hour. These activities can include any other form of occupational or recreational activity that is dynamic in nature and of similar intensity, such as cycling, yard work, and swimming. This amount of exercise equates to approximately five to seven 30-minute sessions per week at an intensity equivalent to 3 to 6 METs or approximately 600 to 1200 calories expended per week.

Note that the specific phrase "... 30 minutes of accumulated activity..." is used in the above-mentioned reports. It has been shown that repeated intermittent or shorter bouts of activity (such as 10 minutes) that include occupational and recreational activity or the tasks of daily living have similar cardiovascular and other health benefits if performed at the moderate intensity level with an accumulated duration of at least 30 minutes per day. People who have already met these standards will receive additional benefits from more vigorous activity.

Many of the studies documenting the benefits of exercise typically use programs consisting of 30 to 60 minutes of continuous exercise 3 days per week at an intensity corresponding to 60% to 75% of the individual's heart rate reserve. It is not usually necessary, however, for healthy adults to measure heart rate diligently because substantial health benefits can occur through modest levels of daily activity, irrespective of the specific exercise intensity. In fact, researchers estimate that as much as a 30% to 40% reduction in cardiovascular events is possible if most Americans were simply to meet the government recommendations for action.

### **What are the risks of exercise?**

During exercise, there is a transient increase in the risk of having a cardiac-related complication (for example, a heart attack or serious heart rhythm disorder). However, this risk is extremely small. For adults without existing heart disease, the risk of a cardiac event or complication ranges between 1 in 400 000–800 000 hours of exercise. In patients with existing heart disease, an event can occur an average of once in 62 000 hours. Importantly, the risk of a cardiac event is significantly lower among regular exercisers. Evidence suggests that a sedentary person's risk is nearly 50 times higher than the risk for a person who exercises about 5 times per week. Stated simply, individuals who exercise regularly are much less likely to experience a problem during exercise. Moreover, contrary to popular view, the majority of heart

attacks (approximately 90%) occurs in the resting state, not during physical activity.

### **How should you begin if you want to become more physically active?**

First, if you currently have heart disease or are over 45 years of age and have 2 or more risk factors (immediate family member with heart disease before age 55, cigarette smoking, high blood pressure, abnormal cholesterol levels, diabetes, sedentary lifestyle, or obesity), you should consult your physician before starting any type of exercise [2]. Clearly, most people can derive significant benefits from integrating a half hour of moderate activity into their day. If you know you simply cannot or will not set aside a half hour of activity on a given day, then try to work more activities into the day by taking the stairs rather than the elevator, or try walking rather than driving a short distance to the store. Try to work several shorter periods of activity, such as 10 minutes, into your schedule. The most important thing is to get started. There is mounting evidence in the scientific literature that physical activity and physical fitness have a powerful influence on a host of chronic diseases, a fact underscored by the recent Surgeon General's report on Physical Activity and Health.

### **Physical Activity and Heart Disease facts**

Physical inactivity is a major risk factor for heart disease and stroke, and contributes to most other modifiable risk factors including diabetes, obesity, high blood pressure and high blood cholesterol.

Physical activity has been shown to contribute significantly to psychological well-being and reductions in rates of depression [7]. Physical activity plays an important role in improving stress management and supporting smoking cessation.

The most recent Canadian Health Measures Survey found that 85% of Canadian adults currently do not meet the recommended amount of physical activity [13], which is 150 minutes of moderate to vigorous aerobic activity per week, accumulated in bouts of 10 minutes or more of all the risk factors for heart disease and stroke, physical inactivity is the most prevalent.

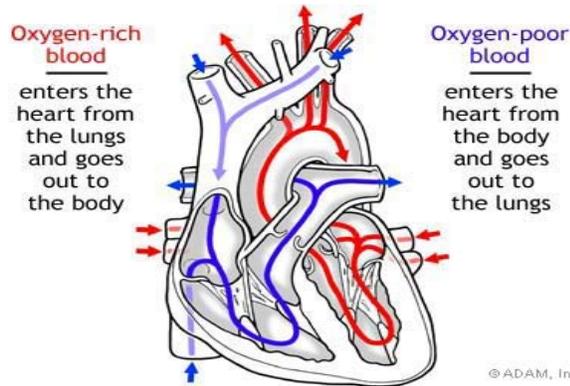
Ninety-three percent of Canadian children and youth are not meeting the physical activity amount recommended by the Public Health Agency of Canada and the World Health Organization, which is 60 minutes of moderate to vigorous physical activity every day.

Canadian children and youth report spending twice as much time in front of a screen (computer and/or television) as they do engage in physical activity.

Physical activity helps to prevent heart disease and stroke by, among other things, lowering blood pressure and increasing levels of high density lipoprotein (HDL) cholesterol ('good' cholesterol) [19]. Physical activity can also help people who already have heart disease avoid additional

### **Exercise's Effects on the Heart**

Inactivity is one of the major risk factors for heart disease. However, exercise helps improve heart health, and can even reverse some heart disease risk factors. Like all muscles, the heart becomes stronger as a result of exercise, so it can pump more blood through the body with every beat and continue working at maximum level, if needed, with less strain.



### Effects of Exercise on Heart Disease and Cholesterol

Exercise has a number of effects that benefit the heart and circulation (blood flow throughout the body). These benefits include improving cholesterol and fat levels, reducing inflammation in the arteries, helping weight loss programs, and helping to keep blood vessels flexible and open. Studies continue to show that physical activity and avoiding high-fat foods are the two most successful means of reaching and maintaining heart-healthy levels of fitness and weight.

### Benefits of Regular Exercise on Cardiovascular Risk Factors

- ✦ Control your weight
- ✦ Reduce your risk of cardiovascular disease
- ✦ Reduce your risk for type 2 diabetes and metabolic syndrome
- ✦ Reduce your risk of some cancers
- ✦ Strengthen your bones and muscles
- ✦ Improve your mental health and mood
- ✦ Improve your ability to do daily activities and prevent falls, if you're an older adult
- ✦ Longer, Increase in exercise tolerance
- ✦ Reduction in blood pressure

### There are a number of physiological benefits of exercise

As one's ability to transport and use oxygen improves, regular daily activities can be performed with less fatigue. This is particularly important for patients with cardiovascular disease, whose exercise capacity is typically lower than that of healthy individuals. There is also evidence that exercise training improves the capacity of the blood vessels to dilate in response to exercise or hormones, consistent with better vascular wall function and an improved ability to provide oxygen to the muscles during exercise. Studies measuring muscular strength and flexibility before and after exercise programs suggest that there are improvements in bone health and ability to perform daily activities, as well as a lower likelihood of developing back pain and of disability, particularly in older age groups.

Patients with newly diagnosed heart disease who participate in an exercise program report an earlier return to work and improvements in other measures of quality of life, such as more self-confidence, lower stress, and less anxiety. Importantly, by combining controlled studies, researchers have found that for heart attack patients who participated in a formal exercise program, the death rate is reduced by 20% to 25%. This is strong evidence in support of physical activity for patients with heart disease. Although the benefits of exercise are unquestionable, it should be noted that exercise programs alone for patients with heart disease have not

convincingly shown improvement in the heart's pumping ability or the diameter of the coronary vessels that supply oxygen to the heart muscle.

### Coronary Artery Disease

People who maintain an active lifestyle have a 45% lower risk of developing heart disease than do sedentary people. Experts have been attempting to define how much exercise is needed to produce heart benefits. Beneficial changes in cholesterol and lipid levels, including lower LDL ("bad" cholesterol) levels, occur even when people performed low amounts of moderate- or high-intensity exercise, such as walking or jogging 12 miles a week. However, more intense exercise is required to significantly change cholesterol levels, notably increasing HDL ("good" cholesterol). An example of this kind of intense program would be jogging about 20 miles a week. Benefits occur even with very modest weight loss, suggesting that overweight people who have trouble losing pounds can still achieve considerable heart benefits by exercising.

Some studies suggest that for the greatest heart protection, it is not the duration of a single exercise session that counts but the total weekly amount of energy expended. Resistance (weight) training has also been associated with heart protection. It may offer a complementary benefit to aerobics. If you have heart disease or risk factors for heart disease, check with your doctor before starting resistance training.

### Effects of Exercise on Blood Pressure

Regular exercise helps keep arteries elastic (flexible), even in older people. This, in turn, ensures good blood flow and normal blood pressure. Sedentary people have a 35% greater risk of developing high blood pressure than physically active people do.

It should be noted that high-intensity exercise may not lower blood pressure as effectively as moderate-intensity exercise. In one study, moderate exercise (jogging 2 miles a day) controlled high blood pressure so well that more than half the patients who had been taking drugs for the condition were able to discontinue their medication.

Experts recommend at least 30 minutes of exercise on most - if not all - days. Studies show that yoga and tai chi, an ancient Chinese exercise involving slow, relaxing movements, may lower blood pressure almost as well as moderate-intensity aerobic exercises.

Anyone with existing high blood pressure should discuss an exercise program with their doctor. Before starting to exercise, people with moderate-to-severe high blood pressure should lower their blood pressure, and be able to control it with medications. Everyone, especially people with high blood pressure, should breathe as normally as possible through each exercise. Holding the breath increases blood pressure.

### Effects of Exercise on Heart Failure

Traditionally, heart failure patients have been discouraged from exercising. Now, exercise performed under medical supervision is proving to be helpful for select patients with stable heart failure.

Progressive resistance training may be particularly useful for heart failure patients, since it strengthens muscles, which commonly weaken in this disorder. Simply performing daily handgrip exercises can improve blood flow through the arteries. Experts warn, however, that the exercise is not appropriate for all heart failure patients.

### **Effects of exercise on strokes**

Physical activity lowers stroke risk. All stroke survivors should have a medical evaluation before starting an exercise program. The effects of exercise on stroke are less established than those with heart disease, but most studies show benefits.

### **Exercise Programs for High-Risk Individuals**

Anyone with heart disease or risk factors for developing heart disease or stroke should seek medical advice before beginning a workout program. Patients with heart disease can nearly always exercise safely as long as they are evaluated beforehand. Some will need to begin their workout under medical supervision. Still, it is often difficult for a doctor to predict health problems that might arise as the result of an exercise program. At-risk individuals should be very aware of any symptoms warning of harmful complications while they exercise.

Some believe that anyone over 40 years old, whether or not they are at risk for heart disease, should have a complete physical examination before starting or intensifying an exercise program. Some doctors use a questionnaire for people over 40 to help determine whether they require such an examination. The questions they use are as follows:

- Has any doctor previously recommended medically supervised activity because of a heart condition?
- Does physical activity bring on chest pain?
- Has chest pain occurred during the previous month?
- Does the person faint or fall over from dizziness?
- Does bone or joint pain intensify during or after exercise?
- Has medication been prescribed for hypertension (high blood pressure) or heart problems?

### **Heart Attack and Sudden Death from Strenuous Exercise**

A small percentage of heart attacks occur after heavy physical work.

**High-Risk Individuals.** In general, the following people should avoid intense exercise or start it only with careful monitoring:

- People who have certain medical conditions: These conditions include uncontrolled diabetes, uncontrolled seizures, uncontrolled high blood pressure, and a heart attack within the previous 6 months, heart failure, unstable angina, significant aortic valve disease, or aortic aneurysm.
- People with moderate-to-severe hypertension: Moderate or severe high blood pressure (systolic blood pressure over 160 mm Hg or diastolic (lower number) pressure over 100 mm Hg) should be brought to lower levels before a person starts a vigorous exercise program.
- Sedentary people should be cautious.
- Episodes of exercise-related sudden death in young people are rare, but of great concern. Some are preceded by fainting, which is due to a sudden and severe drop in blood pressure. It should be noted that fainting is relatively common in athletes, and is dangerous only in people with existing heart conditions. Young people with genetic or congenital (present at birth) heart disorders should avoid intensive competitive sports.
- Anabolic steroids or products containing ephedra have been associated with cases of stroke, heart attack, and even death.

The risk for heart attack from exercise should be kept in perspective, however. Some form of exercise, carefully personalized, has benefits for most of the individuals mentioned above. In many cases, particularly when the only risk factors are a sedentary lifestyle and older age, exercise can often be increased over time until it is intense.

### **Hazardous Activities for High-Risk Individuals.**

The following activities may pose particular dangers for high-risk individuals:

- Intense workouts may be particularly hazardous for people with risk factors for heart disease, especially older people. Examples of intense workouts include snow shoveling, running, race walking, tennis, heavy lifting, heavy gardening. These workouts tend to stress the heart, raise blood pressure for a brief period, and may cause spasms in the arteries leading to the heart. Some studies suggest that competitive sports, which couple intense activity with aggressive emotions, are more likely to trigger a heart attack than other forms of exercise.

### **Listening for Warning Signs**

It should be noted that according to one study, at least 40% of young men who die suddenly during a workout have previously experienced, and ignored, warning signs of heart disease. In addition to avoiding risky activities, the best preventive tactic is simply to listen to the body and seek medical help at the first sign of symptoms during or following exercise. These symptoms include the following:

- Irregular heartbeat
- Shortness of breath
- Chest pain

### **Benefits of regular physical activity**

You know exercise is good for you, but do you know how good? From boosting your mood to improving your sex life, find out how exercise can improve your life. Want to feel better, have more energy and perhaps even live longer? Look no further than exercise. The health benefits of regular exercise and physical activity are hard to ignore. And the benefits of exercise are yours for the taking, regardless of your age, sex or physical ability. Need more convincing to exercise? Check out these seven ways exercise can improve your life.

#### **❖ Exercise controls weight**

Exercise can help prevent excess weight gain or help maintain weight loss. When you engage in physical activity, you burn calories. The more intense the activity, the more calories you burn. You don't need to set aside large chunks of time for exercise to reap weight-loss benefits. If you can't do an actual workout, get more active throughout the day in simple ways by taking the stairs instead of the elevator or revving up your household chores.

#### **❖ Exercise combats health conditions and diseases**

Worried about heart disease? Hoping to prevent high blood pressure? No matter what your current weight, being active boosts high-density lipoprotein (HDL), or "good," cholesterol and decreases unhealthy triglycerides. This one-two punch keeps your blood flowing smoothly, which decreases your risk of cardiovascular diseases. In fact, regular physical activity can help you prevent or manage a

wide range of health problems and concerns, including stroke, metabolic syndrome, type 2 diabetes, depression, and certain types of cancer, arthritis and falls.

❖ **Exercise improves mood**

Need an emotional lift? Or need to blow off some steam after a stressful day? A workout at the gym or a brisk 30-minute walk can help. Physical activity stimulates various brain chemicals that may leave you feeling happier and more relaxed. You may also feel better about your appearance and yourself when you exercise regularly, which can boost your confidence and improve your self-esteem.

❖ **Exercise boosts energy**

Winded by grocery shopping or household chores? Regular physical activity can improve your muscle strength and boost your endurance. Exercise and physical activity deliver oxygen and nutrients to your tissues and help your cardiovascular system work more efficiently. And when your heart and lungs work more efficiently, you have more energy to go about your daily chores.

**Conclusions**

The data reviewed here suggest that regular physical activity and higher cardio respiratory fitness decrease overall mortality rates in a dose-response fashion. Whereas most studies of physical activity and health address specific diseases and health conditions, the studies in this chapter provide more insight into the biologic mechanisms by which mortality rate reduction occurs.

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