EMPOWER YOUR HEALTH
GUIDE TO PHYSICAL ACTIVITY

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The sponsors of this guide are dedicated to the prevention of endocrine disorders, such as diabetes, obesity, osteoporosis and high cholesterol. They are dedicated to improving the lives of patients through healthy lifestyles.
# Table of Contents

**Introduction**  
*The EmPower Guide to Physical Activity*  
Donald A. Bergman, MD, FACE  

**Chapter Summaries**  
Donald A. Bergman, MD, FACE  

**Chapter 1**  
*Physiology of Physical Activity*  
Jeffrey I. Mechanick, MD, FACP, FACE, FACN  

**Chapter 2**  
*Physical Activity and Cardiovascular Health*  
Sandy Friedman, MD  

**Chapter 3**  
*Physical Activity and Weight Loss*  
Martin M. Grajower, MD, FACP, FACE  

**Chapter 4**  
*Physical Activity and Bone Health*  
Paula Rackoff, MD  

**Chapter 5**  
*Physical Activity and Diabetes*  
Zachary T. Bloomgarden, MD, FACE  

**Chapter 6**  
*Physical Activity for Pregnant Women with Diabetes*  
Lois G. Jovanovic, MD, FACE
Chapter 7
*Physical Activity for the Physically Challenged*
Suman K. Mishr, MD, FACE

Chapter 8
*Physical Activity for the Elderly*
Kristina Blohm Rudgear, MD
Special section included

*How to Improve Your Balance*
U.S. Department of Health and Human Services, National Institute on Aging

Appendix 1

**Specific activity for your workout from the President’s Council on Physical Fitness and Sports**

*Stay Active and Be Fit!*
U.S. Department of Health and Human Services, President’s Council on Physical Fitness and Sports

Appendix 2

**Additional Stretching, Strength Training and Endurance Activity**

*President’s Challenge: Physical Activity*

*Get Fit and Be Active! How to Be More Active and Get in Shape to Meet the President’s Challenge.*
U.S. Department of Health and Human Services, President’s Council on Physical Fitness and Sports
Introduction

Guide to Physical Activity

“To life!” is an ancient toast that still can be heard at celebrations today. It is also the first line of a song from a popular Broadway musical which deals with enduring values in a turbulent world. Most cultures and religions around the world celebrate the value and beauty of life. And yet, a passage from one of the world’s oldest religions reminds us that we have a choice. The Old Testament says that we can choose life or death, and asks us to choose life so that we and our children may live.

Today, we are plagued with the twin epidemics of poor nutrition and lack of physical activity. Around the world, from large cities to remote Pacific Islands, we see adults and children who are overweight because of too much food and too little activity. We are raising a generation of overweight children who may die before their parents. We are making the wrong choices. It is time to choose wisely, to choose life, to choose better nutrition, and more activity.

Physical activity has remarkable power. As mentioned in the chapters of this guide, physical activity can help us survive heart attacks and cancer. People are not active because they do not have the time or because they do not know how to get started. This manual explains how to get started. It deals with physical activity in general, and also deals with special circumstances: children, the elderly, the physically challenged, and people with diabetes, heart disease, obesity, low bone mass, or who are pregnant.

This guide is the first produced by the American Association of Clinical Endocrinologists (AACE) and the American College of Endocrinology (ACE). I would like to recognize the great effort of: the Co-Editor, Dr. Rhoda Cobin; the authors of each chapter (who are listed separately on the title page); Dr. Martin Grajower, who came to AACE with the idea for this book; and the AACE staff, including Lauren Corley, Bryan Campbell, Sarah Bradley, Sissy Horn, Nicole Wilhelm, and Don Jones, the CEO of AACE. Lastly, I would like to thank Donald Liss, MD, Assistant Clinical Professor of Rehabilitative Medicine at Columbia University and Co-Director of The Physical Medicine and Rehabilitation Center, P.A., for his information about physical activity programs.
Getting Started
First, read the chapter which best describes your condition. For example read chapter 8 if you are over 65. Even though only one or two of these chapters may apply to you, you will learn a lot about the value of physical activity by reading all of the chapters. Each chapter explains, in medically correct but easy to understand language, why physical activity is good for you. These chapters also help you understand what type of physical activity will be appropriate for your condition.

This symbol at the beginning of a paragraph means the paragraph deals with specific types of physical activity.

After you have read the chapters of this guide, please refer to the final two sections in this guide. These sections describe specific activities for your workout from the President’s Council on Physical Fitness and Sports. You will also get tips on how to get in shape for the President’s Award.

Tips to Remember
• You should always begin your workout with a warm up, then do some stretching, followed by brief strength training, and finish with an endurance type of activity (such as walking or jogging). You should then have a cool down period followed by more stretching. If you are middle-aged or older, balance training is helpful (see page 89 for examples of balance exercises).

• You must start your workout gradually, particularly if you are out of shape.

• Certain types of activity may be dangerous if you have problems such as heart disease, osteoporosis, diabetes, or if you are pregnant. Always check with your doctor before beginning a new physical activity program.

• Compulsive physical overactivity is not healthy. Check with your doctor about the type and amount of physical activity that is right for your body type.

Remember, physical activity is for everyone. No excuses!

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EmPower Your Health Guide to Physical Activity
Physiology of Physical Activity

There are two main types of exercise. Strength training, such as sprinting or lifting weights, involves specific groups of muscles, and is particularly useful in people who are out of shape or elderly. Endurance training (running, jogging, swimming, rowing) improves cardio-respiratory fitness. Exercise involves the use of oxygen to burn food, which releases energy (aerobic exercise). When a person is physically fit hormone levels improve, the immune system works better, and the heart pumps more efficiently.

Physical Activity and Cardiovascular Health

Physical activity reduces the impact of many risk factors for stroke and heart attack. People who get regular physical activity are less likely to develop adult onset (type 2) diabetes. Physical activity also lowers blood pressure, improves cholesterol, and may even reduce the risk of metastatic (widespread) cancer. Being physically fit helps to stabilize the lining of blood vessels (endothelium) where damage takes place and where plaque buildup begins.

Physical Activity and Weight Loss

To improve cardiovascular health, a person needs to sweat. On the other hand, weight loss involves simply burning calories, and any form of physical activity will do. You will burn the same number of calories if you walk a mile in 30 minutes or sprint that same mile in six minutes. Burn more calories than you eat, and you will lose weight.
Physical Activity and Bone Health

The best time to stimulate bone growth is when children are 11 to 14 years of age. Gymnastics and weight lifting produce the greatest gains in bone mass at this time. Too much exercise, however, if it is associated with disordered eating patterns and decreased hormone levels, can actually lead to bone loss. Physical activity during adulthood helps to maintain bone mass. Many short sessions of physical activity build more bone than the same amount of physical activity performed in a single session. Activity should include resistance (such as weight lifting), and weight bearing (such as tennis, stair climbing, and jumping). Physical activity for the older adult should include balance training and gait training. Abdominal crunches and physical activity that stresses the bones must be avoided in people who already have osteoporosis.

Physical Activity and Diabetes

Physical activity improves the uptake of sugar by skeletal muscles in a way that is independent of and complementary to the effect of insulin. Physical activity also increases the effect of insulin on the muscles. This helps to improve the uptake of sugar into muscle and lower the lipid levels in the muscles. Physical activity also helps patients lose weight and reduce fat in the abdominal wall. Physical activity of any kind provides health benefits; the activity does not have to be vigorous. However, daily exercise provides the most benefit. Five thousand steps per day is a reasonable goal (two thousand steps equal one mile). Use a pedometer to measure your progress. Both endurance types of activity and strength training are useful. Special precautions must be taken in diabetics who are on medication (insulin as well as oral agents) to avoid hypoglycemia. Moderate to high intensity physical activity may be a problem for diabetics with certain types of eye disease (such as retinopathy) neuropathy, and cardiac and vascular disease. Check with your physician first.

Physical Activity for Pregnant Women with Diabetes

Pregnant women with diabetes who have regularly exercised before pregnancy can continue during pregnancy. For those out of shape, beginning a cardiovascular fitness program during the first trimester is not recommended. Arm exercise machines provide a reasonable form of physical activity for pregnant women who are out of shape. However, certain types of physical activity may affect the uterus, the baby’s heart rate, and delivery of sugar to the baby. Check first with your obstetrician and your endocrinologist.
Physical Activity for the Physically Challenged

Start with low intensity aerobic exercises for 10 to 15 minute sessions, three to five times a week. Stop if you feel fatigued. First do strength-training exercises using heavier weights to strengthen atrophied muscles. Next, do repetitive exercises, using lighter weights if mobility is a problem, to increase endurance. Flexibility training (stretching) improves range of motion, balance, coordination, and the ability to carry out the regular activities of daily living. The “talk test” and measuring heart rate helps you to gauge whether your activity is light intensity, moderate intensity, or high intensity. Type of activity, workload, duration, and intensity must be modified according to the type and extent of physical limitation.

Physical Activity for the Elderly

“Elderly” used to refer to people over 60; but, by keeping physically fit and adopting healthy life styles, we have some control over whether or not we are truly “elderly.” Physical activity refers to any activity that uses muscles, increases the heart rate, and spends more energy than it takes the body to maintain itself. A regular program of physical activity increases the number of blood carrying capillaries in our muscles. This improves the delivery of oxygen and nutrients. Resistance training increases the size and number of muscle fibers, increases the strength of muscles and tendons, and improves joint stability. Endurance training increases the ability of the muscles to store food energy as glycogen. All forms of physical activity increase the number of mitochondria (energy factories) in muscle cells. This improves the body’s metabolism and use of strength training and balance training are particularly good for the nervous system. Also, physical activity increases oxygen flow to the brain.

Physical Activity for Children

Activity should last a minimum of 30 minutes and take place three times a week. Start gradually. Use your heart rate as a goal (for example children age 10 to 17 will want to maintain a heart rate of 148 beats per minute, which they can work up to gradually). Always check with your physician, to be sure this is a safe and reasonable goal. Do not push yourself. You should stretch before and after exercise for a total of 10 to 12 minutes per day. You should drink water during exercise and after exercise, even if you do not feel thirsty. Vary your routine, because different exercises work different muscle groups.
Exercise and physical activity are essential components of any healthy lifestyle; they help us feel better and live longer. They have profound and wide-ranging effects on the body, far beyond muscle building. Understanding the physiology of exercise, the changes it produces within the body, will help us appreciate its benefits and hopefully encourage us to make exercise an important part of our lives.

Coming to Terms
Before discussing the changes exercise produces within the body, we should define some terms.

**Physical activity** is any contraction by skeletal muscles that results in an energy expenditure that is greater than the resting energy expenditure.

**Exercise** is planned, structured, and repetitive body movements that improve physical fitness. People usually exercise as part of a leisure activity.

**Aerobic exercise** involves continuous, rhythmic, and repetitive movements of large muscle groups. Examples of aerobic exercise are running, jogging, cycling, cross-country skiing, swimming, and rowing. Energy for this type of activity is supplied by the “burning” of food (fuel) in the presence of oxygen. Carbon dioxide and water are produced as by-products.

**Anaerobic exercise** happens during extreme aerobic activity when not enough oxygen is available to burn food (fuel). Lactic acid is produced as a by-product when energy is created from food and muscle fatigue occurs. Anaerobic exercise metabolism also occurs during isometric (muscle-building) strength training types of activity (lifting weights or doing squats).

**Resistance training** improves muscle strength by isotonic weight training or isometric exercises.
**Endurance training**, such as running, jogging, swimming, and rowing, improves cardio-respiratory fitness through regular and frequent aerobic exercise sessions.

**Eccentric exercise** involves lengthening of the muscle fibers as tension develops, for example, downhill running, downhill skiing, stretching, and long jumps.

**Flexibility exercises**, such as stretching and yoga, improve the slow (static) or fast (dynamic) range of motion of a particular joint and may lessen the risk of joint injury.

**Sport** is a form of exercise that involves a set of rules and competition, for example, soccer, baseball, football, basketball, gymnastics, track and field, and lacrosse.

**Exercise economy** is the speed per energy consumption.

**Isotonic exercise** is repetitive low-resistance training such as running or swimming. This is continuous exercise which results in huffing in puffing (see chapter two).

**Isometric exercise** is high-resistance, low-repetition activity such as lifting weights and squats. This type of exercise builds muscle mass and helps to build muscle strength in the elderly or in people who have not exercised recently.

**Exercise efficiency** is the power output per energy consumption.

**Synchronous exercise** refers to the use of muscle groups which are called fast-twitch muscles. These are strength-training exercises such as sprinting.

**Asynchronous exercise** involves the use of different kinds of muscles, which are usually slow-twitch muscles (muscles that have the increased ability to use oxygen to produce energy from food). These are endurance exercises such as marathon running.

**How Physical Activity Affects the Body**

The body responds to physical activity by making many lasting changes that improve the workings of the circulatory and respiratory systems. Physical activity reduces the risk of heart disease. Physical activity also improves blood glucose levels in patients with diabetes, which protects their heart and helps them live longer.

The body’s response to physical activity is coordinated by the brain and endocrine (hormonal) system. Hormones control growth, metabolism, mood, and reproduction, and influence almost every cell.
and organ in our body. When a person is physically fit, the *parasympathetic nervous system* dominates, making the heart beat slower. When a person is out of shape, the *sympathetic nervous system* is overactive, especially at rest, and the heart beats faster. Physical activity also increases levels of testosterone, a hormone that builds muscle (anabolic), and decreases levels of cortisol, a stress hormone that breaks down muscle to be used as fuel (catabolic). Moderate, regular physical activity (such as brisk walks) also causes several positive changes in the immune system. Various immune cells circulate through the body more quickly, and are better able to kill bacteria and viruses. On the other hand, too much intense activity can suppress the immune system for 3 to 72 hours, increasing the risk of infection. Indeed, there is a complex interplay among the brain, immune system, and endocrine system during physical activity.

So what happens when we take part in physical activity? First, the *cardiac output* increases. The heart pumps more blood to deliver more oxygen and fuel to the working muscles and organs. As we age, our heart slows down. Your maximum heart rate, the greatest number of times per minute your heart is capable of beating, is about 220 minus your age. However, endurance training conditions the heart to beat more efficiently. It beats slower, but pumps more blood with each beat. In technical terms, the *stroke volume* increases. This is the amount of blood ejected by the left ventricle of your heart with each beat.

**Muscling In**

Muscles also work more efficiently when the heart delivers extra oxygen and fuel during physical activity. Moreover, *mitochondria*, our cellular power plants, become more efficient at producing energy. Muscles burn stored glucose to produce the cellular fuel adenosine triphosphate (ATP). ATP is, in fact, the fuel for energy within every cell in the body. This glucose-ATP conversion produces pyruvate. Extra oxygen is needed to breakdown this pyruvate, or it will produce lactic acid, which impairs muscle contraction and stimulates nerve endings in the muscle to produce the pain (the burn) felt with intense physical activity. Thus, the maximal amount of oxygen consumed by the body (VO2max) increases with intense physical activity. There is a point at which the body produces lactic acid so rapidly that it can no longer remove it from the working muscles quickly enough. This is the *lactate threshold*. With training, it is possible to push your threshold higher, from 60% of
the VO2max up to 80%. All processes involved with the effects of physical activity on muscle are determined by our genes, and so may differ from person to person.

Strength training improves the synchronous recruitment of muscles by the nervous system, while endurance training improves the asynchronous recruitment of muscles. Synchronous recruitment in muscles with resistance exercises results in the coincident firing of multiple motor units and ultimately increased physical force from synergistic muscles. These neural adaptations which coordinate synchronous recruitment produce a training effect of increased strength within the first two weeks of resistance exercise. Sprinting and high-intensity exercises recruit fast-twitch muscles. Slow-twitch muscles, with increased mitochondria (the power plants) and myoglobin (the oxygen-transporting and storage protein of muscle), are important for endurance sports, like marathon running. Most people have 50% fast-twitch and 50% slow-twitch muscles. This can vary with genetic makeup, providing some athletes with an “unfair” advantage. We lose about 10% of fast-twitch muscles with each decade after age 50. Specific exercises can develop one type of muscle compared with the other, but cannot convert one type of muscle into the other.

Physical Activity and Diabetes
Physical activity clearly helps patients with diabetes. Because physical activity increases uptake of glucose by the muscles, people with diabetes may require less insulin with exercise. Muscle contraction increases the production of glucose transporters, which increases glucose uptake independent of insulin. This helps avoid high blood glucose levels even in diabetes where there is insulin deficiency (type 1) or insulin resistance (type 2). The lower blood glucose levels activate the sympathetic nervous system, which sends a signal to increase the production of adrenaline. Adrenaline improves muscle mitochondrial function and endurance. Other pathways are also activated with muscle contraction, which redirect glucose away from the synthesis of glycogen so that it can be used for energy.

Part of YOUR Lifestyle
In conclusion, physical activity is an essential part of a healthy lifestyle. Physical activity is relaxing, improves our state of mind, and helps the body work more efficiently in many ways. By causing positive changes in hormones and molecules in various tissues, physical activity can ultimately decrease our risk for heart disease and improve glucose control for persons with diabetes.
Everyone knows that physical activity is important. Still, only one in four Americans gets even the minimum recommended level of physical activity. Up to 250,000 Americans die each year from lack of physical activity. Nearly half of Americans are overweight or obese, and healthcare experts predict that this will cause a crisis of vascular disease. Inactive individuals double their risk of acquiring vascular disease, about the same increase associated with diabetes, hypertension, or smoking.

What Is Physical Activity?

In the following paragraphs “physical activity” will refer to isotonic activity, which produces aerobic metabolism. Isotonic refers to highly repetitive, low-resistance training such as running, biking, rowing, swimming and all sports with continuous activity requiring huffing and puffing. Energy for this is very efficiently supplied by the burning of sugars and fats in the presence of oxygen and is called aerobic. At rest there are about 600 calories of sugar and 100,000 calories of fat available for fuel. At the very beginning of physical activity, fat, in the form of free fatty acids, is preferentially consumed. As physical activity becomes more intense, the body begins to use glucose (a type of sugar). Even though far more energy is stored as fat than as glucose, as much as 10 to 30% of consumed aerobic fuel is glucose. In extreme aerobic activity, the muscles cannot get enough oxygen to convert glucose to water and carbon dioxide. Instead, the body switches to its anaerobic mode of fuel consumption, producing lactic acid, associated with muscle fatigue. Isometric exercises are high-resistance, low-repetitive activities such as lifting heavy weights, pull-ups, squats, etc. These are exercises ideally suited for building muscle mass, which may be necessary for some people (for example, the elderly) to strengthen weakened muscles enough to permit aerobic activity. Isometric exercise mostly uses the anaerobic mode of metabolism.
Reduces Risk Factors

Physical activity reduces the impact of many risk factors for stroke and heart attack. For example, during physical activity, uptake of the carbohydrate glucose improves, and insulin, a hormone that decreases blood glucose levels, becomes more effective. Consequently, blood levels of insulin decrease. This process may be beneficial. Although insulin deficiency is the hallmark of type 1 diabetes, paradoxically, because of tissue resistance, most often in overweight individuals, there is an excess of insulin in type 2 diabetes. Insulin excess can increase salt retention, constriction of arteries, excessive and pathologic growth of the smooth muscles of arterial walls, and stimulation of hormones such as adrenalin and renin, which in excess, are harmful to the vascular system. Exercise can improve, or in some cases even cure, insulin intolerance (which frequently precedes diabetes), and diabetes as well. People who get regular physical activity are much less likely to develop type 2 diabetes.

Physical activity also lowers high blood pressure. Both systolic and diastolic hypertension will decrease by 4 to 5 mm Hg, independent of weight loss, in people who take part in physical activity on a regular basis.

Improves Lipid Levels

Blood fats, referred to as lipids, exist in a variety of shapes and chemical compositions. The fats themselves are usually bound to proteins, and the resultant molecule can have great independent importance. Cholesterol bound to protein can be described as a high-, intermediate-, low-, or very-low-density lipoprotein. Low-density lipoprotein (LDL, “bad cholesterol”) in excess is a potent risk factor for vascular disease. However, up to 40% of people with stroke or heart attack have lower levels of LDL cholesterol than the population at large. For decades researchers have realized that the problem is more complex than just cholesterol, and, yes, physical activity just might play a role. Clusters of LDL molecules exist in the bloodstream in two sizes: large, “fluffy” molecules and small, dense molecules. The small molecules are more likely to acquire a charge through an electron transfer process called oxidation. In this state they become “attack molecules” that are more likely to attach to vascular wall receptors and find their way into the vessel wall, causing atherosclerotic plaque.

Unconfirmed evidence suggests that physical activity somehow causes these small dense LDL molecules to change into large, “fluffy,” less harmful LDL
molecules. Low levels of high-density lipoprotein (HDL, “good cholesterol”) are two or three times more important than LDL in predicting the risk for heart attack, and independently as important as a risk for stroke. HDL is involved in reverse cholesterol transport; that is, it helps transport cholesterol out of cells of the arteries and back into the bloodstream. It also stops fat-containing cells from sticking to the vascular lining, blocks excessive cell production within the arterial wall, and helps prevent inflammation within the arterial wall. Inflammation is known to be a major factor in both the production of atherosclerotic plaques and rupturing of these plaques, leading to vessel clotting and blockages (occlusion).

Low HDL is commonly associated with high triglycerides, a fat consisting of a molecule of glycerol usually bound to three molecules of the fatty acids. Fatty acids are the main energy supplier of fats. The combination of low HDL and high triglyceride is often more dangerous than high cholesterol alone and is associated with fat collecting around the gut (central obesity), caused by fat coating the intestines and its attachments. This combination is also associated with insensitivity to insulin, pre-diabetes, and type 2 diabetes. In type 2 diabetes, blood sugar levels are elevated, especially after eating, due to decreased sensitivity of body tissues to insulin. Unfortunately, correction of the low HDL /high triglyceride condition is more difficult than lowering the LDL. Physical activity is one of the most important interventions; it lowers triglycerides and raises HDL. Dramatic improvements have been seen in patients who exercise; improvements greater than described in most studies. These successful patients, however, get at least 30–45 minutes per day of physical activity, five or six days per week. This usually reduces central obesity. A genetic factor exists, which explains why different people will require different amounts of physical activity to achieve the same endpoint. However, even moderate physical activity (such as walking), and mild increases in HDL, will have some positive effect. Every 1% mg increase in HDL reduces the risk of vascular events by 3%.

**Improves Clotting**
Physical activity might help patients with various risk factors for cardiovascular disease. Increased blood stickiness (coagulability) predisposes to clotting, atherosclerosis, and vascular events. Excess fibrinogen, the main protein of clot formation, is a risk factor that seems to decrease in response to an exercise program. C-reactive protein (CRP), a nonspecific serum marker reflecting inflammation, is an independent
risk factor when not elevated as a consequence of an identifiable illness such as pneumonia, sinusitis, or allergy. CRP may be a stronger predictor than LDL, although it is most dangerous in the presence of elevated LDL, and loses much of its negative impact when the LDL is kept low. As with fibrinogen, levels of CRP decrease with physical activity.

**Improves Your Outlook**
Physical activity also decreases anxiety and depression, and enhances self-esteem. Investigators have discovered increased levels of neurohormones, endorphins, and opiate receptors in the brain after physical training. Psychological turmoil often leads to a heart attack, and these patients have poor outcomes following the attack. It has not been proven that anger management can improve cardiovascular outcome, but many practitioners have seen patients who have “worked themselves into the grave.” For some patients, physical activity could be the best prescription for their anxiety or depression.

Although difficult to prove, much evidence suggests that obsessive-compulsive personalities who are chronic smokers can substitute, or partially substitute, a regular routine of physical activity for smoking.

**Effect on the Cells**
Arteries carry heavily oxygenated blood to the tissues. When exposed to high sugar (diabetes), lipid abnormalities of various types, smoking, hypertension, high CRP and/or many other proposed risk factors, the arteries will malfunction before they eventually develop any signs of atherosclerosis. This state is called endothelial dysfunction. It refers to the loss of the ability of the vascular bed to normally dilate in response to physical activity. The endothelium is a single layer of cells lining the vessel wall, and is now known to manufacture and secrete many chemical substances essential for vessel health. For example, endothelin results in vessel constriction, whereas nitric oxide results in vessel dilatation, and is also an inhibitor of vessel inflammation. All of the major risk factors just mentioned deplete nitric oxide. Exercise can restore nitric oxide levels and reverse endothelial dysfunction.

Thus, physical activity has shown benefits on “soft endpoints” such as easily measured risk factors, which one would reasonably expect to result in less mortality and/or morbidity, referred to as “hard endpoints.” As expected, physical activity not only improves soft endpoints, but also seems to favorably affect hard endpoints. Observational studies
indicate aerobic activity reduces the risk of heart attack, death from heart attack, and even stroke. Surprisingly, aerobic physical activity may also decrease dementia. Even more surprisingly, evidence suggests that physical activity decreases the risk of colon cancer, breast cancer, cancer of female reproductive organs, and prostate cancer. Limited studies randomizing patients into control groups, or cardiac rehabilitation programs, following a cardiac event, indicate that physical activity can reduce mortality by up to 25%. Some skeptics point out that physical activity may not be the actual factor in improved health, but may rather be a marker of other positive behavior. For example, people who have a regular schedule of physical activity might be more likely to take their medications as prescribed or eat a healthier diet. Most physicians, however, believe that the evidence supplied by the soft endpoint data strongly supports the concept that physical activity improves morbidity and mortality, at least in cardiovascular disease.

Be Heart Smart
A lot depends on your present health. If your heart is healthy, it is almost impossible to damage it with too much physical activity. In a healthy heart, the valves open normally, and the larger coronary arteries, the vessels that carry blood into the contracting heart muscle, do not have serious obstructions. The heart muscle itself is of sufficient strength; and, there are no unusual congenital or electrical problems of the conduction system. Those with suspected or known heart disease must consult with their physicians; and, it is beyond the scope of this chapter to describe in detail the possible considerations. Most patients, with known coronary disease of sufficient severity to limit the intensity and duration of physical activity, would have mechanical intervention (angioplasty or coronary bypass surgery) rather than medication alone in order to be able to exercise without worrying about limitations. However, mechanical intervention is not possible in all patients, nor do all patients need it, particularly if the anatomic problem is not severe. On the other hand, even if patients feel well and their physical examination reveals no abnormality, additional tests might be necessary if risk factors place them at risk for a first heart attack or stroke.

Adults with diabetes are a special class. They appear to have the same risk of having a first heart attack as an adult without diabetes would have of a second heart attack, having survived the first. Moreover, although individuals
with diabetes often have the hallmark symptom of coronary disease, chest pain (angina pectoris), they are more likely than individuals without diabetes to be asymptomatic, or have only a minor shortness of breath.

The heart beats 80,000 times per day. If it misses even five beats in a row, the patient might drop to the floor, unconscious. The heart accomplishes its Herculean task by extracting a huge amount of oxygen from the bloodstream as it passes through the heart muscle, even when the patient is at rest. Compared to other organs, the heart muscle is more dependent on increasing flow in order to increase oxygen delivery, as opposed to extracting even more oxygen from the blood. As the work of the heart increases in response to an aerobic activity performed by particular muscle groups (by increasing heart rate, pumping against increasing systemic blood pressure and increasing the strength of each contraction), narrowing of a vessel could cause malfunctioning of that part of the heart muscle it supplies. Imagine putting a tourniquet around your bicep and rapidly pumping your fist. After a short period, you would notice a cramp in your forearm. You also might notice that the involved muscle groups feel hardened and less flexible. This state of increased blood requirement and insufficient blood flow is called ischemia. In the case of the heart, it is call myocardial ischemia. Also, relative to the heart, the symptoms are called angina.

Angina is not necessarily the same for all people. It depends as much on how one is “wired” as it does on which particular heart muscles are involved. In typical angina, the most common type, physical activity causes an increasing feeling of pressure over the precordium, the area over the heart and stomach. Occasionally this sensation spreads down the left shoulder and arm, or up to the jaw. Angina that does not follow this pattern is called atypical angina. A few of the many presentations of atypical angina include shortness of breath upon exertion, without chest discomfort, upper abdominal discomfort, even with belching, belching alone, right-sided chest discomfort, and upper extremity or facial pain alone. The list of syndromes of atypical angina is a long one, and continues to grow. Always tell your doctor if physical activity gives you any symptoms that you feel above the level of your hips.

Angina is probably a good thing, sort of an early warning system for the heart.
People with diabetes have a problem in that they are likely not to have this early warning system, and are more likely to have silent ischemia. In fact, even individuals without diabetes can have many periods of silent ischemia during a week of angina. Most studies have found that silent ischemia is as dangerous as typical angina. Many physicians do feel, however, that shortness of breath upon exertion or fatigue, as a component of angina, indicates that the ischemia is particularly severe.

Not all myocardial ischemia is important enough to require invasive intervention, but doctor and patient should make this decision together. One helpful hint in getting through life with myocardial ischemia is that ischemic syndromes tend to be unique, but tend not to change over time. An individual patient’s symptoms may be more or less severe, or sometimes spread to regions other than the heart, but symptoms wildly different than one’s anginal syndrome are not likely to be angina. If your angina is a left-sided chest pain, then right-sided pain is probably not angina. Pains lasting a few seconds, or located just under an area less than a dime, or under a thin strip of tissue, or specifically related to any particular motion or position, are also probably not anginal.

People with silent ischemia represent a special problem. Unfortunately, the best way to monitor the appearance or course of this syndrome is frequent testing, and the patient should always watch for symptoms such as exertion-related fatigue or shortness of breath. Although inadequate blood flow to the heart muscle is probably the most common problem affecting patients who don’t get enough physical activity, there are many others, including leg pains from poor circulation, a congested circulation due to inefficient pumping of the heart (called congestive heart failure or CHF), lack of oxygen in the lungs, joint problems, brain damage from inadequate blood flow, and social and psychological problems such as depression, insomnia, stress, and many others. A caring physician might be able to counsel such patients directly regarding types, duration, and intensity of physical activity. Most patients can easily perform physical activity at home or work without having to use a gym, health club, or rehabilitation center. Often consultation with an orthopedist, cardiologist, pulmonologist, mental healthcare provider, or trained nurse practitioner might be helpful. Occasionally a social worker can help make activity sessions possible. It might be difficult for some people such as single mothers, children caring for
an aging parent, and the unemployed to get enough physical activity, yet solutions can often be found.

**How Do I Start?**

In years of encouraging people to get enough physical activity, some general principles have been noted that seem to help patients develop a program and stick to it:

First and foremost, show up! Make a schedule and keep it. Whether it is exercise in your living room or a health club, a walk, a hike, or a swim, if you have scheduled it, do it. Often people skip their workout when they don’t feel up to it, thinking they won’t be able to do their best. Maybe it won’t be your best workout, but it’s much more important to establish a routine and stick to it. Even professional athletes sometimes feel off before a game, and yet find they played well after all. You never know. Just do it.

Prioritize. Even people who absolutely need to exercise aerobically one half hour, six days per week, may feel guilty about taking time away from their job or family. Well, to be blunt, a stroke, heart attack, or premature death will certainly cut into your work schedule and mean less quality time spent with your family.

You and your family should realize that physical activity will ultimately allow you more time to fulfill your obligations. Use a wall calendar with large boxes in it, or a Personal Digital Assistant (PDA), or even have your partner (or secretary if you have one) to set up specific times and dates for you to be physically active.

**Stretch.** Most people know that stretching prevents injury and improves performance. Lengthening thigh muscles, and the buttocks minimizes back injury. Lengthening the calf muscles and the Achilles tendon will minimize tears, Achilles’ tendonitis, and heel spurs. Upper body stretches will minimize rotator cuff and shoulder syndromes. People run, bike, and swim faster if the contracting muscles have to work less to lengthen the opposing lengthening muscles. Also, as a practical point, it is much harder to show up for an activity if your muscles are stiff. Muscles that are not ready to be stretched send messages to the brain, telling you “enough is enough.” You don’t have to stretch immediately before the activity, but you should stretch every day. Stretch each muscle group to the point of tugging, of moderate resistance, not to the point of pain, and hold it for
thirty seconds to a minute. Painful and jerky stretches might tear muscle fibers, causing microscopic bleeding, swelling, inflammation, and even more muscle stiffness. Stretching twice a day is probably four times as effective as stretching once a day, but definitely stretch every day. Consult your doctor or another healthcare professional if you have special problems such as orthopedic or rheumatologic disorders.

**Have fun.** People who have played sports before usually have an easier time. They know how to get in shape; they can more easily be patient, since they have learned that they have to work up to their peak performance. They understand that sometimes it takes time before one starts to have fun. Finally, they know which sports they will enjoy and may have a good idea at what level they can reasonably expect to play. For people who have not played sports, exercise is more of a learning experience, but can still be fun and may become a significant part of their life. Beginners should keep an open mind, try different types of aerobic sports and exercises, maybe with a group or even with a trainer, and experiment until they find an activity that is fun for them.

**Patience is everything.** Imagine yourself training for an event that will come 6 months to a year from the first day you start your activity. You might feel a gratifying change in body shape or performance in two weeks, but this might take as long as two months. Moreover, the rate of change in improvement cannot be predicted from the beginning months. No matter how pessimistic you might be, it is likely you will have periods of exhilaration if you just stay with it.

**Cross train.** If your passion is biking, go for it. However, if your aim is getting in shape in general, consider different types of aerobic activity. A half hour workout on day one could be 15 minutes of rowing, followed by 15 minutes on the Stairmaster. The next session could be 15 minutes of biking, followed by 15 minutes of rowing. Cross training obviously develops many different muscle groupings, but, more importantly, gives you the flexibility to continue one form of physical activity if pain, stiffness, or injury stops you from performing another. Besides, many professional athletes feel that cross training is less likely to produce repetitive stress and sports-related injuries.
**Avoid injury.** Equipment does matter, particularly shoes and sneakers. Sneakers should fit comfortably from day one and should have a lot of cushion in the sole. Get new ones at least once a year, or two to three times a year if you spend a lot of time on asphalt. Run on soft surfaces if you can. Grass, bridle paths, soil, and even sand are easy on the feet and (especially) knees. Bikers who don’t wear a helmet are eight times more likely to have a serious brain injury. Wear a helmet, and replace it every three years because the padding deteriorates. All equipment such as skis, bikes, and roller blades should be checked and tuned at least once a year. Never swim outdoors without someone who can help if necessary or at least call for help. Never ski off the trail, or on difficult, unfamiliar slopes without an experienced friend or a professional. Above all, use common sense.

**No effort, no gain.** This is not as catchy as “no pain, no gain,” but this is real life, not the Olympics. Hanging around the gym chatting with trainers is not physical activity. Aqua jogging and water calisthenics are terrific low-impact workouts, but floating doesn’t count as physical activity either. It is more difficult to determine how much physical activity is enough. Only the few people with heart disease have to worry about making the heart do too much work. Consult your doctor. Your medical history, physical exam, and testing might reveal that you have to limit your activity. Cardiac rehab programs are ideal for such patients, both for teaching self-monitoring tools and for building confidence. Patients without access to such programs can be taught to regulate their physical activity based on symptoms and self-monitoring of heart rate. Relatively inexpensive machines can give digital readouts of heart rate. Doctor and patient should consider using anything that the modern era can provide to ensure the safety of the physically active individual, including angioplasty, surgery, use of pacemakers or automatic defibrillating devices, and proper medication.

**Everyone Needs Physical Activity**

Whether you are 30 and healthy or 80 with painful arthritis, planning, effort, stretching, achievement, fun, and healthy body changes are all relevant and meaningful. Tripling one’s aerobic capacity is even more of an accomplishment for a person who can only go from room to room, and who, because of training, can now travel or walk easily in a museum or mall. Such an achievement is no less heroic, no less outstanding, than it would be for an inactive 30-year-old to train and win a triathlon.
The Metabolic Syndrome: Sign of the Times

About one of every four Americans have the metabolic syndrome, a cluster of abnormalities increasing their risk of developing diabetes and cardiovascular disease, or dying from any cause.¹ People with the metabolic syndrome have three or more of the following risk factors: abdominal obesity, a high triglyceride level, hypertension, a low HDL cholesterol level, and an elevated glucose level.² The Adult Treatment Panel guidelines (ATP III)³ list diet and physical activity as important parts of any program to reduce a person’s risk by managing this syndrome. Doctors will play an important role in instructing patients how to develop a healthy lifestyle incorporating these elements, and encouraging patients to stick to it. Doctors may offer advice on a diet for weight loss, or may refer patients to a nutritionist, particularly if the individual has special needs. The physical activity component may present a problem, since unfortunately there is no exercise equivalent to a nutritionist. Personal trainers are expensive and may not have enough medical training to tailor the exercise to a patient’s medical needs. There are doctors who specialize in physical medicine (physiatrists); they are particularly well qualified to advise patients how to lose weight, and can also refer patients to physical therapists for detailed instruction. It is not certain that insurance companies will reimburse for weight loss therapy if the diagnosis is listed as obesity. The Internal Revenue Service does list obesity as an illness, and therapies to treat it (such as a health club and trainer) are usually tax deductible as medical expenses. Generally, though, doctor and patient together will develop a physical activity program to lose weight; patients do their part by becoming informed, by realizing the seriousness of the situation and the importance of losing weight, and by resolving to follow the physical activity program.

The complete ATP III guidelines, available
on the web at http://www.nhlbi.nih.gov/guidelines/cholesterol/atp3full.pdf, provide helpful tables. These include Examples of Moderate Physical Activity for Healthy Adults and Ways to Incorporate More Physical Activity into the Day. This chapter will describe the goals of physical activity and provide suggestions on how to achieve these goals.

Physical Activity vs. Exercise

To begin with, we use the words physical activity instead of exercise. When it comes to weight loss, there is a tremendous difference between the two. The “no pain, no gain” concept of exercise does not apply to weight loss. To improve cardiovascular health, a person needs to sweat and raise the heart rate; weight loss involves simply burning up calories, and any form of physical activity burns up calories. You burn the same number of calories if you walk a leisurely mile in 30 minutes, or sprint that mile in six minutes. It’s a lot easier, too. Many people are discouraged from becoming more active because they think they need to join a health club, take the time to change into sneakers and shorts, or give up a block of time to exercise. Not at all. Gaining or losing weight is simply a matter of “calories in/calories out.” Burn more calories than you eat, and you will lose weight. It’s that simple.

Worry Yourself Thin?

Anything you can do to be more physically active will contribute to weight loss. In fact, people who are unconsciously more active than others, such as people who fidget, burn up as many as 350 calories per day more than people who tend to be relatively still throughout their day. Researchers at the Mayo Clinic4 have coined the phrase non-exercise activity thermogenesis (NEAT) to describe this increased number of calories burned by people who are more active during their “inactive” times. Their research shows that lean people tend to do things such as fidget, pace, and chew gum (burns up 11 calories per hour) that burn up calories, in contrast to overweight people, who by their nature tend to be more still and sedentary. Don’t count on gum chewing to help shed those pounds.

Playing the Numbers

Every 3,500 calories equals about one pound of weight.5 In other words, if someone eats 3,500 calories more than they burn, they will gain one pound, and vice versa. If we divide 3,500 calories into seven days of the week, that means someone interested in losing one pound per week would need to have a deficit of 500 calories per day. This 500-calorie deficit could be achieved by eating 500 fewer calories per day, burning up 500
more calories per day, or any combination of the two. For most overweight patients, losing two pounds per month would significantly improve their lipid levels and blood glucose levels, and improve other cardiovascular risk factors. That would require a daily deficit of 250 calories. Losing weight is only half the battle; most people regain the weight they lose. Those who successfully keep the weight off have changed their lifestyle to include increased physical activity.

Furthermore, one study showed that, in postmenopausal women with type 2 diabetes, weight loss without physical activity did not reduce abdominal fat, while physical activity, even without weight loss, did reduce abdominal fat. Since abdominal fat is associated with the metabolic syndrome and insulin resistance, in at least this group of patients it is obvious that physical activity is very beneficial.6

Ways to Increase Physical Activity
Certainly, exercising on a regular basis is one way. It is best to get regular physical activity for 30–45 minutes at least three times per week. (Recommendations vary. Please consult with your physician.) When weight loss is the goal, any physical activity will do. Aerobic, non-aerobic, swimming, walking, weight lifting, using various machines at a gym or health club, or doing home exercise using a video are all good ideas. There is a chart available at http://www.netfit.co.uk/calchart.pdf that outlines the number of calories burned for some common forms of physical activity. Of course, anyone starting any routine of physical activity should start slow and build up their tolerance to avoid undue stress on their muscles and heart. Many insurance companies at least partially reimburse people who join a gym or other exercise facility if their doctor recommends it to help reverse the health problems associated with being overweight.

Many people simply will not get regular physical activity, whether because of time or financial constraints, limitations due to arthritis, or simple laziness. These people need to get the message that nothing is more important than life and good health, and that physical activity is the key to both. Fortunately, most people can be encouraged to increase their physical activity level, once they understand that they do not need to “exercise” but to become more physically active, and that the total of all increased physical activity achieved throughout the day adds up. Individuals can find creative new ways to become more physically active, and can even
keep track of how many calories they can burn. Some patients, especially those with arthritis, will benefit from a more structured and personalized program, such as can be given by a physical therapist.

Examples of simple ways to increase physical activity include taking the stairs instead of the elevator, walking instead of driving (for example, getting off the train one stop earlier, parking at the far end of the parking lot at work or at the mall, or walking a few blocks before hailing a taxi), pacing while waiting for a train or bus instead of just standing in one place, pacing while talking on the telephone, or doing chores around the house. One way to see whether you are, in fact, achieving your goal is to wear an inexpensive pedometer before and after beginning your new lifestyle. Generally, 2000 steps is the equivalent of walking one mile. To find your baseline physical activity level, measure any 3 days of the week and average them.7

Get Active!
Those of us over 40 realize how technological advances have reduced the level of physical activity in our daily lives. For example, we now email or fax rather than walk to the nearest mailbox; we order online rather than travel to the department store; we answer the ringing cell phone rather than get up to answer the desk phone; and couch potatoes don’t even have to get up to change the channel anymore, thanks to the remote control. Our children’s playground has shifted from the sandlot to the video arcade; looking on the bright side, at least their thumb muscles will be in good shape.

If we understand some of the causes of the progressive weight gain in society and take action, we may still be able to reverse the trend, not just for ourselves, but also for our families.

Further Reading
Table of Calories Burned for Some Common Activities:
http://www.netfit.co.uk/calchart.pdf

Nutrition and Your Health: Dietary Guidelines for Americans:

ATP III Guidelines, National Cholesterol Education Program:
References


CHAPTER 4

PHYSICAL ACTIVITY AND BONE HEALTH

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Physical Activity and Bone Health

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Physical activity is good for your bones, no matter how old you are. The American College of Sports Medicine recognizes two basic strategies to make the skeleton more resistant to fracture:

1. Maximize the gain in bone mineral density (BMD) in the first three decades of life.
2. Minimize the decline in BMD that occurs after age 40 due to endocrine changes, aging, and decreased physical activity.¹

Strong Bones Start in Childhood
Because the greatest increase in bone mass occurs in puberty, this is the ideal time to stimulate bone growth. It is estimated that over a quarter of all an adult’s calcium is laid down during the two adolescent years of peak skeletal growth.² Research suggests that physical activity during childhood and early adolescence may account for up to 17% of the difference in BMD among individuals.³ Bone is stimulated the most by physical activity (mechanical stress) when children are between the ages of 11 to 14 years.³ Those participating in high-intensity physical activity such as gymnastics and weight lifting show the greatest gains in bone mass. Dietary and/or hormonal deficiency can offset the benefits of adolescent exercise. This is commonly seen in female athletes, many of who have disordered eating patterns, amenorrhea, and osteoporosis.

There is strong evidence that strengthening bones through exercise in puberty provides benefits that last long into adulthood. For this reason, the American College of Sports Medicine suggests the following program for children and adolescents:

Mode: Impact activities such as gymnastics, jumping (soccer, basketball).
Intensity: High in terms of bone loading, with safety precautions.
Frequency: At least three days per week.
Duration: 10 to 20 minutes (two short sessions might be more effective).¹

Keep It Up
Physical activity during adulthood helps to maintain BMD. It is difficult to determine exactly how much BMD is increased by physical activity. It is known, however, that these gains are lost when physical activity is discontinued. A very recent study followed postmenopausal women for three years. One group partici-
pated in a vigorous training program, and the other group had no scheduled physical activity. Women who took part in the physical activity had no changes in BMD in measurements at the spine, hip, and heel. Women not in the physical activity group had significant decreases in bone density at all 3 sites.\(^4\)

**Even Walking Helps Bones**

Physical activity benefits only those bones used during the actual activity. Many short exercise sessions build more bone than the same amount of physical activity performed in a single daily session. This could mean that bone cells lose sensitivity to repeated physical activity.\(^5\) While physical activity produces only modest increases in BMD, strength training and weight-bearing activities produce consistent and impressive decreases in falls and fractures. For example, in one study Tai Chi reduced the risk of multiple falls by 47.5\% in the elderly.\(^6\) A Consensus Development Conference sponsored by the National Institutes of Health (NIH) determined that physical activity reduced the risk of falls by 25\%.\(^7\) In the Nurses Health Study, the group with the highest level of physical activity had 67\% fewer hip fractures. Even women who did no other physical activity reduced their risk of hip fracture by 41\% just by walking for at least 4 hours a week.\(^8\) In another study, postmenopausal women who walked 4 hours a week maintained bone density measured at the lumbar region of the spine, a common site for fractures. The group of women who did not walk regularly lost bone density over the year of the study.\(^9\) Women’s bones are less responsive to physical activity after estrogen levels fall at menopause.\(^10\) Physical activity can even reduce the bone loss caused by a diet that is lacking in calcium.\(^11\)

**Weight-bearing Activities**

To preserve bone health into adulthood, weight-bearing activities must submit bones to more stress than they normally receive. The American College of Sports Medicine therefore recommends the following for adults:

- **Mode:** Weight-bearing activities (tennis, stair climbing, jumping) and resistance exercise (weight lifting).
- **Intensity:** Moderate to high.
- **Frequency:** Weight-bearing activities 3 to 5 times per week and resistance exercise 2 to 3 times per week.
- **Duration:** 30 to 60 minutes per day.\(^1\)

People of all ages need to participate in physical activities safely, and in a safe environment. Physical activity for older adults should include balance training and gait training. Individuals with severe osteoporosis of the spine must avoid abdominal crunching and overly stressful activities. As always, check with your doctor before starting any regimen of physical activity.
References


Doctors have known for decades that physical activity is an important element of diabetes management, along with diet and medication. In recent years, however, studies have provided high-quality evidence on the importance of physical activity and fitness in this common metabolic abnormality. This chapter will review the substantial benefits of physical activity for the patient with type 2 diabetes. Hopefully this information will encourage doctors to recommend and patients to adhere to long-term physical activity programs for the treatment and prevention of diabetes and its complications.

Why Is Physical Activity Good for People with Diabetes?

Researchers have discovered many of the effects of physical activity on the body’s cells. We now know that physical activity increases glucose uptake by skeletal muscles, in a way that is independent of and complementary to the effect of insulin. Physical activity increases AMP-activated protein kinase, a major regulator of lipid and glucose metabolism in the cells. This glucose uptake system parallels the effect of insulin on transport of glucose across the cell membrane and is one of the ways that the drug metformin and the thiazolidinediones (rosiglitazone and pioglitazone) lower glucose levels. Physical activity increases the effect of insulin on the muscles, increasing their uptake of glucose, and lowers lipid levels in the muscles. In addition, physical activity not only helps patients lose weight, but also reduces abdominal fat. Fat is the tissue most responsible for insulin resistance and the changes in lipid levels and blood pressure that lead to the atherosclerosis. For this reason, increasing physical activity may be as necessary as restricting the diet for persons with type 2 diabetes.

Benefits of physical activity

Many studies have shown that regular physical activity has a positive effect on carbohydrate metabolism and insulin sensitivity. These benefits can last for years. In one very recent study, researchers took data on about 300 people for 10 years. Of these, 161 people engaged in physical activity on
a regular basis, and 136 people had no regular physical activity. Beginning at age 67, levels of HDL cholesterol increased (improved) with physical activity, while levels of this protective lipid decreased in the group with no regular physical activity. Weight and waistline increased in both groups, but less so in those who had made regular physical activity a part of their lifestyle. Another study, comparing 46 African American women without diabetes, found that those with moderately good aerobic fitness had lower weight and blood pressure, and higher insulin sensitivity, than those with low or very low levels of fitness. Similarly, a study of 80 Amish persons (whose lifestyle includes a great deal of physical activity) found that the more time they spent in moderate to vigorous activity, the greater their insulin sensitivity. Physical activity of any kind provides health benefits; it does not have to be vigorous. A study that took data on 600 middle-aged men and women for five to six years found that the more energy these people spent (which took into account all types and intensities of activity in daily life), the less likely they were to develop the metabolic syndrome. In another study, researchers encouraged people with type 2 diabetes to take a daily walk. After two years, those who walked at least one mile a day had some improvement, and those who walked three miles or more a day lost weight, lost inches off their waist, had lower blood pressure, improved their heart rate, fasting plasma glucose, cholesterol levels, triglycerides, and reduced their risk of heart disease. Insulin sensitivity also improves in children who take part in regular physical activity, though this benefit is lost when they stop. Furthermore, physical activity reduces a person’s risk of getting diabetes. Individuals with impaired glucose tolerance (IGT) have a high risk of developing diabetes. In a Swedish study, men with IGT who took part in physical activity for one hour twice a week (mostly walking) reduced their risk of diabetes by almost two thirds. Men who did develop diabetes but adopted a healthy diet and included physical activity in their lifestyle, lived longer. A large Chinese study also found that fewer people with IGT who improved their diet and increased their physical activity (mostly walking for about two hours a week) developed diabetes over a six-year period. Many studies confirm that physical activity improves blood glucose levels as effectively as most oral medication in patients with type 2 diabetes (though not in type 1). Most of the improvement
seems to be due to increased insulin sensitivity. Regular activity at least three times per week can maintain this improvement. In addition, insulin-resistant patients with hypertension who engage in regular physical activity have a 5- to 10-mm Hg drop in blood pressure. Often triglyceride levels fall, HDL cholesterol levels rise, and the hypercoagulable state improves as well.

**People don’t get enough physical activity**
Fewer than half of Americans take part in regular physical activity.13 Over a third of overweight people report no leisure-time physical activity at all.14 One of the findings that came out of the important San Antonio Heart Study was that Mexican American men with less leisure physical activity were more likely to develop type 2 diabetes. Physical activity and weight loss by dieting both decreased risk of diabetes in women.15 In type 1 diabetes, people who are in a lower social class, as measured by educational level, are known to have lower levels of physical activity.16

In general, people with diabetes exercise less than those without diabetes. This may explain why people with diabetes are more likely to be obese.17 Of course, it may also be that people who are obese are simply more likely to develop diabetes. At any rate, there is a strong link between physical activity, obesity, and diabetes. An interesting study compared Pima Indians living in the mountains of Mexico with those living in Arizona. Arizona Pimas were more than 25 kg heavier, with an average body mass index (BMI) of 33.4 kg/m², and about half had diabetes. (The range for normal BMI is 18.5 kg/m² to 24.9 kg/m²; people with BMI 25 kg/m² and over are considered overweight, and those with BMI 30 kg/m² and over are considered obese.) The Mexican Pimas had an average BMI of 24.9 kg/m², and fewer than 10% had diabetes. This study in people with a very similar genetic makeup suggests that a lifestyle including a healthy diet and physical activity protects against diabetes, and that this disease develops when the healthy lifestyle is lost.18

**Planning Physical Activity in Type 2 Diabetes**
For a sedentary middle-aged woman with diabetes or at risk of diabetes, a modest program of daily physical activity, with calorie expenditure of 200 kcal, will double the calories burned in activity. However, many people with diabetes are highly sedentary and have a decreased capacity for aerobic exercise that may need to be taken into account when designing an exercise program.
Daily exercise provides the most benefit. (Recommendations vary. Please consult with your physician.) In a study of obese patients with type 2 diabetes enrolled in a program of physical activity, fasting insulin levels and the insulin/glucose ratio dropped well below baseline as insulin sensitivity improved. However, these values were almost tripled 48 hours after the last activity session, indicating that the improvement wanes rapidly. Patients will also need to maintain a healthy diet. When healthy, sedentary, obese, older men were either put on a weight-loss diet or assigned an exercise program, men on the diet lost more weight, burned more body fat, and had greater improvements in fasting insulin levels, triglyceride levels, HDL levels, and blood pressure.

Types of physical activity
Walking is an excellent activity that most people with diabetes can easily enjoy. Using a pedometer or step counter is helpful. About 2,000 steps equal one mile, so 5,000 steps per day seems a reasonable goal, with patients encouraged to walk more if they can. A walking speed of 4.0 km/h is widely accepted as moderately intense physical activity. One study found that patients with diabetes tended to walk at 3.3 km/h, and so were perhaps not getting the full health benefit. All walking is good, and brisk walking is better, whenever possible. Patients can find other helpful suggestions for active living at http://www.americaonthemove.org or http://www.presidentschallenge.com.

The debate over aerobic vs. anaerobic activity has been going on for some time. Some experts claim that anaerobic activity is better because it burns up more calories. Recently the Diabetes Aerobic and Resistance Exercise (DARE) clinical trial divided previously inactive people with type 2 diabetes into two groups. Both groups exercised at local YMCAs, and were supervised by personal trainers. One group did aerobic (endurance) exercise, and the other, anaerobic (strength) resistance training. Over six months, blood glucose levels improved in both groups, and to the same extent. The combination of both forms of exercise improved blood glucose levels more than either type alone. In a smaller, eight-week study in Singapore, blood glucose levels also improved in both groups, but much more with resistance training.

The Diabetes Prevention Program approach
The Diabetes Prevention Program was an important study in 3,234 people who were at high risk for developing
diabetes. The researchers taught patients basic skills related to nutrition, exercise, and behavior change, and encouraged them to reach a goal of 150 minutes of moderate activity each week. Each participant was assigned a lifestyle coach to help devise ways to remove the barriers to taking part in physical activity on a regular basis. After about three years, 74% of patients reached the goal, suggesting that most people at risk of developing diabetes can realistically make 150 minutes per week of moderate activity part of their lifestyle. Setting goals and incorporating physical activity routines into patients’ lifestyles were much more effective than simply telling people to attend a gym. The guiding principle for physical activity was, “Do it when you want to, with whom you want,” using neighborhood walks, community fitness centers, and up to $100 annually for “rewards” of the person’s choice such as t-shirts.²⁵

People can reasonably maintain 150 minutes of physical activity a week. In the Walking Women Study, one group of postmenopausal women was assigned to walk about 150 minutes weekly, while another group was not. Ten years after the study, the group that was assigned to walking was still walking more and was more physically active in general. These women had less heart disease, fewer hospitalizations, surgeries, and falls.²⁶

**Physical activity and hypoglycemia**

A person’s fitness level and the timing of exercise to meals both affect glucose levels during exercise. When there are diabetic complications, their control and the treatment used to control them, including the site and method of insulin administration, are also factors. Different factors control heavy vs. light exercise, because carbohydrate utilization increases, free fatty acid mobilization is suppressed, catecholamine (“adrenaline”) levels increase, but glucagon decreases with increasing exercise intensity. In patients with diabetes, the degree of metabolic control is important, both during and in the days before the exercise. People without diabetes who get hypoglycemia show a blunted catecholamine response to exercise on the following day, which may have implications for the exercise tolerance of patients with diabetes who have hypoglycemic episodes.

**Insulin therapy**

Rapid-acting insulin analogs are very useful in treating people with diabetes who take part in regular physical activity. These drugs not only reduce post-meal glycemia more than regular
insulin, but their dosage can easily be reduced, typically by half, before an exercise session. This decreases the post-meal glycemic rise while lessening the glycemic drop during exercise, reducing the risk of hypoglycemia. Because exercise increases the rate of absorption of insulin from subcutaneous injection sites, injection in the thigh followed by lower extremity exercise will increase insulin levels, increasing the risk of hypoglycemia. This is particularly a problem with regular human insulin and the intermediate-acting insulins NPH and lente. It does not seem to be an issue with the long-acting insulin glargine, which has a different pattern of absorption when administered the evening before exercise, even to persons with type 1 diabetes. Sulfonylurea insulin secretagogues are not as well studied, but similar caveats may apply to their use. The more rapid-acting meglitinides, and, perhaps, drugs acting via the glucagon like peptide-1 pathway, may be less likely to cause hypoglycemia.

Caveats
A number of physical conditions may make it difficult for a person to exercise. Physical activity is particularly a problem in older people with diabetes, who often are not able to perform even mild exercise to help them lose weight. Severe arthritis could certainly limit physical activity. This may also be the case with morbidly obese people who are at risk of osteoarthritis, particularly in the knees. Paradoxically, these are the people who have the most to gain from physical activity. Before deciding that a person cannot participate in physical activity, doctor and patient should explore forms of exercise, such as water aerobics, which can be enjoyed even by people with severe physical limitations.

The heart
Likewise, people with severe heart disease, either coronary insufficiency or congestive heart failure, should not exercise without the supervision of a cardiologist. There is also the risk that physical exercise might worsen heart disease in people with unrecognized coronary insufficiency. Many people with diabetes have asymptomatic coronary disease, and this should be considered before beginning a regimen of physical activity. However, positive screening tests such as exercise electrocardiography and even nuclear imaging with exercise or dipyridamole cannot reliably predict coronary disease on angiography. It is, then, the role of the doctor caring for the person with diabetes to determine whether cardiac testing is required for that
specific individual. Many authorities recommend that people over age 35 with diabetes have their heart checked before beginning a program of physical activity. Certainly testing is necessary if there are cardiac symptoms (typical or atypical), an abnormal ECG, other signs of vascular disease, or risk factors besides diabetes.31

People with insulin resistance may also have a decrease in exercise capacity, limiting their ability to take part in physical activity. It has been shown that many people without diabetes but with coronary disease have poor exercise capacity and poor heart rate recovery, limiting their ability to exercise.32 Cardiovascular autonomic dysfunction (refers to the part of the nervous system that is not directly under our control such as blood pressure and heart rate) often involves exercise intolerance because of the blunting of the tachycardia and blood pressure rise seen with exercise. It is important that this may also be a feature of the neuropathy-like state associated with obesity.33 Paradoxically, cardiac output may fall in individuals with autonomic neuropathy during exercise. Cardiac autonomic neuropathy (CAN) may limit an individual’s exercise capacity and endanger the heart during exercise. Signs of CAN may include resting tachycardia (heart rate >100 beats per minute), a >20 mm Hg fall in systolic blood pressure upon standing without an increase in heart rate, or abnormalities of the skin, pupils, gastrointestinal tract, or genitourinary system. CAN in diabetes may cause sudden death or myocardial ischemia without typical chest pains.34 Indeed, a recent report (in people without diabetes) suggested that a resting heart rate >75 beats per minute or an increase of less than 90 beats per minute during exercise may increase the risk of sudden death.35 This highlights the importance of physical conditioning.

The lung
There is also strong evidence of lung involvement in persons with long-term diabetes. This problem is under-recognized because symptoms and disability develop later in the lung than in the kidney or retina. However, even without overt disease, lung diffusing capacity is often decreased, particularly during exercise. This is a form of diabetic microvascular disease, more commonly seen in people whose blood glucose control has been less strict.36 Researchers noted decreased diffusing capacity and lung volume in people with type 1 diabetes followed for over seven years. Lung impairment was most severe in individuals with poor glucose control.37
The eyes
Intense physical activity could cause problems in people with severe diabetic retinopathy (eye disease) at risk of retinal bleeding. People with diabetes should be screened for this condition at their annual eye examination.

Summary
There are many reasons why people with diabetes should incorporate a program of physical activity into their lifestyles. In addition to the obvious benefits of gains in strength and endurance, physical activity increases insulin sensitivity, improves levels of lipids and triglycerides, lowers high blood pressure, helps people lose weight, and burns abdominal fat, the tissue most responsible for insulin resistance. Regular physical activity can also prevent diabetes from developing in people at high risk, such as those with IGT.

Daily exercise is best. Having a regular routine is important. About 150 minutes of moderate physical activity each week seems like a reasonable and realistic goal. Brisk walking is an excellent activity that most people can easily schedule and perform.

Long-acting insulins and the more rapid-acting meglitinides are less likely to cause hypoglycemia than regular human insulin and intermediate-acting insulins, or sulfonylureas. In addition, people with musculoskeletal conditions, diabetic autonomic neuropathy, and diseases of the heart or lung should work with their doctor to design a realistic physical activity regimen. All people, but especially those with diabetes, should consult their doctor before beginning a program of physical activity.
References


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CHAPTER 6

PHYSICAL ACTIVITY FOR PREGNANT WOMEN WITH DIABETES

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Physical Activity for Pregnant Women with Diabetes

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• Women with type 1 diabetes or type 2 diabetes who have a regular routine of physical activity or exercise before pregnancy can safely continue it during pregnancy. Beginning a cardiovascular fitness program during the first trimester is not recommended.

• Arm exercises, when a woman is seated in a sturdy, hard-cushioned chair with good back support, provide a safe form of physical activity for pregnant women who are inactive and out of shape, and may be helpful in addition to diet therapy for women with gestational diabetes.

• Postpartum, if glucose control is maintained, women with diabetes should be able to start or resume a program of physical activity as quickly as women without diabetes.

Physical Activity, Pregnancy, and Diabetes

Pregnancy itself is physical activity: the metabolic rate, minute ventilation, and respiratory exchange all increase as they do with mild to moderate physical activity. A woman with type 1 diabetes who is contemplating pregnancy must realize the importance of maintaining control of blood glucose levels. She must also realize that physical activity during pregnancy involves some risk, and may complicate glucose control. In pregnancies complicated by diabetes, a program of physical activity requires frequent adjustment of insulin doses to assure the best possible therapy during and after the activity. A program of physical activity may be helpful as part of the glucose control protocol for the
woman with pregestational diabetes, either type 1 or type 2, but physical activity does add another variable that may make glucose control more difficult. The only study of physical activity (a walking program) as therapy in type 1 diabetes in pregnancy found no improvement in after-dinner blood glucose levels. Physical activity in the first trimester may increase the risk of a spontaneous abortion, even in healthy pregnant women without diabetes. However, as long as their blood glucose levels are kept within the normal range, women with type 1 diabetes have no greater risk of spontaneous abortion than women without diabetes. If the blood glucose levels of a woman with diabetes are elevated (A1C greater than 6.5%), then her risk of spontaneous abortion (independent of the risk associated with physical activity) rises dramatically as her blood glucose levels rise. Thus, physical activity is an added risk if the activity program makes it harder to maintain blood glucose levels as near normal as possible. Also, any woman with type 1 diabetes and vascular complications should follow the recommendations for any patient with type 1 diabetes and vascular compromise, including restrictions of certain physical activities for the patient with retinopathy. If hypertension exists before or develops during pregnancy, bed rest may be needed to manage blood pressure, and no physical activity program would be possible. There are other reasons a woman may need bed rest during pregnancy that would independently require her to avoid physical activity, such as vaginal bleeding due to placental previa or premature labor.

Starting During Pregnancy?
Physical activity may be a pleasant and productive alternative to insulin therapy. However, studies underline the need for caution. Women who develop gestational diabetes are often obese and inactive, which complicates the risks involved with starting a physical activity program. Several studies link physical activity to premature labor or slowing of the baby’s heartbeat. Other studies suggest that physical activity by the mother may increase the baby’s heartbeat, or decrease the baby’s glucose uptake.

However, the techniques used to measure effects on the fetus have been crude, and hard to use while the mother is taking part in physical activity. In addition, ethics committees have restricted the use of strenuous physical activity in studies during pregnancy, making it hard to determine safe limits for pregnant mothers.
physical activity becomes the treatment of choice for lowering blood glucose concentrations, it will be necessary to find which types and durations do not seriously affect uterine activity, or the fetal heart rate, glucose uptake, or growth.

**Gestational Diabetes Mellitus**

Gestational diabetes mellitus (GDM) is a form of diabetes that begins in or is diagnosed in pregnancy. Physical activity may be a helpful addition to therapy in this form of diabetes. GDM occurs in about 3.5% of all pregnancies, generally when there is a history of diabetes in the family or the woman has previously had a baby over 8lb, 13oz. A baby this large increases the risks of cesarean section or trauma to the birth canal and the baby. Women with a history of GDM have a 10% per year risk of developing type 2 diabetes, and thus half of these women will develop permanent diabetes within five years of pregnancy. A woman can reduce her risk of developing permanent diabetes by beginning a program of physical activity to lose weight and a low-carbohydrate diet to increase insulin sensitivity.

**Treatments for GDM**

Low carbohydrate intake is the first line of treatment for high blood glucose after a meal. The ideal diet for a woman with GDM restricts carbohydrates to less than 40% of the total daily caloric intake. However, if glucose levels are greater than the target level of 120 mg/dL one hour after beginning the meal, the diet must be further restricted to less than 30% carbohydrates. This might be hard for many women. Insulin would then be used to maintain peak glucose levels below 120 mg/dL one hour after eating. A woman could maintain her diet at 40% carbohydrates, but perform 20 minutes of physical activity before a meal. Thus, safe levels of physical activity could be a valuable addition to the low-carbohydrate diet for GDM.

Physical activity may prove to be the ideal treatment in GDM. It increases the rate at which the body absorbs meal-related glucose. In addition, a regular program of physical activity reduces many risks of pregnancy, including the risk of having a baby large enough to complicate delivery. Although insulin therapy reduces hyperglycemia, it may not correct the cause, which may involve increased insulin resistance. Women with GDM can benefit from a treatment plan that reduces blood glucose and reduces insulin resistance, such as a
plan including physical activity. If diet and physical activity are not sufficient to normalize glucose levels, insulin therapy will be needed.\textsuperscript{22}

\textbf{Safety First}

Physical activity during pregnancy has become a hot topic. Most experts now agree that moderate-intensity physical activity is safe for mother and baby.\textsuperscript{20,23} Before 1985, doctors advised inactive, overweight women (including those with GDM) not to start a physical activity program while pregnant. In 1985, the Second International Workshop-Conference on Gestational Diabetes Mellitus\textsuperscript{24} recommended that women who had a physical activity program before pregnancy be allowed to continue their program during pregnancy. The conference also recommended that doctors obtain a physical examination and complete history before advising pregnant women to begin any physical activity program. Later conferences on GDM determined that pregnant women could safely start a moderate-intensity arm exercise program.\textsuperscript{25} Health providers should review a patient’s type of diabetes, glucose control, and any long-term complications to determine the type and intensity of physical activity that would most benefit the mother and the baby.

\textbf{Types of Physical Activity}

Physical activity appears to lower blood glucose levels and decrease the need for insulin during pregnancy in women with diabetes.\textsuperscript{26,27} However, not many studies have investigated which types of physical activity are best for mother and baby. In one study,\textsuperscript{14} researchers measured the effect of five different types of physical activity on the prevalence of fetal distress, low birth weight, maternal hypertension, and uterine contractions. In this study, fit pregnant women rode a standard bicycle or a recumbent bicycle, or used a walking treadmill, a rowing machine, or an upper arm machine. The standard bicycle was the most strenuous on the mother and baby, causing uterine contractions in half of the 25 sessions. The recumbent bicycle, on the other hand, did not cause uterine contractions but did produce hypotension in the mother. The walking treadmill was safe until the user increased the pace to a jog, at which point 40\% of the women experienced contractions. The rowing machine was relatively safe if the user secured the seat and did most of the work with the arms. Only 10\% of women who used the rowing machine had uterine contractions. The safest form of physical activity, however, was the upper arm machine, which did
not produce any uterine contractions, maternal hypotension, or heart rate changes in the baby. Thus, the safest forms of physical activity are those that do not put stress on the trunk of the body, but use the upper-body muscles.

Jovanovic et al.\(^{26}\) later tested the use of an arm machine to increase glucose tolerance in women with GDM. In this study, ten out-of-condition women had their diet restricted, and ten had a restricted diet and used an arm machine program for six weeks. All 20 women increased their glucose tolerance, but the increase was much greater in the women who exercised as well as restricted their diet. The researchers also found that the women who exercised needed less insulin.

In a similar study, women with GDM who rode bikes for about one hour, 3 times a week did not require insulin injections, but women who were not on the physical activity program, did require insulin injections. Blood glucose levels were about the same for both groups throughout the study.\(^{28}\) The study supported the earlier report of Jovanovic et al.\(^{26}\) showing that women with GDM could safely increase insulin sensitivity by taking part in physical activity during their pregnancy.

On the other hand, another study found that riding a stationary bike for 3 or 4 thirty-minute sessions each week did not reduce pre- and post-meal blood glucose, A1C, or occurrence of newborn hypoglycemia for women with GDM.\(^{29}\) There was an increase in cardiorespiratory fitness with physical activity. The lack of benefit on blood glucose could have been due to the fact that researchers only supervised the women for half of their physical activity sessions each week. It is possible that the women did not keep up their program without supervision. The researchers concluded that people need more intense physical activity over a longer period of time to reduce their blood glucose levels.

**Simple Arm Exercise Program**

Women can take part in a simple but effective physical activity program at home, using the upper body (the safest form of activity), without the need for the machines available at health clubs.

- A person starts by finding something that weighs at least two pounds, such as large cans of soup or books.
- While sitting in a sturdy, hard cushion chair with good back support, the person lifts the weights, one in each hand, above their head, and then brings them down to shoulder level,
repeating so that the arms lift once a second. This can even be done while watching TV.

- To check that the workout is sufficiently intense to provide cardiovascular benefits, the person should try to sing, “Row, row, row your boat, gently down the stream...” without taking a breath. Having to take a breath while singing this first phrase is the sign that the individual is getting a good workout.
- Maintaining this level of activity for 20 minutes, at least three sessions per week, might allow a person with diabetes to take more carbohydrate in the diet, and may make it possible to control meal-related glucose without insulin injections. If there is too much carbohydrate in the diet, it might be necessary to perform this activity before each meal. Once insulin injections become necessary, the dose will need to be adjusted until all of the blood glucose levels are less than 120 mg/dL one hour after the start of each meal.

What Studies Need to Be Done

Future studies will establish which types of physical activity are safe and helpful for pregnant women with diabetes. These studies should examine different types of physical activity on the physiology of the baby, on the mother’s blood pressure, on glucose tolerance, and on birth weight. Also, researchers should develop an algorithm that considers the age of the mother, the fitness of the mother before pregnancy, any complications, and screening techniques, to use before a healthcare provider recommends which form of physical activity should be used to treat diabetes during pregnancy. Women who are considering pregnancy may benefit from starting a physical activity program before they are pregnant.

Postpartum

Women should resume a physical activity program as soon as they feel ready. Most women will be able to take part in regular physical activity by 2 weeks after a vaginal delivery. After a cesarean delivery, women should wait 4–6 weeks before undertaking a physical activity program. As long as glucose levels are well controlled after delivery, women with diabetes recover as quickly, and thus can safely return to a physical activity program as quickly, as women without diabetes.30
References


Everyone needs physical activity. While disability complicates matters, physically challenged individuals can still obtain the important benefits of participation in a regular program of physical activity. However, physical activity does increase the risks of worsening complications, or causing musculoskeletal injuries. There are precautions that doctor and patient can take to overcome many limitations and develop an effective physical activity program.

Topics covered in this chapter are:
• Diabetes and Disability
• Physical Activity is Good for Mind and Body
• How Much Is Enough?
• Types of Physical Activity
• Intensity of Physical Activity
• Measuring Intensity
• Physical Activity and Depression
  o Activities for Diabetes-Related Disabilities
  o Diabetic Retinopathy
  o Renal Disease
  o Peripheral Vascular Disease (PVD) and Peripheral
• Neuropathy (PN)
• Limb Differences
• Mental Impairment or Dementia
• Arthritis of the Hips
• Arthritis of the Knees
• Rx for Activity
• Further Reading

Diabetes and Disability
Several impairments and chronic conditions that are important causes of disabilities are more prevalent in diabetes. Obesity, visual impairment, cardiovascular diseases, and other complications are common in diabetes and increase the burden of physical disability in these individuals. People with diabetes are more likely to have difficulty walking or climbing stairs than people without diabetes. People with diabetes also have poor balance, and a greater difficulty with activities of daily living.¹ In a large Third National Health and Nutrition Examination Survey (NHANES III), men and women aged 60 or older with diagnosed diabetes were two to three times more likely to be unable to walk one-fourth of a mile, climb stairs, or do housework than similar-aged adults without diabetes.
In particular, women with diabetes had a much slower walking speed, worse balance, and a higher likelihood of falling than women without diabetes. It is estimated that, of the over five million older Americans with diabetes, 1.2 million are unable to do major physical tasks. This indicates that older patients with diabetes may greatly benefit from physical activity programs that target basic impairments such as strength and balance, which are major factors in the disablement process.

**Physical Activity is Good for Mind and Body**

Physical activity provides many benefits to the body and the mind. Individuals obviously benefit in strength, endurance, balance, and cardiovascular fitness. Earlier chapters in this book describe the manner in which physical activity also improves insulin sensitivity. In addition, physical activity provides a sense of mastery and accomplishment, increases self-esteem, energizes the individual, improves sleep, and helps individuals conquer fear of injury from activity. These psychological benefits are particularly important in individuals with physical challenges, who often have difficulties with self-image. Importantly, physical activity can also improve depression, which is not only common in diabetes, but accounts for much of the excess risk of disability seen in these individuals.¹

**How Much Is Enough?**

Aerobic, anaerobic, high-impact, and low-impact activities are described earlier in this book. The Institute of Medicine which is part of the National Academy of Sciences, now recommends at least one hour of moderately intense physical activity each day to maintain cardiovascular health at a maximal level. This recommendation is double the daily minimum goal set by the 1996 Surgeon General’s report.³ Weight loss requires more prolonged activity. The American College of Sports Medicine (ACSM) points out that some post-exercise tissue discomfort is natural. However, they caution people to avoid all activity that causes joint pain lasting longer than seven hours.⁴ Most people can tolerate low-intensity aerobic exercises. These can be started in 10- to 15-minute sessions, three to five times a week, and increased slowly to the recommended one hour each day. People should stop their activity if they feel fatigue.

**Types of Physical Activity**

There are several types of physical programs in common use. They focus on achieving cardiovascular fitness, building strength, or increasing flexibility/functionality. Here are some general suggestions for each type of activity.
Cardiovascular Fitness:
• Vary your workout each session.
• Be creative! Increase activity by walking throughout the day, during lunch breaks, coffee breaks, or around the house during TV commercials.
• Choose a pace that feels good to you. Use the “Conversation Rule:” you should be able to converse while exercising.5
• Take slow, deep breaths and “think tall” to maintain good posture.
• Types of cardiovascular training include walking (outside or treadmill), cycling (outside or stationary bicycle), and swimming.

Building Strength:
• Perform each movement through a complete range of motion.
• Do not hold your breath while strength training. Instead, exhale or breathe out while pushing the weight up or out, and inhale or breathe in while letting the weight down or in. Again, “think tall” to maintain good posture.
• To increase endurance, use lighter weights and do eight to twelve repetitions.
• To increase strength, use heavier weights and do five to eight repetitions.
• Types of strength training include weight machines, free weights, plastic tubing, “toys” (such as medicine balls), and circuit training.

Increasing Flexibility/Functionality:
• Flexibility/functionality activities improve range of motion, balance, coordination, and the ability to carry out the regular activities of daily living.
• Practice flexibility training (stretching) before and after every cardiovascular or strength workout.
• Hold stretches and progress slowly.
• Thoroughly stretch every muscle group used in a workout. Spend more time on tight muscle groups.
• Stretching should not be painful.
• Types of flexibility training include stretching, yoga, and Pilates.

Intensity of Physical Activity
The time required to achieve benefit from any physical activity depends on the intensity of that activity. Higher intensity activities require less time spent to achieve the same benefit. Lower intensity activities require more time.

Light-intensity activities: walking slowly, golf (with a powered cart), swimming, gardening, bicycling, very light effort (such as dusting or vacuuming), conditioning exercises, light stretching or warm-up.

Moderate-intensity activities: walking briskly, golf (no cart), swimming (casual), lawn mowing (power mower),
tennis (doubles), bicycling (five to nine mph, level terrain), scrubbing floors, washing windows, weight lifting, nautilus machines, free weights.

*High-intensity (vigorous) activities:* jogging or running, swimming (laps), mowing lawn (hand mower), tennis (singles), bicycling (more than 10 mph, or on hills), moving furniture.⁶

**Measuring Intensity**
There are several ways to measure the intensity of exercise. These include the talk test, the pulse rate, the perceived exertion scale, and metabolic equivalent (MET) measurement. The first three are simple.

*Talk test:* The talk test measurement is simple. At a *light* intensity level, a person should be able to sing during the activity. At a *moderate* intensity level, a person should be able to carry on a conversation comfortably during the activity. At a *vigorous* intensity level, a person is winded or too out of breath to carry on a conversation.⁷

*Pulse rate:* A person’s maximum heart rate is based on their age. An estimate of a person’s maximum age-related heart rate can be obtained by subtracting their age from 220. For moderate-intensity physical activity, a person’s target heart rate should be 50% to 70% of their maximum heart rate. For vigorous-intensity physical activity, a person’s target heart rate should be 70% to 85% of their maximum heart rate.⁷

*Perceived exertion scale:* This measure reflects how strenuous physical activity feels to the individual, combining all sensations and feelings of physical stress, effort, and fatigue. While engaging in an activity, a person chooses a number from six (no exertion at all) to 20 (maximal exertion) that best describes their level of exertion.

6: No exertion at all
7: Extremely light
8–9: Very light
10–11: Light
12–13: Somewhat hard
14–15: Hard (heavy)
16–17: Very hard
18–19: Extremely hard
20: Maximal exertion

On the scale, 9 is very light exercise. For a healthy person, it is like walking slowly at a normal pace. On the scale, 13 is somewhat hard exercise, but still feels comfortable. On the scale, 17 is very strenuous activity. A healthy person can still go on, but has to push to go further. On the scale, 19 is extremely strenuous exercise. This
is the most strenuous exercise many people have ever experienced.

People can use this measure to gauge the intensity level of their activity. They can then use this information to adjust the intensity of the activity by speeding up or slowing down their movements.⁷

**MET measurement:** Another way of measuring physical activity intensity is by the metabolic equivalent (MET) level. Activities can be classified as light, moderate, or vigorous based on how hard a person has to work to do the activity, that is, by the amount of oxygen used by the body during the activity.⁷ A table of physical activities at different levels of effort based on METs is available online at: [http://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA_Intensity_table_2_1.pdf](http://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA_Intensity_table_2_1.pdf).

**Physical Activity and Depression**
Depression is a barrier to maintaining a program of physical activity. Depression is more common among people with diabetes than people without it, and may be the link between diabetes and mental or physical decline. Depression can also limit a person’s ability to manage their own diabetes, and thus increase the risk for diabetes-related complications and death. Treating depression might improve a person’s ability to participate in regular physical activity. Medication may be needed. Exercise in general improves depression, and yoga breathing exercises and meditation may help.

**Activity in Diabetes-Related Disability**
Many physically challenged people watch a lot of TV. These people can increase muscular endurance by doing 8 to 12 repetitions with light weights, using the full range of motion for arm muscles, during each commercial break. Individuals with diabetes-related disabilities should do low-intensity activities for 10 minutes, 3 or 4 times a day, with adequate rest periods.

**Diabetic Retinopathy**
Annual eye examinations can detect retinopathy. Regular exams are important because retinopathy is often silent and can cause blindness. Exercise does not improve retinopathy, but may help prevent it.

Aerobic activities are better than anaerobic activities for the individual with mild diabetic retinopathy. Individuals should coordinate breathing with the activities. Helpful activities include endurance exercises, bicycling, low-intensity machine rowing, swimming,
and walking. Patients with active proliferative diabetic retinopathy, retinal detachment, or vitreous hemorrhage should only engage in mildly intense activities, because increases in blood pressure during exercise could increase bleeding. People with diabetic retinopathy should not engage in any activities involving breath holding, weight lifting, boxing, trumpet playing, lowering the head below the heart, or lifting the arms.

**Renal Disease**
Microalbuminuria is present in normal individuals after exercise. This is harmless. In mild renal disease there is microalbuminuria at rest, or a slight increase in urine albumin. Albumin increases with the increasing blood pressure seen with exercise. This is also harmless. Exercise capacity is reduced in renal disease, and these people should take part in only light- to moderate-intensity physical activity.

People with moderate renal disease should generally not perform strenuous activities. In patients on dialysis, exercise testing before physical activity is not very productive. The exercise capacity and function capacity is limited due to anemia, reduced cardiac output, and blunted heart rate increase. It is generally safe simply to monitor the blood pressure during physical activity and stop activity if the blood pressure goes too high. These patients should schedule their physical activity on non-dialysis days or at least 2 hours before dialysis, in 10-minute sessions. This may improve kidney function in some patients. Low-resistance, high-repetition exercises are particularly good, and may help improve activities of daily living. Endurance exercises are helpful because muscular power is reduced in these patients. Continuous activity for 30 minutes is a realistic, achievable goal. There is evidence that bicycling may be good for patients on dialysis. 

**Peripheral Vascular Disease (PVD) and Peripheral Neuropathy (PN)**
Symptoms and signs of peripheral vascular disease (PVD) are described on the AACE website at: http://www.aace.com/. Pain at rest limits the ability to walk and may indicate a need for further investigation and treatment before taking part in physical activity. PVD may be silent, and can be discovered by regular pulse examination of the feet and yearly Ankle Brachial Index (ABI) testing. Supervised walking may open collateral circulation. AACE recommends non-weight-bearing and arm exercises for these patients.

**Neuropathy**
People with autonomic neuropathy (AN) do not increase the heart rate by exercising compared to those without.
Measurement of increase in heart rate in these patients will not serve as a useful guide for the target heart rate level of exercise. Individuals should use the perceived exertion scale instead of, or in addition to, the heart rate. These patients should have blood glucose monitored before, during, and after physical activity because of the possibility of hypoglycemia seen with AN. Preferred exercises are non-weight-bearing exercises. The low-intensity exercises and activity are better. Exercise should be stopped if the patient cannot talk while exercising. Intensive exercise may lead to fainting, dizziness, silent heart attacks, and sudden death. The rate of perceived exertion is better than heart rate for deciding a target level of exercise. The water temperature should be below 85°F to avoid fainting and collapse.

Peripheral neuropathy (PN) causes the loss of protective sensation, such as touch, from the feet. High-impact activity can then easily damage the feet. PN also leads to a loss of the fat pad in the feet. This can destroy the arch of the uncushioned foot, and derange the foot joints. Patients with PN need special shoes to prevent foot ulcers, and must avoid all weight-bearing activity. Repetitive weight-bearing exercises such as extended walking or jogging can damage the feet, cause blisters and ulcers, and may lead to loss of limb.

The physical activity program for these patients should be designed to improve the tone of lower extremity muscles and improve balance. Such a program could alternate weight-bearing aerobic activity with non-weight-bearing activities, especially if neuropathy or PVD is present. Non-weight-bearing activities or aquatic therapy is safer if PN has reduced sensations. Supervised chair exercises, light weight lifting while sitting, swimming, bicycling, arm exercises, or rowing would be effective. Yoga, preferably under guidance from a certified instructor, can improve stretching and endurance.

**Limb Differences**
Any disability makes a person less likely to engage in regular physical activity. Still, even individuals who have experienced amputation or were born with limb differences can benefit from moderately intense activities (such as 30–40 minutes of using a wheelchair) or shorter sessions of more intense activity (such as 20 minutes of wheelchair basketball). Out-of-shape patients may need initial resistance training prior to aerobic activities.
Or, they may take part in non-weight-bearing activities involving the upper body, such as lifting small weights or modified row boating.

Adaptive floor hockey, canoeing, rafting, and hand cycling are all excellent physical activities for individuals with limb differences.

Adaptive floor hockey can be a productive and enjoyable activity for people with any of a range of disabilities. This game is not limited to players in wheelchairs. Instead of playing on ice, the teams play indoors on a wooden floor.

Canoeing is a great way to experience the outdoors. A custom-made seat with padding to protect the buttocks and legs is an example of an adaptation made to accommodate an individual with a disability.

Rafting is another paddle sport that is easily adaptable to the needs of people with disabilities.

Hand cycling is growing rapidly as a sport for people with limited use of their legs. Hand cycles have three wheels and allow the rider to pedal and steer using only his or her upper body. Recumbent and upright hand cycles are available. On a recumbent hand cycle, a person’s torso reclines and the legs stretch out in front. On an upright hand cycle, a person sits upright, just as in a wheelchair. One advantage of the upright model is that it is easier to transfer to and from a wheelchair, compared with a recumbent bike. In addition, the higher profile makes the upright model more visible (and thus safer) in traffic.

Mental Impairment or Dementia
Diabetes that remains uncontrolled for many years can impair cognition by a number of mechanisms. Factors associated with cognitive decline include depression, hypertension, and cardio- and cerebrovascular diseases, all of which occur to varying degrees in individuals with diabetes. These people can take part in supervised activity in groups at day camps.

Hip Arthritis
Because it is painful to walk with arthritis of the hips, many of these people avoid physical activity and gain weight. These people can easily engage in upper extremity activities such as light weight lifting, stationary cycling, hand cycling, yoga, and aquatic activities.

Arthritis of the Knees
Jogging with healthy knees will not
cause arthritis unless the jogging surface is uneven. An earlier injury to the knees can also result in arthritis. Swimming is excellent exercise and is easy on the knees (except for the dolphin kick of the butterfly stroke). Walking is also a low-impact activity, and suitable for people with arthritis of the knees. Most of these people should be able to jog as well if they have not had an injury. Cycling is another low-impact option.

Activities that involve flexing, especially weight-bearing (such as a full squat) can be difficult for people with arthritis of the knees. Plyometrics are exercises that involve a jumping movement, such as skipping, bounding, jumping rope, hopping, lunges, jump squats, and clap push-ups are all examples of plyometric exercises. Some plyometrics can be very hard on the knees. People with arthritis of the knees should consult their doctor before even considering these or other activities involving twisting and landing motions such as basketball, tennis, and soccer.

**Aquatic Activities**

Aquatic activities are excellent exercise that anyone can tolerate. They are appropriate for many physically challenged individuals who might have difficulty taking part in other activities. Aquatic activities are ideal for individuals with sensory disorders, a limited range of motion, weakness, poor motor coordination, pain, spasticity, perceptual/spatial problems, balance deficits, respiratory problems, circulatory problems, depression, poor self-esteem, cardiac diseases, joint replacement, orthopedic injuries or trauma, obesity, neurologic disorders (such as multiple sclerosis), osteoporosis, arthritis, or fibromyalgia. They are also safe and beneficial in pregnancy.

**Rx for Activity**

Proper clinical evaluation and exercise testing will precede the development of any physical activity program for physically challenged individuals. Patients with diabetes will have blood glucose checked before, during, and after exercise, with adjustment of insulin dose, or snacks before or during exercise as necessary.

An appropriate physical activity program for physically challenged individuals will have the following components:

1. Type of activity (such as walking, swimming, or cycling).
2. Specific workloads (such as walking speed).
3. Duration of activity session.
4. Intensity guidelines—target heart rate (THR) range and estimated rate of perceived exertion (RPE).
5. Precautions regarding certain orthopedic or other concerns or related comments.
By thoughtfully choosing these components, people with disabilities and their doctors can develop a productive, sustainable program of physical activity that can maintain an individual in the best possible health.

**Further Reading**

*Handbook of Exercise in Diabetes* / Edited by Neil Ruderman, with the assistance of John T. Devlin, Andrea Kriska and Stephen H. Schneider, MD. Alexandria, VA: American Diabetes Association, 2002. This resource contains data on the effects of exercise on blood glucose and metabolism, prevention of type 2 diabetes, treatment plans, and medication adjustment, as well as exercise’s effects on conditions such as retinopathy, nephropathy, and neuropathy.


References


CHAPTER 8

PHYSICAL ACTIVITY FOR THE ELDERLY

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Disclaimer: The subject of physical activity for the elderly is complex, and the elderly vary greatly in their individual activity needs and capabilities. The following general recommendations are not intended to replace advice from an individual’s healthcare provider.

Activity: Rx for Aging
Good news: sickness is not a necessary part of aging. Research on aging now finds that some simple changes can help many people avoid disability, weakness, and disease.1-6 Adults with a healthy lifestyle, who eat well (and a little less), who don’t smoke or drink to excess, who keep emotionally involved with others, and who keep mentally and physically fit may be able to delay the physical process of aging. The era of anti-aging medicine has arrived. As in other areas of medicine, new discoveries will continue to give us insight into living well, and longer. Be cautious; anti-aging is a relatively new medical specialty, but there is already much non-scientific misinformation in the papers and on television. Follow logical suggestions for healthy living, and always discuss health matters with a qualified healthcare professional.

Who’s “Elderly?”
Physical activity for the elderly; let’s start by defining our terms. The meanings of “elderly” (or geriatric) and “physical activity” have changed a lot over the years. People now live longer, healthier lives and benefit from modern medicine and modern living. “Elderly” used to mean over age 60, but today the definition is more complex. A person’s age in years (chronological age) is only one part of the picture. Most experts now also consider a person’s physiological age, which reflects an interplay between genetics and environment, to determine who is “elderly.” Environmental factors that influence physiological age include disease, nutrition, physical activity, lifestyle, stress, and education. Because we can change these factors, we now have some control over whether or not we are “elderly.” In this chapter we will simply define “elderly” as a chronological age greater than 70, while understanding that our physiological age may be much more or much less, depending on who we are and how we live.
What’s “Physical Activity?”
The meaning of “physical activity” has also changed quite a bit over the years. Society has come a long way since the industrial revolution. Life is now much easier, and people do a lot less physical work. Thanks to cars, computers, supermarkets, and fast food, we spend less and less energy in our daily lives. Video games have even made our recreation easier. While it’s nice to be comfortable, here’s the price of progress: technology has made us a sedentary society that is now battling the epidemics of type 2 diabetes and obesity. Physical activity used to be a normal, non-negotiable part of everyday life, and recreational physical activity used to be considered fun. Today, many people feel that physical activity is a chore, a strenuous task that takes a lot of time and has to be scheduled into our busy lives like an aerobics class or a workout in the gym. Really, though, “physical activity” is any activity that uses muscles, increases the heart rate, and spends more energy than it takes the body to maintain itself (the basal metabolic rate). Some examples of physical activity for inactive elderly people are listed in Example 1. As you can see, they’re not hard work, don’t have to take a lot of time, and can be fun.

Ask Your Doctor
Many elderly people have diseases or conditions that limit their ability to take part in physical activity. Most elderly people take medicines; some medicines alter the body’s normal response to physical activity. Also, elderly people are more susceptible to the usual risks of physical activity, such as falls, dehydration, and heat exhaustion. Therefore, all elderly individuals must have a thorough medical exam before beginning a program of regular physical activity. Just as with medicines, physical activity has risks and benefits. However, if you stick to the rule, “Start low and go slow” and follow the suggestions in Example 2, the benefits should outweigh any risk.

Physical Activity & the Elderly Body
This section will discuss some changes that occur in the body as we age, and how a regular routine of physical activity can affect these changes. This is just a few paragraphs on what is really a complex subject, so please discuss your individual situation with a healthcare professional.

The heart
The heart and the cardiovascular system change with age, in predictable ways that reduce our capacity for
physical activity. As we age, the heart pumps less blood with each beat, reducing the body’s ability to use oxygen. In medical terms, the stroke volume and cardiac output decrease, leading to a reduction in maximum oxygen consumption (VO2max). VO2max declines by about 9% per decade after age 30 in people who do not have heart disease. Thus, as we age, less oxygen and nutrient-rich blood reaches tissues such as muscle. Regular aerobic activity can delay or even reverse this age-related decline in capacity.

Also, as we age, atherosclerosis (hardening of the arteries) narrows our blood vessels, increasing the resistance to blood flow. This raises our systolic blood pressure by 10 to 50 mm Hg. (The systolic pressure is the pressure when your heart pumps out blood. This is shown in the top number of your blood pressure reading, such as the 120 in 120/80. The bottom number is the diastolic pressure. This is the pressure when your heart relaxes between beats to fill with blood again.) High blood pressure and other conditions often seen in the elderly such as orthostatic hypotension, autonomic dysfunction, and abnormal heartbeats such as paroxysmal atrial fibrillation (heart flutter), sick sinus syndrome, premature atrial contractions (PACs), and premature ventricular contractions (PVCs) all increase the chance of a fatal arrhythmia, heart attack, or stroke. Therefore, it is very important for inactive elderly people to get a cardiac exercise stress test before beginning a physical activity program. Finally, people usually monitor their heart rate to gauge how hard they’re exercising. This measurement is often inaccurate in elderly individuals because the heart naturally slows with aging. In addition, many elderly people take prescription drugs that alter the heart’s response to physical activity. More useful ways to monitor the intensity of physical activity include the perceived exertion scale or the “talk test,” both described in detail in Chapter 7. In general, an activity is too strenuous for an elderly person if they can’t carry on a normal conversation while taking part in the activity.

The lungs

As we age, our respiratory system also changes in ways that reduce our capacity for physical activity. Over the years the number of tiny air sacs in the lungs (alveoli) declines, and skeletal changes, such as kyphosis (spinal curving) and vertebral fractures decrease the functioning area of the lungs. Respiratory muscles also may
The muscles
Many inactive elderly people notice a decline in muscle mass and strength. This is a frequent complaint. In fact, the number and size of muscle fibers diminishes as we age. When this occurs in small muscle groups, it produces a loss of coordination of fine movement. The loss of muscle also slows our metabolism. If we don’t reduce our caloric intake to compensate for this, we will gain weight and increase our risk of insulin resistance and type 2 diabetes. Many elderly people consult an endocrinologist to find out if the muscle loss is due to a hormonal problem, such as a testosterone deficiency. While it is reasonable to check for a hormonal problem, muscle loss is usually due to deconditioning. Studies in which people who did not have a hormonal deficiency received hormone injections found few gains but many side effects. To date, the best (and safest) treatment for age-related muscle loss is a physical activity program that includes endurance training, resistance training, flexibility training, and balance training, as described in Example 2 (Rx: Physical Activity for the Elderly).

A program of regular physical activity increases the number of capillaries in our muscles, which improves the delivery of oxygen and nutrients. Heart muscle also benefits. Increasing the number of capillaries also improves the removal of lactic acid from working muscle, and makes heat dissipation more efficient. Resistance training increases the size and number of muscle fibers, increases the strength of muscles and tendons, and improves joint stability. Endurance training increases the ability of the muscles to store glycogen. All forms of physical activity increase the number of mitochondria in muscle cells, which improve the body’s metabolism and use of glucose.

The nervous system
Scientists once believed that the brain and nervous system could not restore...
themselves, and thus any damage or decline was permanent. We now know
that this is not entirely true. It is true that the speed of nerve impulses declines
with age, slowing our reflexes and impairing balance and coordination.\textsuperscript{11} However, regular physical activity can
counteract these changes. Strength training and balance training are
particularly effective.\textsuperscript{10} Moderately-intense physical activity increases
oxygen flow to the brain and increases metabolic activity in some areas of the
brain. Studies are now in progress to
determine if these effects can prevent cognitive decline.

In general, physical activity benefits all organ systems. The common ailments of
constipation, chronic fatigue, depression, and rheumatoid arthritis all improve with
physical activity.\textsuperscript{4} Physically fit individuals
have fewer sick days and more energy than inactive individuals, and accomplish
more. The most impressive benefit of increased physical activity is a great
improvement in the ability to perform activities of daily living.\textsuperscript{3} This allows
more elderly people to maintain their independence and delays the need for
assisted living. Prolonging the period of independent living allows an individual to
maintain their quality of life.

Conclusion
Physical activity can benefit nearly
every person, and at every age. We will
never be too old to become more fit and
improve our lives with physical activity.
As you have seen in this chapter, almost
any physical activity will improve the life
of an inactive elderly person. So, what
are you waiting for? “Start low and go
slow,” follow the suggestions in Example
1, and you will be well on your way to
total well being!

Example 1

\textbf{Examples of Physical Activity for an Inactive Elderly Person}

Walking, dancing, playing with
grandchildren. Housekeeping, yardwork,
gardening. Water aerobics, swimming,
jogging in pool. Yoga (the stretching
or breathing kind). Tai Chi, stretching
exercises, breathing exercises. Bicycling,
rowing machine, elliptical machine. Golf,
tennis, bowling, hiking, weight lifting.

Example 2

\textbf{Rx: Physical Activity for the Elderly}

A therapeutic physical activity program
for any elderly person must consider age-
related physical changes, maintain safety
as a primary concern, and be tailored to
that individual’s strengths and likes. The
program must make adaptations for diminished hearing, vision, and balance, as well as the decreases in cardiac output, muscle mass, joint flexibility, and bone mass seen with advancing age. The following elements are part of any good prescription for physical activity:

1. All components of a physical activity program for an elderly person must start slowly and progress slowly.
2. STOP physical activity and seek medical treatment if chest tightness, chest pain, shortness of breath, dizziness, or other illness occurs during the activity. Do not engage in physical activity during an acute illness, if dehydrated, or if fever, chills, or other symptoms are present.
3. Begin every workout session with a 10-minute warm-up that includes a gradual increase in heart rate, an increase in blood flow and glucose utilization in skeletal muscle, and gentle stretching to prevent injury.
4. The intensity of the activity should be between 40% to 70% of your maximal heart rate (220 minus age).
5. Start the program with 15-minute sessions (or as tolerated) and gradually increase to 60-minute sessions with a maximum of 90-minute sessions (which you can divide throughout the day). About three to six sessions per week is a reasonable goal.
6. All types of aerobic activity are appropriate, depending on your health. (See Example 1 for examples of physical activity.)
7. People with arthritis should avoid continuous, repetitive weight-bearing physical activity as this may cause orthopedic injury. Instead, these people can try alternative physical activities including swimming, water aerobics, Pilates, yoga, Tai Chi, and possibly rowing or cycling.
8. Add resistance training to the aerobic activity recommendations given above. Resistance training will help to maintain muscle mass and tone, bone strength, proper posture, and possibly help to prevent falls.
9. Focus resistance training sessions on the use of light weights (40 to 50% of one maximum lift) with multiple repetitions (12 to 15 repetitions per set). Train large muscle groups first, then proceed to smaller muscle groups. Initially perform only one set with approximately 30 seconds of rest between exercises. Sets can gradually be increased to a maximum of three sets per training session.
10. Resistance training sessions should initially (and periodically) be supervised by a professional trainer who can teach proper body alignment and slow, controlled movements with a full range of motion to prevent injury. Elderly
individuals MUST avoid lifting heavy weights to prevent injury!
11. End each aerobic and resistance training session with a 5–10 minute cool-down to return an individual to baseline heart rate and to facilitate the body’s removal of lactic acid.
12. Engage in flexibility training only after “warming up” your muscles, such as with an aerobic training session or a resistance training session. Hold stretches in position for at least 15 seconds, and avoid extreme pain.
13. Be patient. Gains in aerobic endurance, strength training, and flexibility must be gradual to prevent injury.
14. REMAIN HYDRATED during all physical activity sessions. To replenish water, drink at least three to six ounces of water every 10 to 15 minutes during physical activity. If you “feel” thirsty, you are already deficient in water.
15. Elderly individuals should avoid physical activity in extreme temperatures and at extreme altitudes as they are less able to adapt to these changes.

Physical activity is fun, and may be as simple as a walk with a family member or friend, or may involve dancing, bowling, or throwing a ball with a grandchild. Just “get moving!” The benefits you reap will extend well beyond your physical health!

References


HOW TO IMPROVE YOUR BALANCE

U.S Department of Health and Human Services
National Institute on Aging

This excerpt is provided by the U.S. Department of Health and Human Services
Exercise: A Guide from the National Institute on Aging

To order the complete exercise guide from the National Institute on Aging, please visit http://www.nih.gov/nia or call 800-222-2225

Each year, U.S. hospitals have 300,000 admissions for broken hips, and falling is often the cause of those fractures. Balance exercises can help you stay independent by helping you avoid the disability – often permanent – that may result from falling.

Progressing
These exercises can improve your balance even more if you add the following modifications: Note that these exercises instruct you to hold onto a chair for balance. Hold onto the table with only one hand. As you progress, try holding on with only one finger-tip. Next, try these exercises without holding on at all. If you are very steady on your feet, move on to doing the exercises using no hands, with your eyes closed. Have someone stand close by if you are unsteady.
Examples of Strength/Balance Exercises
This excerpt is provided by the U.S. Department of Health and Human Services
Exercise: A Guide from the National Institute on Aging

To order the complete exercise guide from the National Institute on Aging, please visit http://www.nih.gov/nia or call 800-222-2225.

Plantar Flexion

Plantar flexion is already included in your strength exercises. When doing your strength exercises, add these modifications to plantar flexion as you progress: Hold table with one hand, then one fingertip, then no hands; then do exercise with your eyes closed, if steady.

1. Stand straight; hold onto a table or chair for balance.
2. Slowly stand on tiptoe, as high as possible.
3. Hold position for 1 second.
4. Slowly lower heels all the way back down. Pause.

5. Repeat 8 to 15 times.
6. Rest; then do another set of 8 to 15 repetitions.
7. Add modifications as you progress.
Examples of Strength/Balance Exercises

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Knee Flexion

Do knee flexion as part of your regularly scheduled strength exercises, and add these modifications as you progress: Hold table with one hand, then one fingertip, then no hands; then do exercise with eyes closed, if steady.

1. Stand straight; hold onto a table or chair for balance.
2. Slowly bend knee as far as possible, so foot lifts up behind you.
3. Hold position for 1 second.
4. Slowly lower foot all the way back down. Pause.
5. Repeat with other leg.
6. Alternate legs until you have done 8 to 15 repetitions with each leg.
7. Rest; then do another set of 8 to 15 alternating repetitions.
8. Add modifications as you progress.
Examples of Strength/Balance Exercises
This excerpt is provided by the U.S. Department of Health and Human Services
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Hip Flexion

Do hip flexion as part of your regularly scheduled strength exercises, and add these modifications as you progress: Hold table with one hand, then one fingertip, then no hands; then do exercise with eyes closed, if steady.

1. Stand, straight; hold onto a table or chair for balance.
2. Slowly bend one knee toward chest, without bending waist or hips.
3. Hold position for 1 second.
4. Slowly lower leg all the way down. Pause.
5. Repeat with other leg.
6. Alternate legs until you have done 8 to 15 repetitions.
7. Rest; then do another set of 8 to 15 alternating repetitions.
8. Add modifications as you progress.
**Examples of Strength/Balance Exercises**

To order the complete exercise guide from the National Institute on Aging, please visit [http://www.nih.gov/nia](http://www.nih.gov/nia) or call 800-222-2225.

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**Hip Extension**

Do hip extension as part of your regularly scheduled strength exercises, and add these modifications as you progress: Hold table with one hand, then one fingertip, then no hands; then do exercise with eyes closed, if steady.

1. **Stand 12 to 18 inches from a table or chair, feet slightly apart.**
2. **Bend forward at hips at about 45-degree angle; hold onto a table or chair for balance.**
3. **Slowly lift one leg straight backwards without bending your knee, pointing your toes, or bending your upper body any farther forward.**
4. **Hold position for 1 second.**
5. **Slowly lower leg. Pause.**
6. **Repeat with other leg.**
7. **Alternate legs until you have done 8 to 15 repetitions with each leg.**
8. **Rest; then do another set of 8 to 15 alternating repetitions.**
9. **Add modifications as you progress.**
Examples of Strength/Balance Exercises

To order the complete exercise guide from the National Institute on Aging, please visit [http://www.nih.gov/nia](http://www.nih.gov/nia) or call 800-222-2225.

**Side Leg Raise**

Do leg raise as part of your regularly scheduled strength exercises, and add these modifications as you progress: Hold table with one hand, then one fingertip, then no hands; then do exercise with eyes closed, if steady.

1. Stand straight, directly behind table or chair, feet slightly apart.
2. Hold onto table or chair for balance.
3. Slowly lift one leg to side 6-12 inches out to side. Keep your back and both legs straight. Don’t point your toes outward; keep them facing forward.
4. Hold position for 1 second.
5. Slowly lower leg all the way down. Pause.
6. Repeat with other leg.
7. Alternate legs until you have done 8 to 15 repetitions with each leg.
8. Rest; then do another set of 8 to 15 alternating repetitions.
9. Add modifications as you progress.
Examples of Strength/Balance Exercises

This excerpt is provided by the U.S. Department of Health and Human Services
Exercise: A Guide from the National Institute on Aging

To order the complete exercise guide from the National Institute on Aging, please visit http://www.nih.gov/nia or call 800-222-2225.

“Anytime, Anywhere” Balance Exercises

These types of exercises also improve your balance. You can do them almost anytime, anywhere, and as often as you like, as long as you have something sturdy nearby to hold onto if you become unsteady.

Examples:
• Walk heal-to-toe. Position your heel just in front of the toes of the opposite foot each time you take a step. Your heel and toes should touch or almost touch.
• Stand on one foot (for example, while waiting in line at the grocery store or at the bus stop). Alternate feet.
• Stand up and sit down without using your hands.
Contents of the President’s Council on Physical Fitness and Sports and Supplemental Activities Section

Appendix 1
Specific Activity for Your Workout from the President’s Council on Physical Fitness and Sports

Stay Active and Be Fit!
U.S. Department of Health and Human Services, President’s Council on Physical Fitness and Sports

Introduction .................................................................109
A Typical Workout

Physical Activity for People with Special Needs .......................110
Making Your Workout Fit Your Special Needs

Basic Aerobic Workout (Endurance) ....................................113
The Basic Aerobic Workout

Flexibility & Stretching ..................................................117
The Basic Flexibility Workout

Strength Training ........................................................123
The Basic Strength-Training Workout

Tools for Basic Training ..................................................132
Modifying Your Workout ..............................................134
Avoiding Injury ..........................................................138
Get Fit, Not Injured

Appendix 2
Additional Stretching, Strength Training and Endurance Activity
President’s Challenge: Physical Activity

Get Fit and Be Active! How to Be More Active and get in Shape to Meet the President’s Challenge.
U.S. Department of Health and Human Services, President’s Council on Physical Fitness and Sports
Before You Get Started on the Exercises

First, read the chapter which best describes your condition. For example read chapter 8 if you are over 65. Even though only one or two of these chapters may apply to you, you will learn a lot about the value of physical activity by reading all of the chapters. Each chapter explains, in medically correct but easy to understand language, why physical activity is good for you. These chapters also help you understand what type of physical activity will be appropriate for your condition.

After you have read the chapters of this guide, please refer to the final two sections in this guide. These sections describe specific activities for your workout from the President’s Council on Physical Fitness and Sports. You will also get tips on how to get in shape for the President’s Award.

Tips to Remember

• You should always begin your workout with a warm up, then do some stretching, followed by brief strength training, and finish with an endurance type of activity (such as walking or jogging). You should then have a cool down period followed by more stretching. If you are middle-aged or older, balance training is helpful (see page 89 for examples of balance exercises).

• You must start your workout gradually, particularly if you are out of shape.

• A typical workout should follow these steps:
  1. Warm-up
  2. Stretch
  3. Strength training (flexibility)
  4. Endurance activity
  5. Cool down period
  6. Stretch again

• Certain types of activity may be dangerous if you have problems such as heart disease, osteoporosis, diabetes, or if you are pregnant. Always check with your doctor before beginning a new physical activity program.

• Compulsive physical over activity is not healthy. Check with your doctor about the type and amount of physical activity that is right for your body type.

Remember, physical activity is for everyone. No excuses!
APPENDIX 1

Stay Active and Be Fit!

A Guide to Fitness and Activity Fundamentals

You’re it. Get fit!

A Program of the President’s Council on Physical Fitness and Sports, U.S. Department of Health and Human Services
A Typical Workout

Workouts should always start off easy, become more intense, and then taper to cool down.

Get with the Program

Stretching and light endurance activities before your workout (warm-up) and after it (cool-down) help you get the most from your exercise program and improve low-back function. Muscle and joint discomfort can occur when you don’t adequately warm up and stretch before working out, or cool down and stretch after working out. Here’s why you need to do each:

Why warm up? Muscles need time to adjust to the new demands that activity places on them.

Why stretch before exercising? It fosters better flexibility and improved posture, and reduces risk of injury during your workout.

Why cool down? Keep moving at a slower pace for several minutes once you’ve completed the high intensity part of your workout, to lower your heart rate gradually.

Why stretch after exercising? Stretch immediately following an aerobic activity while your muscles are warm and pliable. This increases physical and mental relaxation, releases muscle tension, and reduces your chance of developing muscle soreness.

Choose Your Activity

There are a variety of ways you can warm up or cool down. Try doing parts of your regular workout, but at a lower intensity. For example, if you run during your workout, then walk to warm up; if you walk during your workout, do gentle calisthenics and movements that mimic walking. Do stretching exercises for the muscles involved in the activity, as well as those in the mid-trunk area. Your cool-down phase is a convenient time to do muscular endurance exercises, such as curl-ups or crunches.

Don’t cut corners on your warm-up and cool-down. If your workout needs to be shorter than usual, reduce the main body of the workout, and be sure to allow 5–10 minutes for the warm-up and cool-down portions.
Older adults, children, women who are pregnant, and people with certain health problems all benefit from physical activity, but they all need a fitness plan with special modifications. Here’s a quick look at the American College of Sports Medicine’s recommendations for special populations.

**Older Adults**

It’s especially important for older adults to ensure a safe workout by choosing well-made fitness equipment and apparel (for example, walking shoes that offer good stability). Older adults should begin with five minutes of easy exercise to warm up, and monitor their exercise intensity and duration to make sure their workout is challenging, but safe. Endurance exercises 3–5 days a week are recommended, with strength exercises on alternate days. Use a heart rate monitor while exercising, so you can get an accurate and consistent reading of how hard you are working. An adequate cool-down is imperative for an older athlete. For more information, go to www.aarp.org.

**Exercising with Children**

When it comes to kids and exercise, the emphasis should always be on fun! When you monitor a child’s workout, remember that kids can overheat more easily than adults, and they may have so much fun that they exercise to exhaustion. Keep kids cool and remind them to take breaks when necessary. Adolescents can use the same recommendations for physical activity as adults (with a minimum of 60 minutes daily).

Encourage children to participate in strength-training activities if they are mature enough to accept and follow directions, and if they are supervised at all times during their workouts. Generally speaking, children who are able to participate in organized sports such as baseball, soccer, or gymnastics, are ready to do some elementary strength training. For younger children, push-ups, sit-ups, and other exercises that use a child’s own bodyweight as resistance will yield the best strength results with the lowest risk of injury. For more information, go to www.presidentschallenge.org.
Pregnant Women

Both mother and child benefit from exercise during pregnancy. It’s fine for healthy, fit pregnant women to perform moderate-intensity, short duration exercise or light-intensity exercise for prolonged periods. Pregnant women should focus on the intensity of their workouts (how hard it feels), and not their performance (how fast they go). Proper warm-ups and cool-downs are essential during pregnancy. It’s easier to get overheated when working out while pregnant, so wear appropriate clothing, drink plenty of fluids, and select the proper environment. Women also need to be vigilant about getting proper nutrition to prevent post-exercise increases in blood glucose levels, which can cause dizziness and nausea. For more information, go to www.melpomene.org.

People with Health Problems

If you have **asthma**, you can—and should—exercise, but you should do so with caution. Studies show that people who have asthma and perform regular exercise tend to experience asthma attacks less frequently, can improve their lung function, and may lose weight and feel better overall. Work with your doctor to be sure you're using the appropriate medication to control your condition during activities. It’s always important for people to choose activities that they enjoy, but it’s worth noting that certain types of endurance sports (such as long-distance running) might be more likely to aggravate an asthmatic condition, while moderate activities such as swimming, walking, and jogging shorter distances are less likely to lead to breathing problems. For more information, go to www.lung.ca/asthma/exercise.

If you have **elevated blood pressure**, increased physical activity may actually help decrease your blood pressure within three to four weeks, says the ACSM. But you shouldn’t exercise with high blood pressure unless the condition is under control, and only with the guidance of your physician. Medications help you control elevated blood pressure, but some also affect your workouts—another good reason to talk with your doctor about your exercise program. Exercise also helps with weight control and reduction of cholesterol and glucose.
levels, both of which reduce your risk of having a heart attack or stroke, even if your blood pressure doesn't drop to normal levels. For more information, go to www.americanheart.org.

If you have diabetes, both moderate-intensity aerobic activity and strength training are highly recommended. It’s important to wear well-made athletic shoes that fit properly and wear cotton socks, because there may be some loss of sensitivity in the feet. Check your feet for blisters and other signs of injury from time to time. For more information, go to www.diabetes-exercise.org/index.asp.

For those with arthritis, exercise is considered the most effective non-drug treatment for reducing pain, increasing range of motion, and improving movement. Speak with your doctor to find out which fitness activities are best suited to your condition. Generally speaking, the best activities for those with arthritis are those that don’t expose the joints to the stress of repeated impact. Walking, biking, tai chi, swimming, and water-based aerobics are all good options. Consider developing an exercise program with the help of a physical therapist or personal trainer skilled in working with people who have arthritis. For more information, go to www.niams.nih.gov.
The emphasis in any fitness program, such as the aerobic (cardio fitness) workout, should be to start slowly and, when in doubt, do too little rather than too much. Begin with easy workouts, and gradually increase the amount of exercise you do during a session.

For example, if running is your goal, begin your training program by walking a distance that you can complete without feeling fatigued or sore. With time, you will be able to walk a greater distance at a faster pace without discomfort. After you can walk 30 minutes briskly without stopping, you can try a walk/run workout.

As you adapt to the interval workouts, you will be able to gradually increase the amount of jogging while decreasing the distance you walk. Gradually work up to jogging 30 minutes continuously.

The National Institutes of Health have developed two training schedules to get you active. Go to www.pueblo.gsa.gov/cic_text/health/exercise heart/page8.htm for a sample walking or jogging program.

Minimum Recommendations

It is recommended that all adults be active at least 30 minutes a day, 5–7 days per week; stretch daily (see p. 19); and do muscular strength and endurance exercises 2–3 times per week (see p. 25). After achieving these basic levels of activity, you'll want to add more aerobic activities to provide added health and fitness benefits. The following sections describe the nature of these cardio workouts.

How Long Should You Work Out?

If you’re just beginning vigorous activities, start with less than 20 minutes and gradually increase the duration of your workout. For most people, 20 to 60 minutes of aerobic activity in your target heart rate range is recommended. After training for several weeks, adjust your duration and intensity for variety. For example, sometimes work out at a higher intensity for a shorter duration, other days work out easily, but for a longer time.
How Often Should You Exercise?

Your heart gets stronger the more you exercise, but benefits begin to level off when you work out at high intensity more than four days a week. Every-other-day workouts are often recommended, because they give muscles and joints a chance to rest, allow improvements in heart function, are associated with a low incidence of injuries, and help you achieve your weight-loss goals. Although exercising for fewer than three days a week is good for heart health, you will have to exercise at a higher intensity to achieve your weight loss goals.

How Hard is Right for You?

Exercise intensity is a measure of the effort you experience in a workout, usually expressed as a percentage of maximal heart rate or oxygen consumption. How hard do you have to work to provide sufficient overload for the cardiovascular and respiratory systems to increase their functional capacities? Gains in cardiorespiratory fitness have been shown to occur in exercise programs in which the training intensity is 75 to 90 percent of maximal heart rate (use 50 to 70 percent if you have been sedentary or are de-conditioned). This range is called your Target Heart Rate range.

Target Heart Rate Training is Efficient

Working out within your target heart rate range will give you the best results if you're trying to burn fat and lose weight. Working out below your range won't raise your intensity to fat-burning levels, and exercising above your range means your body is no longer working aerobically (but anaerobically instead, which will help you build endurance, but not burn fat).

Once you determine your target heart rate (see How to Calculate Your Target Heart Rate, p. 17), you can use subjective judgment to determine whether the intensity of your workout should be higher or lower. Researchers call this your Rating of Perceived Exertion (RPE), and studies have found that using your RPE can be almost as accurate (and a lot less expensive) than buying a heart rate monitor.

If you're just starting an exercise program, use the lower part of the target heart rate range. If you are more active and in good health, use the upper part of the range. Whatever your fitness level, if your workout is so easy that you're able to do the work without effort, you should increase the intensity. On the other hand, be sure your workout isn't so taxing that you're short of breath, feeling pain, or can't go the duration you planned. If it is, decrease your intensity.
Measuring Your Pulse

To see if you are exercising within your target heart rate range, count the number of times your heart beats during 10 seconds of exercise. Multiply this number by six to see whether you are exercising within your target range.

A digital watch or watch with a second hand can be helpful. Check your pulse at your wrist or neck. The radial artery can be found on the thumb side of either wrist, just below the base of the thumb. Apply gentle pressure with your fingers until you feel the pulse. Begin your count with “zero” on the starting time mark; then count the pulses for the desired time length.

Your carotid pulse is taken on your neck just below the jaw beside the windpipe. Use the fingertips of the index and middle fingers to press gently. Do not move your fingers around in a massaging motion while trying to find your carotid pulse. This can lower your blood pressure and cause dizziness. The same counting system used for the radial pulse check can be used for the carotid pulse check.

How to Calculate Your Target Heart Rate

Here’s how you would calculate your target heart rate if you were a 45-year-old:

Estimate your maximal heart rate (220–your age = 220–45 = 175).

Take 70 percent and 90 percent of that value: 70 percent of 175 beats per minute = 122 beats per minute; 90 percent of 175 beats per minute = 158 beats per minute.

So for 45-year-olds, the target heart rate range is between 122 and 158 beats per minute.

Since your actual maximum heart rate may be higher or lower than 220 minus your age (this formula is just a good estimate for beginners), the target heart rate range should be used as a guideline. If it seems too hard, use a lower intensity. If it seems too easy, then go to a higher intensity.

For older adults and those who haven’t been very active, shoot for 50 to 70 percent of your maximum heart rate. For most others, exercising at 70 to 90 percent of your maximum is optimal. The key is to go at an intensity that allows you to exercise for the duration needed. Exercise intensity and duration must be balanced so that you can exercise long enough to expend 150 to 400 kilocalories per day, in order to achieve good heart and lung function and body composition goals.
Perceived Exertion (RPE) Measures Success

If you're not using a heart rate monitor during your exercise session, you can adjust the intensity of your activity based on your Rating of Perceived Exertion (Borg, 1998). It's normal to sense effort, and maybe even discomfort, but you should never be in pain during a workout. Your fitness goals and the state of your health should determine your appropriate rate of exertion.

Plan your workout intensity based on your Rating of Perceived Exertion.

- Warm-ups and cool downs should be from very easy (you can converse with no effort) to easy (you can converse with almost no effort).

- Three to four times a week you should exercise moderately so a conversation requires a bit of effort.

- Two or three times a week do short workouts that are so vigorous that conversation requires a lot of effort.

Perceived Exertion Scale

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>12</td>
<td>Somewhat Hard</td>
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<tr>
<td>13</td>
<td>Somewhat Hard</td>
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<td>20</td>
<td>Very, Very Hard</td>
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Adapted from Borg (1998).
Flexible people can easily reach or bend for things they need, and sudden movements don’t result in pulled muscles. Stretching all your joints is important to maintain a full range of motion.

Maintaining a full range of motion means your muscles should be able to pass through a complete range of movement easily and with no pain. In addition, stretching in the abdominal, back, and upper leg areas can help you develop and maintain a healthy low back. Low-back pain is one of the most common complaints, and one of the most frequent causes of activity limitation, among adults in the U.S. Good flexibility and range of motion can decrease the probability of a low-back problem. If you do have a backache, good range of motion can be a factor in reducing the severity of the problem. Maintaining good physical fitness and strengthening your trunk muscles with appropriate exercises are keys to decreasing the chances of having low-back pain.
What to Do

Try the following exercises. Repeat each one, holding it for 20 seconds; gradually build to 30 seconds if you still feel tight. For more options go to www.nia.nih.gov/exercisebook/chapter4_stretching.htm.

Stretching Tips

- All warm-up programs should consist of pulse-raising activities, along with mobility and stretching activities.
- Only stretch after the muscles have warmed up.
- Only stretch to the point of mild tension. Stretching should never be painful.
- Don’t bounce or use jerky movements when you are stretching.
- Do not hold your breath. Breathing normally will help you relax.

To stretch your calf (back of lower leg), stand with feet hip-width apart, back straight, and stomach tight. Keep the knees slightly bent. In a straight line from head to the left heel, lean forward, keeping the left heel on the floor. Place both hands on right thigh. Repeat on other side. The front leg should be kept over the ankle.
For a **hamstring stretch (back of thigh)**, stand up straight, with your right foot slightly behind hips. Slowly bend the rear leg as if sitting backwards. Keep the front leg straight with a very slight bend at the knee. Place hands on right thigh. Push buttocks backwards, slowly, until you feel a slight tension in your hamstring. Keep your neck in line with your spine. Never place your hands on the front leg. Make sure your feet are correctly positioned for balance before stretching.

To **strengthen the front of your thigh (quadriceps)**, stand with feet together, bend your left knee and with your left hand lift the left foot towards your buttocks. Bend slightly on the supporting leg. Keep the knees close together. Tilt the pelvis forward and keep the back straight. Always keep the support leg bent. Use a wall or other object for balance. Keep your back straight and stomach tight.
For **chest and shoulders (pectoralis and deltoid)** stretch, stand with feet shoulder-width apart and knees slightly bent. Place both hands on the buttocks and gently ease the shoulders backwards. This should give a feeling of the chest “opening.” Hold.

The **lower back** stretch starts when you stand with feet shoulder-width apart, knees bent, with your hands on thighs. Shoulders should be slightly apart. Slowly pull stomach in and curl upwards (similar to a cat). Hold. Be sure your weight is supported by placing your hands on your thighs. Be careful to slowly uncurl to original position. Keep chin up and eyes focused in front of you.
To stretch your **upper back**, stand with feet shoulder-width apart and knees slightly bent. Clasp your hands in front of you at shoulder height with the palms away from the body. Gently push the palms outward, without locking the elbows. Keep your back straight and the tummy tight, knees slightly bent.

Another way to stretch your **shoulder** is to take the right arm across the body at shoulder height, keeping the shoulder relaxed. Place the left hand or forearm on the right arm slightly above the elbow and gently bring the right arm towards the chest. Keep the back straight and stomach tight. Make sure the knees are slightly bent at all times. Keep head facing forward.
To stretch your hips, sit on a mat with your right leg straight in front of you. Bend your left leg and cross it over your right leg so that your left foot is alongside your right knee. Bring your right elbow across your body and place it on the outside of your left thigh near the knee. Slowly twist your body as you look over your left shoulder. Your right elbow should be exerting pressure against your left thigh. Repeat in the other direction.

To stretch over-all, stand with feet shoulder-width apart and knees slightly bent. Raise your arms overhead and bring your hands together. Slowly begin to stretch upward.
For many years, strength training was primarily used by adult athletes to enhance sports performance and increase muscle size. However, strength training is now recognized as an important method of enhancing health and fitness for people of all ages and abilities.

You can expect a wide variety of health and fitness benefits from regular, moderate-intensity strength training. Strength training (also known as resistance training) is a method of conditioning designed to increase one’s ability to exert or resist force. A wide range of loads and a variety of training tools are used in strength training, including free weights (barbells and dumbbells), weight machines, elastic tubing, medicine balls, stability balls, and a person’s own body weight. Strength training is not the same as the competitive sports of weightlifting, power lifting, or bodybuilding.

Strength training can improve your ability to perform daily tasks like carrying in the groceries or lifting a child up for a hug. And the more muscle you have (as opposed to fat), the more calories you burn—even at rest. The only drawback with strength training is that it often requires equipment, so you’ll need to purchase some or do your workouts at a recreation center or gym.

Below are some good exercises that will help you increase your strength and don’t require equipment. You will benefit from these workouts but you will be able to affect more muscles using free weights, weight machines, or stretchy bands. Choose from a variety of strength training options. For more information, go to www.nia.nih.gov/exercisebook/chapter4_strength.htm.
## Comparing Different Tools for Strength Training

Will you get a better workout if you use hand weights or a weight machine? A medicine ball or stretchy resistance bands? The truth is, each mode of training has its own pros and cons. Here’s how they stack up against one another:

<table>
<thead>
<tr>
<th></th>
<th>Weight Machines</th>
<th>Free Weights</th>
<th>Weighted Balls</th>
<th>Stretchy Bands</th>
<th>Body Weight</th>
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<td>Excellent</td>
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<td>Low</td>
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</tbody>
</table>

Adapted from Faigenbaum & McInnis (2003).
**Strength Training 101**

In order for the body to adapt to any training program, the exercise stimulus must be greater than the body is accustomed to (overload). For example, if you can easily complete 20 repetitions with 25 pounds while performing a barbell curl, then increase the weight or the number of sets to improve your arm strength or endurance.

The principle of progressive resistance refers to continually and progressively placing demands on the body that are greater than it is accustomed to. A reasonable guideline is to increase the training weight about 5 percent, and decrease the repetitions by two to four when a given load can be performed for the desired number of repetitions with proper exercise technique. For example, if you can easily do 16 repetitions while performing the chest press exercise using 100 lbs., increase the weight to 105 lbs. and decrease the repetitions to 12 to make gains in muscle strength and endurance.

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**What to Do**

Strength and conditioning specialist Doug Lentz developed the following program to help people build strength. It’s so effective that it was provided to the military during the Gulf War to keep our troops fit when they didn’t have access to strength training equipment. You can divide the exercises in half and work your upper body one day and your lower body the next. Or do them all, but every other day. Start by doing 10 repetitions of each exercise, and each week increase your repetitions by two until you can do 16. Then break the workout into two sets of eight repetitions and increase your reps again until you do two sets of 10 to 15 reps.
You can work on your shoulder and neck muscles with **shrugs**.

With your arms at your sides, shrug your shoulders to an “I don't know” posture, then relax and let your shoulders drop. This is more effective with resistance, but you don’t need to buy anything. Begin by holding cans of food in your hands with your arms hanging by your sides; then progress to buckets of sand, or anything you have handy that weighs a few pounds.

**Push-ups** are great for your chest muscles. Here are several ways to do them:

The military-style push-up is performed with your body horizontal and nothing touching the ground except your hands and toes. An easier version of the push-up can be done with knees bent so that hands and knees touch the ground throughout the exercise.

For variety, try incline push-ups, which emphasize upper chest. Perform these with hands elevated on a couple of thick books or a box.

For lower chest emphasis, perform **decline push-ups**, with feet elevated instead of hands.
- Work your trunk with a **rotational movement**. Stand with your hands on your hips, elbows pointed outward.

From the waist lean your body one way as far as you can, then rotate so that your head swings forward at about waist level, across to the other side, and then back up.

- You can get a great **abdominal workout** with bent leg sit-ups or crunches.

Bend your knees so that your feet are comfortably flat on the floor, fold your arms across your chest, and raise your shoulders about a foot off the ground.
Appendix 1

- Work your upper back with **scapular retractions**.
  Sit upright and pull your shoulders back to squeeze your shoulder blades together, trying to make them touch in the middle of your back. Hold a few seconds, then relax.

- For your lower back, try prone **lumbar extensions**.
  Lie on your stomach with your arms and legs stretched straight out. Raise your arms and legs off the ground a few inches, hold a few seconds, and then lower them. As you repeat this move, try to get your arms and legs higher off the ground.
Don’t neglect your forearm muscles—they control wrist movement. These wrist exercises will help to keep your forearms strong:

In **wrist extension**, raise one hand as far as you can bend your wrist, and push your fingers back on the palm side, using the other hand. Now push the fingers of the first hand against this resistance until you feel the muscle tension in your lower forearm muscles.

For **wrist flexion**, bend your hand downward so that your wrist is fully bent in the opposite direction, and push on the backs of your fingers with the other hand. Push the fingers of the first hand against this resistance until you feel muscle tension in your upper forearm muscles.

Alternate extension and flexion exercises for each forearm, holding each position for several seconds.

You can work out your biceps with **arm curls** using either cans of food for dumbbells, or pushing with the other hand for resistance.

Rest your upper arm down the front of your body and pull your lower arm up until the clenched palm is close to your shoulder.
Dip exercises are good for the triceps at the back of your upper arms.

Begin by sitting on the ground in front of a chair or stool. Reach your arms out behind you and grasp the edge of the chair, palms down. Raise your hips off the ground and straighten your body. Now lower and raise your body by bending your elbows. This is a kind of upside down push-up.

For your front thigh try wall squats.

Stand with your back straight against a wall with your feet a thigh's width in front of your body. Slide your back down the wall until you are in a parallel squat position, thighs horizontal. Hold until your thigh muscles begin to burn, and then push up to the starting position. Repeat a few times until your quads are tired.
- **Lunges** are good for your legs and front hips, favoring the hamstrings and gluteal muscles.

  Stand upright and take a big stride forward. Your trunk should go down close to the floor, and your planted leg should trail straight and almost horizontal behind your body, raised on the toes. You can take several short steps to bring your front leg back to the starting position.

  Repeat for the other leg.

- You can work your calves with **toe raises** on a stair or block.

  Stand on both feet, with one hand on a rail for balance and your weight on the balls of your feet at the edge of the step. Lower your heels until they are as far below the stair as you can manage. Now slowly raise your heels until they are as high above the stair as you can reach. Lower and raise your heels through the full range of motion of your ankles. A dozen of these will give your calves and Achilles tendons a good workout, and they are good for your ankles, too.
Once you’ve decided to get in shape, you may decide to join a fitness program at a local recreation center, health club, workplace, or place of worship. Whatever you choose, you’ll want to invest in a few basic pieces of equipment.

**Proper Footwear**

Choose a pair of athletic shoes designed for the activities you plan to participate in. Running and walking shoes are made for people to move forward and backward, and provide stability for this type of movement. They are also more cushioned for impact while running and walking. Tennis, basketball, and cross training shoes, on the other hand, are made for both front-to-back and side-to-side movements. What does this mean? Get running shoes for running or walking. Use walking shoes or cross trainers for walking. Try cross trainers or tennis or basketball shoes for strength training and other activities.

**Fitness Apparel**

Depending on the temperature and humidity, you’ll need shorts or full-length pants, plus sleeveless, short-sleeve, or long-sleeve tops, all made of lightweight acrylic fabrics that wick sweat away from your skin.

**Water Bottle**

You can find basic bottles with tops to squirt water into your mouth at your grocery store. Others that can be strapped to you for long workouts can be found at sporting goods stores.
Pedometer

A pedometer should be comfortable to wear all day and be held securely by its clip. An extra safety leash can help. The display should be easy to read without removing the unit from your waistband. The simplest pedometers count your steps and display steps or distance; others estimate calories burned and provide times.

Hand Weights

Get two sets—one light, one heavy. Beginners should try two- or three-pound weights and five-pound weights. If you have a good base of upper-body strength, try five- and eight-pound weights, or eight- and 10-pound weights.

Stretchy Resistance Bands

These inexpensive latex bands often come in sets of three—light, medium, and heavy resistance—along with directions for using them instead of hand or ankle weights. They can be purchased at many sporting goods stores, and they provide resistance during both upper and lower body strength exercises.
Appendix 1

Modifying Your Workout

If you're planning to stay active for the rest of your life (and you should be), you need to work out in a way that's safe and prevents injury.

Modify your fitness activities according to the weather or other environmental conditions where you are working out, or if you have specific health problems. And, when injuries occur, learn to treat the minor ones, and know when to seek professional care.

Your heart rate is one indication of the proper exercise intensity. Environmental factors such as heat, humidity, pollution, and altitude cause your heart rate and your perception of effort to increase during an exercise session. This could shorten your exercise session and reduce the chance of your expending sufficient calories to experience a training effect. By monitoring your heart rate or perceived exertion and slowing down your workout to train within your target range, you will be able to keep on exercising in a variety of conditions.

It's Cold Out There!

Exercising in the cold isn't a problem if you plan ahead and dress appropriately. But problems develop quickly if you don't take the necessary precautions. Hypothermia is a decrease in body temperature that occurs when your body's heat loss exceeds its heat production. Your body temperature is affected by environmental factors, such as air temperature, water vapor pressure, wind, and whether air or water are involved; insulating factors, such as clothing and subcutaneous fat; and the capacity for sustained energy production. Surprisingly, the environmental temperature does not have to be below freezing to cause hypothermia. Wind and water can be bigger factors than temperature.

The rate of heat loss at any given temperature is directly influenced by wind speed. Wind increases the number of cold air molecules coming into contact with the skin, increasing the rate of heat loss. The wind chill index indicates what the "effective" temperature is for any combination of temperature and wind speed, and allows you to properly gauge a variety of conditions. Keep in mind that if you are running, cycling, or cross-country skiing into the wind, you must add your speed to the wind speed to evaluate the full impact of the wind chill.
What you wear during exercise can make a big difference in how your body handles cold temperatures. The key is to dress in layers. Not only will mixing and matching layers help you stay dry and wind resistant, you can also take off layers as your body warms up. Your inner layer should be something that wicks (or pulls) sweat away from your body. Cotton doesn't do the trick, but acrylics and wool do. The middle layer should keep you warm, and the outer layer should keep you dry and protected from the wind.

Symptoms of cold stress include numbness, tingling, fatigue, and pain. If hypothermia occurs, get out of the cold, wet, and wind; remove wet clothing; drink something warm and get into a warm environment, such as in a sleeping bag or bed.

Too Hot to Trot?

Overheating is one of the few things that can kill an otherwise healthy person. Recognize the stages of heat illness: from heat cramps to heat stress to heat stroke. Although treatment of these problems is important, prevention is a better approach.

By monitoring your intensity level (either by heart rate or rate of perceived exertion), you can greatly reduce your risk of heat illness. On a hot day, if you see your heart rate climbing or if your regular workout seems harder than normal, slow down. Heart rate is a sensitive indicator of dehydration, environmental heat load, and acclimatization.

Symptoms of heat illness include excessive sweating (or no sweat), fatigue, dizziness, racing heart, and confusion. If you feel the effects of the heat, get to a cooler place, drink cool fluids, fan yourself to enhance sweat evaporation, and if necessary, place ice on your body or get into a cool pool.

Prevent Heat Issues

- **Get Fit**: Fit people have a lower risk of heat injury, can tolerate more work in the heat, and acclimatize to heat faster.
- **Get Acclimated**: Seven to 10 days of exercise in the heat increases your capacity to sweat, initiates sweating at a lower body temperature, and reduces salt loss. Body temperature and heart rate responses are lower during exercise, and the chance of salt depletion is reduced.


- **Drink Up:** Inadequate hydration reduces sweat rate and increases the chance of heat injury. Generally, during exercise the focus should be on replacing fluids. Drink water regularly throughout the day, as well as before, during, and after your workouts.

- **Watch the Thermostat:** Exercising in temperatures greater than skin temperatures (98.6˚ F or 37˚ C) results in a heat gain. While evaporating sweat cools the body, you still may not be able to keep up with the heat gain.

- **Dress for Success:** As much skin surface as possible should be exposed to encourage evaporation (but use a sun block to reduce exposure to dangerous UV rays). Wear light-colored clothing made from fabrics that wick sweat to the surface for evaporation; materials impermeable to water will increase the risk of heat injury and should be avoided.

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**Cold Weather Safety**

- Do wear appropriate clothing in layers that provide insulation.
- Do remove layers of clothing as you warm up.
- Do stay as dry as possible.
- Don’t exercise in extreme cold. Either take your workout indoors, or skip the workout.

**Hot Weather Safety**

- Do learn how to deal with heat illness symptoms (cramps and lightheadedness, for example).
- Do exercise during the cooler parts of the day to avoid heat gain from the sun, or from building or road surfaces heated by the sun.
- Do gradually increase exposure to heat and humidity to safely acclimatize over a period of 7–10 days.
- Do drink water before, during, and after exercise. Weigh in each day to monitor hydration.
- Do wear only shorts and a tank top to expose as much skin as modestly possible (and use sun block for protection from UV rays).
- Don’t wait until you feel thirsty to start drinking fluids; if you’re thirsty, dehydration has already begun.
Hot and Humid: Heat is one thing, but high humidity is another. High humidity can impede the body's ability to cool itself because your sweat won't evaporate quickly.

Watch Your Intensity: During times of high heat and humidity, your heart rate increases as your body tries to combat the heat. A typical workout may not seem typical. Monitor your intensity and avoid racing or demanding workouts in the heat.

Wind: Although wind increases your risks during cold weather exercise, it can decrease them in hot weather—as long as you are well hydrated. Wind increases the rate of evaporation, which in turn can help keep you cooler. But don't be misled by the wind; sun block, water, and monitoring your heart rate are still important.

Exercise and Poor Air Quality

Air pollution includes a variety of gases and particles that are products of the combustion of fossil fuels (for example, ozone, sulfur dioxide, and carbon monoxide). The smog that results when these pollutants are in high concentration can have detrimental effects on your health and performance. The gases affect performance by decreasing your body's capacity to transport oxygen, increasing airway resistance and altering the perception of effort required. Physiological responses to these pollutants are related to the amount, or “dose,” received. The major factors determining the dose are the concentration of the pollutant, duration of your exposure to the pollutant, and volume of air you inhale. Clearly, you inhale a large volume of air during exercise, and this is one reason why you need to curtail your outdoor physical activity during times when pollution is at peak levels.

Environmental Safety

- Do reduce your exposure to pollutants prior to exercise, because the physiological effects are time- and dose-dependent.
- Do avoid areas where you might receive a large dose of carbon monoxide, such as smoking areas, high traffic areas, and urban environments.
- Don't schedule activities during the times when pollutants are at their highest levels, such as during morning or evening rush hour.
Get Fit, Not Injured

It's a fact of life that when you exercise, you run the risk of injuring yourself.

That risk is increased in activities that combine intensity greater than 85 percent of maximal heart rate, duration longer than 40 minutes at a time, and frequency of more than four times a week. In addition, running and aerobic dance or step workouts are more likely to cause muscle and skeletal trauma than walking, cycling, and swimming. Games—especially competitive ones such as football and soccer—are associated with more injuries than controlled, moderate-intensity activities such as cycling. Older individuals and those who exercise in extreme environmental conditions are at greater risk for problems related to exercise.

Does that mean exercise isn't safe? Not at all. By exercising wisely, you will improve your health. If you aren’t used to regular exercise, talk with your doctor about getting a thorough health screening prior to vigorous exercise. Remember to start your program slowly and progress deliberately to higher intensities, duration, and frequency. Always listen to your body; if you experience unusual soreness or fatigue, take a break, and return to your workout at a lower intensity or duration once the discomfort is gone.

Does It Hurt?

When you begin a new activity, it’s normal to experience some muscle soreness 24 to 72 hours afterwards. If you continue to do the activity at low intensities, you should be able to do it without soreness. That said, you may have an injury if you experience any of the following:

- Extreme tenderness when a body part is touched.
- Pain while at rest, pain that does not disappear after warming up, joint pain, or increased pain when moving the body part.
- Swelling or discoloration.
- Changes in normal body function.
At the first sign of any of these symptoms, try some self-treatment. Remember, the PRICE is right for self-treatment:

- **Protect** the body part from further damage. Stop exercising or reduce the intensity with which you exercise.
- **Rest** the body part: do not try to “walk off” the injury.
- **Ice** the injured area to reduce the blood flow to the injured site (several minutes at a time periodically, for 24 to 72 hours).
- **Compress** the area firmly while holding the ice in place. After the ice is removed, you may want to wrap the injured area.
- **Elevate** the injured body part whenever possible to reduce swelling and blood flow to the injured area.

These methods can be used for minor acute injuries. However, a medical professional should check extreme tenderness, pain, swelling, or discoloration. Or if you have a minor ache or pain that doesn’t go away after a week or so of treatment, check with your doctor. For more information on sports injuries, go to www.americanrunning.org, and click on fitness articles, injuries, and sports medicine.

**Too Much, Too Soon**

Many sports injuries occur because you try to do too much too fast. They occur when you have excessive frequency, volume, or intensity of training combined with inadequate rest and recovery. How do competitive athletes train so hard and not get hurt? They increase their workouts gradually. You’d be amazed how much you will be able to do if you gradually increase your training load over time. Just monitor your progress and if you notice your heart rate or exertion level going up when it shouldn’t, or if you notice pain when you exercise, slow down or rest for a bit.
APPENDIX 2

Get Fit and Be Active!
A Handbook for Youths Ages 6–17

How to Be More Active and Get in Shape to Meet the President’s Challenge

You’re it. Get fit!

The President's Challenge Physical Activity & Fitness Awards Program
A Program of the President's Council on Physical Fitness and Sports, U.S. Department of Health and Human Services
Warming Up and Stretching

**Warm Up**
Before you exercise, you should always warm up your body. When you warm up your body, you get your muscles and joints ready to exercise. Most people are warmed up when they begin to sweat and breathe more heavily. Warming up makes your muscles more limber and decreases your chance of being injured during exercise.

**Flexibility**
When training for flexibility you should have already warmed up; you should never perform flexibility exercises when your muscles are cold. Once you have warmed up and are beginning to stretch, the proper form is to stretch until there is some tension on the muscle; do not bounce or try to reach repeatedly while holding a single stretch. When stretching you should reach and hold the stretch while maintaining the proper position for each specific stretching activity. Following are listed a few examples of flexibility exercises.

**Neck Stretch**
While sitting or standing with your head in its normal upright position, slowly tilt it to the right until tension is felt on the left side of your neck. Hold that tension for 10 to 30 seconds and then return your head to the upright position. Repeat to the left side, and then toward the front. Always return to the upright position before moving on.
Reach to the Sky
Stand with feet shoulder-width apart. Raise both arms overhead so that your hands are intertwined with palms together. Hold for 10 to 30 seconds and relax.

Reach Back
Stand with feet shoulder-width apart and hold your arms out to the sides with thumbs pointing down. Slowly move both arms back until you feel tension. Hold for 10 to 30 seconds and relax.

Arm Circles
Stand with feet shoulder-width apart and hold arms straight out to the side with your palms facing up. Start moving your arms slowly in small circles and gradually make larger and larger circles. Come back to the starting position and reverse the direction of your arm swing.
Twister
Sit on a mat with your right leg straight in front of you. Bend your left leg and cross it over your right leg so that your left foot is alongside your right knee. Bring your right elbow across your body and place it on the outside of your left thigh near the knee. Slowly twist your body as you look over your left shoulder. Your right elbow should be exerting pressure against your left thigh. Hold the stretch for 10 to 30 seconds, relax, and repeat for the other side.

Toe Touch
While seated, extend both legs in front of you. Keep your back straight and reach for your toes with both hands without bouncing. Do not bend your knees. Hold this stretch for 10 to 30 seconds. Repeat.
**Knee to Chest**
Lie on your back on a mat with your legs straight. Bend your left knee and bring it up toward your chest. Grasp the underside of your thigh and slowly pull your thigh to your chest. Hold for 10 to 30 seconds. Release, and repeat with the right leg.

**Butterfly**
Sit on a mat with your knees bent. Put the soles of your feet (or shoes) together and hold onto your ankles. Place your elbows on the inner sides of your knees and slowly apply downward pressure until you feel tension. Hold for 10 to 30 seconds and repeat.

**Hurdler's Stretch**
While seated, place one foot on the inside of the other leg just above your knee. Keep the other leg extended and straight. With your back straight, press forward toward the thigh of your extended leg. Use your hands for support. When you feel some tension in the back of your leg hold the stretch for 15 to 20 seconds. Do not bounce while holding this stretch. Repeat twice with legs in each position.
**Calf Stretch**
Place your hands against a wall while standing upright. Bend one knee slightly in front of your body while you extend the opposite leg backward until the foot is placed flat on the floor. With your back straight, you should feel some tension in the back of your leg. Hold the stretch for 15 to 20 seconds and repeat twice with each leg.

**Thigh Stretch**
Keep your body upright and place the ankle of one of your legs in the hand on the same side of your body. Be sure to keep the leg you are stretching underneath your body and close to the other leg. Hold the stretch for 15 to 20 seconds once you feel some tension in the front of your leg. Repeat twice with each leg.
Child’s Pose
Kneel down and sit back on your feet with your heels pointing outward. Rest your forehead on the floor, relaxing your face, neck, and shoulders. Bring your arms alongside your body with palms turned toward the ceiling. Take 10 to 15 deep, slow breaths. Roll body back up and back down to repeat.

Cat and Camel
On your hands and knees with your head parallel to the floor, arch your back and then let it slowly sag toward the floor. Try to keep your arms straight.
After you have warmed up you can begin to perform exercises that will strengthen your muscles and improve your muscular endurance. When doing these exercises always make sure you are using the correct form. Doing excessive repetitions or lifting more weight does not make you stronger sooner. By trying to do too much when performing strengthening exercises you can increase your risk of injury. Always pay attention to your body and its safety. Performing the exercises listed here can improve your strength and muscular endurance.

**Crunch**

Lie down on the floor with your legs bent and your feet placed flat on the floor. Cross your arms on your chest. Lift your chest toward your knees until your shoulders come off of the floor. Lie back down once your shoulders come off the floor. Repeat for a predetermined number of repetitions.

**Leg Lift**

Lie on the floor with your back parallel to the floor. Place your hands alongside your body, extending your legs toward the ceiling. Lower your legs without them touching the floor. Lift your legs back to the starting position, repeating 8 to 12 times.
**Push-Away**
Start developing your upper body with the push-away until you can comfortably do three sets of 10 in one workout.

**Bent Knee Push-up**
Once you meet your goal for push-aways, try the bent-knee push-up, starting with two sets of 5 and increasing until you can do two sets of 10 in a single workout.
Right Angle Push-up
You should lie face down with your hands under your shoulders, fingers straight, with legs straight, parallel, and slightly apart; your toes should support your feet. Straighten your arms while keeping your back and knees straight, and lower your body until you have a 90-degree angle at the elbows. Repeat for a predetermined number of repetitions. This exercise can also be done with bent knees.

Modified Pull-up
Place a pole or pipe that will support your body weight on the seat of two chairs that are about four feet apart. Lie on your back underneath the bar and grasp it with both hands about shoulder width apart. Pull your chest up to the bar, keeping your body straight from head to toe. Lower your body back to the floor; repeat for a predetermined number of repetitions.
Dip/Chair Dip
If you have a dip bar, place your hands on the bars with your arms straight and your feet hanging free. Lower your body by bending your elbows until your arms are bent at a 90-degree angle. Repeat for a predetermined number of repetitions. Also, you can do these with chairs as support if you do not have the proper dip bar. Place two chairs approximately shoulder width apart and use the arms of the chairs as your support. Place both feet together in front of you with your heels resting on the floor and legs straight. Perform the dip the same as it was performed on a dip bar.
Once you have completed exercising you are ready to cool down. It is just as important to cool down after exercise as it is to warm up before exercise. When you cool down you should let your breathing return to normal. It is best to walk around for a few minutes to make sure your breathing is normal and let your heartbeat slow down. After you have walked around for a few minutes following vigorous exercise you are ready to begin your cool-down stretches.

The stretching exercises you do after exercise can be the same exercises you did for your warm-up or you can add other stretches. Most importantly you should stretch all major muscle groups, especially those that you used during exercise.
**Body Mass Index**

The final item of the Health Fitness Award is Body Mass Index (BMI). This is used to compare your weight relative to your height and to estimate your total body fat. Here is how to calculate your BMI: $w(\text{kg}) / h(\text{m})^2$

**Step One:** Convert your weight to kilograms (kg)  
2.2 lbs = 1 kg

**Step Two:** Convert your height to meters (m)  
1 inch = 0.0254m

**Step Three:** Square your height  
height x height

**Step Four:** Divide your weight by your height squared  
$w(\text{kg}) / h(\text{m})^2$

**Example**

A 16-year-old boy who weighs 154 pounds (70 kg), and is 68 inches tall (1.727 meters) has a BMI of:

$$\frac{70 \text{ kg}}{(1.727\text{m})^2} = \frac{70}{2.98} \approx 23.5 \text{ kg/m}^2$$

Based on the BMI range for a 16-year-old boy listed in the table at right, a BMI index of 23.5 puts this boy in the desirable range. Use this BMI chart for quick calculation. Use a ruler to connect the height column to the weight column and read the BMI number in the middle.
