CHAPTER 7

EXERCISE

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INTRODUCTION

The past two decades have seen a much-publicized fitness boom in America. From sales of aerobic dance videotapes to popular participation in marathon running, indicators abound that Americans are interested in "working out." However, there is also evidence that a significant proportion of the population, especially the young, engage in little physical activity. The increase in hours spent watching television, the epidemic rates of obesity, and the abundance of energy-saving modern conveniences all testify to the fact that many people live in a sedentary manner.

Unfortunately, exercise is often perceived by those who need it most as a painful or exhausting process. Properly performed, however, regular moderate exercise should be *a* life-enhancing part of health maintenance. There is no need for athletic-level effort, highly structured programs, or costly equipment to gain the benefits of increased physical activity. For those who are at high risk of cardiovascular disease, a sensible program of exercise can help reduce that risk; and for those who have had a heart attack or have other symptoms of coronary heart disease, a medically supervised program can slow or even partially reverse the loss of cardiac function.

WHY EXERCISE?

What, precisely, are the benefits of exercise? Increased protection against cardiovascular disease is a proven one, although exercise alone does not confer immunity to heart disease. Regular exercise also may work synergistically to help control a host of other independent risk factors for coronary heart disease, including obesity, stress, high blood pressure, and high levels of blood lipids, including cholesterol and triglycerides. (See Chapters 3, 4, and 12.) It is an excellent way to reduce stress, another independent risk factor for coronary heart disease. (See Chapter 8.) In addition, the initiation of an exercise program often helps stimulate or reinforce other positive life-style changes, such as better nutrition or smoking cessation. (See Chapters 5 and 6.) It promotes an enhanced self-image and sense of control.

Increased physical activity is associated with longer life, and in old age it can improve quality of life and the ability to continue enjoying work and recreation. In general, exercise provides a positive, enjoyable foundation for a healthier way of living; unlike many health-enhancing measures, it adds something pleasant to one's existence rather than taking something away.

A DEFINITION OF FITNESS

Overall physical fitness consists of several components. The most important of these for most adults is cardiovascular (aerobic) endurance, the ability of the body to take in, transport, and use oxygen efficiently to metabolize carbohydrates and fats for energy. Other components of fitness include muscular strength, flexibility, and body composition (the relative proportion of lean to fat tissue). Ideally, an exercise program will help to improve all these components, but a distinction must be made between the regular physical exertion necessary to produce cardiovascular fitness-thus helping to reduce the risk of coronary artery disease—and the level of muscle strength and endurance required for athletic competition.

It is well recognized that even moderate exercise can modify heart disease risk. An expenditure of 2,000 calories a week through exercise is generally considered sufficient. This may come from a variety of sources, including such everyday activities as housework, gardening, and walking the dog. (See Table 7.1.) Expending even a modest amount of energy is better than being sedentary. In fact, those who have been sedentary will actually derive more cardiovascular" benefit from a low-level workout than those who are more fit. As their cardiovascular fitness improves, they will need to expend more energy to produce the same effect.

There are two primary modes of exercise: aerobic and anaerobic. The difference between them is important in choosing which types of activities to include in an exercise program to benefit the heart and circulatory systems.

ANAEROBIC EXERCISE

Short, intense bouts of activity, also called *isometric* exercise, do not require the muscles to burn oxygen as fuel. The familiar feelings of muscle fatigue and exhaustion result when a person crosses the "anaerobic threshold from moderate to more intense activity, causing lactic acid to build up in the muscles in a so-called oxygen debt. Examples of isometric exercise include some types of calisthenics, as well as weight lifting and use of Nautilus machines. Isometric exercise is a good way to increase muscle strength and endurance, but it does little to improve cardiovascular fitness. Since it may cause temporary but

Table 7.1
Calories Used in Various Activities

Activity	*Calories expended (per minute)*
Badminton	6
Basketball	7
Bicycling, 6 mph	4
10 mph	7
12 mph	9
Bowling	4
Canoeing (2.5 mph)	4
Dancing, aerobic	9
ballroom	6
square	6
Dusting	3
Furniture polishing	6
Gardening	4
Golf, power cart	3
pulling cart	5
Horseback riding (trotting)	6
Ice skating	7
Ironing	2
Jogging, 5 mph	8
7 mph	12
Jumping rope, slow	7
medium	9
fast	11
Mopping floors	4
Roller skating	6
Rowboating (2.5 mph)	5
Rowing, machine	6
scull racing	7
Running, 8 mph	13
10 mph	17
Scrubbing floors	6
Skiing, cross-country	11
downhill, 10 mph	10
Squash and handball	10
Table tennis	6
Tennis, singles	7
doubles	6
Vacuuming	4
Walking, 2 mph	3
3 mph	5
4 mph	7

Number of calories is calculated for a 150-pound person. For a 100-pound person, reduce the calories by 0.67; for a 200-pound person, multiply by 1.33. Because individual metabolic rates vary, all numbers are approximate, but they are useful in establishing relative values of various activities.

marked rises in blood pressure, it may be ruled out for people with uncontrolled high blood pressure, or hypertension. (See Chapter 12.)

AEROBIC EXERCISE

This type of exercise improves cardiovascular health by increasing the efficiency with which the body uses oxygen for energy. (The term "aerobic" refers to the use of oxygen.) To qualify as aerobic, an activity must be of sufficient duration to require oxygen consumption. Any rhythmic activity that uses large muscle groups and can be maintained for an extended period of time will increase the body's cardiovascular endurance if performed regularly. Examples include walking, running, jogging, swimming, aerobic dancing, skating, cycling, rowing, jumping rope, and cross-country skiing.

What actually happens to the body's functioning through regular aerobic exercise? Through a process called the *training effect*, the body becomes more efficient in extracting oxygen from the blood. All the organs involved in oxygen transport-including the heart, lungs, muscles, and blood vessels—learn to work more effectively with less effort. With training, muscle fibers actually become better able to obtain oxygen from the hemoglobin in red blood cells; they extract a higher percentage of oxygen than those of an untrained person. The lungs can take in and expel a greater volume of air in a single breath. Hence, exertion produces less "huffing and puffing" than before training.

As training progresses, the heart becomes accustomed to pumping more blood in a single stroke (increased stroke volume) and is thus able to accomplish the same workload, both during exertion and at rest, with fewer beats per minute. These two effects of training explain why athletes have a slower resting pulse than untrained individuals, and why their pulse rate returns to its resting state more quickly after exertion. The resting heart rate of an athlete might be 45 to 50 beats per minute, compared to 75 to 80 beats per minute in a sedentary person. The body becomes more proficient at diverting blood to working muscles, including the heart. The heart muscle itself may enlarge somewhat in highly trained individuals, although this effect is neither harmful nor necessary to improved fitness.

Finally, exercise enables the body to burn fat more efficiently for fuel. For people trying to lose excess weight, this enhances the effect of calorie restriction and encourages the loss of fat rather than the lean body mass that is muscle. Most often, someone who has a weight problem is consuming more calories than he or she is expending; the body stores the extra calories as fat. It takes 3,500 calories to equal 1 pound of fat, so in order to lose a pound, a person must expend 3,500 more calories than he or she takes in.

Not only does exercise promote the use of fat—as opposed to muscle—for energy, but it also increases the body's demands for energy. Walking or jogging, for example, burns approximately 100 calories for every mile covered. A pace faster than a stroll adds cardiovascular benefits and increases the rate at which calories are burned, but walking at any pace will burn calories. (For the calorie expenditures of other activities, see Table 7.1.)

One reason many dieters become discouraged is that the body's metabolism usually slows down in reaction to calorie restriction; exercise can help counteract that decrease. At the same time, regular exercise helps control appetite, making it easier to stick to a moderate program of calorie restriction. Improved muscle tone contributes to a trimmer, healthier look, enhancing the effect of weight loss. Exercise simply promotes a sense of well being.

HOW MUCH EXERCISE IS ENOUGH?

The training effect of exercise depends on four variables: frequency (how often a person exercises); intensity (how strenuously or, in some cases, at what speed); duration (how long); and mode (type of exercise). Aerobic activities allowing moderate exertion over long periods are best suited to improving the vital capacity of the lungs and the efficiency of the heart. But the other factors are open to considerable variation, depending on an individual's health profile, schedule, interests, and motivation. Because these factors are interrelated, a change in one will mean an increase or decrease in the others. For example, walking a mile burns the same amount of calories as running a mile. In the running mode, the body works at a greater *intensity* but covers the ground more quickly, so the *duration is* shorter. Walking is done at a slower speed, so it takes longer to cover the same ground. A person running at 6 miles an hour will burn about 330 calories running 3 miles in 30 minutes. In order to burn approximately the same number of calories, a person walking at a lower intensity, 3 miles an hour, will either have to increase the duration to

one hour or, at the same duration, to increase the frequency by dividing the walking into two half-hour sessions.

According to the American College of Sports Medicine (ACSM), the following recommendations can guide healthy adults in achieving fitness:

- *Frequency.* Exercise should be performed three to five days a week.
- *lntensity.* Intensity is expressed in terms of maximum heart rate, which is determined by subtracting one's age from 220. The maximum heart rate for a 40-year-old, for example, would be 180 (220 – 40 = 180). Exercising at this maximum, however, would soon result in exhaustion. The ACSM guidelines recommend exercising at 60 to 90 percent of maximum heart rate. Using the same example, a 40-year-old would exercise at an intensity that brings the pulse up to between 108 (180 x .60) and 162 (180 x .90) beats a minute. For nonathletes, the American Heart Association (AHA) recommends working at a target heart rate of between 60 and 75 percent of the maximum rate; older people or those in poor health may start out in the low end of the range, while better-conditioned people may start at a higher range. After six months or so, exercisers may want to work up to 75 to 85 percent of maximum heart rate. There is no need to exceed that; most people can stay in excellent condition at 75 percent. (For a fuller explanation of how to gauge the intensity of exercise, see "The Exercise Session," page 90.)
- *Duration.* Each session should last 20 to 60 minutes.

Clearly, these guidelines leave the exerciser a great deal of latitude when developing an individual plan. Is it better to exercise closer to the minimum described, or closer to the maximum? Does exceeding the maximum described above yield any additional benefits, or can it do harm?

The answers to these questions will vary, depending upon a person's initial fitness level, the potential for injury because of orthopedic or other conditions such as arthritis, and desired goals. The person who wants to improve from a good baseline level of conditioning to the status of a marathon runner will have very different requirements from the obese and completely sedentary individual who wishes to introduce some additional activity safely into his or her weekly routine. In addition, the choice of a particular activity or set of activities will reflect personal abilities, circumstances, and preferences.

In general, the greater the frequency, intensity, and duration of exercise, the more improvement can be expected in aerobic capacity. People who start an exercise program with a very low level of fitness will notice a greater initial improvement than those who start in better condition. Studies of the efficiency of exercise training tend to produce conflicting data, but they have generally shown that exercising for more than four to five days a week produces little additional cardiovascular benefit, while exercising fewer than three days a week is inadequate to achieve the training effect. The minimum level of exertion to start improving oxygen consumption is about 60 percent of maximum heart rate. This *target heart rate* changes with age and other factors.

Although it is the total amount of exercise that will improve and maintain fitness, the relationship of intensity and duration of exercise can be manipulated, as described earlier, to suit the individual exerciser. Of course, exercise must be done regularly on a long-term basis to consolidate the gains of the training period; missing a session occasionally won't set one back significantly, but some studies have shown up to 50 percent loss in fitness improvement after 4 to 12 weeks without exercise.

The question "How much is enough?" raises another question: "How much is too much?" For people at high risk for coronary heart disease (CHD) or those who already have it, this is an issue to be resolved in consultation with the physician, based on medical test results such as the exercise stress test. (See Chapter 10.) For healthy adults, there is a slight risk of injury from intense and prolonged exercise that involves jumping or pounding, such as running, jogging, and rope-jumping, or from any activity that involves overuse of certain joints, muscles, and connective tissues. Graduated, balanced workouts with appropriate warm-ups and cool-downs are the best safeguards against injury. (See Table 7.2 for sample programs.)

GETTING STARTED

Even for a healthy adult, starting an exercise program can seem a daunting task in the middle of a busy but sedentary life. The following suggestions can help such individuals to get going:

Table *7.2*
Sample Exercise Prescriptions

The following exercise programs illustrate how two very different people might approach their fitness goals. They are intended only as examples; any exercise prescription, particularly one for a person with heart disease, should be individualized under a physician's supervision. Each session should be preceded by a five-minute warm-up period (low-intensity exercise and stretching) and followed by a five-minute cool-down period. Frequency should be flexible; increase when comfortable at a certain level, and decrease or discontinue if injury or discomfort occurs.

A 35-Year-Old Individual, Healthy But Sedentary

	Week	Intensity *(heart rate)*	Duration *(minutes)*	Frequency *(times/ week)*
Initial Phase	1	50%	10	3
	2	60%	10	3
	3	70%	15	3
	4	70–75%	15	4
	5	75–80%	20	4
Improvement Phase	6–9	75–80%	20	4
	10–13	80%	25	4
	14–16	80%	30	4
	17–19	80%	30	4–5
	20–23	80%	30	4–5
	24–27	80%	30	4–6
Maintenance Phase	28+	80%	40–60	4–6

Note: Intensity is reflected in *target heart rate,* a percentage of the age-adjusted maximal heart rate (220 minus a person's age). Thus, for a 35-year-old, 185 beats per minute is maximal, and 60% of that figure equals 111 beats per minute.

A 60-Year-Old Individual with Stable Angina

	Week	Intensity *(heart rate)*	Duration *(minutes)*	Frequency *(times/ day)*	Frequency *(days/ week)*
Initial Phase	1	below angina threshold[1]	5–10	1	3
	2	" "	12	2	3
	3	" "	14	2	4
	4	" "	16	2	4–5
	5	" "[1]	18	1	5
Improvement Phase	6–9	" "	20	1	5
	10–13	" "	24	1	5–6
	14–16	" "	24	1	6
	17–19	" "	28	1	6
	20–23	" "	30	1	6
	24–27	" "[1]	30	1	6
Maintenance Phase	28+	" "	40+	1	6

[1]Scheduled treadmill exercise test. An exercise prescription for an individual with known heart disease is carried out under physician supervision as part of a rehabilitation program. Intensity is limited by the *angina threshold,* the heart rate at which symptoms of chest pain develop (determined during a treadmill exercise test). The goal is to reach an average heart rate just below this threshold, which varies among individuals. Intensity is readjusted periodically as threshold improves.

. Start gradually. One of the commonest mistakes among the would-be fitness buff is-to start in a burst of enthusiasm, then give up because of exhaustion, pain, and possibly even injury. For the totally sedentary, or those with orthopedic impairments such as arthritis or severe obesity, conditioning might better begin with an upgrade in simple, everyday activities: taking the stairs instead of the elevator, for example, or parking the car farther from work and walking the rest of the way. A brisk daily walk, even one of five to ten minutes, is better than sitting still and forms the basis for progress to more prolonged and vigorous exercise. It is also unlikely to produce the kind of failure or discomfort that destroys motivation.

- *Choose enjoyable activities.* The person who hates running will never practice it regularly for a lifetime, no matter how good his or her intentions. People should take up activities that interest them and that they feel comfortable performing. A person who needs social interaction might do best in a low-impact aerobic dance class, while someone who prefers solitary pursuits might prefer a daily walk alone each dawn or dusk.

- *Anticipate obstacles,* and plan around them. For many people, "no time" is the chief excuse for not exercising. In some instances, though, a closer analysis of the daily schedule may reveal ways to include exercise, such as an early-morning run, a brisk lunch-hour walk, or an after-work swim instead of an after-work drink. Often, the extra effort to include exercise in a tight schedule pays back handsomely in stress reduction, alertness, and productivity later.

Climate may be a barrier in some areas or some seasons; for these times, indoor workouts, at home or in the setting of a health club or community fitness center, maybe a valid alternative. The same logic applies to higher-crime areas where exercising outdoors alone, particularly at night, is considered unwise.

- Encourage *support from family, friends, and co-workers.* People who are trying to change their life-style need help and understanding from those around them. It may help to explain one's goals and involve others in accomplishing them—for example, by inviting a sedentary lunchtime companion to join in a noontime walk a few days each week, or planning family activities such as hiking or swimming together.

THE EXERCISE SESSION

Whether an exercise session is 20,30, or 40 minutes long, it is essential to warmup beforehand and cool down afterward. Warming up serves several purposes. It starts channeling blood to working muscles, causes heart and respiration rates to start a gradual rise, and helps stiff muscles and joints to limber up. A good warmup maybe five to ten minutes of moderately brisk walking or cycling, followed by gentle (never ballistic, or bouncing) stretches of major muscle groups. Or the warmup can simply be performing the chosen exercise at a slower pace, such as walking before running. To prevent injury, exercisers should always warm up muscles before stretching them. Stretching may be done at the end of the exercise session, immediately after the cool-down. (The cool-down lowers the heart rate, but the muscles will remain warm enough to be stretched.)

After vigorous exercise, blood tends to pool in the lower extremities unless there is an appropriate cool-down period before sitting or lying down; this cool-down might consist of slow walking, more gentle stretching, or a slow, easy five to ten minutes of the same activity pursued in the session.

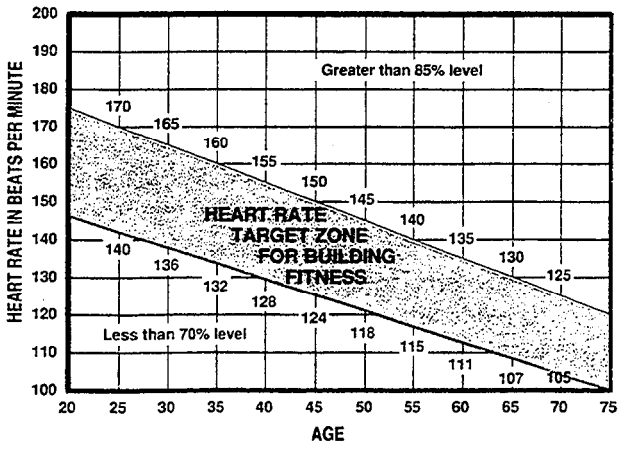
How can a novice exerciser know whether he or she is working hard enough to accomplish fitness goals, but not too hard for safety? One simple method is the "talk test": A person working at a reasonable rate of aerobic exertion will still be able to talk with a companion, but will notice an increased rate of breathing and some perspiration. A more accurate method involves determining the target heart rate for exercise training (using the 220-minus-age formula previously described) and taking the pulse to monitor whether that rate is being achieved.

People who are elderly or have coronary heart disease or other medical conditions may be instructed to start training at a lower target heart rate and work up gradually to 70 percent or more. If the pulse exceeds this rate, it is wise to slow down; if it remains below this rate, gradually increase the intensity of exercise until the target rate is achieved. (See Figure 7.1 for recommended heart rates.)

To monitor heart rate, take the pulse for 15 seconds (use the second hand of a watch, clock, or stopwatch) and multiply by 4. A pulse is found by laying the first two fingers across the inside of the wrist or *lightly* across the carotid artery, which lies on the neck to either side of the Adam's apple. There is no need to take the pulse frequently; occasional checks are adequate to determine whether target heart range has been reached.

Another key to safe and enjoyable exercise is "listening to the body." For example, heart patients may suffer a worsening of angina if they exercise shortly after eating; thus, vigorous activities should be deferred for 2 to 3 hours after eating. In the heat of exertion-especially in competitive activities such as tennis or marathon running—it is tempting to ignore cues of pain, stress, or exhaustion from the whole body or from particular joints or muscles. Avoiding injury, however, means acknowledging and responding to discomfort with a change in pace or a switch to another activity that uses different muscle groups. The expression "No pain, no gain" has been discredited by exercise physiologists, cardiologists, and other experts on fitness. In fact, one should never

Figure 7.1
Recommended Heart Rate Ranges for Cardiovascular Fitness



Signs of Excessive Effort

The following symptoms may indicate that an individual is exercising too hard, too long, or too often.

During or Right After Exercise

Chest pain (angina)
Light-headedness or confusion
Nausea or vomiting
Crampy pain in leg (claudication)
Pallor or bluish skin tone
Breathlessness lasting for more than ten minutes
Palpitations

Delayed

Prolonged fatigue (24 hours or more)
Insomnia
Weight gain caused by fluid retention
Persistent racing heartbeat

Source: Adapted from Steven N. Blair et al., eds., Resource Manual for Guidelines for Exercise Testing and Prescription (Philadelphia: Lea& Febiger, 1988), ch. 27.

work up to pain or exhaustion except as part of a diagnostic medical test. (See box, "Signs of Excessive Effort.")

In addition, exercisers should take the following special precautions:

- *Hot weather.* It is very easy for heat exhaustion and heatstroke to occur when exercising at high temperatures. Drink plenty of water before, during, and after exercise, and do not rely on thirst alone as a guide to water requirements. Wear lightweight, breathable clothing, and stop exercising at any sign of dizziness, nausea, or difficulty breathing. A number of synthetics, such as polypropylene (sold under such brand names as Thermax and Drylete), are excellent as a first layer of clothing because of their ability to wick perspiration away from the skin, keeping it dry so that it does not feel cold and clammy. Synthetics such as Gore-Tex and Thintech are good for the outer layer because they are wind- and water-resistant.
- Cold weather. People who ski, run, or hike in very cold temperatures should dress in warm, lightweight layers of clothing that can be removed as needed during exertion. High winds not only intensify cold, but also increase the likelihood of frostbite. Go indoors at any sign of numbness or tingling in the face or extremities.
- *High altitudes.* The thinner air at very high altitudes makes it more difficult to extract adequate oxygen from the air without an adjustment period of several days. A person who has recently arrived in a mountainous area would be wise to start even a familiar level of exercise slowly and to begin with caution any new activity such as skiing or hiking.

For other conditions that may temporarily preclude exercise, see box, "When to Defer Exercise."

THE EXERCISE PRESCRIPTION

Medical professionals often refer to an "exercise prescription" as part of an individual's health care plan. This term implies a formal, structured, and medically supervised program; but how necessary these strictures are depends on individual circumstances.

For healthy adults who simply wish to become more active, a structured exercise program such as that offered by a gym or health club is not necessary unless an individual finds it helpful for purposes of motivation and adherence. And for people under age 35 or so, with no known medical problems or risk factors for coronary heart disease, it is not necessary

When to Defer Exercise

The following are reasons to suspend a program of physical activity until a physician can be consulted:

Chest pain or progression of cardiac disease
Recurrent illness
Abnormally high 'blood pressure
Orthopedic problem
Severe sunburn
Severe alcoholic hangover
Dizziness or vertigo
Swelling or sudden weight gain
Dehydration
Environmental factors:
  Weather (excessive heat/humidity)
  Air pollution (smog)
Use of certain prescription drugs (ask a physician or pharmacist)

Source: Adapted from Steven N. Blair et al., eds., ***Resource Manual for Guidelines for Exercise Testing and Prescription*** (Philadelphia: Lea & Febiger, 1988), ch. 27.

to undergo a medical evaluation before starting an exercise program if such a program is begun gradually. Men over age 45 and women over age 50 who have been sedentary should get a physician's okay before beginning an exercise program.

Some people should begin exercising only under a physician's supervision. These include people with coronary heart disease, elderly people, and those with other medical conditions, such as asthma, arthritis, and diabetes mellitus, that may have an impact on physical activity. For them, a thorough preliminary health assessment is in order, and activity may be best followed in the form of a specified, graded regimen.

The medical assessment of physical fitness takes into account weight; age; other cardiovascular risk factors such as smoking, high blood pressure, high blood cholesterol, and a family history of heart disease; current medications (some of which can affect the output of the heart); and a history of orthopedic problems or other medical conditions. For those with coronary heart disease or a family history of premature death from heart disease, an exercise stress test, and possibly some other diagnostic procedures, may be necessary to determine a safe exercise level. (See Chapter 10.)

An exercise prescription is developed based on these factors plus the person's own interests and abilities. It may be formal or informal; weekly charts or calendars may be used to record miles walked, pace and heart rate achieved, and other variables like body weight, dietary changes, discomfort or symptoms, and mood. A good exercise prescription will allow for flexibility, variety, and incremental progress. Such a program is typically included as part of cardiac rehabilitation programs for heart stick survivors, either in the hospital or in a community-based setting. (See Chapter 28.)

Many health clubs, gymnasiums, or "cardiac fitness centers" offer clients a prescription-type exercise regimen as part of their services, but some of these can be quite expensive. Caution should be used when choosing such a facility or program. A health club or similar center should offer personnel who are trained in exercise physiology and are alert to the cautions and concerns outlined in this chapter. Facilities that concentrate on competitive or ostentatious performance, or that stress anaerobic exercises, such as yoga or weight training, to the exclusion of cardiovascular training, are to be avoided. In addition, facilities should be clean, convenient in terms of location and scheduling, and uncrowded at the times planned for attendance.

THE PAYOFF FOR HEART HEALTH

Even if physical activity did nothing for the heart, it would still be worth doing for the improvements in self-image, energy level, and mood. Adding to these rewards, though, are the very real physiological improvements in cardiovascular functioning and tangible risk reduction in the following areas:

BLOOD LIPIDS

Regular, vigorous exercise has been shown to reduce elevated levels of total and LDL ("bad) cholesterol in the bloodstream and most notably to increase levels of protective HDL ("good) cholesterol. (See Chapter 4.) Part of the increase in HDL levels seen with training may result from a concomitant decrease in body fat—another proven way to raise HDL.

BLOOD PRESSURE

Moderate exercise, especially with loss of excess weight, may lower elevated blood pressure without drugs. In fact, in about 25 percent of those with mild hypertension, these measures alone may reduce pressure to safe levels.

OBESITY

The time-honored formula for weight loss—to burn more calories than you eat—is more easily said than done, at least if diet alone is the prime weight-loss strategy. In many obese people, the basal metabolic rate is likely to go down when calories are cut back, meaning that the body is actually conserving fat in response to dieting. Exercise, on the other hand, raises the metabolic rate both during the session and, according to some researchers, for a while afterward. Thus, by exercising, it may be possible to lose weight without cutting calorie consumption; and by exercising in conjunction with calorie restriction, it may be possible to avoid the metabolic slowdown that frustrates so many habitual dieters. Supplementing calorie restriction with exercise also prevents loss of muscle along with the loss of body fat.

BLOOD CLOTTING

There is evidence that vigorous exercise reduces the stickiness of platelets, the blood components respon-

sible for clotting. Because blood clots, or *thrombi,* are the triggers for many heart attacks and strokes in persons with atherosclerosis, this effect may further reduce the risk of such events.

DIABETES

Exercise helps make the body's use of insulin more efficient and can blunt the rises in blood sugar associated with diabetes mellitus. Better diabetic control, in turn, is linked to a lower rate of cardiovascular and other complications. The effect of exercise on obesity-often an accompaniment of diabetes—is an added benefit.

RISKS OF EXERCISE

It should be remembered that running or any other vigorous exercise does not by itself confer immunity to coronary heart disease. In fact, vigorous exercise carries a slight increased risk of sudden death, a term usually associated with fatal heart rhythm abnormalities. (See Chapter 16.) For this reason, people with a cardiovascular risk factor such as a family history of premature heart disease, high blood cholesterol, or chest pain should *not* take up exercise without medical assessment and supervision.

On the other hand, virtually everyone can enjoy the benefits of exercise if exercise programs are carefully designed to meet individual needs and if exercisers are taught to recognize warning signs that indicate they should stop and rest or possibly seek medical help. After Jim Fixx, the author who helped popularize jogging, died while running in 1984, many people became concerned about this possibility. R should be pointed out, however, that Mr. Fixx may have ignored two important factors: He was the son of a premature heart disease victim, and he was believed to have run in spite of chest pain.

WHAT RESEARCH SHOWS

The effects of exercise have been difficult to document in long-term, controlled clinical trials. This is due to the difficulty of documenting consistent and comparable activity levels in large groups of people. There is still no definitive survey proving that regular exercise will lower heart disease rates. However, there are numerous epidemiologic studies—that is, retrospective surveys examining the health and habits in large groups of people—that strongly suggest that the benefits of exercise include avoiding coronary heart disease and lengthening life.

In one landmark study, heart disease rates were compared in two groups of London men: bus drivers, who sat most of the day, and bus conductors, who were more active. The conductors had a significantly lower rate of heart attacks. However, this study left key questions unanswered, including whether the conductors may have been drawn to their active jobs because they were in better physical condition in the first place and whether the drivers may have been subjected to other factors, such as stress, that were not accounted for by exercise level alone. Other studies, including those of physically active men such as longshoremen, have shown an association between exertion and heart health, but again no causative link was shown; in some countries, such as Finland, physically active lumberjacks who ate that country's typical high-fat diet showed no protection against heart disease and, indeed, had a high rate of heart attacks.

The most recent, and compelling, evidence that moderate exercise can lengthen life came from a study by Ralph Paffenbarger, M. D., and colleagues at Stanford University in 1982. Among 17,000 graduates of Harvard University, aged 35 to 74, those who expended at least 2,000 calories a week in exercise (including light activities such as walking around the office) had a significantly lower death rate from heart attack than those who were sedentary. Interestingly, the death rate rose slightly at the very highest levels of exertion; moderate, rather than extremely strenuous, activity appeared to be the protective factor.

THE EXERCISE STRESS TEST

The exercise stress test, which is described in detail in Chapter 10, serves to alert the physician to the possible presence of heart function abnormalities that may be triggered or worsened by exertion. During the test, a person exercises to 85 percent of his or her maximum ability (or until symptoms of heart disease or other problems result, at which point the test is immediately stopped). Meanwhile, blood pres-

sure, heart rhythm, and, in some cases, oxygen consumption are continuously recorded. If the results are abnormal, further testing may be recommended, based on the person's age, gender, and other risk factors. It should be noted, however, that exercise stress tests have a false positive rate (a result indicating disease when none is present) of anywhere from 15 to 40 percent; this rate is even higher in young women with no symptoms of heart disease. It may also be less reliable in trained athletes.

The stress test is especially important for determining the safe level of exercise during heart attack recovery and may be performed at intervals during cardiac rehabilitation to monitor progress.

Who needs an exercise stress test before starting a program of activity?

Definitely needed: Anyone over 40 who has symptoms or a family history of coronary heart disease, or more than two risk factors for it—including being male. (See Chapter 3.)

Possibly needed: People who are elderly or extremely sedentary, but otherwise free of cardiovascular symptoms or risk factors. The decision to perform a stress test on these individuals is made in consultation with the physician based on their overall health profile and proposed exercise goals. Also, younger people with one or two possible risk factors for heart disease may wish to consult a physician on the need for an exercise stress test, particularly if they plan to take up a new and strenuous activity.

Not needed: Young, healthy people with no cardiovascular risk factors or symptoms. The exercise stress test has been marketed by some "fitness centers" or trainers as a good tool for assessing baseline fitness and motivating improvement however, for most nonathletes, this is a costly and inappropriate use for the test.

EXERCISE AND THE ELDERLY

It is normal for some degree of aerobic capacity to be lost along with the aging process. In many people, however, much of that loss is due to declining activity levels rather than physiological change related to age itself. A 70-year-old who exercises regularly may well be in better "shape" than a 35-year-old who is totally sedentary. Research has shown that even in old age, conditioning can improve cardiovascular endurance, muscle strength, and well-being.

In many communities, this is being acknowledged through programs aimed at offering elderly people the opportunity to exercise in a safe and pleasant manner. Older people should start at a slower pace and increase the intensity and duration of their exercise more gradually than younger people, and they should select "low-impact" aerobic activities that do not place extra stress on joints (swimming, cycling, or walking, for example). Most important, they should realize that age alone is no barrier to physical fitness, no matter how long a person has been inactive.