Procedures in Family Practice

Fitness Evaluation and Exercise Prescription

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Proper exercise positively affects most of the risk factors of coronary heart disease and frequently enhances the quality of life. Maximum exercise test evaluation is recommended for adults over 35 years of age prior to initiating an exercise program. Key elements for an adult exercise program include activities for flexibility, muscular tone, and cardiorespiratory endurance. Proper warm-up may improve performance and reduces the potential for injury. Exercise motivation is enhanced by variation.

Lifestyle related illness contributed to greater than 50 percent of the deaths in the United States in 1976.[1] Cardiovascular disease was the leading cause of death in middle age. Lifestyle habits aggravate many of the risk factors accelerating coronary heart disease, the major cause of cardiovascular death.

Exercise modifies most risk factors of coronary heart disease and may reduce the incidence of myocardial infarction and death from this cause. Kannel[2] reviewed 5,127 men and women in the Framingham Study and found that the more active an individual was, the less the risk of a cardiac event, whereas the most sedentary individuals had a distinctly worse outlook and were particularly liable to fatal heart attacks. Cooper et al[3] found an inverse relationship between physical fitness and the following: resting heart rate, body weight, percent of body fat, serum levels of cholesterol and triglycerides, blood glucose, and systolic blood pressure. Universal Fitness Testing Services, Seattle, prescribed exercise to over 3,000 individuals after appropriate exercise testing between 1972 and 1980. At the time of reevaluation, many individuals commented on an improved feeling of well-being, less fatigue, and more efficiency in their daily patterns of living. These comments are consistent with the conclusions of Heinzelmann and Bagley.[4]

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Table 1. Beneficial Physiological Adaptations to Exercise

Lower resting heart rate and blood pressure
Lower heart rate and blood pressure for submaximal work
Increased stroke volume and cardiac output throughout exercise
Faster recovery to baseline heart rate and blood pressure
Decreased ventilation equivalent
Increased maximum oxygen uptake
Increased arteriovenous oxygen difference at maximum work
Increase in total hemoglobin

Because there are many variations of exercise prescription, a satisfactory program can be developed for most adults. Exercise is an inexpensive recreation; therefore, it is reasonable that family physicians exercise test and prescribe appropriate exercise for their patients.

Physiology of Exercise

The basic physiological response to exercise is an increase in total body oxygen consumption made possible by increases in pulmonary ventilation, cardiac output, and oxygen extraction by the tissues.[5-7] Greater cardiac output is the result primarily of accelerated heart rate and, to a lesser extent, of greater stroke volume. About one half of the increased oxygen uptake is due to increasing oxygen extraction by working muscle, with the other half resulting from an augmentation of maximal cardiac output. Compared with those of the peripheral musculature, myocardial oxygen needs are primarily met by increased heart rate rather than improved oxygen extraction. There is an essentially linear relationship between oxygen uptake and heart rate in normal individuals at all levels of submaximal work. Maximal exercise heart rate decreases with age. Peripheral resistance decreases with increasing levels of dynamic exercise, so that systolic blood pressure typically increases while diastolic pressure usually shows minimal change or falls with progressive exercise. Pertinent, beneficial physiological adaptations to exercise are summarized in Table 1.

Adenosine triphosphate, the high energy phosphate required for skeletal muscle activity, can be derived from either an oxidative (aerobic) or a glycolytic (anerobic) metabolic pathway. At low levels of exercise, energy is derived both from fat and carbohydrate, but carbohydrate utilization is most efficient and is progressively achieved through increased work. Maximum exercise is therefore closely dependent on the glycogen content of exercising muscle.[8]

An interesting sidelight of exercise is the redistribution of blood flow from rest through exercise.[9] At rest, the flow of blood is fairly equally distributed to the various parts of the body. With exercise, blood is selectively delivered to the exercising muscle and shunted away from the skin and the splanchnic, hepatic, and renal vascular beds. During maximum exercise, the blood flow is redistributed to the point that almost 90 percent of the blood flow is directed to the exercising muscles. Digestion requires shunting of up to 70 percent of the available blood to the upper gastrointestinal area. This is why exercising soon after eating may lead to difficulties because of the conflicting circulatory requirements of exercise, digestion, and the heart.

Maximum oxygen uptake V_{O_2MAX} is the generally accepted index of cardiovascular and respiratory fitness. Oxygen uptake is measured in terms of milliliters per kilograms per minute. An easier method of correlating exercise activities is by using the metabolic equivalent (MET). One MET equals an oxygen consumption of 3.5 ml/kg/min, the amount required while sitting.

Aerobic metabolism occurs in exercise of low intensity and long duration. It uses the oxygen delivered to the exercising muscles to maintain the exercise. As long as the supply of oxygen is equal to the demand, the exercise can be maintained. Examples of exercise involving aerobic metabolism are jogging one mile or bicycling five miles.

Anaerobic metabolism is used in exercise of high intensity and short duration. Essentially, it uses the oxygen present in the exercising muscles at the time exercise is initiated or when the intensity of the exercise is extremely high. If the intensity of exercise is such that the supply of oxygen to the exercising muscle is not able to meet the oxygen requirement of the exercising muscle, then the muscle will soon fatigue, a condition frequently associated with a painful buildup of lactic acid. An

Table 2. Contraindications to Exercise and Exercise Testing

Absolute Contraindications	Relative Contraindications	Conditions Requiring Special Consideration and/or Precautions*
Manifest circulatory insufficiency ("congestive heart failure")	Uncontrolled or high-rate supraventricular dysrhythmia	Clinically severe hypertension (diastolic over 110 mmHg, grade III retinopathy)
Acute myocardial infarction	Repetitive or frequent ventricular ectopic activity	Angina pectoris and other manifestations of coronary insufficiency
Active myocarditis	Untreated severe systemic or pulmonary hypertension	Marked obesity
Rapidly increasing angina pectoris with effort	Ventricular aneurysm	Renal, hepatic, and other metabolic insufficiency
Recent embolism, either systemic or pulmonary	Moderate aortic stenosis	Overt psychoneurotic disturbance requiring therapy
Dissecting aneurysm	Uncontrolled metabolic disease (diabetes, thyrotoxicosis, myxedema)	Neuromuscular, musculoskeletal, or arthritic disorders that would prevent activity
Acute infectious disease	Severe myocardial obstructive syndromes (subaortic stenosis)	
Thrombophlebitis	Marked cardiac enlargement	
Ventricular tachycardia and other dangerous dysrhythmias (multifocal ventricular activity)	Toxemia of pregnancy	
Severe aortic stenosis		

*These patients generally should receive supervised exercise therapy
From American College of Sports Medicine: Guidelines from Graded Exercise Testing and Exercise Prescription. Philadelphia, Lea & Febiger, 1975

example of exercise demanding this type of metabolism would be running the 100-yard dash.

Exercise and Exercise Testing

Exercise and exercise testing are commonly indicated for the following situations: (1) sedentary lifestyle, (2) overweight and obesity, (3) hyperlipemia (hypercholesterolemia and hypertriglyceridemia), (4) hypertension, (5) alternative to smoking, (6) tension (anxiety), and (7) family history of hypertension, coronary heart disease, and stroke. Table 2 displays the contraindications to exercise and exercise testing.[10]

Fitness Evaluation

For persons less than 35 years of age, the Kasch Pulse Recovery Step Test[11] is a method of fitness evaluation (Table 3). A maximum heart rate is

Table 3. Recovery Heart Rate Fitness Table Using the Kasch Pulse Recovery Step Test, 1976 (by age)

	6-12 years		18-26 years		27-60 years	
Class	**Boys**	**Girls**	**Men**	**Women***	**Men**	**Women***
Superior	74	82	68	73	69	74
Excellent	75-83	83-93	69-75	74-82	70-78	75-83
Good	84-92	94-103	76-83	83-90	79-87	84-92
Average	93-103	104-115	84-92	91-100	88-99	93-103
Fair	104-112	116-125	93-99	101-107	100-107	104-112
Poor	113-121	126-136	100-106	108-114	108-115	113-121
Very poor	122	137	107	115	116	122

Note: Three-minute step test: complete step (up and down), both feet, 12-inch step, 24 times per minute, one-minute recovery
*Arbitrary data
From Kasch F: A comparison of the exercise tolerance of post rheumatic and normal boys. J Assoc Phys Ment Rehabil 15:35, 1961; and Kasch F, personal communication, October 1980

necessary to calculate appropriate training heart rate ranges for cardiovascular endurance training. In this age group, maximum heart rate can be estimated by deducting the age from 220 ± 10.

For those over 35 years, a properly supervised maximum exercise test is preferred to obtain an accurate maximum heart rate. It has been suggested that when using estimated maximum heart rates and when exercising individuals near 80 to 85 percent of these heart rates, 15 to 20 percent will be exercising very close to their maximum heart rate. Also, individuals with coronary heart disease tend to have lower maximum heart rates. Therefore, an accurate maximum heart rate is an additional safety factor for prescribing exercise for those individuals over 35 years of age. Maximal exercise testing also reveals asymptomatic myocardial ischemia in about 8 to 12 percent of middle-aged men, a higher yield than that obtained in less demanding tests.[12]

In Sweden, Åstrand did many of the early exercise studies using a Monark bicycle ergometer. Tables 4 and 5 illustrate a modified Åstrand maximum test, developed by Cardio-Pulmonary Research Institute (CAPRI) in Seattle. The two most widely used treadmill tests are the Standard Treadmill Balke Test[13] (Table 6) and the Bruce Multistage Treadmill Test[14,15] (Table 7).

The disadvantage of bicycle testing is that for many it is an unnatural exercise compared with walking and tends to favor those patients with strong quadriceps. Niederberger[16] found higher

Table 4. CAPRI Symptom Limited Bicycle Ergometer Test: Workloads (KPM)

	Workload (at 50 rpm)	
Stage (3 min)	**Men**	**Women**
1	300	150
2	600	300
3	900	450
4	1,200	600
5	1,500	750
6	1,800	900

systolic blood pressures and heart rates during bicycle exercise when comparing the multilevel bike and treadmill tests of nine patients at equivalent percentages of V_{O_2MAX}. The advantage of the Balke test is that it begins at a lower level than the Bruce test and progresses more slowly. Each level increases energy expenditures by approximately one MET. The disadvantage of the Balke test is that it takes longer, and some individuals will not reach their exercise maximum by the end of Level 12. The Bruce test is quicker and each person tested essentially reaches his or her maximum heart rate using this protocol. In a study of 170,000 exercise tests reported in the *Journal of the American Medical Association* in 1971, using protocols

Table 5. CAPRI Protocol: Oxygen Requirements of Bicycle Ergometric Workloads (ml/kg/min)*

Body Weight kg (lbs)	Workload (KPM)								
	150	300	450	600	750	900	1,200	1,500	1,800
50 (110)	12.0	18.0	24.0	30.0	36.0	42.0	54.0	66.0	78.0
60 (132)	10.0	15.0	20.0	25.0	30.0	35.0	45.0	55.0	65.0
70 (154)	8.5	13.0	17.0	21.5	25.5	30.0	38.5	47.0	55.5
80 (176)	7.5	11.0	15.0	19.0	22.5	26.0	34.0	41.0	49.0
90 (198)	6.7	10.0	13.3	16.7	20.0	23.3	30.0	36.7	43.0
100 (220)	6.0	9.0	12.0	15.0	18.0	21.0	27.0	33.0	39.0

*Metabolic equivalents (METs) may be calculated by dividing ml/kg/min of oxygen consumption by 3.5

from 73 medical centers, 60 percent used treadmill testing.[17] The Bruce exercise protocol is the maximum treadmill test most frequently used by physicians.

Fitness classification (Table 8) can be obtained from the Åstrand bicycle test or the Balke treadmill test or the Bruce treadmill Test by converting exercise performance to V_{O_2MAX}.

Table 6. Balke Standard Treadmill Test (at 3 mph)

Stage*	Treadmill Grade (%)	Oxygen Uptake (ml/kg/min)	METs
1	2.5	15.16	4.33
2	5.0	18.80	5.37
3	7.5	22.40	6.4
4	10.0	26.04	7.44
5	12.5	29.65	8.47
6	15.0	33.29	9.51
7	17.5	36.89	10.54
8	20.0	40.53	11.58
9	22.5	44.14	12.61
10	25.0	47.74	13.64
11	27.5	51.38	14.68
12	30.0	54.99	15.71

*Each stage is 2 minutes long
From Balke B, Ware RW: An experimental study of physical fitness of air force personnel. US Armed Forces Med J 10:675, 1959

Exercise Prescription

A good adult exercise program emphasizes cardiorespiratory endurance training complemented by calisthenics that stress flexibility and muscle tone.

Static (isometric) exercise, which involves little or no joint movement, is to be discouraged because this type of exercise decreases cardiac output through impaired venous return while markedly increasing systolic blood pressure.[18] Dynamic (isotonic) exercise, which involves joint movement, is preferred because it markedly increases heart rate and increases cardiac output with only moderate elevation of the systolic blood pressure.[19] Cardiorespiratory endurance training involves raising the heart rate to a specified point and maintaining that heart rate for 15 to 45 minutes. Types of dynamic exercise that will provide this are jogging, swimming, cycling, and walking. Table 9 details endurance exercise equivalent levels for each activity. For years, heart rate has been the major guideline for cardiorespiratory endurance exercise prescription. In order to improve cardiopulmonary endurance, an individual must raise his or her heart rate to some basic minimum percent of the maximum heart rate and maintain this level for a specific period of time. For safety, it is not desirable to achieve maximum heart rates in noncompetitive adult fitness programs. The American College of Sports Medicine has set a training heart rate guideline for healthy individuals at 60 to 90

Table 7. Bruce Multistage Treadmill Test

Level (3 min)	Treadmill Speed (mph)	Treadmill Grade (%)	Distance Traveled Miles (elevation in feet)	Oxygen Consumption (ml/kg/min)*	METs
1	1.7	10	0.1 (45)	14.0	4.0
2	2.5	12	0.2 (124)	23.10	6.6
3	3.4	14	0.4 (250)	35.00	10.0
4	4.2	16	0.6 (427)	49.70	14.2
5	5.0	18	0.8 (664)	60.20*	17.2*
6	5.5	20	1.1 (954)	71.75*	20.5*
7	6.0	22	1.4 (1,307)	84.00*	24.0*

*Approximation

Table 8. Cardiorespiratory Fitness Classification*

Age (years)	Maximal Oxygen Uptake (ml/kg/min) Low	Fair	Average	Good	High
Women					
20-29	<24	24-30	31-37	38-48	49+
30-39	<20	20-27	28-33	34-44	45+
40-49	<17	17-23	24-30	31-41	42+
50-59	<15	15-20	21-27	28-37	38+
60-69	<13	13-17	18-23	24-34	35+
Men					
20-29	<25	25-33	34-42	43-52	53+
30-39	<23	23-30	31-38	39-48	49+
40-49	<20	20-26	27-35	36-44	45+
50-59	<18	18-24	25-33	34-42	43+
60-69	<16	16-22	23-30	31-40	41+

*Data from Preventive Medicine Center, Palo Alto, California, and from a survey of published sources
From Exercise Testing and Training of Apparently Healthy Individuals: A Handbook for Physicians. Dallas, American Heart Association, 1972

percent of the maximum heart rate.[20,21] Since many physicians will be working with novice athletes, a good practical heart range would be 70 to 85 percent of the maximum heart rate. The MET concept has been used more recently as an adjunct to heart rate. Sixty percent of the maximum MET value corresponds very closely to 70 percent of the maximum heart rate. Eighty percent of the maximum MET value corresponds very closely to 85 percent of the maximum heart rate. By knowing a person's maximum MET exercise performance, a metabolic equivalent exercise program can be developed using these percentages. This is especially helpful in cardiac rehabilitation in which patients are receiving such drugs as propranolol.

Flexibility is an area that needs to be developed

Table 9. Endurance Exercise Equivalents

	Jogging	Swimming	Cycling	Walking
Level 1 (5 METs)*	Walk 1 mile in 12-15 min	Swim 25 yards; rest 30 sec; repeat 5 times (time: 4-5 min)	Cycle 2 miles in 8-12 min	Walk 1 mile in 15-18 min
Level 2 (6 METs)*	Walk .1 mile; jog .1 mile; repeat 5 times (time: 13-15 min)	Swim 50 yards, rest 15 sec; repeat 4 times (time: 4-5 min)	Cycle 4 miles in 16-24 min	Walk 1.5 miles in 21-25 min
Level 3 (7 METs)*	Walk .1 mile, jog .2 mile; repeat 5 times (time: 18-20 min)	Swim 75 yards, rest 15 sec; repeat 4 times (time: 6-7 min)	Cycle 6 miles in 24-36 min	Walk 1.5 miles in 18-21 min
Level 4 (8 METs)*	Walk .1 mile, jog .3 mile; repeat 4 times (time: 16-18 min)	Swim 100 yards, rest 15 sec; repeat 4 times (time: 7-9 min)	Cycle 8 miles in 32-48 min	Walk 2 miles in 24-29 min
Level 5 (8.5 METs)*	Walk .1 mile, jog .4 mile; repeat 4 times (time: 24-26 min)	Swim 200 yards, rest 15 sec; repeat 3 times (time: 12-15 min	Cycle 10 miles in 40-60 min	Walk 2.5 miles in 30-36 min
Level 6 (9 METs)*	Walk .1 mile, jog .6 mile; repeat 3 times (time: 23-24 min)	Swim 300 yards, rest, swim 300 yards, rest, swim 100 yards (time: 15-17 min)	Cycle 12 miles in 48-60 min	Walk 3 miles in 36-40 min
Level 7 (9.5 METs)*	Walk .1 mile, jog 1 mile, walk .1 mile, jog .5 mile (time 21-23 min)	Swim 300 yards, rest, swim 300 yards, rest, swim 150 yards (time: 15-17 min)	Cycle 13 miles in 52-65 min	Walk 3.5 miles in 42-46 min
Level 8 (10 METs)*	Walk .1 mile, jog 1 mile, walk .1 mile, jog 1 mile (time: 20-22 min)	Swim 350 yards, rest, swim 350 yards, rest, swim 150 yards (time: 18-20 min)	Cycle 14 miles in 56-70 min	Walk 4 miles in 50-54 min
Level 9 (11 METs)*	Walk .1 mile, jog 1.5 miles, walk .1 mile, jog .5 mile (time: 18-20 min)	Swim 400 yards, rest, swim 400 yards, rest, swim 150 yards (time: 20-22 min)	Cycle 15 miles in 60-75 min	Walk 4.5 miles in 55-60 min
Level 10 (12 METs)*	Walk .1 mile, jog 2 miles (time: 16-18 min)	Swim 500 yards, rest, swim 500 yards (time: 20-22 min)	Cycle 16 miles in 64-80 min	Walk 5 miles in 70-80 min

Data from Universal Testing Services, Inc., Seattle, Washington
*Approximate for jogging; swimming, cycling, and walking are slightly less

because, as a person ages, the muscles and tendons tend to shorten and the ligaments tend to become less resilient. This then leads to increased stiffening and increased chance of muscular injury. To develop flexibility, the muscles, tendons, and ligaments need to be stretched. Ballistic (bouncing) movement is discouraged because there is an increased potential for injury. Static (slow and steady) movement, using the body weight and force of gravity, is the authors' preferred stretching technique. Figure 1 displays a general calisthenic program. Anderson[22] illustrates many supplemental calisthenics for various activities. Calisthenics are recommended prior to cardiopulmonary endurance exercise as part of the warm-up.

Younger adults are frequently interested in muscular strength and endurance training. Muscular strength is developed by working a specific muscular group against a set resistance. Strength development is enhanced by lifting a large amount of weight a limited number of times. Muscular endurance is developed by lifting a smaller amount of weight a larger number of times. Endurance training also improves muscle tone and definition. When lifting weights, it is important that the person exhale as the weight is being lifted and inhale as the weight is being lowered to help prevent a Valsalva effect.

It is generally accepted that warm-up and cool-down activities are integral parts of physical training, even though the literature has not shown conclusive evidence for the value of warm-up, particularly in respect to performance.[23] Warm-up is designed to increase circulation, which increases oxygen delivery to muscle tissue, and to raise body temperature. An increase in the temperature of muscle decreases muscle viscosity and increases the efficiency of muscle contraction.[5,23] Warm-up also reduces the potential for muscle and joint injury.[24] It has also been shown that strenuous activity, without a warm-up, can bring about an increase in myocardial ischemia.[25]

The cool-down is designed to reduce cardiac output gradually. This gradual reduction aids in replenishing the energy stores and removing the waste products from the exercised muscles, thus lessening the potential for muscle soreness.[23,26] Cooling down gradually also helps prevent the pooling of blood in the lower extremities, which in some cases could cause lightheadedness or syncope, especially if the exercise was performed in an erect posture.[23]

An exercise program should be started slowly, and the intensity and duration should be increased gradually. Two days of exercise per week is the absolute minimum that will bring improvement.[27] Five days of exercise a week is the most a person should do, and as a rule, allowing a day of recovery between exercise sessions reduces fatigue and the potential for injury.[28]

An exercise prescription includes instructions for calisthenics, type of endurance exercise (including warm-up and cool-down), duration of exercise, frequency of exercise, precautions, and frequency of re-evaluation. Following are two examples of exercise prescription.

Case Illustrations

Case 1

A 62-year-old man, 5 feet, 11 inches in height and weighing 198 pounds, was administered a Bruce treadmill test of 300 seconds duration. Sedentary functional aerobic impairment (FAI) was determined to be 32 percent. Maximum heart rate during the test was 140 beats per minute (training heart rate 98 to 119). The subject showed normal hemodynamic response during exercise, with an abnormally high heart rate during recovery; there was no evidence of ischemic heart disease. The test and history suggest a fitness classification of "fair" (see Table 8) with decreased cardiovascular tone.

This man is overweight with below-average fitness as evidenced by his short time on the treadmill and his high recovery heart rate. Arbitrarily, the authors believe a recovery heart rate above 115 beats per minute at five minutes of recovery using the Bruce protocol is an indication of diminished cardiovascular tone. Individuals in this age range who have not exercised for years are seldom inclined to begin jogging, and experience suggests the best compliance occurs using a walking or stationary bicycle program.

This man would be started on Level 1 of Table 9. His physical state is such that he might not be able to walk a mile briskly in 18 minutes; consequently, he will do the best he can, and his level would not be improved until he can comfortably walk a mile within the designated time. Warm-up could consist of five repetitions of calisthentics

Neck and Shoulder Girdle

Neck rotation—two repetitions each direction

Backward swim—10 repetitions each arm

Side and Lower Back

Side stretch—10 repetitions each direction

Trunk rotation—10 repetitions each direction

Abdomen

Shoulder curl (half sit-up)—10 to 15 repetitions

Sit-up—10 to 15 repetitions

Hip and Groin

Hip abduction—10 repetitions each leg

Groin stretch—two repetitions, 10 seconds each (push down on knees with elbows while grasping ankles)

Hamstring/Quadriceps

Toe touch—two repetitions, 10 seconds each

Half squat—two repetitions, 10 seconds each

Lower Leg

Double leg Achilles stretch—two repetitions, 10 seconds each

Single leg Achilles stretch—two repetitions, 10 seconds each

Figure 1. Warm-up calesthenics. Standing exercises may be performed as a group before floor exercises

and the stretches from Figure 1. He would increase his calisthentic repetitions to ten as they become more comfortable. Cool-down would consist of walking more slowly for five to ten minutes. Frequency would be three times weekly or every other day.

The cycling program could be carried out using a Monark or comparable bike. After adjusting the seat properly and pedaling at a speed of approximately 12 miles an hour, he would attempt to cycle two miles in approximately ten minutes with a tension setting of one (300 kilopondmeters (KPM)). If this proved difficult, the setting could be reduced to one half (150 KPM). Calisthenics could be carried out as a warm-up, and cool-down would consist of pedaling slower against no resistance for five minutes. Exercise levels would not be increased until he was comfortable with Level 1 and recovery was complete in five to ten minutes.

Levels would not be increased more often than every two weeks. Both the walking and bicycling programs would be monitored by the carotid or radial pulse rate, and the speed of walking or pedaling would be adjusted to the heart rate training range. This individual may find that Level 4 or 5 is as far as he would like to progress. The physician must use common sense in setting an appropriate goal for his or her patients. Follow-up for a person such as this would be reasonably frequent, with the first follow-up in one month and then every three months for at least one year, with an appropriate follow-up exercise test in 6 to 12 months. The exercise program should be accompanied by dietary counseling.

Case 2

A 36-year-old woman, 5 feet, 3 inches in height and weighing 132 pounds, was administered a maximum ergometer test (CAPRI protocol) lasting 610 seconds. Maximum heart rate was 180 beats per minute (training heart rate 126 to 153). The subject showed normal hemodynamic response to exercise; there was no evidence of ischemic heart disease. A fitness classification of "fair" is suggested.

This woman is also overweight and below average in fitness. A woman of this age may elect a walking program but is frequently more interested in jogging or swimming, if a pool is available. The jogging program would start at Level 1 (Table 8) and would increase no more often than every two weeks and only if the performing pulse rate is in the training range and recovery is satisfactory. Joggers in this age range, especially men, would generally be interested in reaching and maintaining Level 10. Calisthenics and walking would be the warm-up, with cool-down being a slower walk. Frequency again would be three times weekly or every other day. Most of the calisthenics could be performed in ten repetitions the first time. The importance of good shoes would be emphasized, and jogging injuries and how they occur should be discussed (see below). The first follow-up would occur in one month, then every three to six months, with the use of a submaximal test periodically to demonstrate improvement. A maximal test would be repeated in one year. Dietary counseling is also indicated.

Follow-Up Evaluation

The progress of a patient over 35 years of age may be followed by using submaximal tests at three- to six-month intervals. The patient exercises on a bicycle or treadmill to a target heart rate (usually 70 to 85 percent of the maximum heart rate obtained on the most recent exercise test), using the same protocol as for the previous maximum exercise test. Improvement is measured by the difference in time involved in reaching the target heart rate on the submaximal test as compared with the previous or initial maximum exercise test. Other points of improvement that may be related to the patient include positive changes in blood pressure and heart rate at various levels. A maximum exercise test every one to two years is recommended. Under 35 years of age, the Kasch Step Test may be repeated at convenient intervals.

Motivation

Motivation begins with the physician. When recommending and prescribing an exercise program, explain the physiological benefits. Point out that exercisers seem to have fewer heart attacks than nonexercisers. A physician who looks fit and exercises provides a positive stimulus. Real interest in the patient's exercise program and appropriate follow-up is also helpful. A study at the University of Washington suggests that patients having periodic exercise tests tend to be more

Table 10. Approximate Range in Energy Cost (METs) of Leisure Activities: Sports, Exercise Classes, Games, Dancing

	METs		METs
Archery (target or field)	3-4	Hunting (bow or gun)	3-7
Backpacking	5-11	Small game (walking, carrying light load)	3-7
Badminton	4-9	Hunting (bow or gun)	
Basketball		Big game (dragging carcass, walking)	3-14
Nongame play	3-9	Jogging 5-6 mph	7-15
Game play	7-12	Mountain climbing	5-10
Bed exercise (arm movement supine or sitting)	1-2	Paddleball (or racquetball)	8-12
Bicycling (for pleasure or to work)	3-8	Sailing	2-5
Bowling	2-4	Scuba diving	5-10
Canoeing, rowing, and kayaking	3-8	Shuffleboard	2-3
Conditioning exercises (calisthenics)	3-8	Skating, ice and roller	5-8
Dancing (social and square)	3-7	Skiing, snow	
Fencing	6-10	Downhill	5-8
Fishing		Cross-country	6-12
From bank, boat, or ice	2-4	Skiing, water	5-7
Stream (wading)	5-6	Sledding (and tobogganing)	4-8
Football, touch	6-10	Snowshoeing	7-14
Golf		Squash	8-12
Using power cart	2-3	Soccer	5-12
Walking (carrying bag or pulling cart)	4-7	Softball	3-6
Handball	8-12	Stair climbing	4-8
Hiking, cross-country	3-7	Swimming	4-8
Horseback riding	3-8	Table Tennis	3-5
Horseshoe pitching	2-3	Tennis	4-9
		Volleyball	3-6

From American College of Sports Medicine: Guidelines for Exercise Testing and Exercise Prescription. Philadelphia, Lea & Febiger, 1975

faithful in exercising than those not being retested.

Exercise may be complemented by a variety of leisure sports and activities that make the exercise program more interesting. Table 10 lists metabolic equivalents of many of these activities.

Some patients may not maintain motivation in spite of the physician's best efforts and may want to stop their exercise programs. When this happens point out that no exercise for three months would return the average person to his previous unconditioned state. By dropping back one level of exercise, making it less strenuous, and exercising two to three times a week, fitness can be maintained. When a motivating activity such as ski season approaches, an individual may increase the exercise level and frequency without undue stress or fatigue.

Exercise Injuries and Cardiac Risks

Jogging has become the exercise avocation of millions in the past decade. Proper shoes are all-important to the jogger.* Shin splints, chondromalacia, muscle soreness, hamstring strain, and

*_Runners World_ magazine periodically tests and compares shoes. Their most recent report, 1982 _Runners World_ Shoe Survey, appeared in the October 1981 issue.

low back pain are the most likely injuries to occur in the jogger because of poor training techniques and improper shoes.[29] The overuse syndromes usually occur when the jogger progresses from one level of training to another, increasing mileage or speed. These symptoms can usually be relieved by reducing speed or training level, or by temporary rest. Calisthenics can aggravate or precipitate bursitis, tendinitis, or myositis of the shoulders, trunk, back, hips, or knees. Reducing the number of repetitions, avoiding ballistic motion, or rest will usually relieve these symptoms. Injuries that persist need medical attention.

Gibbons[30] evaluated acute cardiac risk of strenuous exercise at the Institute for Aerobics Research in Dallas. In reviewing the computer logs of 374,798 person-hours of exercise over a five-year period, which included 2,726,272 km of running and walking, it was found that only two cardiac events and no deaths had occurred. Maximum risk estimates consistent with these data ranged from 0.3 to 2.7 events per 10,000 person-hours of exercise for men and 0.6 to 6.0 events per 10,000 person-hours for women. If exercise were performed three times per week for 30 minutes per session for a year, maximum risk estimates would drop to 0.002 to 0.027 events per person-year for men and 0.005 to 0.05 events per person-year for women.

Conclusion

Exercise is an inexpensive activity which, when properly done, can be fun. The dividend is a better quality of life with diminished risk of coronary heart disease, especially when coupled with other appropriate health habits. Physicians in general have been slow to endorse exercise because of their limited knowledge of the field. It is hoped that this paper will stimulate exercise testing and prescription and thereby strengthen the role of the family physician in his or her service to the patient.

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