Exercise: A Practical Guide For Helping The Patient Achieve A Healthy Lifestyle

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Abstract: **Starting patients on an exercise program can accomplish more than many other efforts a physician undertakes. The wide range of physical and psychological benefits of exercise suggests that physicians should make a greater effort to motivate patients to begin such programs. Through a combination of personal role-modelling, patient education about exercise physiology and the benefits of exercise, and appropriate use of the exercise prescription, physicians can make a major impact by converting patients from a sedentary to an active lifestyle. (J Am Bd Fam Pract 1989; 2:238-46.)**

Exercise, whether in the form of running, walking, or other activity, has become increasingly popular over the past decade. Physicians have increased their personal participation in such programs and have also developed a heightened awareness of the health care needs of the recreational and competitive athlete. This increased interest is evidenced by the rapid growth of the American College of Sports Medicine and by the decision of the American Board of Family Practice to develop a Certificate of Added Qualification in Sports Medicine.[1]

Though the benefits of exercise are well documented, not all physicians have the skills to guide patients through a fitness program. Further, there are few good sources of information for this purpose. This article reviews the benefits of aerobic exercise, summarizes current knowledge of exercise physiology, and provides a practical guide for helping patients through an exercise program.

Aerobic versus Anaerobic Exercise

Many patients do not understand the term "aerobic" in relation to exercising; nor do they know the difference between aerobic and anaerobic activities. Because most studies of the benefits of exercise have used aerobic activities, it is important to recognize the difference between the two modes. One reason for the confusion is that no single activity is exclusively aerobic or anaerobic.

Aerobic exercise requires the use of oxygen to produce energy and results in the metabolic products of water and carbon dioxide. Exercises that are predominantly aerobic are those that are performed at a moderate effort level and use continuous movement of large muscle groups. Anaerobic exercise involves bursts of speed or intense effort, when energy needs temporarily outstrip the rate that the body can deliver oxygen to the muscle. Energy derived from anaerobic metabolism produces pyruvic acid and lactic acid as byproducts. Because the accumulation of lactic acid in the muscles produces extreme discomfort, anaerobic activity can be sustained for only a few minutes.[2]

Most activities have both an aerobic and an anaerobic component (Figure 1), and some, such as long-distance running (which is predominantly aerobic), can become anaerobic simply by increasing speed.[3] *It is important to emphasize to patients that anaerobic activities will not provide the same benefits as aerobic ones.* Aerobic activities include running, walking, rowing, bicycling, aerobic dance, cross-country skiing, and swimming. While other activities may play an important role in the patient's overall fitness program, they should be used as supplements to the primary activity.

Dispelling Myths about Exercise

Patients have a tendency to justify their past failures for exercising and to avoid the decision for embarking upon a new program. A great deal of denial is at work, much like in patients

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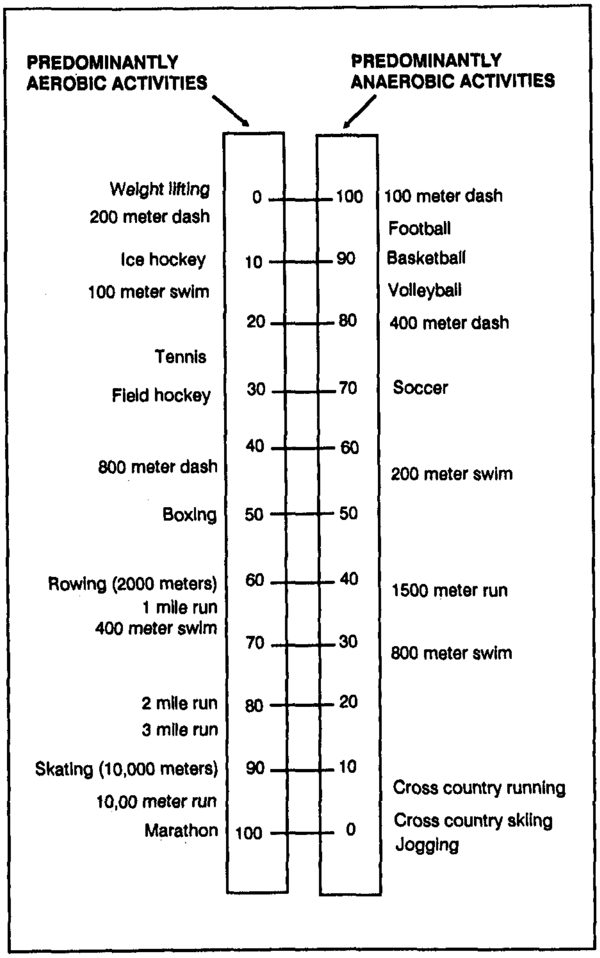

Figure 1. The energy continuum. Approximate percentages of aerobic versus anaerobic effort from various forms of exercise. Adapted from Fox E.[3, p 24]

who abuse alcohol, smoke, and fail to wear seat belts. One of the most common reasons given for not beginning an exercise program is "having bad knees." While it is true that running results in a large variety of aches and pains around the knees, the origin of most of them is probably muscular or ligamentous – not articular – and results from poor conditioning rather than joint problems.

Lane, et al. studied 41 long-distance runners to assess the adverse effects of running on the skeletal system.[4] Radiographs of the hands, spine, and knees were compared with 41 nonrunners. No differences were noted between the two groups in joint space narrowing, crepitation, joint stability, or symptoms. In a related study, Panush, et al. compared a group of 17 men who averaged 28 miles per week for 12 years with 18 nonrunners.[5] Clinical and radiological examinations between the two groups were not significantly different.

An often-asked question about exercise is whether there is any evidence that it will prolong life. Paffenbarger, et al. examined the physical activity of 16,936 Harvard alumni, ranging from 35 to 74 years of age, over a 16-year period.[6] They found that, with increasing levels of exercise, death rates progressively decreased. Overall death rates were 25 to 33 percent lower among those who expended 2000 kcal/week. This amount of exercise equates to about 40 minutes of vigorous activity 5 times per week.

The Benefits of Exercise

In addition to increased longevity, exercise has numerous other benefits. It is one of the most effective ways to relieve stress.[7] Not only does a single session of exercise help to discharge immediate feelings of anxiety, but persons who exercise regularly report a sustained decrease in feelings of stress and depression. It also decreases type A behavior and increases feelings of self-esteem.[8,9]

In addition to these largely psychological effects, regular exercise results in a number of profound physical changes. It contributes to the prevention of heart disease through a number of different mechanisms, including increases in high-density lipoproteins, vagal tone, and myocardial stroke volume and decreases in heart rate, systolic blood pressure, cardiac output at submaximal exercise levels, circulating plasma catecholamine levels, and cardiac afterload. There is evidence that exercise increases insulin sensitivity, fibrinolysis, ejection fraction at rest and during exercise, and myocardial hypertrophy; raises the ventricular fibrillation threshold; and decreases platelet aggregation, regional ischemia, and myocardial catecholamines. In addition, blood volume and total body hemoglobin increase with exercise.[10]

At the muscular level, aerobic exercise increases the number and density of mitochondria, which can result in more efficient metabolism. In addition, an overall increase in the volume of skeletal muscle occurs, and there is an increase in capillaries, which aids the flow of blood and oxygen to the tissues during exercise and rest. These changes allow the removal of lactic acid more rapidly from the muscles and increase the body's ability to use fatty acids as fuel. Furthermore, they allow an overall increase in the ability to use oxygen and a decrease in the rate at which glycogen stores are depleted.[11]

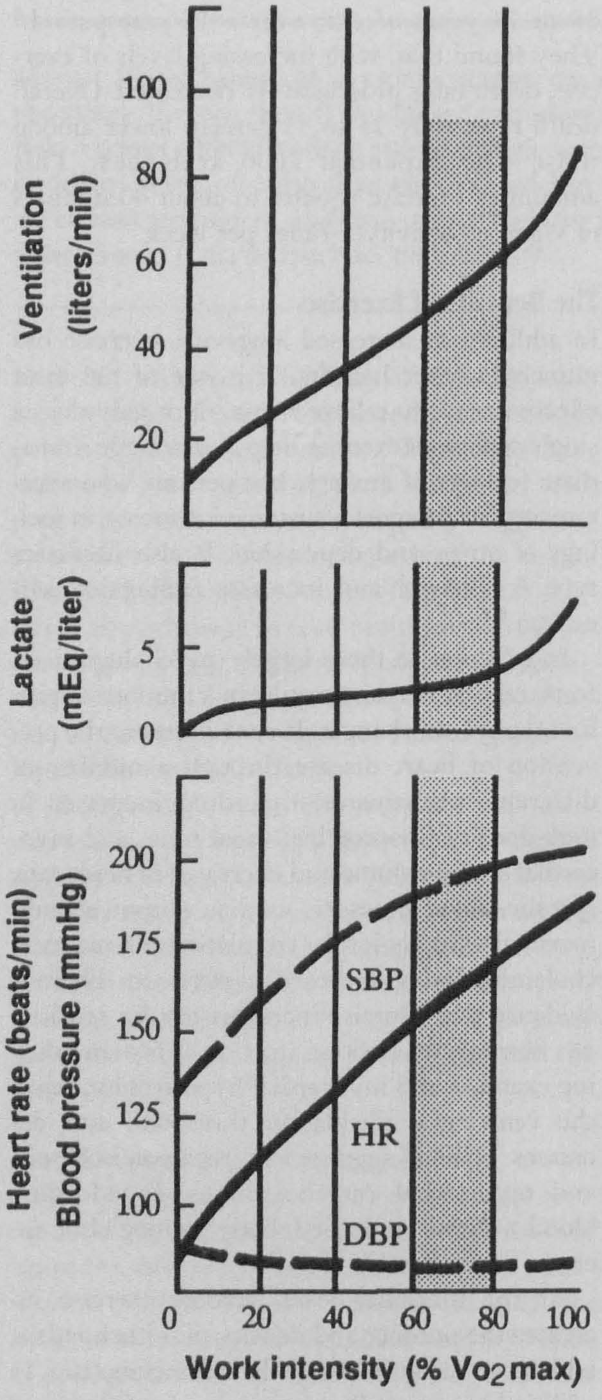

Figure 2. Cardiopulmonary and metabolic response to progressive exercise.
SBP = Systolic blood pressure; DBP = Diastolic blood pressure; HR = Heart rate.
Used with permission from Hanson PG, Giese MD, and Corliss RJ.[16]

What Is Physical Fitness?

There is much confusion in the public's perception of the meaning of physical fitness. While cardiovascular endurance is probably the best overall measure of fitness, the components of strength, power, muscular endurance, flexibility, agility, balance, and proprioception are also a part of a person's fitness profile.[12] Cardiovascular endurance can be measured most accurately by a person's maximum oxygen uptake – the maximum rate at which the body can use oxygen during exercise. Because this is technically difficult to measure, the best means of approximating this value is by measuring the heart rate during exercise (see below). For a man ranging from 30 to 39 years of age, an oxygen uptake of 31.5 mL/kg/min is indicative of very poor fitness, while 49.5 mL/kg/min is considered superior. These values equate to the ability to run a mile in 11 minutes or 6 minutes, 36 seconds, respectively.

The Physiology of Exercise

It is important for patients to understand the reasons for the transformation that occurs from an exercise program. Exercise effort is measured as the percent of the body's maximum ability to use oxygen ($\dot{V}O_2$ max). As fitness improves, the $\dot{V}O_2$ max increases. To continue improvement, exercise must be consistently performed in the range of 60 to 80 percent of the $\dot{V}O_2$ max or 60 to 80 percent of a person's maximum effort.

Figure 2 shows that $\dot{V}O_2$ max has a linear relation to heart rate.[13] To determine heart rate, I advise patients to stop running and immediately count either the carotid or the brachial pulse for 10 seconds and multiply by 6. By determining the maximum heart rate and monitoring the pulse, patients determine whether their exercise is in the "training zone." If it is below, effort can be increased; if above, it should be decreased. For those who would like a more precise approach, a number of "wristwatch"-sized digital pulse monitors have been recently marketed. The maximum heart rate can be determined from a table, measured on a treadmill, or estimated by subtracting the patient's age from 220, an adequate method for most situations.

There is an even simpler method to determine whether the effort is in the proper training zone. The Borg scale uses a subjective determination of the amount of effort involved at a given moment.

It ranges from very, very light (slow walk) to very, very hard (all out speed).[14] Using this scale, patients should strive to keep their exercise at the "somewhat hard" level (Table 1). At this level, the heart rate will be in the range of 60 to 80 percent of its maximum. The "somewhat hard" range can be achieved by using the "talk test." This is the fastest pace that can be maintained while still able to carry on conversation.

As noted above, aerobic activities can become anaerobic if the degree of effort is increased. A person's anaerobic threshold is ascertained by noting the point at which ventilation suddenly increases sharply (Figure 2). This point is reached when the patient's effort exceeds about 80 percent of $\dot{V}O_2$ max.[16] The body's production of lactic acid rises sharply and accounts for the extreme muscular discomfort that occurs during vigorous exercise. The patient should be taught this concept to avoid entering the anaerobic zone during exercise sessions. One common reason patients give up on exercise before becoming fit is that they spend too much time in an anaerobic, rather than in aerobic, mode.

As training continues, the resting pulse decreases, and the pulse for a given amount of effort is lower than it was before beginning an exercise program. This phenomenon is referred to as the "training effect" and, along with the muscular development described above, results in continued gradual improvement long after the initial achievement of cardiovascular fitness.

Table 1. Borg Scale of Rated Perceived Exertion.*

Score	Subjective Rating
6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

*Adapted from Borg G and Linderholm H.[15 p 194]

Individualizing the Exercise Program

It is important to fit the exercise activity to the patient so that the program can lead to a lasting change in lifestyle. While a predominantly aerobic activity is superior for building cardiovascular and muscular endurance, most activities will confer some degree of fitness. The aspect of "playing" must not be forgotten, for if the activity is not enjoyable, it will soon be dropped. It is better to sacrifice reaching the patient's maximum aerobic potential in return for developing a program that will last.

A person's physical makeup makes some sports activities more suitable than others. For example, marathon runners are virtually all quite thin, whereas sprinters tend to be bulky and muscular. One is built for stamina, the other for speed and power. Marathoners tend to have a predominance of "slow-twitch" or type I muscle fibers, whereas sprinters tend to have more "fast-twitch," or type II fibers.[17] Fast-twitch fibers can also be divided into fast-twitch-oxidative-glycolytic (FOG) and fast-twitch-glycolytic (FG). The FOG fibers function in an intermediate zone between the type I and the FG fibers. They contract like fast-twitch fibers but have an oxidative capacity that is greater than pure type II fibers.

Type I fibers take nearly twice as long to contract as type II fibers. On muscle biopsy, slow-twitch (type I) fibers show as dark staining, whereas fast-twitch (type II) fibers appear lighter.[18] The slow-twitch fibers are used to a greater extent in aerobic, endurance activities, while fast-twitch fibers are used preferentially in explosive, forceful anaerobic activities. The number of fast- versus slow-twitch fibers appears to be genetically conferred, but distance training causes selective hypertropy of slow-twitch fibers. Evidence suggests, however, that interconversions can occur between FG and FOG fibers and may account for the reason fast-twitch–predominant persons can become proficient in endurance events.[19]

Assessment of the Patient's Readiness to Start Exercising

History

Exercise habits should be an integral part of a patient's history. If the patient is already exercising, inquiry into the type and duration of workouts often shows the need for adjustments. Patients who are not exercising at all should be strongly encouraged to begin.

The most important initial step in the history is the determination of cardiac risk factors. Most exercise-related sudden deaths occur in persons who have significant coronary atherosclerosis before beginning an exercise program. If patients have no risk factors for coronary disease and are less than 45 years old, they may begin a program without further medical evaluation. Risk factors for coronary disease include a history of hypertension, hypercholesterolemia, cigarette smoking, an abnormal resting EKG, a family history of coronary artery disease, and diabetes mellitus.[20] Inquiries should also be made to determine the presence of medical conditions such as exercise-induced asthma and degenerative joint disease that can limit the patient's ability to exercise.

Use of the Exercise Stress Test

According to the American College of Sports Medicine, all patients with one or more coronary risk factors and all patients aged 45 years or older should have exercise stress testing performed before the initiation of an exercise program. As noted by Zoller and Boyd, many family physicians are now performing this test in their offices.[21] Richard and Birrer have provided an excellent, comprehensive, and practical guide to performing exercise stress tests.[22]

It is important to remember when interpreting the results of the stress test that its predictive value is highly dependent upon the presence of risk factors; i.e., the pretest likelihood of having the disease. Thus, in an otherwise healthy 45-year-old person with chest pain, a positive stress test has only a 15 percent likelihood of indicating the presence of a coronary artery disease. Therefore, in such low-risk patients, a positive test is more likely to be falsely positive than it is to indicate the presence of coronary artery disease.[23] Therefore, while negative tests are reassuring, positive and equivocal tests in patients who are at low risk for coronary disease must be interpreted with caution. In most cases, it is appropriate to repeat the study using thallium in order to increase the sensitivity and specificity of the test.

Physical Examination

Weight and Body Composition

The patient's weight should always be recorded before beginning an exercise program. Because weight loss is a likely result, monitoring it provides an incentive for continuing to exercise. While overall weight is the easiest and most practical measurement, an estimate should also be made of the percent of weight that is body fat. This value is most accurately determined by the displacement method, which requires weighing the patient in an underwater tank.

A reasonably accurate—and significantly more practical—value can be obtained by using skin calipers.[16] These must be of high quality to get accurate results, and measurements must be taken with great attention to detail, recognizing that a 1- or 2-millimeter difference will result in a significant error. Measurements are usually taken from the back, medial to the scapula; from the abdomen, lateral to the umbilicus; and from the posterior middle of the upper extremity (Figure 3). A good set of calipers can be obtained from Cambridge Scientific Industries (Cambridge, MD) for about $175. The measurements can then be translated to percent body fat (Table 2).

Cardiovascular Evaluation

The greatest emphasis during a preexercise physical examination should be placed on the cardiovascular system. The pulse should be monitored for 1 or 2 minutes to assess the presence of cardiac dysrhythmia. Blood pressure should be taken in the supine, sitting, and standing positions. Auscultation of the lungs should be performed with attention to rales, wheezes, or rhonchi. An assessment of peripheral pulses should include the carotid, femoral, and pedal, noting the presence of thrills or bruits. The chest should be palpated for characterization of the cardiac impulse and for the presence of a thrill. Heart auscultation should be directed toward the presence of murmurs, clicks, gallops, or rubs. Finally, the eyes should be examined for the presence of xanthelasma, and the skin surface scanned for evidence of xanthoma.

Musculoskeletal System

The extremities and spine should be inspected for any deformity or abnormality that might interfere with exercise. Particular attention should

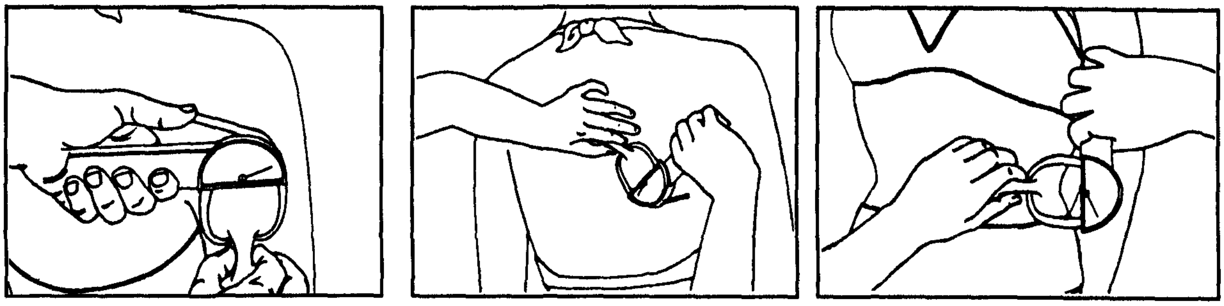

Figure 3. Skinfold measurement. The skinfold is held firmly between the thumb and index finger with no muscle tissue included. The caliper is placed on the skinfold as close as possible to the thumb and finger. Adapted from Fox E.[3, p 248]

be directed to the presence of scoliosis, muscle atrophy, severe valgus or varus deformities, or pes planus.

Laboratory Evaluation

An otherwise healthy patient needs only to have a total serum cholesterol measured. Other laboratory tests should only be done for specific indications. The role of the exercise stress test is discussed above. A resting EKG and a chest roentgenogram should probably be performed on patients who are 45 years old or more if they have not been obtained previously.

The Exercise Prescription

Once the patient has been properly assessed, the physician should prescribe a specific exercise program. The exercise prescription should be used with the same care and precision that is used for prescribing medication. The elements of an exercise prescription include the *type of exercise*, *frequency*, *duration* of individual workouts, *intensity*, and *rate of progression*. In addition, information about *warm-up* and *cool-down periods* and *stretching* should also be given.

Type of Exercise

One of the forms of predominantly aerobic exercise noted above should be recommended as the foundation of the patient's program. I believe it is a good idea to recommend the addition of one or two secondary activities. These can be substituted occasionally to help prevent boredom and burnout and to develop different muscle groups.

It is important to ascertain which activities the patient is most likely to want to continue. Activities that provide a more social atmosphere, such as tennis, volleyball, or basketball, should not be discouraged but should be considered adjuncts rather than the foundation of an exercise program.

Frequency and Duration

The recommended duration of workouts varies from 15 to 60 minutes, depending upon the patient's goals, state of fitness, type of exercise, and

Table 2. Measurement of Body Fat by Skinfold Thickness.

Classification	Estimated Body Fat*	Skinfold Thickness (mm)			
		Triceps	Scapular	Abdomen	Sum
Lean	< 7% (< 12%)	< 7 (< 9)	< 8 (< 7)	< 10 (< 7)	<25 (23)
Acceptable	7–15% (12–25%)	7–13 (9–17)	8–15 (7–14)	10–20 (7–15)	25–48 (23–46)
Overfat	> 15% (> 25%)	> 13 (> 17)	> 15 (> 14)	> 20 (> 15)	> 48 (> 46)

*Normal values for females in parentheses.

environmental conditions.[24] Most exercise physiologists agree that the minimum requirement for maintenance of basic fitness is about 30 minutes of exercise at 60 percent of the maximum heart rate for at least 3 sessions per week. Figure 4 shows that an increase from 2 to 3 days per week results in dramatic increase in maximum oxygen uptake,[24, p 73] while increases more than 3 days per week result in much less dramatic additional improvement.

Intensity

The most accurate means of determining the appropriate level of intensity for the workout is to use the target heart rate. Because it is more difficult for a patient with a low pulse to achieve a high heart rate, the resting pulse must be taken into consideration in this calculation. Furthermore, the intensity of effort desired must also be taken into account. The formula for this calculation is:

training heart rate = resting pulse + % maximum heart rate (maximum heart rate − resting pulse)[20, p 21]

For example, a 35-year-old patient whose resting pulse rate is 75/min and who is exercising at 60 percent capacity will have target heart rate of 141 beats/min (75 + 60%[110] = 141).

An alternative to the use of calculated heart rates is to use a combination of the talk test and the Borg scale (Table 1). With increasing practice, patients will learn to judge intuitively whether they are performing in the "training zone."

It is more important for the patient to continue exercising for the entire period than to achieve a faster pace for shorter periods. Many patients who have been inactive for several years have a difficult time accepting anything other than the "no pain-no gain" approach. If patients are unable to exercise at the same rate for the entire period, they should continue on at a slower pace. This will result in faster attainment of fitness than the patient who exercises furiously, stops, recovers, and then resumes hard exercise.

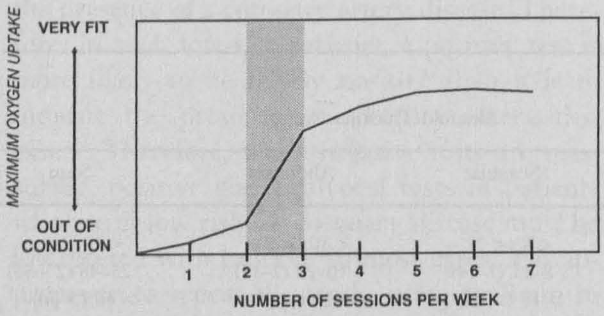

Figure 4. Effect of frequency on fitness. Note dramatic increase from 2 to 3 sessions per week.

Rate of Progression

The biggest mistake most persons make is either in starting or progressing too fast. The result is a painful experience, which the patient is often reluctant to repeat. It also results in delayed muscular soreness that is further discouragement for continuing the program. Staying within the "training zone" will allow achievement of fitness in a slow, progressive, and relatively painless manner.

Patients may need to be reminded periodically that it usually takes at least 12 weeks to achieve basic cardiovascular fitness and that this process cannot be shortened. Should they wish to progress beyond 30 minutes per day, total mileage generally should not be increased by more than 10 percent per week. Increasing faster than this may lead to overuse injuries such as plantar fasciitis, Achilles tendonitis, and muscle strains.

Stretching

There are several reasons why stretching is important. Exercise strengthens and adds bulk to muscles. Without a stretching program, the length of these muscles shortens, resulting in a greater tendency for injuries to occur. About 5 minutes should be devoted to stretching before or after each exercise session. While some advocate stretching before exercise, others argue that it is better to stretch after exercise, because it is easier and safer to stretch warm muscles.

The proper method of stretching must also be emphasized; it consists of slow, progressive, gentle increases in muscle length. After holding the stretch position for about 30 seconds, it is usually possible to increase an additional few millimeters without risking injury. The old-fashioned method of bounce-stretching is to be discouraged, because it stimulates the stretch reflexes, causing the muscle being stretched to contract. Specific stretching exercise techniques are well described by Anderson and Anderson.[25]

Warm-Up and Cool-Down

Warming up slowly is important for a number of reasons. Cold muscles are more susceptible to strains and sprains. Moreover, as Costill has noted, an early rapid pace uses a disproportionate amount of glycogen and may result in premature fatigue and a miserable, unenjoyable experience.[26] Very slow activity should be continued for 5 to 10 minutes and is best marked by the time it takes to "break a sweat." The desired pace can then be reached and maintained for the remainder of the session.

The primary reason for a cool-down period is to prevent blood from pooling in the lower extremities. Consequently, lactic acid is less likely to be deposited in the muscles and cause soreness. I recommend that patients continue slow activity until breathing returns to the baseline level and until any feelings of muscle fatigue have dissipated. This usually requires 3 to 5 minutes.

Diet and Weight Control

A discussion of exercise would not be complete without mentioning diet. As noted above, most patients who exercise will lose weight without really trying. Depending on intensity, running burns approximately 600 calories/hour. In addition, the increased metabolism induced by exercise persists long after the exercise itself.

Most athletes quickly discover that a low-fat, high-complex carbohydrate diet allows them to exercise more comfortably and to perform better. Coincidentally, this results in greater weight loss and also lowers serum cholesterol. Good sources of complex carbohydrates include whole grain breads, cereal, fruits, beans, potatoes, and pasta.

Helping Patients Continue after the "New" Has Worn Off

Starting an exercise program is difficult enough, but keeping patients motivated to continue for a lifetime is a major challenge. I do not believe it is possible unless the patient begins genuinely to enjoy the activity. One way to make this happen is to establish a self-monitoring program that provides meaningful feedback to the patient about rate of progress. One helpful tool is a training log. Weekly, monthly, and yearly totals are usually kept, as well as the results of any competitive events. It is very satisfying for patients to review the log and to realize how far they've come. It may also be quite helpful to analyze patterns of exercise that result in more enjoyable or more effective sessions.

Another important way to help patients comply with an exercise program is to make workouts a social event. Joining a local exercise group or working with others who have the same ability range helps tremendously when motivation begins to fade. Furthermore, the conversation that occurs during the activity tends to minimize discomfort and boredom. Finally, most persons, even during routine workouts, exhibit some competitive spirit. This tends to push patients a little bit harder than they would if exercising alone. The result is a higher level of fitness and a greater tendency to exercise regularly.

Finally, patients should be encouraged to enter local competitive events. They will soon discover that the goal is not to win the event or even to be competitive within an age group. Rather, it will become a social occasion, will result in a further networking of "kindred spirits," and will provide an opportunity for them to test their limits and assess progress in the quest for fitness.

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