Nutrition, exercise, and healthy aging

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ABSTRACT

Advancing age is associated with a remarkable number of changes in body composition, including reduction in lean body mass and increase in body fat, which have been well documented. Decreased lean body mass occurs primarily as a result of losses in skeletal muscle mass. This age-related loss in muscle mass has been termed "sarcopenia". Loss in muscle mass accounts for the age-associated decreases in basal metabolic rate, muscle strength, and activity levels, which, in turn are the cause of the decreased energy requirements of the elderly. In sedentary persons, the main determinant of energy expenditure is fat-free mass, which declines by about 15% between the third and eighth decade of life. It also appears that declining energy needs are not matched by an appropriate decline in energy intake, with the ultimate result being increased body fat content. Increased body fatness and increased abdominal obesity are thought to be directly linked to the greatly increased incidence of non–insulin-dependent diabetes mellitus among the elderly. In this review we will discuss the extent to which regularly performed exercise can affect nutrition needs and functional capacity in the elderly. We will also discuss a variety of concerns when prescribing exercise in the elderly, such as planning for a wide variability in functional status, medical status, and training intensity and duration. Finally, we will attempt to provide some basic guidelines for beginning an exercise program for older men and women and establishing community-based programs.

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Sarcopenia, the age-associated loss of muscle mass (1), is a direct cause of an age-related decrease in muscle strength. Our laboratory (2) examined muscle strength and mass in 200 healthy 45- to 78-year-old men and women, and concluded that muscle mass (not function) is the major determinant of age- and sex-related differences in strength. This relationship is independent of muscle location (upper vs lower extremities) and function (extension vs flexion). Reduced muscle strength in the elderly is a major cause of their increased prevalence of disability. With advancing age and very low activity levels seen in the very old, muscle strength and power are critical components of walking ability (3). The high prevalence of falls among the institutionalized elderly may be a consequence of their lower muscle strength.

The question that we have been attempting to address is: To what extent are these changes inevitable consequences of aging? Our data suggest that changes in body composition and aerobic capacity that are associated with increasing age may not be age related at all. By examining endurance-trained men, we saw that body fat stores and maximal aerobic capacity were not related to age, but rather to the total number of hours these men were exercising per week (4). Even among sedentary persons, energy spent in daily activities explains more than 75% of the variability in body fatness among young and older men (5). These data and the results of other investigations indicate that levels of physical activity are important in determining energy expenditure and, ultimately, body fat accumulation.

AEROBIC EXERCISE

Aerobic exercise has long been an important recommendation for the prevention and treatment of many of the chronic diseases typically associated with old age. These include non–insulin-dependent diabetes mellitus (NIDDM) (and impaired glucose tolerance), hypertension, heart disease, and osteoporosis. Regularly performed aerobic exercise increases the maximum capacity to take in and use oxygen during exercise (Vo_2max) and insulin action. Meredith et al (6) examined the responses of initially sedentary young (aged 20 to 30 years) and older (aged 60 to 70 years) men and women to 3 months

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of aerobic conditioning (70% of maximal heart rate, 45 minutes/day, 3 days/week). They found that the absolute gains in aerobic capacity were similar between the two age groups. However, the mechanism for adaptation to regular submaximal exercise appears to be different between old and young people. Muscle biopsies taken before and after training showed a more than twofold increase in oxidative capacity of the muscles of the older subjects, whereas the young subjects showed smaller improvements. In addition, skeletal muscle glycogen stores in the older subjects, significantly lower than those of the young men and women initially, increased significantly. The degree to which the elderly demonstrate increases in maximal cardiac output in response to endurance training is still largely unanswered. Seals and coworkers (7) found no increases after 1 year of endurance training whereas, more recently, Spina et al (8) observed that older men increased maximal cardiac output and healthy older women demonstrated no change in response to endurance exercise. If these gender-related differences in cardiovascular response are real, it may explain the lack of response in maximal cardiac output when older men and women are included in the same study population.

EXERCISE AND CARBOHYDRATE METABOLISM

The fact that aerobic exercise has substantial effects on skeletal muscle may help explain its importance in the treatment of glucose intolerance and NIDDM. Seals and coworkers (9) found that a high-intensity training program resulted in greater improvements in the insulin response to an oral glucose load than lower-intensity aerobic exercise. However, their subjects began the study with normal glucose tolerance. Kirwan and coworkers (10) found that 9 months of endurance training at 80% of the maximal heart rate (4 days/week) resulted in reduced glucose-stimulated insulin levels; however, no comparison was made to a lower-intensity exercise group. Hughes and coworkers (11) demonstrated that regularly performed aerobic exercise without weight loss resulted in improved glucose tolerance, rate of insulin-stimulated glucose disposal, and increased skeletal muscle GLUT-4 levels in older subjects with glucose intolerance. In this investigation, a moderate intensity aerobic exercise program was compared with a higher-intensity program (50% vs 75% of maximal heart rate reserve, 55 minutes/day, 4 days/week for 12 weeks). No differences in effect were seen between the moderate- and higher-intensity aerobic exercise on glucose tolerance, insulin sensitivity, or muscle GLUT-4 (the glucose transporter protein in skeletal muscle) levels, indicating, perhaps, that a prescription of moderate aerobic exercise should be recommended for older men or women with NIDDM or at high risk for NIDDM to help to ensure compliance to the program.

Endurance training and dietary modifications are generally recommended as the primary treatment for persons with NIDDM. Cross-sectional analysis of dietary intake supports the hypothesis that a low-carbohydrate/high-fat diet is associated with the onset of NIDDM (12). This evidence, however, is not supported by prospective studies where dietary habits have not been related to the development of NIDDM (13,14). The effects of a high-carbohydrate diet on glucose tolerance have been equivocal (15,16). Hughes et al (17) compared the effects of a high-carbohydrate (60% carbohydrate and 20% fat)/high-fiber (25 g dietary fiber/1,000 kcal) diet with and without 3 months of high intensity (75% maximum heart rate reserve, 50 minutes/day, 4 days/week) endurance exercise in older men and women with glucose intolerance. Subjects were fed all of their food on a metabolic ward during the 3-month study and were not allowed to lose weight. These investigators observed no improvement in glucose tolerance or insulin-stimulated glucose uptake in either the diet or the diet-plus-exercise group. The diet-plus-exercise group demonstrated a significant and substantial increase in skeletal muscle glycogen content, and at the end of the training their muscle glycogen stores were considered to be saturated. Because the primary site of glucose disposal is skeletal muscle glycogen stores, the extremely high muscle glycogen content associated with exercise and a high-carbohydrate diet likely limited the rate of glucose disposal. Thus, when combined with exercise and a weight-maintenance diet, a high-carbohydrate diet had a counter-regulatory effect. It is likely that the value of a high-carbohydrate/high-fiber diet is in the treatment of excess body fat, which may be an important cause of the impaired glucose tolerance. Recently, Schaefer and coworkers (18) demonstrated that older subjects consuming an ad libitum high-carbohydrate diet lost weight.

There appears to be no attenuation of the response of elderly men and women to regularly performed aerobic exercise compared with the response seen in young subjects. Increased fitness levels are associated with reduced mortality and increased life expectancy. Fitness has also been shown (19) to prevent the occurrence of NIDDM in those who are at the greatest risk for developing this disease. Thus, regularly performed aerobic exercise is an important way for older people to improve their glucose tolerance.

Aerobic exercise is generally prescribed as an important adjunct to a weight loss program. Aerobic exercise combined with weight loss has been demonstrated to increase insulin action to a greater extent than weight loss through diet restriction alone. In a study by Bogardus et al (20), diet therapy alone improved glucose tolerance, mainly by reducing basal endogenous glucose production and improving hepatic sensitivity to insulin. Aerobic exercise training, on the other hand, increased carbohydrate storage rates; therefore, "diet therapy plus physical training produced a more significant approach toward normal" (22, p 316). However, aerobic exercise (as opposed to resistance training) combined with a hypocaloric diet has been demonstrated to result in a greater reduction in resting metabolic rate than diet alone (21). Heymsfield and coworkers (22) found that aerobic exercise combined with caloric restriction did not preserve fat-free mass and did not further accelerate weight loss compared with diet alone. This lack of an effect of aerobic exercise may have been due to a greater decrease in resting metabolic rate in the exercising group. In, perhaps, the most comprehensive study of its kind, Goran and Poehlman (23) examined components of energy metabolism in older men and women engaged in regular endurance training. They found that endurance training did not increase total daily energy expenditure because there was a compensatory decline in physical activity during the remainder of the day. In other words, when elderly subjects participated in a regular walking program, they rested more, so activities outside of walking decreased and, thus, 24-hour energy expenditure was unchanged. Ballor et al (24) compared the effects of resistance training to that of diet restriction alone in obese women. They found that resistance exercise training resulted in increased strength and gains in muscle size as well as a preservation of fat-free mass during weight loss. These data are similar to the results of Pavlou et al (25) who used both aerobic and resistance training as an adjunct to a weight loss program in obese men.

STRENGTH TRAINING

Although endurance exercise has been the more traditional means of increasing cardiovascular fitness, strength or resistance training is currently recommended by the American

College of Sports Medicine as an important component of an overall fitness program (26). This is particularly important in the elderly in whom loss of muscle mass and weakness are prominent deficits.

Strength conditioning or progressive resistance training is generally defined as training in which the resistance against which a muscle generates force is progressively increased over time. Progressive resistance training involves few contractions against a heavy load. The metabolic and morphologic adaptations resulting from resistance and endurance exercise are quite different. Muscle strength has been shown to increase in response to training between 60% and 100% of the one repetition maximum (1RM). 1RM is the maximum amount of weight that can be lifted with one contraction. Strength conditioning will result in an increase in muscle size and this increase in size is largely the result of increased contractile proteins. The mechanisms by which the mechanical events stimulate an increase in RNA synthesis and subsequent protein synthesis are not well understood. Lifting weight requires that a muscle shorten as it produces force. This is called a concentric contraction. Lowering the weight, on the other hand, forces the muscle to lengthen as it produces force. This is an eccentric muscle contraction. These lengthening muscle contractions have been shown to produce ultrastructural damage that may stimulate increased muscle protein turnover (27).

Improving muscle strength can enhance the capacity of many older men and women to perform activities such as climbing stairs, carrying packages, and even walking

Our laboratory examined the effects of high-intensity resistance training of the knee extensors and flexors (80% of 1RM, 3 days/week) in older men (aged 60 to 72 years). The average increases in knee flexor and extensor strength were 227% and 107% respectively. Computed tomography (CT) scans and muscle biopsies were used to determine muscle size. Total muscle area as determined by CT analysis increased by 11.4%, whereas the muscle biopsies showed an increase of 33.5% in Type I fiber area (slow twitch) and a 27.5% increase in Type II fiber area (fast twitch). In addition, lower body VO_2max increased significantly while upper body VO_2max did not, indicating that increased muscle mass can increase maximal aerobic power. It appears that the age-related loss in muscle mass may be an important determinant in the reduced maximal aerobic capacity seen in elderly men and women (28). Improving muscle strength can enhance the capacity of many older men and women to perform activities such as climbing stairs, carrying packages, and even walking.

We applied this training program to a group of frail, institutionalized elderly men and women (mean age=90±3 years, range=87 to 96 years) (29). After 8 weeks of training, the 10 subjects in this study increased muscle strength by almost 180% and muscle size by 11%. A similar intervention on frail nursing home residents demonstrated not only increases in muscle strength and size, but increased gait speed, stair-climbing power, and balance (30). In addition, spontaneous activity levels increased significantly, whereas the activity of a nonexercising control group was unchanged. In this study, the researchers also examined the effects of exercise combined with a protein-energy supplement (240-mL liquid supplying 360 kcal in the form of carbohydrate [60%], fat [23%], and soy-based protein [17%]) designed to augment energy intake by about 20% and provide one third of the Recommended Dietary Allowance (RDA) (31) for vitamins and minerals (see Figure 1). Although no interaction was seen with muscle strength, functional capacity, or muscle size (no differences in improvements between the supplemented group and a nonsupplemented control group), the men and women who consumed the supplement and exercised gained more weight than the three other groups examined (exercise/control, nonexercise supplemented, and nonexercise control). The nonexercising subjects who received the supplement reduced their habitual dietary energy intake so that total energy intake was unchanged. It should be pointed out that this was a very old, very frail population with diagnoses of multiple chronic diseases. The increase in overall levels of physical activity has been a common observation in our studies (30,32,33). Because muscle weakness is a primary deficit in many older persons, increased strength may stimulate more aerobic activities like walking and cycling.

In addition to its effect on increasing muscle mass and function, resistance training can also have an important effect on the energy balance of elderly men and women (34). Men and women participating in a resistance training program of the upper and lower body muscles required approximately 15% more energy to maintain body weight after 12 weeks of training compared with their pretraining energy requirements. This increase in energy needs came about as a result of an increased resting metabolic rate, the small energy cost of the exercise, and what was presumed to be an increase in activity levels. Although endurance training has been demonstrated to be an important adjunct to weight loss programs in young men and women by increasing their daily energy expenditure, its usefulness in treating obesity in the elderly may not be great. This is because many sedentary older men and women do not spend much energy when they perform endurance exercise because of their low fitness levels. Thirty to 40 minutes of exercise may increase energy expenditure by only 100 to 200 kcal with very little residual effect on energy expenditure. Aerobic exercise training will not preserve lean body mass to any great extent during weight loss. Because resistance training can preserve or even increase muscle mass during weight loss, this type of exercise for those older men and women who must lose weight may be of genuine benefit.

BONE HEALTH

The increased energy need resulting from strength training may be a way for the elderly to improve their overall nutritional intake when the energy is derived from nutrient-dense foods. In particular, calcium is an important nutrient to increase because calcium intake was found to be one of the only nutrients consumed at a level below the RDA in the diet of free-living elderly men and women in the Boston Nutritional Status Survey (35), which assessed free-living and institutionalized elderly men and women. Careful nutrition planning is needed to reach the recommended calcium levels of 1,500 mg/day for postmenopausal women with osteoporosis or using hormone replacement therapy, and 1,000 mg/day for postmenopausal women taking estrogen. Increased energy intake from calcium-containing foods is one method to help achieve this goal.

In one of the few studies to examine the interaction of dietary calcium and exercise, we studied 41 postmenopausal women consuming either high-calcium (1,462 mg/day) or moderate-calcium (761 mg/day) diets. Half of these women participated in a year-long walking program (45 minutes/day, 4 days/week, at 75% of heart rate reserve). Independent effects of the exercise and dietary calcium were seen. Compared with the moderate-calcium group, the women consuming a high-calcium diet displayed reduced bone loss from the femoral neck, independent of whether the women exercised. The walking prevented the loss of trabecular bone mineral density seen in the nonexercising women after 1 year. Thus, it appears that calcium intake and aerobic exercise are both independently beneficial to bone mineral density at different sites. The effects of 52 weeks of high-intensity resistance exercise training was examined in a group of 39 postmenopausal women (32). Twenty were randomly assigned to the strength training group (2 days/week, 80% of 1RM for upper and lower body muscle groups). At the end of the year significant differences were seen in lumbar spine and femoral bone density between the strength-trained and sedentary women (see Figure 2). However, unlike other pharmacologic and nutritional strategies for preventing bone loss and osteoporosis, resistance exercise affects more than just bone density. The women who participated in strength training improved their muscle mass, strength, balance, and overall levels of physical activity. Thus, resistance training can be an important way to decrease the risk of osteoporotic bone fractures in postmenopausal women.

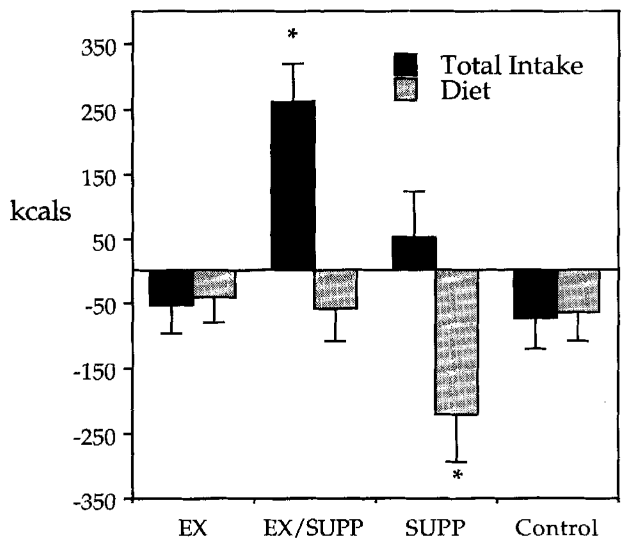

FIG 1. The effects of a dietary supplement providing 360 kcal/day and 29 g protein per kilogram per day and high-intensity resistance exercise training on habitual and total dietary intake in very old and frail nursing home residents. In nonexercising subjects, the supplement caused a decrease in habitual intake and no change in total energy intake. The only group that increased total energy intake was the group receiving the exercise intervention and the supplement. (Adapted from reference 30.)

PROTEIN NEEDS AND AGING

Inadequate dietary protein intake may be an important cause of sarcopenia. Previous estimates of dietary protein needs of the elderly using nitrogen balance have ranged from 0.59 g to 0.8 g per kilogram per day (36-38). However, the low value was reported by Zanni et al (38) who preceded their 10-day dietary protein feeding with a 17-day protein-free diet, which was likely to improve nitrogen retention during the 10-day balance period. Recently, we (39) reassessed the nitrogen-balance studies mentioned above using the currently accepted, 1985 World Health Organization (40) nitrogen-balance formula. These newly recalculated data were combined with nitrogen-balance data collected on 12 healthy older men and women (8 men and 4 women, age range=56 to 80 years) consuming the current RDA for protein or double this amount (0.8 g per kilogram per day and 1.6 g per kilogram per day, respectively) in our laboratory. Our subjects consumed the diet for 11 consecutive days and nitrogen balance (milligrams of nitrogen per kilogram per day) was measured during days 6 to 11. The estimated mean protein requirements from the three retrospectively assessed studies and the current study (39) can be combined by weighted averaging to produce an overall protein requirement estimate of 0.91±0.043 g per kilogram per day. The combined estimate, excluding the data from our 12 subjects, is 0.894±0.048 g protein per kilogram per day.

The current RDA of 0.8 g per kilogram per day is based on data collected, for the most part, on young subjects. The RDA includes an upward adjustment based on the coefficient of variability (CV) of the average requirement established in these studies (0.6 g per kilogram per day). According to the CV previously established for nitrogen-balance studies, an adequate dietary protein level for 97.5% of the elderly population would be provided by an intake of 25% (twice the standard deviation) above the mean protein requirement. Our data suggests that safe protein intake for elderly adults is 1.25 g per kilogram per day. On the basis of current and recalculated short-term nitrogen-balance results, a safe recommended protein intake for older men and women should be set at 1.0 g to 1.25 g high-quality protein per kilogram per day. Sahyoun (35) reported that approximately 50% of 946 healthy free-living men and women above the age of 60 years living in the Boston, Mass, area consume less than this amount of protein. The same study showed that 25% of the elderly men and women consume <0.86 g and <0.81 g protein per kilogram per day, respectively. A large percentage of homebound elderly people consuming their habitual dietary protein intake (0.67 g mixed protein per kilogram per day) have been shown (41) to be in negative nitrogen balance.

High-intensity resistance training appears to have profound anabolic effects in the elderly. Data from our laboratory demonstrate a 10% to 15% decrease in nitrogen excretion at the initiation of training that persists for 12 weeks. That is, progressive resistance training improved nitrogen balance; thus, older subjects performing resistance training have a lower mean protein requirement than do sedentary subjects. These results are somewhat at variance to the results of Meredith et al (42), which demonstrated that regularly performed aerobic exercise causes an increase in the mean protein requirement of middle-aged and young endurance athletes. This difference likely results from increased oxidation of amino acids during aerobic exercise that may not be present during resistance training.

MUSCLE STRENGTH TRAINING IN THE ELDERLY

Muscle strength training can be accomplished by virtually anyone. Many health care professionals have directed their patients away from strength training in the mistaken belief that it can cause undesirable elevations in blood pressure. The systolic pressure elevation during aerobic exercise is far greater than that seen during resistance training performance with proper technique. Muscle-strengthening exercises are rapidly becoming a critical component of cardiac rehabilitation pro-

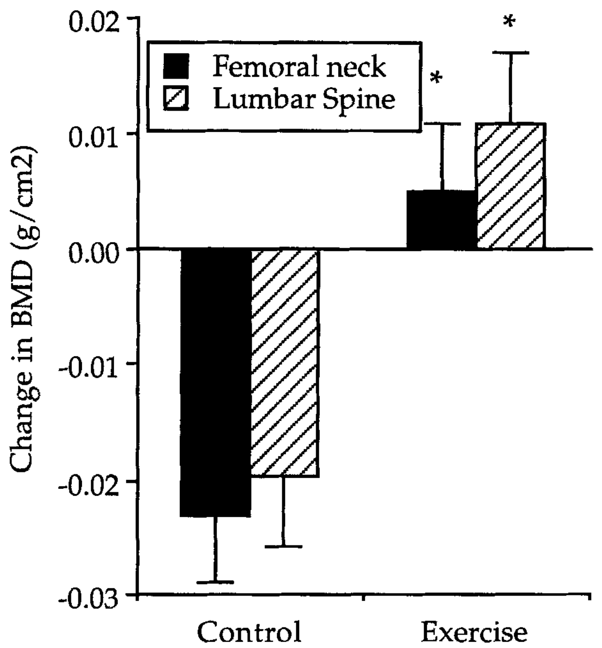

FIG 2. The effects of high-intensity resistance exercise in femoral and lumbar bone mineral density (BMD) on postmenopausal women. The exercise group performed strength training on the upper and lower body muscles 2 days/week at 80% of the one repetition maximum. The control group maintained their current activity levels and did not participate in any regular exercise program. (Adapted from reference 30.)

grams as clinicians realize the need for strength and endurance for many activities of daily living.

GUIDELINES FOR RESISTANCE EXERCISE PRESCRIPTION IN ELDERLY PEOPLE

The following are some practical suggestions for implementing an exercise program for the elderly. We have included guidelines for resistance exercise training, a medical screening questionnaire used for a community-based fitness program, and recommendations on how to begin a community-based program.

Candidates

Adults of all ages are candidates for involvement in an exercise program. However, elderly patients or patients with hypertension should be carefully evaluated before beginning a strength training program. Instead of a treadmill stress test, we use a weight-lifting stress test. Have the patient perform three sets of eight repetitions at approximately 80% of 1RM. Monitor electrocardiogram and blood pressure responses during the exercise. Patients with rheumatoid or osteoarthritis may participate. Patients with a limited range of motion should train within the range of motion that is relatively pain free. Most patients will see a dramatic improvement in the pain-free range of motion as a result of resistance training.

Exercises

Resistance training should be directed at the large muscle groups that are important in everyday activities, including those in the shoulders, arms, spine, hips, and leg. Each repetition should be performed slowly through a full range of motion, allowing 2 to 3 seconds to lift the weight (concentric contraction) and 4 to 6 seconds to lower the weight (eccentric contraction). Performing the exercise more quickly will not enhance strength gains and may increase the risk of an injury.

Training Intensity and Duration

A high-intensity resistance training program has been shown to have the most dramatic effects at all ages. This is a training intensity that will approach or result in muscular fatigue after the muscle has been lifted and lowered with proper form 8 to 12 times. A weight that you can lift 20 or more times will increase your muscular endurance, but not result in much of a gain in strength or muscle mass. The amount of weight that is lifted should increase as strength builds. This should take place about every 2 to 3 weeks. In our studies, we have seen a 10% to 15% increase in strength per week during the first 8 weeks of training. We have seen substantial gains in muscle strength and mass as well as an improvement in bone density with only 2 days/week of training.

Breathing Technique

For proper breathing technique, inhale before a lift, exhale during the lift, and inhale as the weight is lowered to the beginning position. Avoid performing the Valsalva maneuver (ie, holding your breath during force production). With proper breathing technique, the cardiovascular stress of resistance exercise is minimal and heart rate and blood pressure should rise only slightly above resting values.

Equipment

Any device that provides sufficient resistance to stress muscles beyond levels usually encountered may be used. Weight stack or compressed-air resistance machines may be found at many community fitness facilities or purchased for home use. Simple weight-lifting devices might include Velcro-strapped wrist and ankle bags filled with sand or lead shot, or heavy household objects such as plastic milk jugs filled with water or gravel, or food cans of various sizes.

INCREASING LEVELS OF PHYSICAL ACTIVITY IN THE ELDERLY

Initial Health Assessment

Community-based exercise programs for men and women over the age of 50 years are growing in popularity. For such programs, physician screening for every participant may be either impractical or a barrier to participation. However, the American College of Sports Medicine recommends a physician-supervised stress test for anyone over the age of 50 who wants to begin a vigorous training program (43). If the general recommendation is for an older person to simply walk or participate in a resistance training program, this test is probably not necessary.

The questions presented in Figure 3 may be helpful in determining which persons should be carefully examined by a physician. This questionnaire was developed by Maria Fiatarone, MD, for use in a statewide, community-based exercise program for men and women over the age of 50. Persons who answered yes to any of the questions were strongly encouraged to speak to a physician before participating. However, participation in the exercise program was not prevented if a person did not have a physician's statement. The reason for many of these questions should be obvious. Clearly, the biggest concern is that a person with cardiovascular disease will experience myocardial infarction during exercise. These question are designed in an attempt to determine who may be at greatest risk.

In our experience, this sort of questionnaire is effective in identifying persons who may be at a higher risk than the general population of men and women over the age of 50 years. Our Massachusetts-wide program—"Keep Moving—Fitness After Fifty"—was a community-based walking program for men and women over the age of 50 years. At its peak, between 7,500 and 8,000 men and women (mean age=67±5 years) had registered and participated. Walking clubs were located throughout the state in nursing homes, retirement communities, hospitals, and Councils on Aging (buildings that housed many of the activities provided by the Massachusetts Executive Office of Elder Affairs). The questionnaire was approved by a medical advisory board for this program. During the 8 years of the program, there were no reports of a myocardial infarction, cardiac arrest, or other cardiovascular event during the exercise training session.

Warm-up and Cool-down

Advancing age results in increased muscle stiffness and reduced elasticity of connective tissue. For this reason proper warm-up and stretching can have a greater effect in reducing the risk of an orthopedic injury in the elderly than in young men and women. A 5-minute warm-up (exercise at a reduced intensity) followed by 5 to 10 minutes of slow stretching is highly recommended. Cool-down after exercise is also important in older persons. One should never finish a workout by immediately jumping into a hot shower. End an exercise session with a slow walk and more stretching. Postexercise stretching will be more effective than the stretching done before the exercise. This is because the muscles have warmed up and, along with tendons and ligaments, are much more elastic. Find a friend to exercise with. The more people one exercises with, the more likely it is that one will stay with the exercise. This is a perfect opportunity for sons and daughters to spend time with their older parents, to the benefit of both generations.

COMMUNITY-BASED PROGRAMS

With interest in the establishment of community-based exercise programs for the elderly increasing, the following recommendations may be helpful.

- Work with local or state agencies. Often, state agencies for aging have a small amount of resources set aside for health-related activities. The persons working in these agencies have access to the elderly population in your area.
- Use an already developed infrastructure. Councils on Aging may have a facility specifically designated for programs that serve the elderly. Contact your local hospital, YMCA, or university.
- Promote and advertise your program as a social exercise program. Often, older women and men will join programs because of increased opportunity for socialization, not necessarily for fitness benefits.
- More women than men will join. Use strategies to increase your recruitment of men.
- Plan for a wide variability in functional status. Highly fit and very frail persons are likely to join. For example, if you establish a walking program, plan to have at least two groups, slow and fast.
- Form a medical advisory group of local physicians.
- Attempt to incorporate some resistance exercise in any newly established program.

A. Do I get chest pains while at rest and/or during exertion?

B. If the answer to question A is "yes": It is true that I have not had a physician diagnose these pains yet.

C. Have I ever had a heart attack?

D. If the answer to question C is "yes": Was my heart attack within the last year?

E. Do I have high blood pressure?

F. If you do not know the answer to question E, answer this: Was my last blood pressure reading more than 150/100?

G. Am I short of breath after extremely mild exertion and sometimes even at rest or at night in bed?

H. Do I have any ulcerated wounds or cuts on my feet that do not seem to heal?

I. Have I lost 10 lb or more in the past 6 months without trying and to my surprise?

J. Do I get pain in my buttocks or the back of my legs—my thighs and calves—when I walk? (This question is an attempt to identify persons who suffer from intermittent claudication. Exercise training may be extremely painful; however, it may also provide relief from pain experienced when performing lower-intensity exercise [44]).

K. When at rest, do I frequently experience fast irregular heartbeats or, at the other extreme, very slow beats? (Although a low heart rate can be a sign of an efficient and well-conditioned heart, a very low rate can also indicate a nearly complete heart block).

L. Am I currently being treated for any heart or circulatory condition, such as vascular disease, stroke, angina, hypertension, congestive heart failure, poor circulation to the legs, valvular heart disease, blood clots, or pulmonary disease?

M. As an adult, have I ever had a fracture of the hip, spine, or wrist?

N. Did I have a fall more than twice in the past year (no matter what the reason)? (Many older persons may have balance problems and at the initiation of a walking program will have a high chance of falling. These persons may benefit from balance training and resistance exercise before beginning a walking program.)

O. Do I have diabetes?

FIG 3. Questionnaire developed by Maria Fiatarone, MD, to determine which persons should be examined by a physician before beginning an exercise program.

CONCLUSION

There is no group in our society that can benefit more from regularly performed exercise than the elderly. Although both aerobic and strength conditioning are highly recommended, only strength training can stop or reverse sarcopenia. Increased muscle strength and mass in the elderly can be the first step toward a lifetime of increased physical activity and a realistic strategy for maintaining functional status and independence.

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