EXERCISE, PHYSICAL ACTIVITY, TRAINING AND AGING

RESEARCH FROM THE SCIENTIFIC ADVISORY PANEL

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Regular physical activity offers numerous physical and mental benefits for older adults, including slowing the aging process, promoting psychological and cognitive well-being, managing many chronic diseases, reducing the risk of physical disability, increasing longevity and greater functional independence.

Health and fitness professionals can play an essential role in helping older adults minimize the physiological effects of an otherwise sedentary lifestyle and increase active life expectancy. Ideally, exercise programs for older adults should include aerobic exercise, muscle-strengthening exercises and flexibility exercises. Individuals who struggle with mobility impairment or are at risk for falling should perform specific exercises to improve balance in addition to the other components of health-related physical fitness. The important thing to remember is that it is possible to improve the ability to exercise at any age.

Physical activity is also an opportunity for social engagement, especially for the elderly. Therefore, unless programs also attempt to increase socialization and enjoyment, it is unlikely that older people will continue to participate in what should be a regular part of their lifestyles. Additionally, health and fitness professionals working with older adults should emphasize that the process of being active is more important than the product of being fit.

KEY POINTS

- There is overwhelming evidence from many studies that regular physical activity is associated with:
  - ✓ Slowing the functional changes that occur with aging which impair the ability to exercise
  - ✓ Optimizing age-related changes in body composition (loss of muscle and bone as well as an increase in body fat)
  - ✓ Promoting psychological and cognitive well-being
  - ✓ Managing many chronic diseases
  - ✓ Reducing the risk of physical disability
  - ✓ Increased longevity
  - ✓ Improved functional independence
  - ✓ A better quality of life
- Regular exercise can minimize the physiological effects of an otherwise sedentary lifestyle and increase active life expectancy.
- When elderly people become stronger, they tend to increase their levels of spontaneous physical activity.
- Professionals working with older adults should emphasize that the process of being active is more important than the product of being fit.

RESEARCH SUMMARY

BECAUSE the interrelationships among exercise, physical training and aging are so complex, it is not possible to adequately discuss them within the space available for this report. Fortunately, the American College of Sports Medicine (ACSM) has already done some of this. The reader should view the entire report for more details.[1]

ACSM asked a group of experts to critically review and synthesize the major published work relevant to exercise and physical activity for older adults. They were also asked to evaluate the strength of the evidence obtained in a number of areas of concern. The evidence was categorized into one of four levels.

- **Level A:** Overwhelming evidence from randomized controlled trials (RCTs) and/or observational studies, which provides a consistent pattern of findings on the basis of substantial data
- **Level B:** Strong evidence from a combination of RCT and/or observational studies but with some studies showing results that are inconsistent with the overall conclusion
- **Level C:** Generally positive or suggestive evidence from a smaller number of observational studies and/or uncontrolled or nonrandomized trials
- **Level D:** Panel consensus judgment that the strength of the evidence is insufficient to place it in categories A through C

Following are the areas that were reviewed, the statements that were made and the strength of the evidence.

Normal Human Aging

- Advancing age is associated with physiologic changes that result in reductions in functional capacity and altered body composition. **A**
- Advancing age is associated with declines in the volume and intensity of physical activity. **A/B**
- Advancing age is associated with increased risk for chronic diseases, but physical activity significantly reduces this risk. **B**
- Regular physical activity increases average life expectancy through its influence on chronic disease development. **A**

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Exercise and Physical Activity and the Aging Process

- Individuals differ widely in how they age and in how they adapt to an exercise program. It is likely that lifestyle and genetic factors contribute to the wide inter-individual variability seen in older adults. **B**
- Healthy older adults are able to engage in acute aerobic or resistance exercise and experience positive adaptations to exercise training. **A**
- Regular physical activity may be a major lifestyle factor that discriminates between those who have and have not experienced successful aging. **B/C**
- Regular physical activity reduces the risk of developing many chronic diseases and conditions and is valuable in the treatment of many diseases. **A/B**

Benefits of Exercise and Physical Activity

- Vigorous, long-term participation in aerobic exercise training (AET) is associated with elevated cardiovascular reserve and skeletal muscle adaptation, which enable aerobically trained older individuals to sustain a submaximal exercise load with less cardiovascular stress and muscular fatigue than their untrained peers. **B**
- Prolonged participation in resistance exercise training (RET) has clear benefits for slowing the loss of muscle mass, bone mass and strength which are not seen as consistently with aerobic exercise alone. **B**
- AET programs of sufficient intensity (≥60 percent of pre-training $\dot{V}O_2max$) and duration (≥3 days/week for 16 or more weeks) can significantly increase $\dot{V}O_2max$ in healthy middle-aged and older adults. **A**
- Three or more months of moderate-intensity AET elicits cardiovascular adaptations in healthy middle-aged and older adults that are evident at rest and in response to acute dynamic exercise. **A/B**
- In studies involving overweight middle-aged and older adults, moderate-intensity AET has been shown to be effective in reducing total body fat. **A/B**
- AET can induce a variety of favorable metabolic adaptations, including enhanced glycemic control, augmented clearance of post-prandial lipids, and preferential utilization of fat during submaximal exercise. **B**
- AET may be effective in counteracting age-related declines in bone mineral density (BMD) in postmenopausal women. **B**

- Older adults can substantially increase strength following RET. **A**
- Substantial increases in muscular power have been demonstrated following RET in older adults. **A**
- Increases in muscle quality are similar between older and younger adults. These improvements do not appear to be sex-specific. **B**
- Favorable changes in body composition, including increased fat-free mass and decreased fat mass have been reported in older adults who perform moderate- or high-intensity RET. **B/C**
- High-intensity RET preserves or improves BMD relative to that seen in sedentary controls, with a direct relationship between muscle and bone adaptations. **B**
- Multimodal exercise (usually including strength and balance exercises) and tai chi are effective in reducing the risk of non-injurious and sometimes injurious falls in populations at an elevated risk of falling. **C**
- Few controlled studies have examined the effect of flexibility exercise on range of motion (ROM) in older adults. How much and what types of ROM exercises are most effective has not been established. **D**
- Regular physical activity is associated with significant improvements in overall psychological well-being. Both physical fitness and AET are associated with a decreased risk for clinical depression or anxiety. **A/B**
- Epidemiological and experimental studies suggest that cardiovascular fitness and higher levels of physical activity reduce the risk of cognitive decline and dementia. **A/B**

- Although physical activity appears to be positively associated with some aspects of quality of life, the precise nature of the relationship is poorly understood. **D**
- There is strong evidence that high-intensity RET is an effective treatment for clinical depression. More evidence is needed regarding intensity and frequency of RET needed to elicit specific improvements in other measures of psychological health and well-being. **A/B**

Conclusions

The ACSM Position Stand concluded that although no amount of physical activity can stop the biological aging process, there is evidence that regular exercise can minimize the physiological effects of an otherwise sedentary lifestyle and increase active life expectancy by limiting the development and progression of chronic disease and disabling conditions.[1] There is also emerging evidence for psychological and cognitive benefits accruing from regular exercise participation by older adults. It is not yet possible to describe in detail exercise programs that will optimize physical functioning and health in all groups of older adults. New evidence also suggests that some of the adaptive responses to exercise training are genotype-sensitive, at least in animal studies. Nevertheless, several evidence-based conclusions can be drawn relative to exercise and physical activity in the older adult population.

A combination of AET and RET activities seems to be more effective than either form of training alone in counteracting the detrimental effects of a sedentary lifestyle on the health and functioning of the cardiovascular system and skeletal muscles.

Although there are clear fitness, metabolic and performance benefits associated with higher-intensity exercise training programs in healthy older adults, it is now evident that training programs do not need to be of high intensity to reduce the risks of developing chronic cardiovascular and metabolic disease. However, the outcome of treatment of some established diseases and geriatric syndromes is more effective with higher-intensity exercise (e.g., type 2 diabetes, clinical depression, osteopenia, sarcopenia and muscle weakness).

The acute effects of a single session of aerobic exercise are relatively short-lived, and the chronic adaptations to repeated sessions of exercise are quickly lost upon cessation of training, even in regularly active older adults.

The onset and patterns of physiological decline with aging vary across physiological systems and between sexes, and some adaptive responses to training are age- and sex-dependent. Thus, the extent to which exercise can reverse age-associated physiological deterioration may depend, in part, on the hormonal status and age at which a specific intervention is initiated.

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Ideally, exercise programs for older adults should include aerobic exercise, muscle-strengthening exercises and flexibility exercises. Individuals who are at risk for falling or mobility impairment should perform specific exercises to improve balance in addition to the other components of health-related physical fitness.

EXERCISE, FITNESS, INACTIVITY AND MORTALITY IN OLDER ADULTS

Fitness and physical activity are interrelated but independent risk factors for all-cause mortality. Kokkinos et al. found that older men with an exercise capacity greater than 5 metabolic equivalents (METs) have a higher survival rate than those with an exercise capacity of 4 METs or less.[2] It has been estimated that daily activities of independent living for healthy sedentary men and women aged 55 to 65 years are associated with a $\dot{V}O_2$ of about 15 mL/kg/min (~4 METs).[3] Thus, if older, less fit adults are working near their maximum while doing daily activities, it is not surprising that they respond by reducing their activity. As a result, their functional capacity and activity levels are reduced even more. The solution is to increase their activity in order to improve their maximal functional capacity and reduce their mortality. As an example, Paganini-Hill, Kawas and Corrada showed that when the elderly increased their leisure-time activity, by even 30 minutes daily, mortality risks were significantly reduced by 15 to 35 percent compared with no time in activity.[4]

When the elderly have low functional capacity and are inactive, they tend to sit more, lose their functional independence and are at a greater risk of becoming frail. Studies show that total sitting time is associated with the risk of dying from all causes.[5] Sitting especially increases the risk of death from cardiovascular disease and is linked to obesity, type 2 diabetes and some cancers.

In this case, the solution is to increase activity and reduce inactivity. How much activity is required? More research is needed to provide precise guidelines, but taking short breaks from sitting is beneficial—even just five minutes an hour helps. One large study of men and women aged 59 to 82 years showed a lower risk of dying by replacing just one hour of sitting time each day with some activity.[6] The impact was more obvious for less active adults. What is the take-home message? Be more active and less inactive. Both are important for people of all ages.

EXERCISE PROGRAMMING FOR THE ELDERLY

The general principles of exercise programming for the elderly are not much different from those for younger people, except that the principles may have to be modified because of restrictions caused by the normal effects of aging. Additional modifications may be needed when clinical problems or disabilities common to the elderly are present (e.g., atherosclerosis, hypertension, emphysema, arthritis, overweight and type 2 diabetes).

The average person aged 65 years has a maximum of 9 METs and the average person aged 75 years has a maximum of 8 METs.[7] Therefore, walking 2 to 3 mph (2 to 3 METs) should be within the capabilities of most older persons and would be a good initial intensity.

As people age, the energy cost of activities of daily living (ADL) increases, the most common of which is walking. Together with an age-related drop in $\dot{V}O_2$max, more energy is expended with many submaximal activities; this means that older people are working closer to their maximum (i.e., their energy reserve is lower and they are working at a higher intensity). One result is that many older adults walk at slower speeds to compensate.

Aging appears to have a minimal effect on the ability to work at or below 50 percent $\dot{V}O_2$max. Older people can work at these lower intensities for as many as eight hours with little problem.[8] While the elderly have more difficulty if intensity is high and pace is imposed, less difficulty can be expected when they can select their own work rate. Valenti et al. studied the effect of one year of training involving endurance, strength and stretching exercises on the fitness and walking economy of untrained adults aged 50 to 83 years.[9] They found that this program increased $\dot{V}O_2$max by 5 percent and decreased the energy cost of walking by 13 percent. This is in contrast to a 6 percent lower $\dot{V}O_2$max and a 5 percent higher walking cost in the control group over the same one-year period. They concluded that less energy needed for walking might promote more sustained physical activity and contribute to prolonging the functional independence of trained older adults.[9]

Because a loss in cardiovascular endurance, muscle strength, flexibility and balance is associated with a loss of independence and a diminished ability to adjust to the requirements of ADL, a good exercise program will emphasize these factors, with the goal of improving general well-being and the ability to take care of oneself.

Data from cross-sectional and longitudinal studies report a drop in muscle strength of about 15 percent per decade from 50 to 70 years, followed by a decrease of around 30 percent per decade.[10] Although a loss of muscle mass and the subsequent drop in muscle strength are considered normal aspects of aging, there are serious health consequences associated with these effects, such as a higher incidence of falls and a loss of independence.[10]

As reported in the ACSM Position Stand,[1] muscle power is lost at a greater rate with age than the loss of strength; this is probably due to a greater loss in the size of type 2 muscle fibers, especially in the lower extremities. Fortunately, RET in older adults increases both strength and power and should be an integral part of any exercise program.

Interestingly, when elderly people become stronger, they tend to increase their levels of spontaneous physical activity; this has been shown in healthy, free-living older adults and in very old and frail adults.[11] Thus, improving strength seems to allow and encourage the elderly to become more active. This positive effect on their lifestyle is often accompanied by improvements in cardiovascular and metabolic functions, as well as increases in insulin action, BMD, flexibility and functional status.[12]

The general principles of strength training for the elderly are essentially the same as those for younger persons. Similarly, if there is an adequate training stimulus, older adults can also have marked increases in strength. Even persons over the age of 90 years have had significant increases in strength with resistance training.[13]

As people age, they generally become less active, increasing the rate at which strength is lost. Reduced lower-body strength is an important factor associated with falls in the elderly. In addition, older people do fewer activities that require balance and reaction time, factors that are also associated with falls. If there are serious problems with balance, the elderly should practice movements that require balance, preferably in a pool or next to a chair or wall for support and safety.

Flexibility is also important for older adults. However, as stated in the ACSM Position Stand,[1] "despite decrements in joint ROM with age and established links among poor flexibility, mobility, and physical independence, there remains a surprisingly small number of studies that have demonstrated or compared the effects of specific ROM exercises on flexibility outcomes in older populations." Results from several studies suggested that flexibility of the major joints of older adults can be improved, but it is not clear how much or what types of stretching exercises are safest and most effective. Nevertheless, it is probably best that older adults should take an extra 10 minutes to stretch the major muscle and tendon groups each day that aerobic or strength activities are done.

ACSM and the American Heart Association recommend that adults over age 65 engage in at least 150 minutes per week of moderate-intensity aerobic activity, 75 minutes of vigorous aerobic activity or an equivalent combination of moderate and vigorous activity, in addition to muscle strengthening two to three days each week.[14]

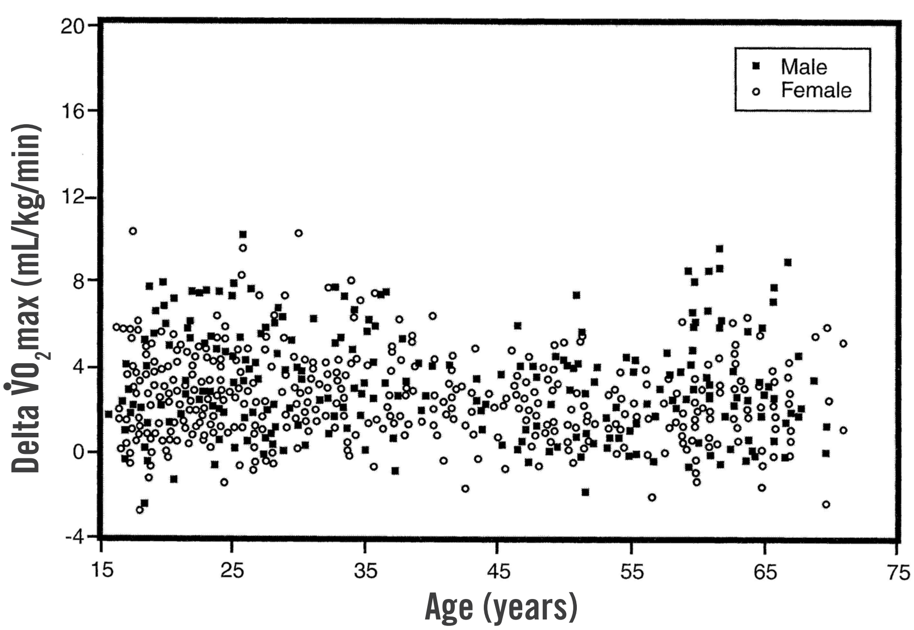
Importantly, one can improve at any age. There have been a number of studies showing that people in their eighties and nineties are able to improve their strength, cardiovascular fitness, flexibility and balance. It should be noted, however, that physical activity is also an opportunity for social engagement, especially for the elderly. Therefore, unless programs also attempt to increase socialization and enjoyment, it is unlikely that older people will continue to participate in what should be a regular part of their lifestyles.

TRAINABILITY AND AGE

Although the updated ACSM Position Stand[1] did not specifically comment on trainability and age, the initial ACSM Position Stand published in 1998[15] did conclude that trainability of $\dot{V}O_2$max is not reduced with age. However, with the exception of the study by Kohrt et al.[16] on 110 men and women aged 60 to 71 years, the other studies cited had many fewer subjects. Skinner et al. reported later on 633 men and women aged 17 to 65 years from the HERITAGE Family Study.[17] When the data from the two studies were combined because the training programs were similar in intensity and frequency, it was clear that there were no significant differences in the absolute increase in $\dot{V}O_2$max reported as a change in mL/kg/min over a range from 17 to 71 years of age (Figure 1). The relationship between age and the change was computed and the correlation coefficient for the combined 743 subjects was -0.08. Looking at Figure 1, it is obvious that there was no significant difference between the response to training of men and women. Although not shown here, there also was no significant difference between the responses of blacks and whites.

Figure 1

Change in $\dot{V}O_2$max (mL/kg/min) of 287 men and 346 women aged 17 to 65 years in the HERITAGE Family[17] and of 53 men and 57 women aged 60 to 71 years in the study by Kohrt et al.[16]



SUMMARY

Improved cognitive and psychological functioning are the usual results of systematic, progressive programs of increased exercise. Although some of these changes may not be as great or come as rapidly for older adults, especially in those who have been sedentary for many years, self-sufficiency and the ability to move with relative ease are attainable and are probably more important for daily living and independence than the high $\dot{V}O_2$max often seen in those who train intensely to improve their fitness.

Health and fitness professionals working with older adults should emphasize that the *process* of being active is more important than the *product* of being fit. The important thing to remember is that it is possible to improve the ability to exercise at any age.

ABOUT THE AUTHOR

James S. Skinner, Ph.D., specializes in exercise physiology and is a professor emeritus in the department of kinesiology at Indiana University. With over 50 years of research on the relationships between exercise, training, genetics and health, he is considered a preeminent expert in his field. A former president of the American College of Sports Medicine (ACSM), Skinner is one of five principal investigators of the HERITAGE Family Study on the role of genetics in the response of cardiovascular disease and diabetes risk factors after training and a member of the group that wrote ACSM's position stand on exercise and physical activity for older adults. He has received the ACSM's Honor Award (the highest award in his field) and over $50 million in grants from various resources. In 2011, he received the Doctor Honoris Causa from Semmelweis University in Budapest, Hungary. He has published more than 290 articles, six books and 19 educational DVDs and has lectured in 60 countries.

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