

STATE OF THE ART
REVIEWSWojtek Chodzko-Zajko, PhD,
Andiara Schwingel, PhD, and
Chae Hee Park, PhDSuccessful Aging: The Role
of Physical Activity

Abstract: *Although no amount of physical activity can stop the aging process, a moderate amount of 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. Ideally, exercise prescription for older adults should include aerobic, muscle strengthening, and flexibility exercises. In addition, individuals at risk for falling or mobility impairment should also perform specific exercises to improve balance. The intensity and duration of physical activity should be low at the outset for those who are highly deconditioned, are functionally limited, or have chronic conditions affecting their ability to perform physical tasks. Furthermore, the progression of activities should be individualized and tailored to tolerance and preference. Incorporating principles of behavioral change into the design and application of exercise and physical activity programs will increase the likelihood of an individual initiating and maintaining a regular program of exercise and/or physical activity. Strategies for maintaining physical function and improving overall health of older adults with chronic conditions and disability are discussed. All older adults with and*

without disabilities should be encouraged to develop a personalized physical activity plan that meets their needs and personal preferences.

Keywords: aging; successful aging; physical activity; exercise

In this article, we examine the extent to which participating in regular physical activity can play an important role in determining whether an

individual ages successfully. Throughout the article, we have chosen to use the more general term of *physical activity* rather than *exercise*, and we have adopted the World Health Organization's (WHO's)¹ broad and inclusive definition of physical activity, which includes all movements in everyday life, including work, recreation, exercise, and sporting activities. We begin with a brief discussion of how and why physical activity is important for older adults. Demographic shifts and epidemiological transitions over the past century have necessitated an increased focus on the prevention of noncommunicative diseases through lifestyle interventions such as physical activity. We note that, although age-related functional decline is an inevitable and inescapable consequence of the aging process, there are considerable interindividual differences with respect to the rate at which this decline progresses. There is increasingly strong



Ideally, exercise prescription for older adults should include aerobic exercise, muscle strengthening exercises, and flexibility exercises.



individual ages successfully. Throughout the article, we have chosen to use the more general term of *physical activity* rather than *exercise*, and we have adopted the World Health Organization's (WHO's)¹ broad and inclusive definition of physical activity, which includes all movements in everyday life, including work, recreation, exercise, and sporting activities. We begin with a brief discussion of how and why physical activity is important for older adults. Demographic

evidence to suggest that avoiding sedentary lifestyles may be one of the most simple and effective means of postponing the onset of functional decline, promoting independence, and maintaining a high quality of life in old age.

The WHO¹ argues that a compelling case for encouraging physical activity across the life span can be presented from the perspective of the *benefits to the individual person* as well as from the collective *benefits to society*. We briefly

DOI: 10.1177/1559827608325456. From the Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Urbana, Illinois. Address for correspondence: Wojtek Chodzko-Zajko, PhD, Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Louise Freer Hall, 906 S. Goodwin Avenue, Urbana, IL 61801; e-mail: wojtek@uiuc.edu.

Copyright © 2009 Sage Publications

summarize the known physiological, psychological, and social benefits of regular physical activity for the individual. In addition, we also comment on why promoting regular physical activity is important from a societal perspective. In the final section of the article, we turn our attention to more practical issues related to prescribing physical activity for older adults. We review current guidelines and recommendations with regard to the intensity, frequency, and duration of physical activity needed to realize beneficial effects. We also summarize best practice recommendations with regard to how best to structure physical activity opportunities in such a way as to stimulate participation, maximize effectiveness, promote enjoyment, and minimize injury risk.

Population Aging and the Rise of Noncommunicable Diseases

Over the past century, pervasive changes in mortality and fertility rates have reshaped the structure of the population pyramid worldwide. The number of people aged 60 and older has tripled over the past 50 years and will more than triple again in the next 50 years.² Population aging represents one of the greatest societal achievements of the past century. However, at the same time, this worldwide phenomenon has brought significant challenges for states and communities with respect to how to provide for needs of the increased number and proportion of older adults.³

A major factor behind global aging and the increased life expectancy observed in most countries has been the impressive advances in public health practices and policies that have greatly reduced premature deaths through the control of previously fatal infectious diseases. During the past century, the impact of infectious diseases has gradually declined, and noncommunicable diseases (NCDs) are rapidly becoming the leading causes of morbidity, disability, and mortality in all regions of the world.⁴ This increased burden of NCDs is disproportionately borne by older adults who experience an

increased relative risk of developing and ultimately dying from numerous chronic conditions, including cardiovascular disease, type 2 diabetes, obesity, and certain cancers.⁵⁻⁸

Of significance to this study is the finding that many NCDs are susceptible to modification through lifestyle change. Longitudinal studies confirm that lifestyle and environmental risk factors explain approximately 75% of the occurrence of coronary heart disease⁹ as well as numerous other chronic diseases and conditions.^{10,11} It is now well documented that major NCDs share common preventable lifestyle-related risk factors that are both behavioral (unhealthy diets, physical inactivity, smoking, and alcohol abuse) and biological (hypertension, obesity, and dyslipidemia).^{12,13} In addition, social, economic, and environmental determinants of health are additional factors that can be linked with NCDs; among these are education, availability, and affordability of healthy food; access to health services; and policies and infrastructures that support a healthy lifestyle.^{14,15}

Despite the complex interrelationships among the multiple NCD risk factors and the individual importance of each one, the WHO has identified regular physical activity as probably the single most effective means by which an individual can reduce the burden of NCDs and thereby promote independence and sustain quality of life in older age.¹ Epidemiological research has consistently shown significant decreases in the relative risk of cardiovascular and all-cause mortality among persons who are classified as highly aerobically fit (and/or highly active) compared with those in a similar age range who are classified as moderately fit (and/or normally active) or low fit (and/or sedentary). The largest increment in mortality benefit is seen when comparing sedentary persons with those in the next highest physical activity level.^{16,17} Additional evidence suggests that muscular strength and power also predict all-cause and cardiovascular mortality, independent of cardiovascular fitness.^{18,19} Thus, avoidance of a sedentary lifestyle by engaging in at least some daily physical activity is a prudent recommendation for reducing the risk of developing NCDs

and postponing morbidities and preserving quality of life.

Individual Differences in the Rate of Aging

Structural changes and resultant functional declines are an inevitable and inescapable consequence of old age. For example, with advancing age, most physiological systems will eventually decline, exhibiting atrophy, dystrophy, and edema at the cellular level. These disruptions in the integrity of the cell are, in turn, precursors of more gross morphological changes, such as decreased elasticity and compliance, demyelination, and neoplastic growth.²⁰ As might be expected, these structural changes are almost always associated with profound functional consequences. In much the same way that structural changes exhibit similarities across physiological systems, the functional consequences are also fairly consistent across different systems of the body. Aging organ systems are usually slower and less accurate; they exhibit not only reduced strength and stability but also decreased coordination and endurance.²⁰

Although structural decay and functional decline are an inescapable consequence of aging, there are often considerable differences between individuals with respect to both the rate and extent of this decline. It is now clear that it is possible for individuals to deviate from expected patterns of aging and, at least for some period of time, postpone the consequences of aging.²¹ A recent review of the physical activity and aging literature concludes that regular physical activity appears to be the only lifestyle behavior identified to date that can favorably influence such a broad range of physiological systems and chronic disease risk factors²² and may also be associated with better mental health²³ and social integration.²⁴ Thus, despite large differences in genetic background among those of a given age cohort, it appears that habitual physical activity is a major lifestyle factor that discriminates between individuals who have and have not experienced successful aging.²⁵⁻²⁹

The Benefits of Physical Activity

Over the past 20 to 30 years, a substantial body of evidence has accumulated regarding the benefits that accrue to older adults who participate in regular physical activity. A comprehensive review of the literature in this area is beyond the scope of this article, but several substantive recent reviews are available and provide excellent summaries of the existing evidence. For example, the American College of Sports Medicine (ACSM), in conjunction with the American Heart Association (AHA), recently published physical activity and public health recommendations for older adults.³⁰ The ACSM/AHA recommendations conclude that regular physical activity acts similarly in middle-aged and older adults by reducing the risk of cardiovascular disease, thromboembolic stroke, hypertension, type 2 diabetes mellitus, osteoporosis, obesity, colon cancer, breast cancer, anxiety, and depression.³¹ Furthermore, the ACSM/AHA recommendations note that among older adult populations, there is substantial evidence that physical activity reduces risk of falls and injuries from falls,³² prevents or mitigates functional limitations,³³⁻³⁵ and is effective therapy for many chronic diseases.

Numerous consensus statements identify a substantial therapeutic role for physical activity in the treatment of coronary heart disease,³⁶⁻³⁸ hypertension,^{36,39,40} peripheral vascular disease,⁴¹ type 2 diabetes,⁴² obesity,⁴³ elevated cholesterol,^{36,44} osteoporosis,⁴⁵ osteoarthritis,^{46,47} claudication,⁴⁸ and chronic obstructive pulmonary disease.⁴⁹ The ACSM/AHA consensus statement notes that clinical practice guidelines identify a role for physical activity in the management of depression and anxiety disorders,⁵⁰ dementia,⁵¹ pain,⁵² congestive heart failure,⁵³ syncope,⁵⁴ stroke,⁵⁵ back pain,⁵⁶ and constipation.⁵⁷ In addition, there is some evidence that physical activity prevents or delays cognitive impairment⁵⁸⁻⁶⁰ and disability^{34,61,62} and improves sleep.^{63,64}

The WHO has proposed an organizational schema that can be used to categorize the benefits of physical activity

for older adults into 2 broad categories: (1) Benefits of Physical Activity for the Individual Persons and (2) Societal Benefits of Promoting Physically Active Lifestyles Among Older Persons.¹ Under the WHO schema, the individual benefits can be summarized into the following general areas: physiological benefits (see Table 1), psychological benefits (see Table 2), social benefits (see Table 3), and the benefits for society (see Table 4). The WHO Physical Activity Guidelines recommend that virtually all older persons should participate in physical activity on a regular basis and that society has a responsibility to advocate for broad-based participation in physical activity whenever possible. The WHO guidelines conclude that regular physical activity provides substantial health-related benefits; it is cheap, safe, and readily available; and physical activity interventions have a major role to play in the prevention, treatment, and management of noncommunicative diseases and conditions associated with advancing age.

In the United States, societal interest in promoting physical activity has been underscored recently by the decision of the Department of Health and Human Services (DHHS) to develop, for the first time, official US Government Physical Activity Guidelines. The recently published DHHS Physical Activity Guidelines Advisory Committee Report⁶⁵ concludes that there is strong evidence that, compared with less active persons, more active men and women have lower rates of all-cause mortality, coronary heart disease, high blood pressure, stroke, type 2 diabetes, metabolic syndrome, colon cancer, breast cancer, and depression. In addition, strong evidence also supports the conclusion that, compared with less active people, physically active adults and older adults exhibit a higher level of cardiorespiratory and muscular fitness, have a healthier body mass and composition, and have a biomarker profile that is more favorable for preventing cardiovascular disease and type 2 diabetes and enhancing bone health. The report concludes that there is more modest evidence indicating that physically active adults and older adults have better quality sleep and health-related quality of life.⁶⁵

Physical Activity Prescription for Older Adults

In this section, we provide a brief synthesis of existing recommendations and guidelines related to physical activity program structure and content. Our goal is to provide clinicians and health practitioners with a succinct summary of current exercise and physical activity guidelines to assist them in prescribing physical activity for older adults.

The current consensus recommendations of the ACSM and AHA with respect to the frequency, intensity, and duration of exercise and physical activity for older adults are summarized below.³⁰ These guidelines recommend that an exercise prescription for older adults should include aerobic exercise, muscle strengthening exercises, and flexibility exercises. In addition, individuals who are frequent fallers or have mobility problems should also perform specific exercises to improve balance.

1. Endurance Exercise for Older Adults

Frequency: A minimum of 5 d/wk for moderate-intensity activities or 3 d/wk for vigorous-intensity activity or some combination thereof can be used to meet this recommendation.

Intensity: On a scale of 0 to 10 for level of physical exertion, 5 to 6 for moderate intensity and 7 to 8 for vigorous intensity.

Duration: For moderate-intensity activities, accumulate at least 30 min/d in bouts of at least 10 minutes each or at least 20 min/d of continuous activity for vigorous-intensity activities.

Type: Any modality that does not impose excessive orthopedic stress; walking is the most common type of activity. Aquatic exercise and stationary cycle exercise may be advantageous for those with limited tolerance for weight-bearing activity.

2. Resistance Exercise for Older Adults

Frequency: At least 2 d/wk.

Intensity: Between moderate (5-6) and vigorous (7-8) intensity on a scale of 0 to 10.

Table 1.

Individual Benefits of Physical Activity for Older Persons: Physiological Benefits

Immediate benefits
<i>Glucose levels:</i> Physical activity helps regulate blood glucose levels.
<i>Catecholamine activity:</i> Both adrenalin and noradrenalin levels are stimulated by physical activity.
<i>Improved sleep:</i> Physical activity has been shown to enhance sleep quality and quantity in individuals of all ages.
Long-term effects
<i>Aerobic/cardiovascular endurance:</i> Substantial improvements in almost all aspects of cardiovascular functioning have been observed following appropriate physical training.
<i>Resistive training/muscle strengthening:</i> Individuals of all ages can benefit from muscle-strengthening exercises. Resistance training can have a significant impact on the maintenance of independence in old age.
<i>Flexibility:</i> Exercise that stimulates movement throughout the range of motion assists in the preservation and restoration of flexibility.
<i>Balance/coordination:</i> Regular activity helps prevent and/or postpone the age-associated declines in balance and coordination that are a major risk factor for falls.
<i>Velocity of movement:</i> Behavioral slowing is a characteristic of advancing age. Individuals who are regularly active can often postpone these age-related declines.

The World Health Organization guidelines¹ have been placed in the public domain and can be freely copied and distributed.

Table 2.

Individual Benefits of Physical Activity for Older Persons: Psychological Benefits

Immediate benefits
<i>Relaxation:</i> Appropriate physical activity enhances relaxation.
<i>Reduces stress and anxiety:</i> There is evidence that regular physical activity can reduce stress and anxiety.
<i>Enhanced mood state:</i> Numerous people report elevations in mood state following appropriate physical activity.
Long-term effects
<i>General well-being:</i> Improvements in almost all aspects of psychological functioning have been observed following periods of extended physical activity.
<i>Improved mental health:</i> Regular exercise can make an important contribution in the treatment of several mental illnesses, including depression and anxiety neuroses.
<i>Cognitive improvements:</i> Regular physical activity may help postpone age-related declines in central nervous system processing speed and improve reaction time.
<i>Motor control and performance:</i> Regular activity helps prevent and/or postpone the age-associated declines in both fine and gross motor performance.
<i>Skill acquisition:</i> New skills can be learned and existing skills refined by all individuals regardless of age.

The World Health Organization guidelines¹ have been placed in the public domain and can be freely copied and distributed.

Table 3.

Individual Benefits of Physical Activity for Older Persons: Social Benefits

Immediate benefits
<p><i>Empowering older individuals:</i> A large proportion of the older adult population voluntarily adopts a sedentary lifestyle, which eventually threatens to reduce independence and self-sufficiency. Participation in appropriate physical activity can help empower older individuals and assist them in playing a more active role in society.</p> <p><i>Enhanced social and cultural integration:</i> Physical activity programs, particularly when carried out in small groups and/or in social environments, enhance social and intercultural interactions for many older adults.</p>
Long-term effects
<p><i>Enhanced integration:</i> Regularly active individuals are less likely to withdraw from society and more likely to actively contribute to the social milieu.</p> <p><i>Formation of new friendships:</i> Participation in physical activity, particularly in small groups and other social environments, stimulates new friendships and acquaintances.</p> <p><i>Widened social and cultural networks:</i> Physical activity frequently provides individuals with an opportunity to widen available social networks.</p> <p><i>Role maintenance and new role acquisition:</i> A physically active lifestyle helps foster the stimulating environments necessary for maintaining an active role in society, as well as for acquiring positive new roles.</p> <p><i>Enhanced intergenerational activity:</i> In many societies, physical activity is a shared activity that provides opportunities for intergenerational contact, thereby diminishing stereotypic perceptions about aging and the elderly.</p>

The World Health Organization guidelines¹ have been placed in the public domain and can be freely copied and distributed.

Table 4.

Societal Benefits of Promoting Physical Activity for Older Persons

<p><i>Reduced health and social care costs:</i> Physical inactivity and sedentary living contribute to a decrease in independence and the onset of many chronic diseases. Physically active lifestyles can help postpone the onset of physical frailty and disease, thereby significantly reducing health and social care costs.</p> <p><i>Enhancing the productivity of older adults:</i> Older individuals have much to contribute to society. Physically active lifestyles help older adults maintain functional independence and optimize the extent to which they are able to actively participate in society.</p> <p><i>Promoting a positive and active image of older persons:</i> A society that promotes a physically active lifestyle for older adults is more likely to reap the benefits of the wealth of experience and wisdom possessed by the older individuals in the community. A large proportion of the older adult population voluntarily adopts a sedentary lifestyle, which eventually threatens to reduce independence and self-sufficiency.</p>

The World Health Organization guidelines¹ have been placed in the public domain and can be freely copied and distributed.

Type: Progressive weight-training program or weight-bearing calisthenics (8-10 exercises involving the major muscle groups of 8-12 repetitions each), stair climbing, and other strengthening activities that use the major muscle groups.

3. Flexibility Exercise for Older Adults

Frequency: At least 2 d/wk.

Intensity: Moderate (5-6) intensity on a scale of 0 to 10.

Type: Any activities that maintain or increase flexibility using sustained

stretches for each major muscle group and static rather than ballistic movements.

4. Balance Exercise for Frequent Fallers or Individuals With Mobility Problems

ACSM/AHA guidelines currently recommend balance exercise for individuals

who are frequent fallers or for individuals with mobility problems. Because of a lack of adequate research evidence, there are currently no specific recommendations regarding specific frequency, intensity, or type of balance exercises for older adults. However, the ACSM Exercise Prescription Guidelines recommend using activities that include (1) progressively difficult postures that gradually reduce the base of support (eg, 2-legged stand, semi-tandem stand, tandem stand, 1-legged stand), (2) dynamic movements that perturb the center of gravity (eg, tandem walk, circle turns), (3) stressing postural muscle groups (eg, heel stands, toe stands), or (d) reducing sensory input (eg, standing with eyes closed).

The ACSM/AHA guidelines recommend the following special considerations when prescribing exercise and physical activity for older adults. The intensity and duration of physical activity should be low at the outset for older adults who are highly deconditioned, are functionally limited, or have chronic conditions that affect their ability to perform physical tasks. The progression of activities should be individual and tailored to tolerance and preference; a conservative approach may be necessary for the most deconditioned and physically limited older adults. Muscle-strengthening activities and/or balance training may need to precede aerobic training activities among very frail individuals. Older adults should exceed the recommended minimum amounts of physical activity if they desire to improve their fitness. If chronic conditions preclude activity at the recommended minimum amount, older adults should perform physical activities as tolerated so as to avoid being sedentary.

Behavioral Recommendations for Physical Activity Prescription for Older Adults

In recent years, increasing attention has focused on the study of behavioral factors that increase the likelihood of an individual initiating and maintaining a regular program of exercise and/or physical activity. In 2005, the ACSM published a consensus statement that summarizes

“Best Practices for Physical Activity Programs and Behavior Counseling in Older Adult Populations.”⁶⁶ The Best Practice Statement summarizes current recommendations with regard to how best to include established principles of behavioral change into an exercise or physical activity program for older adults.

Incorporating a comprehensive behavioral management strategy in physical activity interventions can help maximize recruitment, increase motivation for exercise progression, and minimize attrition. The following behavioral strategies are identified in the 2005 ACSM Best Practice Statement as the major factors that increase the likelihood a person will sustain a new physical activity behavior.

Social support. Social support from family and friends has been associated with long-term exercise adherence in older adults.⁶⁷ Examples of social support strategies include peer support (eg, tell a friend and bring a friend, exercise buddy system) and professional health educator support (telephone counseling, mail follow-up).

Self-efficacy. For many seniors, aging is associated with a loss of perceived control.⁶⁸ There is growing evidence that people are more likely to initiate and maintain physical activity if they feel confident about their ability to succeed and if they are afforded a variety of opportunities to actively participate in physical activity. Health contracts, practice/mastery experiences, modeling, and having choices enhance self-efficacy.

Active choices. As part of a comprehensive behavioral strategy, tailoring the exercise program to the needs and interest of participants has successfully motivated older adults to initiate and maintain a routine of regular physical activity.⁶⁹ Therefore, physical activity leaders should work closely with individuals to design a physical activity regimen that reflects the person's preferences and capabilities. There is growing evidence that providing choices concerning exercise program characteristics (such as group-based vs individual activity programs and choice of exercise location) contributes to greater adherence.

Health contracts. A health contract is a written agreement negotiated between the participant and a health professional to accomplish a health goal.⁷⁰ The contract usually includes difficult but realistic goal setting and a measurable, specific, time-delimited plan or course of action for reaching the health goals. The use of a health calendar to record physical activity provides a means for the participant to monitor the targeted physical activity and to reinforce a commitment to the exercise routine. Self-monitoring is most effective when completed frequently (as it occurs or daily), focuses on the behavior (not absence of), and is specifically defined.

Perceived safety. Concerns for safety have been identified as a barrier to exercise by many older adults.⁷¹ Physical activity programs can help alleviate inappropriate concerns about safety by educating participants about actual risks of physical activity and by helping individuals understand how to self-monitor their exercise intensity levels.

Regular performance feedback. Providing regular and accurate performance feedback can assist older adults in developing realistic expectations of their own progress.⁷² Performance feedback should be positive and meaningful to the individual. Observation of meaningful positive changes in performance and success in achieving expected outcomes is associated with exercise adherence in older adults.

Positive reinforcement. Positive reinforcement is any procedure introduced in an intervention that increases the likelihood of maintenance of the activity.⁷³ Examples of effective reinforcement strategies in physical activity settings include recruitment incentives, rewards for reaching targeted goals, and public recognition for attendance and adherence. The effect of reinforcement can be maximized when it is valued by the individual being targeted.

Injury and Risk Management

The ACSM Best Practice Statement notes that although there are some risks associated with participation in regular physical activity, the risks associated with a sedentary lifestyle far exceed them.⁶⁶ Physical

activity risks are related to level of intensity, with lower intensity physical activity being associated with the lowest risk. Low-intensity physical activity reduces the risks of injury and muscle soreness and may be perceived as less threatening than moderate- to high-intensity routines. Although lower risk is associated with lower intensity exercise, the consensus is that moderate physical activity has a better risk/benefit ratio, and moderate-intensity physical activity should be the goal for older adults. Although having an ongoing dialogue with a health care provider is recommended, the involvement of a primary care provider prior to beginning a program of physical activity depends on a person's health condition and the level of intensity and mode of physical activity. Sedentary older adults typically engage in short sessions (<10 minutes) of various types of low-intensity physical activity. There are rarely medical concerns about performing low-intensity activities, for example, the National Institutes of Health (NIH) Behavioral Change Consortium reports⁷⁴ an absence of study-related adverse events in 11 NIH-funded clinical trials examining the effects of physical activity interventions in an older adult population. The ACSM Best Practice Statement concludes that low-intensity physical activity can be safely performed regardless of whether an older adult has recently had a medical evaluation.

The ACSM Best Practice Statement does recommend that before starting or increasing their level of physical activity, older adults should have a strategy for risk management and prevention of activity-related injuries. The most important strategy is to start with low-intensity physical activity and increase intensity gradually. Whenever possible, physical activity bouts should include a warm-up and cool-down component. Increasing muscular strength around weight-bearing joints, particularly the knee, also reduces the risk of musculoskeletal injury. Other strategies include active stretching during the warm-up and cool-down portions of aerobic exercise programs, participating in a variety of activities, and avoiding high-intensity vigorous exercise. Vigorous activities, including running and jogging and vigorous participation in

sports, should be recommended only to older adults who have progressed to and are accustomed to these activities or who have sufficient fitness, experience, and knowledge required to perform vigorous activities.⁷⁵

Participating in physical activity is an excellent way for older adults with chronic conditions and disabilities to maintain their physical function and improve their overall health. All older adults with disabilities should be encouraged to develop a physical activity plan. After discussions with their health care provider or exercise professional, older adults with chronic conditions or disability should understand the amount and types of activity that are appropriate for them. Preferably, the physical activity recommendation or "prescription" should be documented in the medical record and provided to the patient in writing. The recommendation should be developed proactively at the time of diagnosis of the chronic condition or when a change in clinical condition occurs. Also, the patient should understand that the physician should be consulted if certain problems or questions arise. Regular provider-patient communication about changes in physical activity level is prudent.

Physical activity is therapeutic for many chronic conditions, so increasing physical activity levels can be comparable to adjusting the dosage of a medication.⁷⁶ Unstable medical problems, such as elevated blood pressure or rapid atrial fibrillation, are generally temporary contraindications to exercise. These problems should be diagnosed and treated whether or not a person seeks to start an exercise program. Once problems are stabilized, the person can begin or resume exercise. Because of the wide variety of disabling conditions, describing specific components of an exercise prescription for each condition can be complex. An excellent resource for information about physical activity and disability or chronic health conditions is the National Center for Physical Activity and Disability (www.ncpad.org). Both older adults and health care professionals should consider seeking expert advice when addressing issues related to physical activity in older adults with disabilities.

Summary and Conclusions

Although no amount of physical activity can stop the aging process, there is evidence that a moderate amount of regular physical activity can minimize the physiological effects of aging and increase active life expectancy by limiting the development and progression of chronic disease and disabling conditions. There is also emerging evidence for psychological 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. Nevertheless, a number of evidence-based conclusions can be drawn relative to exercise and physical activity in the older adult population. A combination of aerobic and resistance training activities appears 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 such programs do not need to be of high intensity to reduce the risks of developing chronic cardiovascular and metabolic disease. 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 habitually active older adults. The transient nature of the acute and chronic effects of exercise suggests that exercise should be performed regularly so that these health benefits can be sustained. Ideally, exercise prescription for older adults should include aerobic exercise, muscle strengthening exercises, and flexibility exercises. In addition, individuals who are at risk for falling or mobility impairment should also perform specific exercises to improve balance in addition to the other components of health-related physical fitness. The intensity and duration of physical activity should be low at the outset for older adults who are highly deconditioned, are

functionally limited, or have chronic conditions that affect their ability to perform physical tasks. Furthermore, the progression of activities should be individualized and tailored to tolerance and preference. Incorporating principles of behavioral change into the design and application of exercise and physical activity programs for older adults will increase the likelihood of an individual initiating and maintaining a regular program of exercise and/or physical activity. Guidelines for risk management in the general population may need to be modified to meet the needs of older adults with chronic conditions and disabilities to assist them in maintaining their physical function and improving their overall health. All older adults with and without disabilities should be encouraged to develop a personalized physical activity plan that meets their needs and personal preferences. **AJLM**

References

- World Health Organization (WHO). *The Heidelberg Guidelines for Promoting Physical Activity Among Older Persons*. Geneva, Switzerland: WHO; 1996.
- World Health Organization (WHO). *World Health Statistics 2008*. Geneva, Switzerland: WHO; 2008.
- Centers for Disease Control and Prevention (CDC). *The State of Aging and Health in America 2007*. Atlanta, GA: CDC; 2007.
- Murray C, Lopez A. *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability From Diseases, Injuries, and Risk Factors in 1990 and Projected to 2020*. Cambridge, MA: Harvard University Press; 1996.
- Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part II. The aging heart in health: links to heart disease. *Circulation*. 2003;107:346-354.
- Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part I. Aging arteries: a "set up" for vascular disease. *Circulation*. 2003;107:139-146.
- Shephard RJ. How much physical activity is needed for good health? *Int J Sports Med*. 1999;20:23-27.
- Singh MA. Exercise and aging. *Clin Geriatr Med*. 2004;20:201-221.
- Magnus P, Beaglehole R. The real contribution of the major risk factors to the coronary epidemics: time to end the "only-50%" myth. *Arch Intern Med*. 2001;161:2657-2660.
- Fox J. A life course approach to chronic disease epidemiology. *BMJ*. 1998;317:421.
- Smith GD. Life-course approaches to inequalities in adult chronic disease risk. *Proc Nutr Soc*. 2007;66:216-236.
- Ezzati M, Hoon SV, Rodgers A, et al. Estimates of global and regional potential health gains from reducing multiple major risk factors. *Lancet*. 2003;362:271-280.
- Lopez AD, Mathers CD, Ezzati M, et al. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *Lancet*. 2006;367:1747-1757.
- Raphael D, Macdonald J, Colman R, et al. Researching income and income distribution as determinants of health in Canada: gaps between theoretical knowledge, research practice, and policy implementation. *Health Policy*. 2005;72:217-232.
- Yarnell J, Yu S, McCrum E, et al. Education, socioeconomic and lifestyle factors, and risk of coronary heart disease: the PRIME Study. *Int J Epidemiol*. 2005;34:268-275.
- Blair SN, Wei M. Sedentary habits, health, and function in older women and men. *Am J Health Promot*. 2000;15:1-8.
- Wei M, Gibbons LW, Kampert JB, et al. Low cardiorespiratory fitness and physical inactivity as predictors of mortality in men with type 2 diabetes. *Ann Intern Med*. 2000;132:605-611.
- FitzGerald S, Barlow C, Kampert J, et al. Sedentary habits, health, and function in older men and women. *J Phys Act Health*. 2004;1:7-18.
- Katzmarzyk PT, Craig CL. Musculoskeletal fitness and risk of mortality. *Med Sci Sports Exerc*. 2002;34:740-744.
- Chodzko-Zajko WJ. Normal aging and human physiology. *Semin Speech Lang*. 1997;18:95-104; quiz 104-105.
- Fries JF. Aging, natural death, and the compression of morbidity. *N Engl J Med*. 1980;303:130-135.
- Holloszy JO. The biology of aging. *Mayo Clin Proc*. 2000;75(suppl):S3-S8; discussion S8-S9.
- Lautenschlager NT, Almeida OP, Flicker L, Janca A. Can physical activity improve the mental health of older adults? *Ann Gen Hosp Psychiatry*. 2004;3:12.
- McAuley E, Blissmer B, Marquez DX, et al. Social relations, physical activity, and well-being in older adults. *Prev Med*. 2000;31:608-617.
- Samaras K, Kelly PJ, Chiano MN, et al. Genetic and environmental influences on total-body and central abdominal fat: the effect of physical activity in female twins. *Ann Intern Med*. 1999;130:873-882.
- Seeman TE, Berkman LF, Charpentier PA, et al. Behavioral and psychosocial predictors of physical performance: MacArthur studies of successful aging. *J Gerontol A Biol Sci Med Sci*. 1995;50:M177-M183.
- Seeman TE, Charpentier PA, Berkman LF, et al. Predicting changes in physical performance in a high-functioning elderly cohort: MacArthur studies of successful aging. *J Gerontol*. 1994;49:M97-M108.
- Tinetti ME, Allore H, Araujo KL, Seeman T. Modifiable impairments predict progressive disability among older persons. *J Aging Health*. 2005;17:239-256.
- Weinert BT, Timiras PS. Invited review: theories of aging. *J Appl Physiol*. 2003;95:1706-1716.
- Nelson ME, Rejeski WJ, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007;116:1094-1105.
- Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007;116:1081-1093.
- American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention. Guideline for the prevention of falls in older persons. *J Am Geriatr Soc*. 2001;49:664-672.
- Kesaniemi YK, Danforth E Jr, Jensen MD, et al. Dose-response issues concerning physical activity and health: an evidence-based symposium. *Med Sci Sports Exerc*. 2001;33(suppl):S351-S358.
- Keysor JJ. Does late-life physical activity or exercise prevent or minimize disablement? A critical review of the scientific evidence. *Am J Prev Med*. 2003;25(suppl 2):129-136.
- Nelson ME, Layne JE, Bernstein MJ, et al. The effects of multidimensional home-based exercise on functional performance in elderly people. *J Gerontol A Biol Sci Med Sci*. 2004;59:154-160.
- Thompson PD, Buchner D, Pina IL, et al. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: a statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity). *Circulation*. 2003;107:3109-3116.
- Fletcher GF, Balady GJ, Amsterdam EA, et al. Exercise standards for testing and

- training: a statement for healthcare professionals from the American Heart Association. *Circulation*. 2001;104:1694-1740.
38. Pollock ML, Franklin BA, Balady GJ, et al. AHA Science Advisory. Resistance exercise in individuals with and without cardiovascular disease: benefits, rationale, safety, and prescription: an advisory from the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, American Heart Association; position paper endorsed by the American College of Sports Medicine. *Circulation*. 2000;101:828-833.
 39. Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA*. 2003;289:2560-2572.
 40. Pescatello LS, Franklin BA, Fagard R, et al. American College of Sports Medicine position stand: exercise and hypertension. *Med Sci Sports Exerc*. 2004;36:533-553.
 41. McDermott MM, Liu K, Ferrucci L, et al. Physical performance in peripheral arterial disease: a slower rate of decline in patients who walk more. *Ann Intern Med*. 2006;144:10-20.
 42. Sigal RJ, Kenny GP, Wasserman DH, et al. Physical activity/exercise and type 2 diabetes: a consensus statement from the American Diabetes Association. *Diabetes Care*. 2006;29:1433-1438.
 43. Screening for obesity in adults: recommendations and rationale. *Ann Intern Med*. 2003;139:930-932.
 44. Brewer HB Jr. New features of the National Cholesterol Education Program Adult Treatment Panel III lipid-lowering guidelines. *Clin Cardiol*. 2003;26(suppl 3):III19-III24.
 45. Going S, Lohman T, Houtkooper L, et al. Effects of exercise on bone mineral density in calcium-replete postmenopausal women with and without hormone replacement therapy. *Osteoporos Int*. 2003;14:637-643.
 46. American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. Recommendations for the medical management of osteoarthritis of the hip and knee: 2000 update. *Arthritis Rheum*. 2000;43:1905-1915.
 47. Exercise prescription for older adults with osteoarthritis pain: consensus practice recommendations. A supplement to the AGS Clinical Practice Guidelines on the management of chronic pain in older adults. *J Am Geriatr Soc*. 2001;49:808-823.
 48. Stewart KJ, Hiatt WR, Regensteiner JG, Hirsch AT. Exercise training for claudication. *N Engl J Med*. 2002;347:1941-1951.
 49. Global Initiative for Chronic Obstructive Lung Disease strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease: an Asia-Pacific perspective. *Respirology*. 2005;10:9-17.
 50. Brosse AL, Sheets ES, Lett HS, Blumenthal JA. Exercise and the treatment of clinical depression in adults: recent findings and future directions. *Sports Med*. 2002;32:741-760.
 51. Doody RS, Stevens JC, Beck C, et al. Practice parameter: management of dementia (an evidence-based review). Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology*. 2001;56:1154-1166.
 52. The management of persistent pain in older persons. *J Am Geriatr Soc*. 2002;50(suppl):S205-S224.
 53. Remme WJ, Swedberg K. Guidelines for the diagnosis and treatment of chronic heart failure. *Eur Heart J*. 2001;22:1527-1560.
 54. Brignole M, Alboni P, Benditt D, et al. Guidelines on management (diagnosis and treatment) of syncope. *Eur Heart J*. 2001;22:1256-1306.
 55. Gordon NF, Gulanic M, Costa F, et al. Physical activity and exercise recommendations for stroke survivors: an American Heart Association scientific statement from the Council on Clinical Cardiology, Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention; the Council on Cardiovascular Nursing; the Council on Nutrition, Physical Activity, and Metabolism; and the Stroke Council. *Stroke*. 2004;35:1230-1240.
 56. Hagen KB, Hilde G, Jamtvedt G, Winnem MF. The Cochrane review of bed rest for acute low back pain and sciatica. *Spine*. 2000;25:2932-2939.
 57. Locke GR III, Pemberton JH, Phillips SF. American Gastroenterological Association Medical Position Statement: guidelines on constipation. *Gastroenterology*. 2000;119:1761-1766.
 58. Abbott RD, White LR, Ross GW, Masaki KH, Curb JD, Petrovitch H. Walking and dementia in physically capable elderly men. *JAMA*. 2004;292:1447-1453.
 59. Weuve J, Kang JH, Manson JE, Breteler MM, Ware JH, Grodstein F. Physical activity, including walking, and cognitive function in older women. *JAMA*. 2004;292:1454-1461.
 60. Larson EB, Wang L, Bowen JD, et al. Exercise is associated with reduced risk for incident dementia among persons 65 years of age and older. *Ann Intern Med*. 2006;144:73-81.
 61. Penninx BW, Messier SP, Rejeski WJ, et al. Physical exercise and the prevention of disability in activities of daily living in older persons with osteoarthritis. *Arch Intern Med*. 2001;161:2309-2316.
 62. Singh MA. Exercise to prevent and treat functional disability. *Clin Geriatr Med*. 2002;18:431-462, vi-vii.
 63. King AC, Oman RF, Brassington GS, Bliwise DL, Haskell WL. Moderate-intensity exercise and self-rated quality of sleep in older adults: a randomized controlled trial. *JAMA*. 1997;277:32-37.
 64. Singh NA, Clements KM, Fiatarone MA. A randomized controlled trial of the effect of exercise on sleep. *Sleep*. 1997;20:95-101.
 65. *Physical Activity Guidelines Advisory Committee Report*. Washington, DC: US Department of Health and Human Services; 2008.
 66. Cress ME, Buchner DM, Prohaska T, et al. Best practices for physical activity programs and behavior counseling in older adult populations. *J Aging Phys Act*. 2005;13:61-74.
 67. Oka R, King A. Sources of social support as predictors of exercise adherence in women and men age 50 to 65 years. *Women Health Research Gender Behavior Policy*. 1995;1:161-175.
 68. Kunzmann U, Little T, Smith J. Perceived control: a double-edged sword in old age. *J Gerontol*. 2002;57B:484-491.
 69. Stewart AL. Community-based physical activity programs for adults age 50 and older. *J Aging Phys Act*. 2001;9:S71-S91.
 70. Haber D, Looney C. Health contract calendars: a tool for health professionals with older adults. *Gerontologist*. 2000;20:235-239.
 71. Bennett GG, McNeill LH, Wolin KY, et al. Safe to walk? Neighborhood safety and physical activity among public housing residents. *PLoS Med*. 2007;4:1599-1606; discussion 1607.
 72. Neff K, King A. Exercise program adherence in older adults: the importance of achieving one's expected benefits. *Med Exerc Nutr Health*. 1995;4:355-362.
 73. Beach LM, Tennant LK. Personal importance, motivation, and performance of older adults. *Percept Mot Skills*. 1992;74:543-546.
 74. Ory M, Resnick B, Jordan P, et al. Screening, safety, and adverse events in physical activity interventions: collaborative experiences from the behavior change consortium. *Ann Behav Med*. 2005;29(suppl):20-28.
 75. Resnick B, Ory MG, Hora K, et al. A proposal for a new screening paradigm and tool called Exercise Assessment and Screening for You (EASY). *J Aging Phys Act*. 2008;16:215-233.
 76. Haskell WL. Health consequences of physical activity: understanding and challenges regarding dose-response. *Med Sci Sports Exerc*. 1994;26:649-660.