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ACSM's Guidelines for Exercise Testing and Prescription

Twelfth Edition



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ACSM's Guidelines for Exercise Testing and Prescription, 12th edition

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CONTENTS

- 1 Benefits and Risks Associated With Physical Activity
- 2 Preparticipation Evaluation
- 3 Health-Related Physical Fitness Testing and Interpretation
- 4 Clinical Exercise Testing and Interpretation
- 5 General Principles of Exercise Prescription
- 6 Exercise Prescription for Healthy Populations With Special Considerations
- 7 Environmental Considerations for Exercise Prescription
- 8 Exercise Prescription for Individuals With Cardiovascular and Pulmonary Diseases
- 9 Exercise Prescription for Individuals With Metabolic Disease and Cardiovascular Disease Risk Factors
- 10 Exercise Testing and Prescription for Populations With Other Chronic Diseases and Health Conditions
- 11 Neurologic Diseases, Conditions, and Disorders
- 12 Behavior-Based Strategy to Promote Physical Activity and Exercise

APPENDICES

- Appendix A Common Medications
- Appendix B Electrocardiogram Interpretation
- Appendix C Metabolic Calculations and Methods for Prescribing Aerobic Exercise Intensity
- Appendix D Reference List of Commonly Used Equations
- Appendix E Editors and Contributing Authors to the Previous Two Editions

Benefits and Risks Associated With Physical Activity

INTRODUCTION

This chapter summarizes information regarding the general benefits and risks of physical activity (PA) and/or exercise. Information related to the benefits of PA and exercise specific to a disease, disability, or health condition are explained within the respective chapters of this edition of the guidelines. PA continues to take on an increasingly important role in the prevention and treatment of multiple chronic diseases, health conditions, and their associated risk factors. Thus, this chapter focuses on the public health perspective that forms the basis for the current PA recommendations (1–6). This chapter concludes with recommendations for reducing the incidence and severity of exercise-related complications for primary and secondary prevention programs.

PHYSICAL ACTIVITY AND FITNESS TERMINOLOGY

PA and exercise are often used interchangeably; however, these terms are not synonymous. *PA* is defined as any bodily movement produced by the contraction of skeletal muscles that results in an increase in caloric requirements over resting energy expenditure (7). *Exercise*, on the other hand, is a type of PA consisting of planned, structured, and repetitive bodily movement done to improve and/or maintain one or more components of physical fitness (7). *Physical fitness*, although defined in several ways, has generally been described as a set of attributes or characteristics individuals have or achieve that relate to their ability to perform PA and activities of daily living (7). These attributes or characteristics are commonly separated into health- and skill-related components of physical fitness. Nonetheless, recent evidence suggests that these components of physical fitness may not be mutually exclusive, as several skill-related components can be important for achieving health goals and, therefore, should be incorporated when designing exercise prescription programs with different populations (e.g., power and balance activities with older adults) (Box 1.1).

Box 1.1**Health- and Skill-Related Components of Physical Fitness****Health-Related Physical Fitness Components**

- Cardiorespiratory endurance: the ability of the circulatory and respiratory system to supply oxygen during sustained physical activity
- Body composition: the relative amounts of muscle, fat, bone, and other vital parts of the body
- Muscular strength: the ability of muscle to exert force
- Muscular endurance: the ability of muscle to continue to perform without fatigue
- Flexibility: the range of motion available at a joint

Skill-Related Physical Fitness Components

- Agility: the ability to change the position of the body in space with speed and accuracy
- Coordination: the ability to use the senses, such as sight and hearing, together with body parts in performing tasks smoothly and accurately
- Balance: the maintenance of equilibrium while stationary or moving
- Power: the ability or rate at which one can perform work
- Reaction time: the time elapsed between stimulation and the beginning of the reaction to it
- Speed: the ability to perform a movement within a short period of time

Adapted from (7). Originally printed in Corbin, Charles B., et al., Concepts in physical education with laboratories and experiments, 4th ed. © 1970, 1974, 1978, 1980 Wm. C. Brown Publishers, Dubuque, IA.

In addition to defining type of PA, it is important to clearly define the wide range of intensities associated with PA (see *Table 5.2*) and with different methods for estimating intensities, which include percentage of oxygen uptake reserve ($\dot{V}O_{2R}$), heart rate reserve (HRR), volume of oxygen consumed per minute ($\dot{V}O_2$), heart rate (HR), or metabolic equivalents (METs; see *Box 5.2* and *Appendix C*). Several chapters throughout the guidelines provide the methodology and guidance for selecting a suitable estimation method based on individual circumstances.

METs are a practical, convenient, and standardized method for quantifying the intensity of various behaviors and activities. One MET is equivalent to resting metabolic rate ($\sim 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) or the amount of oxygen consumed while sitting at rest. Among adults, light-intensity PA is defined as 1.6–2.9 METs, moderate as 3.0–5.9 METs, and vigorous as ≥ 6.0 METs (6). *Table 1.1* gives specific examples of MET values for activities in each of the described intensity ranges. A comprehensive catalog of absolute intensity values for various behaviors and activities can be found in the Compendium of Physical Activities (8–10).

Because of age-related declines in cardiorespiratory fitness (CRF, or the integrated capacity to transport oxygen from the atmosphere to the mitochondria to perform physical work) (2,4,11), when older and younger individuals work at the same MET level, the relative exercise intensity (e.g., $\dot{V}O_{2\max}$) will usually be different (see *Chapter 5*), as an older individual will typically work at a greater relative percentage of maximal oxygen consumption ($\dot{V}O_{2\max}$) than a younger individual.

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TABLE 1.1 • Metabolic Equivalents (METs) Values of Common Physical Activities Classified as Light, Moderate, or Vigorous Intensity

Light (1.6–2.9 METs)	Moderate (3.0–5.9 METs)	Vigorous (≥6.0 METs)
Walking Walking slowly around home, store, or office = 2.0 ^a	Walking Walking 3.0 mi · h ⁻¹ = 3.0 ^a Walking at very brisk pace (4 mi · h ⁻¹) = 5.0 ^a	Walking, jogging, and running Walking at very, very brisk pace (4.5 mi · h ⁻¹) = 6.3 ^a Walking/hiking at a moderate pace and grade with no or light pack (<10 lb) = 7.0 Hiking at steep grades and pack 10–42 lb = 7.5–9.0 Jogging at 5 mi · h ⁻¹ = 8.0 ^a Jogging at 6 mi · h ⁻¹ = 10.0 ^a Running at 7 mi · h ⁻¹ = 11.5 ^a
Household and occupation Standing performing light work, such as making bed, washing dishes, ironing, preparing food, or store clerk = 2.0–2.5	Household and occupation Cleaning, heavy — washing windows, car, clean garage = 3.0 Sweeping floors or carpet, vacuuming, mopping = 3.0–3.5 Carpentry — general = 3.6 Carrying and stacking wood = 5.5 Mowing lawn — walk power mower = 5.5	Household and occupation Shoveling sand, coal, etc. = 7.0 Carrying heavy loads, such as bricks = 7.5 Heavy farming, such as bailing hay = 8.0 Shoveling, digging ditches = 8.5
Leisure time and sports Billiards = 2.5 Boating — power = 2.5 Croquet = 2.5 Darts = 2.5 Fishing — sitting = 2.5 Playing most musical instruments = 2.0–2.5	Leisure time and sports Badminton — recreational = 4.5 Basketball — shooting around = 4.5 Dancing — ballroom slow = 3.0; ballroom fast = 4.5 Fishing from riverbank and walking = 4.0 Golf — walking, pulling clubs = 4.3 Sailing boat, wind surfing = 3.0 Table tennis = 4.0 Tennis doubles = 5.0 Volleyball — noncompetitive = 3.0–4.0	Leisure time and sports Bicycling on flat — light effort (10–12 mi · h ⁻¹) = 6.0 Basketball game = 8.0 Bicycling on flat — moderate effort (12–14 mi · h ⁻¹) = 8.0; fast (14–16 mi · h ⁻¹) = 10.0 Skiing cross-country — slow (2.5 mi · h ⁻¹) = 7.0; fast (5.0–7.9 mi · h ⁻¹) = 9.0 Soccer — casual = 7.0; competitive = 10.0 Swimming leisurely = 6.0 ^b ; swimming — moderate/hard = 8.0–11.0 ^b Tennis singles = 8.0 Volleyball — competitive at gym or beach = 8.0

^aOn flat, hard surface.^bMET values can vary substantially from individual to individual during swimming as a result of different strokes and skill levels.

Adapted from (8–10).

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Nonetheless, physically active older adults may have CRF comparable to or greater than those of physically inactive younger adults. This relationship will be similar when comparing individuals with different fitness levels, where those with lower $\dot{V}O_{2\max}$ will work at a higher percentage of their maximal ability compared to their more fit counterparts at the same absolute MET value.

PUBLIC HEALTH PERSPECTIVE FOR CURRENT RECOMMENDATIONS

In the mid-1990s, the American College of Sports Medicine (ACSM), in conjunction with the U.S. Centers for Disease Control and Prevention (CDC) (12), the U.S. Surgeon General (13), and the National Institutes of Health (NIH) (14), issued landmark publications on PA and health. An important goal of these reports was to clarify for exercise professionals and the public the amount and intensity of PA needed to improve health, lower susceptibility to disease (morbidity), and decrease premature mortality (12–14). In addition, these reports documented the positive dose-response relationship between PA and health.

In 1995, the CDC and ACSM recommended that “every U.S. adult should accumulate 30 minutes or more of moderate physical activity on most, preferably all, days of the week” (12). This recommendation was quickly followed in 1996 by *Physical Activity and Health: A Report of the Surgeon General*, a landmark report detailing the myriad health benefits associated with regular PA (13). Collectively, the intent of these statements was to increase public awareness of the health-related benefits of moderate-intensity PA. As a result of increasing awareness of the adverse health effects of physical inactivity and confusion around the original PA recommendations, the ACSM and American Heart Association (AHA) issued updated recommendations for PA and health in 2007 (*Box 1.2*) (3).

Box 1.2

The ACSM-AHA Primary Physical Activity Recommendations (3)

- All healthy adults aged 18–65 years should participate in moderate-intensity aerobic PA for a minimum of 30 minutes on 5 d · wk⁻¹ or vigorous-intensity aerobic activity for a minimum of 20 minutes on 3 d · wk⁻¹.
- Combinations of moderate- and vigorous-intensity exercise can be performed to meet this recommendation.
- Moderate-intensity aerobic activity can be accumulated to total 30 minutes by performing bouts, each lasting ≥10 minutes.
- Every adult should perform activities that maintain or increase muscular strength and endurance for a minimum of 2 d · wk⁻¹.
- Because of the dose-response relationship between PA and health, individuals who wish to further improve their fitness, reduce their risk for chronic diseases and disabilities, and/or prevent unhealthy weight gain may benefit by exceeding the minimum recommended amounts of PA.

ACSM, American College of Sports Medicine; AHA, American Heart Association; PA, physical activity.

Shortly after the publication of the joint ACSM and AHA recommendations, the federal government convened an expert panel, the 2008 Physical Activity Guidelines Advisory Committee (15), to review the scientific evidence on PA and health published since the 1996 U.S. Surgeon General's Report (13). This committee found compelling evidence regarding the benefits of PA for health as well as the presence of a dose-response relationship for many diseases and health conditions. The 2008 Physical Activity Guidelines Advisory Committee provided the *Physical Activity Guidelines Advisory Committee Report* (15), which resulted in two important conclusions that influenced the development of subsequent PA recommendations:

1. Important health benefits can be obtained by performing a moderate amount of PA on most, if not all, days of the week.
2. Individuals who maintain a regular program of PA that is longer in duration, of greater intensity, or both are likely to derive greater benefits than those who engage in lesser amounts.

These recommendations from the *Physical Activity Guidelines Advisory Committee Report* ultimately resulted in the *2008 Physical Activity Guidelines for Americans*, which were the first comprehensive guidelines related to PA published by the Federal government (see <https://health.gov/paguidelines/2008/>) (5).

After a decade of research and implementation of the *2008 Physical Activity Guidelines for Americans*, the federal government convened another expert panel, the 2018 Physical Activity Guidelines Advisory Committee (16), to further review the scientific evidence on PA and health published since the *2008 Physical Activity Guidelines for Americans* (5) were released. The committee identified further evidence supporting the beneficial effects of PA on health. Beyond attenuating chronic disease risks, additional conclusions regarding the benefits of PA for health from the *2018 Physical Activity Guidelines Advisory Committee Scientific Report* include, but are not limited to, the following:

1. For those who are inactive, PA of any intensity (light, moderate, or vigorous) can provide health benefits.
2. Health benefits can be experienced following just a single bout of moderate-to-vigorous physical activity (MVPA).
3. Any bout of MVPA, regardless of duration, can be included when quantifying daily or weekly volumes of PA intended to be counted toward meeting recommendations.

The collective findings from the *2018 Physical Activity Guidelines Advisory Committee Scientific Report* (16) have been further summarized and incorporated into the most recent federal PA guidelines — the *Physical Activity Guidelines for Americans, Second Edition* (<https://health.gov/paguidelines/second-edition/>) (Box 1.3) (6).

Notable among changes reflected in the 2018 guidelines is the elimination of the previous requirement that aerobic activities must occur in bouts of at least 10 minutes in duration to elicit significant health benefits (6). There is now