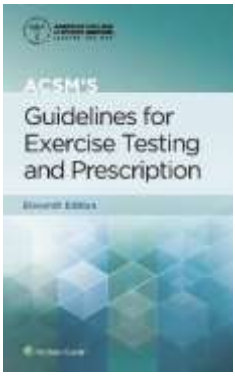

ACSM's Guidelines for Exercise Testing and Prescription, 11th edition

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ACSM'S Guidelines for Exercise Testing and Prescription

Eleventh Edition

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CHAPTER 1

Benefits and Risks Associated with Physical Activity

INTRODUCTION

This chapter summarizes information regarding the benefits and risks of physical activity (PA) and/or exercise. Additional 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). Additionally, 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 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).

In addition to defining 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 includes 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 D*). Several chapters throughout the guidelines provide the methodology and guidance for selecting a suitable estimation method based on individual circumstances.

METs are a useful, convenient, and standardized method for quantifying the absolute intensity of various behaviors and activities. 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).

Because of age-related declines in maximal aerobic capacity (4,11), when older and younger individuals work at the same MET level, the relative exercise intensity (*e.g.*, $\%\dot{V}O_{2max}$) will usually be different (see *Chapter 5*). In other words, the older individual will be working at a greater relative percentage of maximal oxygen consumption ($\dot{V}O_{2max}$) than their younger counterparts. Nonetheless, physically active older adults may have aerobic capacities comparable to or greater than those of physically inactive younger adults. This relationship will be similar when

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

[a]On flat, hard surface.
[b]MET values can vary substantially from individual to individual during swimming as a result of different strokes and skill levels.

Adapted from (8–10).

comparing individuals with different fitness levels, where those with lower $\dot{V}O_{2max}$ 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

More than 20 yr ago, the American College of Sports Medicine (ACSM), in conjunction with the Centers for Disease Control and Prevention (CDC) (12), the U.S. Surgeon General (13), and the National Institutes of Health (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 dose-response relationship between PA and health (*i.e.*, some activity is better than none, and more activity, up to a point, is better than less).

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 the *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 an increasing awareness of the adverse health effects of physical inactivity and because of some confusion and misinterpretation of 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 yr should participate in moderate intensity aerobic PA for a minimum of 30 min on 5 d · wk^{-1} or vigorous intensity aerobic activity for a minimum of 20 min 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 the 30 min minimum by performing bouts each lasting ≥10 min.
- 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.

CHAPTER

11 Brain Health and Brain-Related Disorders

INTRODUCTION

Brain health can be broadly defined as the optimal or maximal functioning of behavioral and biological measures of the brain and the subjective experiences arising from brain function (*e.g.*, mood). The *2018 Physical Activity Guidelines Scientific Report* (1) concluded that there is unequivocal evidence that exercise influences brain health and that individuals with conditions that affect brain health (*e.g.*, major depression) could greatly benefit from engaging in exercise.

This chapter contains the exercise testing and exercise prescription (Ex R_x) guidelines and recommendations for individuals with health conditions related to the brain. As with the other chapters, the Ex R_x guidelines and recommendations are presented using the Frequency, Intensity, Time, and Type (FITT) principle of Ex R_x based on the available evidence from professional society position papers and scientific literature. For some brain health conditions, there is insufficient information regarding appropriate volume and progression of exercise training. In these instances, guidelines and recommendations provided in other chapters of the *ACSM Guidelines* should be adapted with good clinical judgment for the condition being targeted. In many instances, exercise training can be performed without a prior clinical exercise test. However, if an exercise test is to be performed, this chapter presents specific recommendations for individuals with various brain health conditions.

One area of brain health that is of high public interest is concussion. However, at the time this 11th edition of the *ACSM Guidelines* was published, there was limited evidence on the role of exercise or physical activity in the mitigation of, or recovery from, concussion. Future editions of the *ACSM Guidelines* and other ACSM publications will contain concussion information as it relates to exercise and physical activity, as the supporting evidence emerges.

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

Attention-deficit/hyperactivity disorder (ADHD) is a common neurodevelopmental disorder characterized by inattention, hyperactivity-impulsivity, or both (2). The prevalence of ADHD worldwide is approximately 5% in children-adolescents and an average around 2.5%–3.4% for adults (3). However, estimates in children-adolescents vary across sex, being markedly more prevalent in boys than in girls with a ratio of 2–3:1 (4,5). Existing data support that ADHD prevalence has not increased over the last three decades (4). Despite the popular belief that ADHD is mainly a pediatric disorder, meta-analyses of follow-up studies have shown that around 65% of ADHD children will continue having ADHD when adults (6). Problems related to ADHD include psychiatric comorbidities (*e.g.*, major depression, anxiety, bipolar disorder), health problems (*e.g.*, obesity, hypertension), psychological dysfunction, academic and occupational failure, social disability, and risky behaviors (*e.g.*, lying, stealing, and substance abuse) (2).

ADHD is a complex disorder, and its etiology is not yet completely understood. Although there is evidence that environmental factors play an important role, ADHD has a strong genetic component, with heritability estimates averaging approximately 75% (6–8). Both pharmacological and nonpharmacological treatments are used to treat ADHD. Although nonstimulants (*e.g.*, selective noradrenaline reuptake inhibitor atomoxetine and long-acting formulations of two α2-adrenergic agonist drugs clonidine and guanfacine) are sometimes used based on contraindications or personal preferences, stimulants (such as amphetamine or methylphenidate) are mostly used to treat ADHD in individuals of all ages (2). Additionally, nonpharmacological treatments, such as dietary, neurocognitive, and behavioral therapies, are also used as an alternative or complement to pharmacological treatments.

According to the 2018 Physical Activity Guidelines Advisory Committee, regular physical activity (PA) improves multiple dimensions of cognition, including two which are of utmost importance for individuals with ADHD: attention and inhibition (1). Inattentiveness is one of the core symptoms of ADHD, and the most updated evidence from the Physical Activity Guidelines Advisory Committee report strongly supports the use of PA to improve attention (9). Impulsivity is another core symptom of ADHD. Existing evidence supports a link between engagement in PA and improvements in cognitive inhibition (10,11). Cognitive inhibition is a major component of executive function dealing with the ability of people to inhibit responses in order to better respond to a specific stimulus. In this context, exercise has been shown to improve inhibition in the general population (12) and children suffering from ADHD (10). Other cognitive functions, such as a better ability to plan and organize daily life activities, considered to be part of executive function, are also positively related to exercise in the general population and can provide additional benefits to those with ADHD (1,13,14). Moreover, sleep duration and quality are often impaired in those with ADHD (15; see reference [13] for a review). The Physical Activity Guidelines Advisory Committee report supports that physically active people have a better sleep quality in terms of the time in bed to

sleep onset, number and duration of times that a person wakes up at night after having fallen asleep, and sleep efficiency, among others (1). This would, therefore, be another mechanism by which exercise can improve ADHD symptomatology.

Major comorbidities in ADHD include obesity (see *Chapter 9*), hypertension (see *Chapter 9*), and depression/anxiety (as discussed in this chapter) (2,3,16,17), and exercise can play a key role in mitigating each of these conditions (1).

Exercise Testing

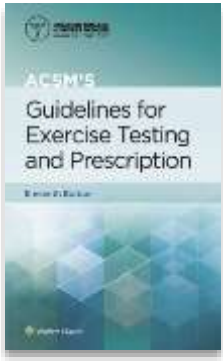
Given the higher prevalence of ADHD in childhood/adolescence than in adulthood, the considerations about exercise testing for individuals with ADHD will be mainly those referred to children and adolescents. In most of cases, individuals with ADHD can start a moderate intensity exercise program without previous medical screening, considering exercise testing for clinical purposes is not necessary unless there is any other health concern (18–20). However, exercise testing both in pediatric and adult populations is always informative as a health indicator and for monitoring improvements in fitness as a consequence of exercise (21). When doing so, the recommendations for exercise testing in the general population (see *Chapters 3* and *4*) will apply to ADHD (22). In children and adolescents, the most updated and evidence-based fitness test battery is the European Union-funded ALPHA battery (23–26), also supported by the Institute of Medicine in the United States (27,28). The tests selected for being the most valid, reliable, and related to future health are (a) the 20-m shuttle run test to assess cardiorespiratory fitness (CRF); (b) the handgrip strength and (c) standing broad jump to assess musculoskeletal fitness; and (d) body mass index (BMI), (e) skinfold thickness, and (5) waist circumference to assess body composition (26). International reference values for correct sex- and age-specific interpretation of fitness assessment are available elsewhere (29–32). Most of these tests are also included in the FITNESSGRAM battery. If ADHD is presented with comorbidities, exercise professionals should review relevant exercise testing options as listed elsewhere in the *ACSM Guidelines*.

Exercise Prescription

Because ADHD is most commonly diagnosed early in life, the Ex R_x principles for healthy children and adolescents apply in ADHD (see *Chapter 6*). Given that ADHD continues into adulthood for nearly two-thirds of children, adult Ex R_x principles also apply (see *Chapter 5*).

Exercise Considerations

- Attention should be paid to potentially coexisting comorbidities, such as overweight/obesity, hypertension, and depression/anxiety.
- Emerging evidence suggests that low physical fitness is common in ADHD (18–20,33). Care should be taken to start slow and to set realistic goals for fitness in this population.



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