The achievement and maintenance of regular physical activity is prudent in the older adult, but accurate physical activity assessment can be difficult in this population. Factors such as type and intensity of the physical activity, walking speed, gait pattern, and body type should be considered when selecting an assessment measure. Aerobic activity coupled with appropriate resistance training can help not only to achieve better health but also to reach a higher level of function, independence, and quality of life, all of which are critical to the older adult.

Introduction

Physical activity is a broad term used to define “any bodily movement produced by skeletal muscles that results in energy expenditure” [1]. The Surgeon General recommends 30 minutes of moderate-intensity activity on most, if not all, days of the week for adults to be physically active and achieve health benefit [2]. These guidelines are constantly being reevaluated to maximize their impact for all subgroups of populations, including older adults. In fact, the American College of Sports Medicine and the American Heart Association recently updated their recommendations for physical activity for older adults. In general, this new round of recommendations is similar to that provided in the Surgeon General’s report, with more emphasis on muscle strengthening activity, activities to maintain or increase flexibility, and balance exercises for individuals at risk for falls [3••].

One of the single most important health-related attributes in older adults is functional independence. Yet, Astrand [4] reported: “...as a consequence of diminished exercise tolerance, a large and increasing number of older people will be living below, at, or just above ‘thresholds’ of physical ability, needing only a minor illness to render them completely dependent.” Physical activity can help to push back that “threshold of physical ability,” which translates into an improvement of physical function that is essential for an increased quality and perhaps length of life in older adults. This article discusses advances in the field, new and interesting findings, and significant trends and developments related to three main areas: 1) techniques for measuring physical activity, energy expenditure, and fitness; 2) benefits of physical activity; and 3) risks associated with physical activity or exercise programs for older adults.

Measurement of Physical Activity, Energy Expenditure, and Fitness

Physical activity assessment: subjective measures

Due to their cost and relative ease of administration, physical activity questionnaires are the most commonly used assessment tools [5]. Major differences among the various questionnaires are their time frame of interest and the types and intensities of activities that they measure (all of which vary relative to the target population). Questions regarding time frame can range from a single question about usual activity to asking participants to recall their activity over 1 week, 1 year, or even a lifetime. Surveys with a short time frame are less vulnerable to recall bias than those with a longer time frame, which may be of particular concern in older individuals. In contrast, assessment over a short period is less likely to reflect “usual” behavior, because activity levels may vary with seasons, an acute illness, or time commitment [5].

In active older individuals, physical activity levels usually can be quantified by using a typical activity questionnaire targeting moderate and high-intensity physical activities commonly performed by healthy adults. Unfortunately, the physical activities most frequently performed by older individuals are usually lower-intensity, unstructured physical activities such as walking and housework. Because it is often difficult for participants to recall these activities, they are harder to assess by questionnaire than higher-intensity activities such as organized sports [6]. Several questionnaires have been developed specifically...
Physical activity assessment: objective measures

Objective measures of physical activity such as pedometers and more complex accelerometers are being used in many clinical trials and community lifestyle intervention efforts. They can capture low-intensity or less structured physical activities better than subjective measures, but they are more expensive and often more labor-intensive than a questionnaire.

Pedometers are small devices worn on the hip that count the number of steps taken or the distance walked by an individual. They have gained attention over the past decade because they can provide fairly accurate, objective measures of walking behaviors. Unlike a questionnaire, pedometers do not rely on participant recall, therefore reducing the possibility of bias. A limitation is that pedometers are designed specifically to capture lower body movement such as walking, but they do not capture activities such as cycling, swimming, and other activities that incorporate upper body movement. Pedometers tend to be less accurate in obese individuals, primarily because they are worn on the waist but need to be perpendicular to the ground to accurately count steps [9]. Alternate placement strategies have been developed for obese individuals. Pedometers also are less accurate at slower gait speeds and in individuals with irregular or unsteady gaits [10•,11–13].

In contrast to pedometers, the accelerometer is more than a step monitor in that it is an electronic sensor that measures the quantity and intensity of movement, resulting in the collection and storage of daily patterns of physical activity. Accelerometers are much more precise and accurate than pedometers and have often been used to validate pedometers [14]. These monitors have been validated in a variety of laboratory and field settings. In adults, the ActiGraph (Pensacola, FL) accelerometer has been shown to be related to metabolic measures, with correlation coefficients ranging 0.66 to 0.89 [15]. Comparisons with oxygen consumption during treadmill exercise and self-selected speed on a track found that the ActiGraph accelerometer was highly related to both measures and was highly sensitive to changes in speed but not changes in grade [16]. The ActiGraph monitor can continuously store data for up to 6 weeks. Not only can it determine the time the physical activity occurred, but it can measure each bout of activity by the minute. The accelerometer is one of the current gold standards in assessing physical activity levels and is often used to validate the much simpler, less expensive pedometer.

The Step Activity Monitor (SAM) (OrthoCare Innovations, Mountlake Terrace, WA) is a two-dimensional accelerometer developed to count steps in individuals with disabilities, abnormal or slow gaits, or lower-extremity prostheses. Sensitivity and frequency settings can be easily adjusted to match a participant’s gait style and speed [17]. The resulting accuracy rates are better than 99% of observed step counts for most individuals while walking [17]. The SAM has been shown to accurately assess steps at slow walking speeds, speeds at which the pedometer and, to a lesser degree, the ActiGraph may not be able to capture with great accuracy [10•]. Because the SAM is worn on the ankle, central obesity does not decrease the accuracy of the measure [18].

Table 1 summarizes strengths and weakness of the various methods for assessing physical activity.

Doubly labeled water

The doubly labeled water method, the gold standard for assessing energy expenditure in older adults, is used to assess the number of calories expended over 1 to 2 weeks. It recently was used in a study of 6 months of calorie restriction [19] and in an observational longitudinal epidemiologic study [20••]. The calories expended in physical activity can be estimated by subtracting the number of calories used in the resting state (as estimated with indirect calorimetry) from the total number of calories consumed. Although more accurate than other methods for assessing total physical activity, it does not capture information about the patterns or intensity of physical activity. The method is too costly to apply in clinical practice or large-scale epidemiologic studies, but it has proven useful in small to moderate sample sizes to lend evidence to the idea that total energy expenditure is important to health regardless of intensity [20••]. It would be a useful adjunct to studies relying on self-report and could provide validation to newer generations of actigraphy.

Long-distance walking tests

In older adults, walking tests have proven to be important in the assessment of the capacity for physical activity. Simple tests of usual walking speed over short courses, such as 3, 4, or 20 meters, can reveal the person’s level of physical activity and predict early disability. A gait speed of 1.0 meters per second is a simple and easily recalled cutpoint that is useful for distinguishing older adults who are at a higher risk for disability [21].

Fitness testing in older adults using standard treadmill and cycle ergometry protocols is also useful, provided that the adult is able to achieve the required rate of movement. However, many standard protocols start at 3.0 mph, which corresponds to a gait speed of 1.3 meters per second and is far above the average gait speed for adults over 70. Many other barriers also hamper the direct assessment of fitness in older adults, including their lack of familiarity with testing, cognitive impairments that can limit motiva-