

Age- and Gender-Related Test Performance in Community-Dwelling Elderly People: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and Gait Speeds

Background and Purpose. The interpretation of patient scores on clinical tests of physical mobility is limited by a lack of data describing the range of performance among people without disabilities. The purpose of this study was to provide data for 4 common clinical tests in a sample of community-dwelling older adults. **Subjects.** Ninety-six community-dwelling elderly people (61–89 years of age) with independent functioning performed 4 clinical tests. **Methods.** Data were collected on the Six-Minute Walk Test (6MW), Berg Balance Scale (BBS), and Timed Up & Go Test (TUG) and during comfortable- and fast-speed walking (CGS and FGS). Intraclass correlation coefficients (ICCs) were used to determine the test-retest reliability for the 6MW, TUG, CGS, and FGS measurements. Data were analyzed by gender and age (60–69, 70–79, and 80–89 years) cohorts, similar to previous studies. Means, standard deviations, and 95% confidence intervals for each measurement were calculated for each cohort. **Results.** The 6MW, TUG, CGS, and FGS measurements showed high test-retest reliability (ICC [2,1] = .95–.97). Mean test scores showed a trend of age-related declines for the 6MW, BBS, TUG, CGS, and FGS for both male and female subjects. **Discussion and Conclusion.** Preliminary descriptive data suggest that physical therapists should use age-related data when interpreting patient data obtained for the 6MW, BBS, TUG, CGS and FGS. Further data on these clinical tests with larger sample sizes are needed to serve as a reference for patient comparisons. [Steffen TM, Hacker TA, Mollinger L. Age- and gender-related test performance in community-dwelling elderly people: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and gait speeds. *Phys Ther.* 2002;82:128–137.]

Key Words: *Berg Balance Scale, Elderly, Gait speed, Six-Minute Walk Test, Timed Up & Go Test.*

Teresa M Steffen, Timothy A Hacker, Louise Mollinger

Examination at both the impairment level (eg muscle force) and functional level (eg, ambulation) is recognized as important in the decision-making process in physical therapy.¹ Many clinical tests are intended to represent functional levels. Some of these tests have high levels of reliability, and various aspects of validity have been described. Limited data are available, however, on the range of measurements on these tests in different populations. The available literature on 4 common clinical tests is reviewed here.

Six-Minute Walk Test (6MW)

Description and Purpose

The 6MW is used to measure the maximum distance that a person can walk in 6 minutes. The test is a modification of the 12-Minute Walk-Run Test originally developed by Cooper² as a field test to predict maximal oxygen uptake. The 6MW is now commonly used to assess function in patients with cardiovascular or pulmonary disease.³ It also has been used to predict morbidity and mortality in patients with left ventricular dysfunction,^{4,5} advanced heart failure,⁶ and chronic obstructive lung disease.⁷ We believe the 6MW is a useful instrument

because of its ease of administration and similarity to normal daily activities. It is a submaximal test of aerobic capacity, although in some patients with heart failure, it appears to be a maximal test.⁸ Thus, the test appears to us to be a better measure of exercise endurance than maximal exercise capacity.

Reliability, Validity, and Reference Data

Some studies^{9,10} have shown good test-retest reliability for measurements obtained with the 6MW in patients with cardiovascular disease, with intraclass correlation coefficients (ICCs [model not stated]) from .94 (61 men, 3 women; mean age=68 years, SD=7, range=45–88)¹⁰ to .96 (40 men, 5 women; mean age=49 years, SD=8).⁶ Other studies have shown construct validity through correlations between distance walked in 6 minutes and peak oxygen consumption in patients with heart failure (N=26–45)^{6,8} or pulmonary disease (N=30)¹¹ ($r=.63-.79$). The 6MW distance has also been found to be a good predictor of peak oxygen uptake and survival in patients with advanced heart failure (N=45).⁶ A distance of less than 300 m in 6 minutes predicted an increased likelihood of death among 833 subjects with left ventricular dysfunction.⁵ In 145 patients awaiting

TM Steffen, PT, PhD, is Director, Program in Physical Therapy, Concordia University Wisconsin, 12800 N Lake Shore Dr, Mequon, WI 53097 (USA) (terry.steffen@cuw.edu). Address all correspondence to Dr Steffen.

TA Hacker, PhD, is Assistant Scientist, University of Wisconsin Medical School, Cardiology Section, University of Wisconsin–Madison, Madison, Wis.

L Mollinger, PT, MS, is Assistant Professor, Concordia University Wisconsin.

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lung transplants, a distance of less than 400 m in 6 minutes was found to be an indicator of an increased risk of dying while on the waiting list (sensitivity=.80, specificity=.27).⁷

Lipkin et al¹² reported a mean distance of 683 m (SD=8) for the 6MW based on only 10 subjects without known pathology, aged 36 to 62 years. More recently, gender-specific regression equations explaining about 40% of the variance in the 6MW distance have been developed for adults without known pathology, based on age, height, and weight.¹³ In a study of subjects aged 40 to 80 years, Enright and Sherrill¹³ recorded a median 6MW distance of 576 m for men (n=117, median age=59.5 years) and a median distance of 494 m for women (n=173, median age=62.0 years).

Berg Balance Scale (BBS)

Description and Purpose

The BBS was developed as a performance-oriented measure of balance in elderly individuals.¹⁴ The BBS consists of 14 items that are scored on a scale of 0 to 4. A score of 0 is given if the participant is unable to do the task, and a score of 4 is given if the participant is able to complete the task based on the criterion that has been assigned to it. The maximum total score on the test is 56. The items include simple mobility tasks (eg transfers, standing unsupported, sit-to-stand) and more difficult tasks (eg, tandem standing, turning 360°, single-leg stance).

Reliability, Validity, and Reference Data

Studies of various elderly populations (N=31–101, 60–90+ years of age) have shown high intrarater and interrater reliability (ICC [model not stated]=.98,^{14,15} ratio of variability among subjects to total=.96–1.0,¹⁶ r_s =.88¹⁷). Test-retest reliability in 22 people with hemiparesis was also high (ICC [2,1]=.98).¹⁸

Content validity of the BBS was established in a 3-phase development process involving 32 health care professionals who were experts working in geriatric settings.¹⁴ Criterion-related validity has been supported by moderate to high correlations between BBS scores and other functional measurements in a variety of older adults with disability: Barthel Index (Pearson r =.67, n=31), Fugl-Meyer Test motor and balance subscales (Pearson r =.62–.94, n=60), Timed Up & Go Test (TUG) scores (Pearson r =-.76, n=31), Tinetti balance subscale (Pearson r =.91, n=31),^{15,19} and the Emory Functional Ambulation Profile (Pearson r =-.60, n=28).²⁰ The BBS scores also correlated moderately with data obtained for the Dynamic Gait Index (Spearman coefficient=.67, n=44),²¹ gait speed (Kendall coefficient of variance=.81, n=20),¹⁸ caregiver ratings of balance (.47–.61 [type of correlation coefficient not identified],

n=93), and center-of-pressure measures of body sway during still and perturbed standing (-.40 to -.67 [Kendall coefficient of variance, n=20, in study by Liston and Brouwer¹⁸; type of correlation coefficient not identified, n=30, in study by Berg et al¹⁹]). Several studies have shown that a baseline BBS score contributes to discrimination between elderly people who are prone to falling and those who are not prone to falling,^{17,19,21,22} although other data have not supported this finding.^{23,24} Riddle and Stratford²⁴ combined the data of Bogle-Thorbahn and Newton¹⁷ and Shumway-Cook et al²¹ on elderly people to demonstrate that using the recommended cutoff score of 45 on the BBS was relatively poor for identifying people who are at-risk for falling (sensitivity=64%) but relatively good for identifying people who are not at-risk for falling (specificity=90%).

In a study of inner-city-dwelling older adults, Newton²⁵ found a mode score of 53 (range=29–56) on the BBS for 251 subjects aged 60 to 95 years (\bar{X} =74.3, SD=7.9). The majority of subjects in this study were African American or Hispanic and women. All subjects lived independently in the community, but 12% used an assistive device for ambulation and 22% reported falling in the past 6 months. Increasing age has not been shown to correlate with decreasing BBS scores.¹⁷

Timed Up & Go Test (TUG)

Description and Purpose

The TUG measures the time it takes a subject to stand up from an armchair, walk a distance of 3 m, turn, walk back to the chair, and sit down. It was developed originally as a clinical measure of balance in elderly people and was scored on an ordinal scale of 1 to 5 based on an observer's perception of the performer's risk of falling during the test.²⁶ Podsiadlo and Richardson²⁷ modified the original test by timing the task (rather than scoring it qualitatively) and proposed its use as a short test of basic mobility skills for frail community-dwelling elderly.

Reliability, Validity, and Reference Data

Intratester and intertester reliability have been reported as high in elderly populations (N=10–30) (ICC=.99,²⁷ ICC [3,1]=.92–.96,²⁸ ICC [3,3]=.98²⁹). However, test-retest reliability of measurements obtained with the TUG in a group of mainly community-dwelling older adults without cognitive impairments (n=844, age range of total sample [N=2,305]=69–104 years) was moderate (ICC [model not stated]=.56).³⁰ Construct validity has been supported through correlation of TUG scores with measurements obtained for gait speed (Pearson r =.75, n=40), postural sway (Pearson r =-.48, n=40), step length (Pearson r =-.74, n=40), Barthel Index (Pearson r =-.79, n=60), Functional Stair Test (Pearson r =.59, n=20), and step frequency (Pearson r =-.59,

n=40).^{26–28} For identifying people who fall, the TUG was found to have a sensitivity and specificity of 87%.²⁹

Ranges of TUG scores have been reported for various samples of elderly people. In the study by Podsiadlo and Richardson,²⁷ 10 men and women without known pathology, aged 70 to 84 years (\bar{X} =75 years, SD not specified), had a mean TUG score of 8.5 seconds (SD not specified, range=7–10). In a study by Hughes et al,²⁸ 20 independent community-dwelling elderly people, aged 65 to 86 years (\bar{X} =81, SD=4.7, had a mean TUG score of 13.05 seconds (SD=2.60, range=8.7–17.3). Newton,²⁵ who has reported on the largest sample (N=251) of older adults (mean age=74 years, SD=7.7, range=60–95), found a mean TUG score of 15 seconds (SD=6.5, range=5.4–40.8). In her study, she included 31 people who used an ambulatory device, and the test protocol varied from the original protocol in use of a 3.05-m (10-ft) distance from the chair to the turnaround point and a 41-cm chair height. Several researchers^{31–35} reported test scores for patient populations. There is no consensus in the literature regarding the effect of aging on TUG scores.^{31,34,36}

Comfortable and Fast Gait Speeds (CGS and FGS)

Description and Purpose

Gait speed is measured over a relatively short distance and thus does not include endurance as a factor. A subject's ability to increase or decrease walking speed above or below a "comfortable" pace suggests a potential to adapt to varying environments and task demands (eg, crossing streets; avoiding obstacles).

Reliability, Validity, and Reference Data

Regardless of the measurement method, gait speed measurements are considered highly reliable in people without known impairments that should affect gait and different patient populations. Intrarater reliability (N=230),³⁷ interrater reliability (N=19–24),³⁸ and test-retest reliability (N=19–41)^{18,38–40} have been reported as high (ICC=.90–.96, r =.89–1.00).

An argument for construct validity has been shown through correlations between measurements of gait speed and measurements obtained for weight-shifting tasks on the Balance Master* (r =-.49 to -.72),¹⁸ the BBS (r =.81),¹⁸ and the TUG (r =-.75).²⁶ In a study by Cress et al⁴¹ of 417 community-dwelling people and 200 nursing home residents (mean age=75.4 years, SD=5.5, range=62–98), gait speed was the strongest independent predictor of self-reported physical function in both groups. Gait speed has been found to have a sensitivity of

80% and a specificity of 89% in screening elderly clients' appropriateness for referral for physical therapy compared with a brief physical therapy evaluation of the clients' appropriateness for physical therapy.⁴² Gait speed also has been shown to differentiate household versus community ambulation status in people with stroke, showing 85% agreement with clinician assessment.⁴³

Average gait speeds for subjects without known impairments over 60 years of age have ranged from 0.60 to 1.45 m/s for comfortable walking speeds^{37,44–51} and from 0.84 to 2.1 m/s for fast walking speeds.^{37,45–47,50,51} Many researchers^{37,44–46,48,50–53} have shown that older adults without known impairments have slower gait speeds than young adults. Depending on the study, the comfortable walking speed of the older adults was an average of 71% to 97% slower than that of the young adults,^{37,44–46,48,50–53} and the fast walking speed of the older adults averaged from 71% to 95% of that of the young adults.^{37,45,46,50,51} Several researchers^{41,54–56} also have reported gait speeds for various samples of community-dwelling older adults, with average comfortable speeds ranging from 0.99 to 1.6 m/s. Older adults without known impairments are reported to be able to increase their walking speed from 21% to 56% above a comfortable pace when instructed to "walk as fast as possible" or "very fast."^{37,45,47,50,51}

Reliability in different elderly populations for all 4 of the clinical tests reviewed here is, in our opinion, good. In addition, some aspects of validity are also supported for these measures. Except for the tests of gait speed in adults without known impairments, however, there is little data available in the literature describing the variance in test performance for older adults who are independently functioning. In addition, we believe the available data are often difficult for clinicians to use as a basis of comparison in documentation because they are not presented in terms of age and gender groupings. The purposes of our study were: (1) to describe the performance of elderly community-dwelling individuals on the 6MW, TUG, BBS, CGS, and FGS and (2) to report these data within age and gender cohorts in order to expand the clinical usefulness of these measures. Although there are many other clinical tests that can be used in the examination of elderly clients, we chose these 4 measures because they are simple and inexpensive to administer in the clinic and, in our view, have acceptable reliability. They also were designed to measure varied aspects of daily functional performance (walking speed, walking endurance, balance, and basic mobility). The decision about which test and how many tests are appropriate to use in the examination of a given client remains a matter of clinical judgment.

* NeuroCom International, 9570 SE Lawnfield Rd, Clackamas, OR 97015.

Method

Subjects

Our study was designed to include 15 subjects in each gender group and in each 10-year age group (60–69, 70–79, and 80–89 years), similar to previous studies of gait speed.^{37,46,55} Our subjects were recruited through various means of community advertisement. If a subject indicated interest in participating, he or she received a telephone call from an interviewer. The interviewer evaluated the subject's appropriateness for inclusion in the study by administering a medical history questionnaire. Five inclusion criteria were used: (1) able to tolerate standing or walking for 6 minutes without shortness of breath, chest pain, or joint pain in the legs, neck, or back that would limit performance of the 6MW, (2) not dependent on the assistance of another person or the assistance of a support device (eg, cane, crutch, walker) for walking during the 6-minute time period, (3) 60 years of age or older, (4) nonsmoker, and (5) no history of dizziness. The inclusion criteria were created to meet the criteria for all tests and to exclude factors (eg, tobacco use, use of assistive devices, joint pain) that might confound certain test results. Only one volunteer (a smoker) failed to meet the inclusion criteria. Ninety-seven subjects were recruited and tested, but the data from one subject were not used in the analysis because he was the only one in the 90- to 99-year-old cohort.

Procedure

Data were collected within one 60-minute test session for each subject in April 1999. Testing was conducted in quiet areas of Concordia University, which were reserved solely for data collection on test days. Subjects were told to wear comfortable walking shoes for the test session. Informed consent was obtained when the subject came into the session. Subjects were given \$20 for their participation.

Demographic data were collected in order to describe the study sample (age, height, weight, medical diagnoses, resting blood pressure, and heart rate). Subjects also answered several questions concerning daily activities in order to describe the activity level of the participants. The tests were administered to each subject in the same order: 6MW, CGS, FGS, BBS, TUG. The same test sequence was followed to limit participant waiting time. No one complained of fatigue or asked for a rest during the session. All examiners were trained in the standardized instructions for administering the tests. The examiners were physical therapy faculty and second-year physical therapist students.

The 6MW was conducted along a 30- × 2.3-m linoleum hallway marked in 1-m increments. A line was made at each end of the walkway to indicate where the person

was to turn. Researchers were positioned at each end of the walkway in case any subject had a problem. Subjects walked alone during the 6MW unless the researcher felt that they were unsafe. Subjects wore a heart rate monitor or carried a pulse oxygen monitor in order to track the resting heart rate between trials. Subjects were instructed to "walk as far as possible in 6 minutes." They were given standardized encouragement at 1, 3, and 5 minutes during the walk: "You're doing a good job" (minute 1), "You're halfway done" (minute 3), "You have 1 minute to go" (minute 5). Each subject had a practice trial and then rested until heart rate returned to the baseline level. A second 6MW trial followed the rest period. Distance walked during each trial was recorded to the nearest meter. Data from the second 6MW trial were used in the analysis, as it has been suggested that 2 tests are necessary to achieve reproducible results.⁵⁷

Two consecutive trials of gait speed data were collected as each subject walked on a marked 10-m walkway in a gym area at a "normal, comfortable speed," followed by 2 trials "as fast as you can safely walk." An examiner walked to the side of and behind each subject to ensure safety. No other activities were conducted and no other people were in the gym area during the test session. Gait speed was measured in hundredths of a second with a stopwatch as the subject walked in the central 6 m of the walkway. Tape markings on the side of the walkway identified the central 6 m for the examiner. The two trials at each speed were averaged for use in data analysis.

The BBS^{15,19} was administered in a quiet area by one examiner. The TUG²⁷ was administered by one examiner in the area adjacent to that used for the BBS. A 3-m distance was marked off on the floor in front of a firm chair with arms (seat height of 46 cm); a large cone was placed on the marker at the end of the 3 m. The test began with each subject sitting, back against the chair, arms resting on the lap, and feet just behind the distance-marker on the floor. Subjects were instructed as follows: "On the word 'go,' stand up, walk comfortably and safely to the cone on the floor, walk around the cone, come back, and sit all the way back in your chair." They were informed that the trial would be timed. Timing began on the word "go" and ended when the subject's back rested against the chair upon returning. A practice trial was performed and then followed by 2 recorded trials. Data obtained during the 2 recorded trials were averaged for use in data analysis.

Data Analysis

Data were analyzed using SPSS-PC (version 10.0).[†] Descriptive statistics and frequencies were determined

[†] SPSS Inc, 444 N Michigan Ave, Chicago, IL 60640.

Table 1.
Mean Demographic Data for Subjects

	Male (n=36-37)			Female (n=59)		
	\bar{X}	SD	Range	\bar{X}	SD	Range
Age (y)	73	8	61-89	73	8	60-88
Resting heart rate (bpm)	71	12	49-101	71	12	45-101
Resting systolic blood pressure (mm Hg)	148	18	120-210	145	17	115-220
Resting diastolic blood pressure (mm Hg)	86	8	70-100	87	5	65-120
Height (cm)	172	7	159-184	159	7	145-176
Weight (kg)	83	14	60-132	74	15	47-115
Body mass index (weight [kg]/height [m] ²)	28	5	23-48	29	6	19-47

Table 2.
Six-Minute Walk Test Distances: Means, Standard Deviations, and Confidence Intervals by Age and Gender (in Meters)

Age (y)	Gender	N	\bar{X}	SD	CI ^a
60-69	Male	15	572	92	521-623
	Female	22	538	92	497-579
70-79	Male	14	527	85	478-575
	Female	22	471	75	440-507
80-89	Male	8	417	73	356-478
	Female	15	392	85	345-440

^a95% confidence intervals.

Table 3.
Berg Balance Scale Scores^a: Means, Standard Deviations, and Confidence Intervals by Age and Gender

Age (y)	Gender	N	\bar{X}	SD	CI ^b
60-69	Male	15	55	1	55-56
	Female	22	55	2	54-56
70-79	Male	14	54	3	52-56
	Female	22	53	4	52-55
80-89	Male	8	53	2	51-54
	Female	15	50	3	49-52

^aTotal score possible=56.

^b95% confidence intervals.

Table 4.
Timed Up & Go Test Scores: Means, Standard Deviations, and Confidence Intervals by Age and Gender (in Seconds)

Age (y)	Gender	N	\bar{X}	SD	CI ^a
60-69	Male	15	8	2	7-8
	Female	22	8	2	7-9
70-79	Male	14	9	3	7-11
	Female	22	9	2	8-10
80-89	Male	8	10	1	9-11
	Female	15	11	3	9-12

^a95% confidence intervals.

for appropriate demographic variables. Means, standard deviations, and 95% confidence intervals by age cohort and gender were calculated for each clinical test. Repeated measurements with the tests, made within the same data collection session, showed high ICCs (2,1) (ICC=.95 for the 6MW, ICC=.97 for the TUG, ICC=.97 for CGS, ICC=.96 for FGS).

Results

Descriptive Data

Descriptive information on the participants is given in Table 1. Self-reported medical histories showed that the study sample included participants with a history of cancer (n=14), diabetes (n=9), high blood pressure (n=35), heart disease (n=14), rheumatic fever (n=5), thyroid disease (n=10), stroke (n=4), arthritis (n=34), low back pain (n=29), and renal disease (n=3). On average, participants had 1.8 medical diagnoses (SD=1.2, range=0-6) and took 1.7 medications (SD=0.2, range=1-14). Almost all participants reported doing light household chores (98%), meal preparation (93%), climbing one or more flights of stairs per day (93%), and going out at least once a week to shop (97%).

Clinical Test Data

Tables 2 through 5 present the means, standard deviations, and 95% confidence intervals, by age cohort and gender, for each measure. There was a consistent trend for mean test scores and confidence intervals to show age-

Table 5.

Comfortable and Fast Gait Speeds: Means, Standard Deviations, and Confidence Intervals by Age and Gender (in Meters Per Second)

Age (y)	Gender	N	Comfortable Gait Speed			Fast Gait Speed			Difference ^b	
			\bar{X}	SD	CI ^a	\bar{X}	SD	CI ^a	\bar{X}	SD
60-69	Male	15	1.59	0.24	1.46-1.73	2.05	0.31	1.89-2.22	0.46	0.34
	Female	22	1.44	0.25	1.33-1.55	1.87	0.30	1.73-2.00	0.43	0.21
70-79	Male	14	1.38	0.23	1.25-1.52	1.83	0.44	1.58-2.09	0.45	0.34
	Female	22	1.33	0.22	1.23-1.43	1.71	0.26	1.63-1.84	0.39	0.17
80-89	Male	8	1.21	0.18	1.06-1.36	1.65	0.24	1.45-1.85	0.44	0.27
	Female	15	1.15	0.21	1.03-1.26	1.59	0.28	1.43-1.74	0.44	0.19

^a95% confidence intervals.^bFast speed minus comfortable speed.

related declines on each measure. This was true for both male and female subjects.

Discussion and Conclusions

In the absence of definitive evidence supporting diagnostic testing, the choice of the best clinical test or tests to use in the examination of an elderly patient remains a matter of clinical judgment. We believe that the choice of measurement should be based on how well the specific problems of a given patient match the purpose of a given test.

Rather than selecting participants who were free from pathologies, we chose to study older people who functioned independently without assistive devices in the community. People who were independently functioning seemed to be a more realistic standard of comparison for the elderly clients seen by physical therapists. We anticipated that the range of performance on the tests by our participants would show substantial variation. The characteristics of our subjects should be kept in mind when interpreting our findings. The participants in our study included more women than men and a larger sample in the 60- to 69-year-old and 70- to 79-year-old cohorts than in the 80- to 89-year-old cohort. Based on the descriptive data, as well as our perception, we believe that the study participants represent elderly people who have few medical comorbidities, are self-reliant in daily activities, and are mobile in the community. Thus, they represent a range of older adults who are fairly active and have fairly good health, in spite of the presence of some pathology.

The test-retest reliability of the 6MW, gait speed, and TUG measurements was high in this study, suggesting that one trial of these tests may adequately represent performance. However, other researchers have reported the need for a practice trial before recording 6MW results^{6,9,10} and have shown only moderate test-retest reliability for TUG measurements.³⁰

All 4 tests in this study showed a trend toward age-related declines as measured for both male and female subjects. These preliminary data suggest the need for using age-related data in order to make judgments for older adults between 60 and 90 years of age. We have provided age- and gender-referenced tables for each of these tests. These data, however, could have been influenced by the effects of multiple tests being applied sequentially.

Our 6MW data extend the age range for data on this test. Lipkin et al¹² reported 6MW distances for 10 subjects without known impairments (mean age=49 years, SD=3, range=36-68) that are at least one standard deviation above the mean distance for our cohort of 60- to 69-year-old subjects. Both male and female subjects in our study walked farther than would have been predicted by the regression equations developed by Enright and Sherrill¹³ (male subjects: \bar{X} =521 m, SD=102 [predicted \bar{X} =476 m, SD=71], t =3.2, P <.003; female subjects: \bar{X} =476 m, SD=101 [predicted \bar{X} =409 m, SD=57], t =7.4, P <.001). Because the regression equations account for only about 40% of the variation in distance walked and Lipkin et al did not include a practice trial in their protocol, differences could occur. Other authors have reported that patients with end-stage lung disease,¹¹ chronic obstructive pulmonary disease,⁵⁸ or New York Heart Association class IV heart failure⁸ walked less than 335 m during the 6MW. Not surprisingly, these patients who had increased rates of mortality and morbidity had notably lower 6MW scores than our subjects who reported few medical problems. Patients with milder forms of heart failure (class II)⁸ or stroke,⁵⁹ however, walked slightly more than 500 m, within the range of most of our subjects. Men and women in the 80- to 89-year-old group in our study did not walk as far as younger individuals with disease, yet the subjects in our study were living independently in the community. These observations and our data again suggest the need to use age-referenced values to appropriately interpret patient data.

Although Bogle-Thorbahn and Newton¹⁷ did not find a relationship between age and BBS data in 66 elderly people, our results suggest that age-related norms may be needed for the BBS. This difference may be due to differences in the population from which the subjects were selected between our study and the study by Bogle-Thorbahn and Newton. The subjects in both studies functioned independently. The subjects in our study, however, lived in the community, whereas those studied by Bogle-Thorbahn and Newton lived in life care communities. Our mean data for the BBS are similar to the mode score reported by Newton²⁵ for inner-city-dwelling older adults, although Newton's data were not reported or analyzed by age cohort. The much wider range of BBS scores found by Newton likely reflects the fact that some subjects used assistive ambulatory devices or reported a history of falling.

Our mean data for TUG scores are on the lower (faster) end of the range of previously reported data for older adults who are independently functioning,^{25,27,28} thus supporting the characterization of our sample as older adults who are fairly active and have fairly good health. Our findings are closest to those of Podsiadlo and Richardson²⁷ and Hughes et al,²⁸ who also used a 3-m walking distance in the test protocol and did not include subjects who required an ambulatory device. Newton,²⁵ who reported the highest (slowest) mean TUG scores (15 seconds) and widest range of scores (5.4–40.8 seconds), used a 3.05-m (10-ft) (slightly longer) walking distance in her protocol, used a lower chair height (41 cm) than was used in other studies, and included subjects who used an ambulatory device; it is likely that all of these factors together produced the higher (slower) scores. The mean TUG scores for our subjects were much faster than those obtained for community-dwelling elderly fallers,³² hospitalized elderly people,³³ and people with Parkinson disease.^{34,35} As in the original study,²⁷ we allowed a practice trial of the TUG before recording the data for trials used in data analysis. In our experience with both subjects without known impairments and subjects with disabilities, the practice trial is needed in order for most subjects to correctly adhere to the multiple directions of this test.

There is a wide range of previously reported gait speeds for people without known impairments and community-dwelling elderly people. Our mean data tend to fall at the higher (faster) end of these reported ranges. These differences in results may be related to methodological differences across studies such as diverse measurement techniques, length of walkways used,⁴⁶ or activity level of the subjects.⁵⁶ Of the many previous studies we reviewed, only Bohannon³⁷ used the same stopwatch method and a similar walkway distance as we did for measuring gait speed. This stopwatch method of measuring gait speed is

easy and inexpensive, making it, in our view, clinically useful. Our mean CGS and FGS measurements for subjects in their 60s and 70s tend to be slightly faster, but well within one standard deviation, of those reported by Bohannon. Bohannon included only subjects who reported “no known neuromuscular, musculoskeletal, or cardiovascular pathology affecting their ambulatory capacity.”^{37(p15)} Our subjects were able to increase their walking speed 29% to 38% beyond a comfortable pace, whereas Bohannon's subjects were able to walk from 37% to 56% faster than a comfortable speed when asked. This range of ability to increase walking speed in our subjects is similar to that found in samples of older adults without known impairments, although in the lower half of that range. Again, these data tend to support the characterization of our subjects as having fairly good health. In our experience, the ability to substantially vary walking speed is often diminished in people with physical disabilities.

The sizes of our samples for the age and gender cohorts are too small to serve as definitive reference data for comparison with patient scores. There were 3 limitations to this study. We attempted, although without success, to include subjects from ethnic minorities and subjects over the age of 90 years to broaden the generalizability of our data. Studies also are needed to define critical thresholds for community-dwelling elderly people who use ambulatory devices. Finally, to make these tests truly useful to the clinician, we also need studies to establish whether these tests are sensitive enough to measure change over time in the presence of rehabilitation interventions. This last limitation is the possible cumulative effect of multiple tests on subject performance.

The descriptive data that we obtained are from a sample of older adults who were in fairly good health, living independently in the community, and self-reliant in daily activities. Our data indicate age- and gender-related differences.

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