Make Sure You Measure Up

Part III of IV
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This article is the third in a series of four devoted to standardized tests that may be performed in the home setting for community dwelling older adults. Parts III and IV of this series will describe two testing measures: gait speed and single limb stance, respectively, which are included in the Motor Function Domain of the National Institutes of Health (NIH) Toolbox.[1] Gait speed (GS) is commonly known as walking speed, gait velocity and walking velocity. GS is included in the NIH toolbox because of its objectivity, validity, reliability, freely available for use and ease of administration. Gait speed is highly recommended as the "sixth vital sign" because of its ability to predict future health status, its ease of administration, ease of grading and interpretation and minimal cost involved.[2]

In order to use gait speed as an objective test, administration of the test needs to be consistent. Researchers have reported using differing distances such as 20 ft, 10 m or 20 m for determination of gait speed.[1,2,3] Gait speed has been divided into two different gait speed measures; one called comfortable (or preferred) gait speed (cgs) and the other called fast (or maximum) gait speed (fgs). Comfortable gait speed is defined as a person's usual or comfortable, self-selected pace and fast gait speed as a person's "as fast as safely possible", self-selected pace.[3,4] Normative data has been provided for both cgs and fgs by Bohannon and Lusardi et al.[4,5] See Table 1 and 2 for normative data for gait speed. The data is stratified by gender and age. Lusardi et al accounted for use of assistive devices in their data collection and as expected, those subjects who used an assistive device had slower cgs than subjects who did not.[4] Steffen et al reported strong test-retest reliability for both cgs (ICC=.97) and fgs (ICC=.96).[3] The researchers noted trends for decreased cgs and fgs with increasing age.[3,4,5] Use caution when comparing normative data from different authors because the units of measure for gait speed can be easily misinterpreted or confusing. Gait speed has been reported in multiple units of time and multiple units for distance in both the English and metric systems i.e.: ft/sec, m/sec, cm/sec, ft/min, m/min and mph to name a few.[3,4,5,6,7]

Table 1. Mean of comfortable gait speed and maximum gait speed presented by gender and decade of age.[5]

Gender/ decade	Comfortable gait speed (cm/sec)	Maximum gait speed (cm/sec)
Men		
20s	139.3	253.3
30s	145.8	245.6
40s	146.2	246.2
50s	139.3	206.9
60s	135.9	193.9
70s	133.0	207.9
Women		
20s	140.7	246.7
30s	141.5	234.2
40s	139.1	212.3
50s	139.5	201.0
60s	129.6	177.4
70s	127.2	174.9

In a more recent study using a larger sample size to determine "normal" (comfortable) gait speed Bohannon compared gait speed measured over 8 and 20 feet.[6] The Summary of Gait speed over 8 and 20 feet stratified by gender and age is found on Table 3. Mean gait speeds were 3.26 ft/sec and 3.29 ft/sec over 8 and 20 feet respectively.[6] Speeds measured over both the 8 and 20 foot distances were correlated strongly ($r=.933$, $p<.001$).[6] Bohannon concluded that measurement of gait speed was feasible in the home care setting for distances of less than 20 feet as long as one step is possible before measurement is begun.[8,9] Finding distances of 8 feet of unobstructed floor space with one step distance before and after the test distance is much more readily available in the home setting over the longer distances used to measure gait speed. The strong correlation that exists for cgs measures from 8 and 20 feet gives the home care clinician confidence to use the cgs for comparison to normative data and for its predictive value.

In the protocols described by Bohannon, Lusardi et al, and Steffen et al, there is an acceleration phase and deceleration phase as part of the gait speed measurement track.[2,4,5] See Table 4 for gait speed measurement procedure. Bohannon measured the time for a subject to walk a distance of 7.62 m (25 feet) allowing for several meters to accelerate and decelerate before and after the test distance.[5] Lusardi et al measured the gait speed using a distance of 3.66 m (12 feet) allowing for 3 m before and 3 m after the test distance allowing for acceleration and deceleration, respectively.[4] Steffen et al had the subjects walk 10 m and the test distance was the middle 6 m allowing for 2

m acceleration and 2 m deceleration.[3] The protocol as outlined in the NIH toolbox instructs the participant to walk as quickly as possible at a pace he or she can maintain for the 20 foot walk distance as the time is recorded.[1]

Gait speed is a powerful tool that can have predictive value. Cesari et al reported that gait speed of less than 1 m/sec identifies persons at high risk of health-related outcomes including mortality and physical disability in well-functioning older people.[10] Montero-Odasso et al found that gait speed is also predictive of adverse health-related outcomes in well-functioning elderly persons and recommend it be considered as a "vital sign".[11] Hardy et al reported that improvements in gait speed predict a substantial reduction in mortality.[12] Studenski et al reported that gait speed of less than .6 m/sec is predictive for future risk of hospitalization and decline in health and function.[13] Rabadi and Blau reported that a gait speed of .15 m/sec or less is predictive of length of stay and discharge disposition to a sub acute facility.[14]

Not only can gait speed be used as a predictive measure of health and mortality, it can be used as a measure to establish safety when ambulating outdoors. Robinett and Vondran studied distance requirements and gait velocity in order for a person to be considered a community ambulator. Necessary velocity varies from 44.5 m/min (0.74 m/sec) in a rural setting to 47.5 m/min (0.79 m/sec) in an urban setting in order to cross a walkway safely.[7] Shumway-Cook et al report necessary gait speeds of 70 m/min to 73 m/min to cross busy city streets.[15] Knowing required gait speed to cross a street safely, can assist a therapist in establishing a patient's homebound status and/or functional status.

Table 2. Mean of comfortable gait speed and maximum gait speed presented by gender, age and use of assistive device.[4]

Age (yr)	Group	Mean for Comfortable gait speed (m/sec)	Mean for Maximum gait speed (m/sec)
60-69	Male	1.26	1.96
	Female	1.24	1.81
	Overall	1.24	1.84
70-79	Male	1.25	1.94
	Female	1.25	1.80
	Overall	1.25	1.86
80-89	Male	0.88	1.29
	Female	0.80	1.20
	No Device	0.91	1.38
	Device	0.63	0.88
	Overall	0.82	1.23
90-101	Male	0.72	1.27
	Female	0.71	1.05
	No Device	0.88	1.29
	Device	0.59	0.93
	Overall	0.71	1.08

Can gait speed be used to predict a risk for falling? Yes, Harada et al found gait speed to demonstrate good sensitivity and specificity (80% and 89% respectively). The cut off value was 34 m/min at increased risk for falling.[16] Being able to predict falls risk, determine health risk and mortality, predict discharge disposition and length of stay, define community ambulation and home bound status using objective quantifiable data makes gait speed a very powerful tool for the therapist treating patients in the home or in any setting. How do you know if gait speed improvements are truly a meaningful change? It has been reported by Perera et al that the best initial estimates of small meaningful change are near 0.05 m/sec for gait speed and substantial meaningful change is closer to 0.10 m/sec.[17] Palombaro et al reported a standard error of the measure and minimal detectable change for habitual (cgs) and fast (fgs) to be 0.08 m/sec and 0.10 m/sec respectively after hip fracture.[18]

Gait speed is a quick, inexpensive test that is valid, reliable and easily administered in the home care setting. Necessary equipment is minimal and the power of this tool is great. This measure should be considered for vital sign status as it can predict mortality, hospitalization, discharge disposition and for adverse health outcomes in well-functioning older adults. The normative data available is useful as a guide for comparison with patient values. These scores can be used to document meaningful progress that is quantifiable and reproducible. Gait speed data is available as a reference to determine if a patient is a safe community ambulator.[7,15] Would the patient make it across the street safely before the light changes green? Is the patient at risk for adverse health outcomes and

Table 3. Summary of Gait speed (ft/sec) over 8 and 20 feet stratified by gender and age.[6]

Gender	Age Range (years)	Gait Speed over 8 Feet Means±SD (95%CI)	Gait Speed over 20 Feet Means±SD (95%CI)
Female	50-59	3.61±0.81	3.64±0.73
	60-69	3.28±0.81	3.30±0.75
	70-79	3.01±0.79	3.05±0.75
	80+	2.50±0.71	2.57±0.72
Male	50-59	3.66±0.77	3.68±0.69
	60-69	3.38±0.75	3.39±0.69
	70-79	3.13±0.80	3.14±0.75
	80+	2.77±0.79	2.73±0.73

falling? These questions can be answered with a gait speed measurement which only takes minutes to complete. Consider adding this tool to your assessment toolbox. The NIH did.

References

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Table 4. Gait speed measurement procedure.

Equipment needed: • Masking tape or paper tape (4 pieces). • Tape measure (English or metric) • Stopwatch. Setup: Decide on length of gait test distance, acceleration zone and deceleration zone based on space availability. Be sure to have unobstructed floor space. • Using masking tape or paper tape mark a start line on the floor (line#1). • Measure an acceleration zone of 1 step to 3 meters based on available space and place a piece of tape at this distance on the floor (line#2). • Measure the test distance of 10 ft etc and place a piece of tape on the floor (line#3). • Measure a deceleration zone of 1 step to 3 meters and place a piece of tape at this distance on the floor (line#4).	Measuring comfortable gait speed: Start position: Patient/client stands behind the start line. Instructions given: • Ask patient to walk at a comfortable pace from before the start line (line#1) to the end line (line#4). Measurement: • Using a stopwatch, time from when the patient's leading limb (toe) crosses the test distance line (line #2) until the leading limb crosses the end test distance line (line#3). Be sure patient does not stop at line #3, patient should walk to line #4 to insure deceleration does not occur in the test distance. Calculation: Comfortable gait speed = test distance/time to complete test distance. Measuring fast gait speed: Same as cgs except for the instructions given to the patient. • Ask patient to walk as fast as you safely can from before the start line (line#1) to the end line (line#4). Measurement and calculation are the same as cgs.