

White Paper: “Walking Speed: the Sixth Vital Sign”

Stacy Fritz, PT, PhD;¹ Michelle Lusardi, PT, PhD²

¹ Clinical Assistant Professor, Physical Therapy Program, Department of Exercise Science, Arnold School of Public Health, University of South Carolina, Columbia SC

² Professor of Physical Therapy & Geriatrics, Dept. of Physical Therapy & Human Movement Science, College of Education & Health Professions, Sacred Heart University, Fairfield, CT

Walking speed is “almost the perfect measure.”¹ A reliable, valid,^{2,3} sensitive⁴ and specific⁵ measure, self-selected walking speed (WS), also termed gait velocity, correlates with functional ability,⁶ and balance confidence.⁷ It has the potential to predict future health status,^{8,9} and functional decline¹⁰ including hospitalization,¹¹ discharge location,^{12,13} and mortality.¹⁴ Walking speed reflects both functional and physiological changes,⁶ is a discriminating factor in determining potential for rehabilitation,¹⁵ and aids in prediction of falls¹⁶ and fear of falling.¹⁷ Furthermore, progression of WS has been linked to clinical meaningful changes in quality of life¹⁸ and in home and community walking behavior.¹⁹ Due to its ease of use²⁰ and psychometric properties, WS has been used as a predictor and outcome measure across multiple diagnoses.^{8,9,19,21-26} In addition, WS was chosen by a panel of experts as the standardized assessment to measure locomotion for the Motor Function Domain of the NIH Toolbox.²⁷

Walking speed, like blood pressure, may be a general indicator that can predict future events and reflect various underlying physiological processes.⁸ While WS cannot stand alone as the only predictor of functional abilities, just as blood pressure is not the only sign of heart disease; WS can be used as a functional “vital sign” to help determine outcomes such as functional status,^{6,8} discharge location,¹² and the need for rehabilitation¹¹ (Figure 1).

Walking is a complex functional activity; thus, many variables contribute to or influence WS. These include, but are not limited to, an individual’s health status,²⁸ motor control,²⁹ muscle performance and musculoskeletal condition,^{30,31} sensory and perceptual function,³² endurance and habitual activity level,³³ cognitive status,³⁴ motivation and mental health,^{35,36} as well as the characteristics of the environment in which one walks.³⁷ While per-

formance measures used in conjunction with WS are often better able to predict health status,²⁸ the use of WS alone can be an excellent predictor.^{11,20} For example, WS predicts the post hospital discharge location 78% of the time, and the addition of cognition or initial FIM scores does not significantly strengthen the ability of defining if a patient will be discharged to home or to a skilled nursing facility.¹²

Several standardized assessments and physical performance tests reliably predict function and health related events. Yet the consistent use of measures in physical therapy and other clinical settings is not widely practiced.³⁸ Factors contributing to this non-use of standardized assessments may include insufficient time, inadequate equipment or space, or lack of knowledge in interpreting the assessment.³⁹ Walking speed is one standardized measure that can be quickly and easily incorporated into the PT examination/evaluation process.

Determining feasibility is the first essential step in deciding to use a test or measure in the clinic. The main questions clinicians should pose regarding a test’s or measure’s feasibility are:

- (1) Is the test safe?
- (2) Is it cost effective?
- (3) How easy is the test to administer? and
- (4) How easily are the results of the test graded and interpreted?

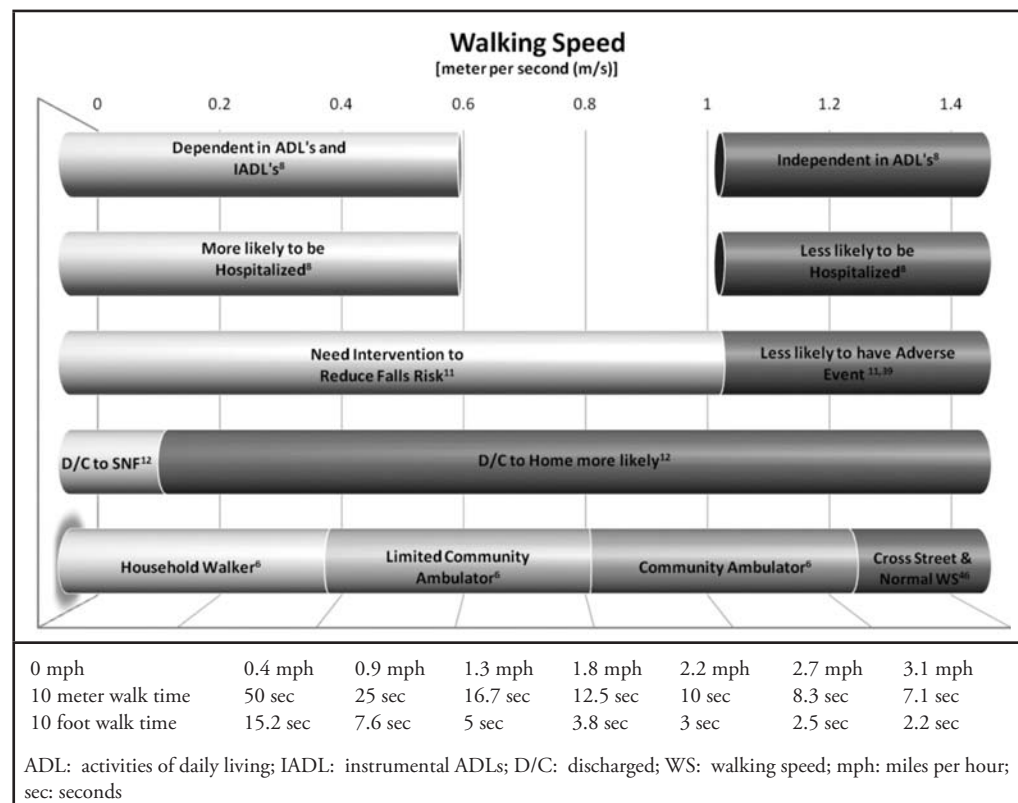


Figure 1. A collection of walking speed times that are linked to dependence, hospitalization, rehabilitation needs, discharge locations, and ambulation category.

An affirmative answer to all these questions, as there is with WS, lends to feasibility of use in a clinical setting. Walking speed is safe, requires no special equipment, adds no significant cost to an assessment, requires little additional time (can be administered in less than 2 minutes⁸), is easy to calculate (distance/time), and is easy to interpret based on published norms^{3,40-42} (Figure 2).

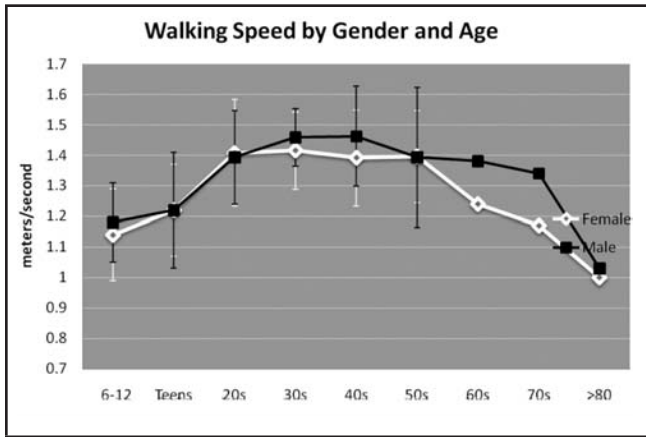


Figure 2. Self selected walking speed categorized by gender and age (6-12 and teens,⁴⁷ 20s-50s,⁴² & 60s-80s⁴⁸).

Walking speed can be quickly and accurately assessed in the majority of physical therapy practice settings, including home care, subacute and acute rehabilitation facilities, long-term care facilities, out-patient offices, and schools, as well as during community wellness/screening activities.⁴³ Measurements of walking speed are highly reliable, regardless of the method for measurement, for different patient populations and for individuals with known impairments affecting gait.^{3,42} Examination of WS requires a stopwatch and as little as a 20 foot space to walk forward.³ While most reported normative values are based on measuring in the middle two-thirds of a longer walkway, allowing walking speed to reach a steady state, others have used shorter distances.^{44,45} If possible, timing WS three times during the examination (with a few minutes of rest between trials) and developing a mean WS value will provide a more accurate estimate of actual self-selected walking speed than a single trial would.^{3,41,43}

Figure 3 displays a suggested reliable, inexpensive method to collect WS by using the 10 meter (m) walk test.²⁵ It requires a 20 m straight path, with 5 m for acceleration, 10 m for steady-state walking, and 5 m for deceleration. Markers are placed at the 5 and 15 m positions along the path. The patient begins to walk “at a comfortable pace” at one end of the path, and continues walking until he or she reaches the other end. The Physical Therapist uses a stopwatch to determine how much time it takes for the patient to traverse the 10 m center of the path, starting the stopwatch as soon as the patient’s limb crosses the first marker and stopping the stopwatch as soon as the patient’s limb crosses the second marker.

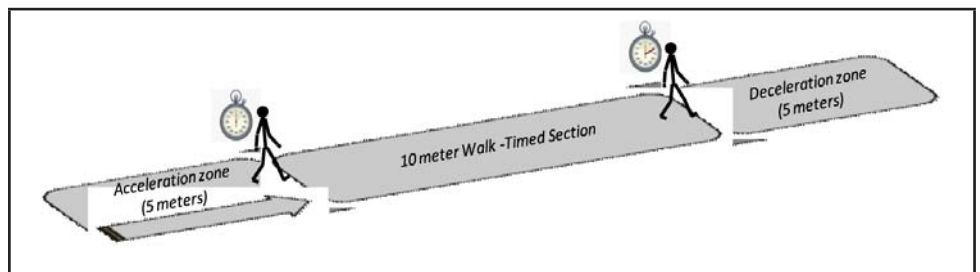


Figure 3. Suggested methods for collecting 10 meter walk test times.

If a full 20 m walkway is not available, shorter distances can be used, as long as there is adequate room for acceleration and deceleration (eg, 5 ft acceleration, 10 ft. steady state, 5 ft. deceleration).

While WS varies by age, gender, and anthropometrics, the range for normal WS is 1.2-1.4m/sec.⁴⁶ This general guideline can help in monitoring our patients, along with norms by age^{42,47,48}(Figure 2), and other cited cutoff points^{6,8,11,12,46} (Figure 1). Interpretation of WS also includes understating what constitutes true change and what change may be due to measurement error.⁴⁹ In a recent study, with a diverse group of older participants with varying diagnoses, 0.05 m/s was calculated as the needed change for a small but meaningful improvement in WS.²⁵ In addition, for patients who do not have normal walking speed, an improvement in WS of at least 0.1 m/s is a useful predictor for well-being,^{9,14} while a decrease in the same amount is linked with poorer health status, more disability, longer hospital stays, and increased medical costs.⁹ The MDC scores are specific to the population and will vary according to your client’s presentation.^{26,50}

Walking speed is an easily accessible screening tool¹¹ that should be performed to offer insight into our patients functional capacity and safety. Physical therapists, as specialists in movement and function, can use WS as a practical and informative functional sixth “vital sign” for all patients; examining walking speed in the same way that we routinely monitor blood pressure, pulse, respiration, temperature, and pain.⁵¹ This sixth “vital sign” provides a relevant functional perspective to the health status provided by the system-level vital signs assessed on most visits to physicians’ offices.

This review summarizes the strong psychometric properties of WS and robust evidence for using this clinical measurement. Walking speed is easily measurable, clinically interpretable,¹⁴ and a potentially modifiable risk factor.⁵² For these reasons, using WS as the sixth vital sign is both pragmatic and essential.

REFERENCES

1. Wade D. *Measurement in Neurological Rehabilitation*. Oxford: University Press; 1992.
2. Richards CL, Olney SJ. Hemiparetic gait following stroke. Part II: Recovery and physical therapy. *Gait Posture*. 1996;149-162.
3. 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.

4. van Iersel MB, Munneke M, Esselink RA, Benraad CE, Olde Rikkert MG. Gait velocity and the Timed-Up-and-Go test were sensitive to changes in mobility in frail elderly patients. *J Clin Epidemiol*. 2008;61:186-191.
5. Harada N, Chiu V, Damron-Rodriguez J, Fowler E, Siu A, Reuben DB. Screening for balance and mobility impairment in elderly individuals living in residential care facilities. *Phys Ther*. 1995;75:462-469.
6. Perry J, Garrett M, Gronley JK, Mulroy SJ. Classification of walking handicap in the stroke population. *Stroke*. 1995;26:982-989.
7. Mangione KK, Craik RL, Lopopolo R, Tomlinson JD, Brenneman S. Predictors of gait speed in patients after hip fracture. *Physiother Can*. 2007;59:10-18.
8. Studenski S, Perera S, Wallace D, et al. Physical performance measures in the clinical setting. *J Am Geriatr Soc*. 2003;51:314-322.
9. Purser JL, Weinberger M, Cohen HJ, et al. Walking speed predicts health status and hospital costs for frail elderly male veterans. *J Rehabil Res Dev*. 2005;42:535-546.
10. Brach JS, VanSwearingen JM, Newman AB, Kriska AM. Identifying early decline of physical function in community-dwelling older women: performance-based and self-report measures. *Phys Ther*. 2002;82:320-328.
11. Montero-Odasso M, Schapira M, Soriano ER, Varela M, Kaplan R, Camera LA, Mayorga LM. Gait velocity as a single predictor of adverse events in healthy seniors aged 75 years and older. *J Gerontol A Biol Sci Med Sci*. 2005;60:1304-1309.
12. Rabadi MH, Blau A. Admission ambulation velocity predicts length of stay and discharge disposition following stroke in an acute rehabilitation hospital. *Neurorehabil Neural Repair*. 2005;19:20-26.
13. Salbach NM, Mayo NE, Higgins J, Ahmed S, Finch LE, Richards CL. Responsiveness and predictability of gait speed and other disability measures in acute stroke. *Arch Phys Med Rehabil*. 2001;82:1204-1212.
14. Hardy SE, Perera S, Roumani YF, Chandler JM, Studenski SA. Improvement in usual gait speed predicts better survival in older adults. *J Am Geriatr Soc*. 2007;55:1727-1734.
15. Goldie PA, Matyas TA, Evans OM. Deficit and change in gait velocity during rehabilitation after stroke. *Arch Phys Med Rehabil*. 1996;77:1074-1082.
16. Guimaraes RM, Isaacs B. Characteristics of the gait in old people who fall. *Int Rehabil Med*. 1980;2:177-180.
17. Maki BE. Gait changes in older adults: predictors of falls or indicators of fear. *J Am Geriatr Soc*. 1997;45:313-320.
18. Schmid A, Duncan PW, Studenski S, et al. Improvements in speed-based gait classifications are meaningful. *Stroke*. 2007;38:2096-2100.
19. Bowden MG, Balasubramanian CK, Behrman AL, Kautz SA. Validation of a speed-based classification system using quantitative measures of walking performance poststroke. *Neurorehabil Neural Repair*. 2008;22:672-675.
20. Guralnik JM, Ferrucci L, Pieper CF, et al. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. *J Gerontol A Biol Sci Med Sci*. 2000;55:M221-231.
21. Meyer-Heim A, Borggraefe I, Ammann-Reiffer C, et al. Feasibility of robotic-assisted locomotor training in children with central gait impairment. *Dev Med Child Neurol*. 2007;49:900-906.
22. Lee CE, Simmonds MJ, Etnyre BR, Morris GS. Influence of pain distribution on gait characteristics in patients with low back pain: part 1: vertical ground reaction force. *Spine*. 2007;32:1329-1336.
23. Rochester L, Burn DJ, Woods G, Godwin J, Nieuwboer A. Does auditory rhythmical cueing improve gait in people with Parkinson's disease and cognitive impairment? A Feasibility study. *Mov Disord*. 2009. <http://www3.interscience.wiley.com/journal/121685802/abstract>
24. Behrman AL, Lawless-Dixon AR, Davis SB, et al. Locomotor training progression and outcomes after incomplete spinal cord injury. *Phys Ther*. 2005;85:1356-1371.
25. Perera S, Mody SH, Woodman RC, Studenski SA. Meaningful change and responsiveness in common physical performance measures in older adults. *J Am Geriatr Soc*. 2006;54:743-749.
26. Palombaro KM, Craik RL, Mangione KK, Tomlinson JD. Determining meaningful changes in gait speed after hip fracture. *Phys Ther*. 2006;86:809-816.
27. NIH Toolbox: Assessment of Neurological and Behavioral Function. Available at: www.nihtoolbox.org. Accessed March 12, 2009.
28. Lord SE, Rochester L. Measurement of community ambulation after stroke: current status and future developments. *Stroke*. 2005;36:1457-1461.
29. Gerin-Lajoie M, Richards CL, McFadyen BJ. The circumvention of obstacles during walking in different environmental contexts: a comparison between older and younger adults. *Gait Posture*. 2006;24:364-369.
30. Buchner DM, Larson EB, Wagner EH, Koepsell TD, de Lateur BJ. Evidence for a non-linear relationship between leg strength and gait speed. *Age Ageing*. 1996;25:386-391.
31. Ostchega Y, Dillon CF, Lindle R, Carroll M, Hurley BF. Isokinetic leg muscle strength in older americans and its relationship to a standardized walk test: data from the national health and nutrition examination survey 1999-2000. *J Am Geriatr Soc*. 2004;52:977-982.
32. teVelde A, Savelsbergh GJ, Barela JA, van der Kamp J. Safety in road crossing of children with cerebral palsy. *Acta Paediatr*. 2003;92:1197-1204.
33. Langlois JA, Keyl PM, Guralnik JM, Foley DJ, Marottoli RA, Wallace RB. Characteristics of older pedestrians who have difficulty crossing the street. *Am J Public Health*. 1997;87:393-397.
34. Persad CC, Jones JL, Ashton-Miller JA, Alexander NB, Giordani B. Executive function and gait in older adults with cognitive impairment. *J Gerontol A Biol Sci Med Sci*. 2008;63:1350-1355.
35. Lemke MR, Wendorff T, Mieth B, Buhl K, Linnemann M. Spatiotemporal gait patterns during over ground locomotion in major depression compared with healthy controls. *J Psychiatr Res*. 2000;34:277-283.
36. Fredman L, Hawkes WG, Black S, Bertrand RM, Magaziner J. Elderly patients with hip fracture with positive affect have better functional recovery over 2 years. *J Am Geriatr Soc*. 2006;54:1074-1081.

37. Robinett CS, Vondran MA. Functional ambulation velocity and distance requirements in rural and urban communities. A clinical report. *Phys Ther.* 1988;68:1371-1373.
38. Duncan PW, Jorgensen HS, Wade DT. Outcome measures in acute stroke trials: a systematic review and some recommendations to improve practice. *Stroke.* 2000;31:1429-1438.
39. Cesari M, Kritchevsky SB, Penninx BW, et al. Prognostic value of usual gait speed in well-functioning older people—results from the Health, Aging and Body Composition Study. *J Am Geriatr Soc.* 2005;53:1675-1680.
40. Oberg T, Karsznia A, Oberg K. Basic gait parameters: reference data for normal subjects, 10-79 years of age. *J Rehabil Res Dev.* 1993;30:210-223.
41. Lusardi M, Pellecchia G, Schulman M. Functional performance in community living older adults. *J Geriatr Phys Ther.* 2003;26:14-22.
42. Bohannon RW. Comfortable and maximum walking speed of adults aged 20-79 years: reference values and determinants. *Age Ageing.* 1997;26:15-19.
43. Bohannon R. Measurement of gait speed of older adults is feasible and informative in a home-care setting. *J Geriatr Phys Ther.* 2009;32:22-23.
44. Bohannon R. Population Representative Gait Speeds and its Determinants. *J Geriatr Phys Ther.* 2008;31:49-52.
45. Centers for Disease Control and Prevention National Center for Health Statistics, National Health and Nutrition Examination Survey Data. Hyattsville, MD: US Department of Health and Human Services, Centers for Disease Control and Prevention, 2001-2002. Available at: <http://www.cdc.gov/nchs/about/major/nhanes/nhanes01-02.htm>. Accessed March 12, 2009.
46. Lerner-Frankiel M, Varcas S, Brown M, Krusel L, Schoneberger W. Functional community ambulation: what are your criteria? *Clin Man Phys Ther.* 1986;6:12-15.
47. Waters RL, Lunsford BR, Perry J, Byrd R. Energy-speed relationship of walking: standard tables. *J Orthop Res.* 1988;6:215-222.
48. Bohannon R. Comfortable Walking Speed: Norms for Adults derived Using Meta-Analysis. NIH Toolbox Conference: Bethesda, MD. 2008.
49. Hollman J, Becman B, Brandt R, Merriwether R. Minimum Detectable change in gait velocity during acute rehabilitation following hip fracture. *J Geriatr Phys Ther.* 2008;3:53-56.
50. Fulk GD, Echternach JL. Test-retest reliability and minimal detectable change of gait speed in individuals undergoing rehabilitation after stroke. *J Neurol Phys Ther.* 2008;32:8-13.
51. Guide to Physical Therapist Practice. Alexandria, Va: American Physical Therapy Association; 2001.
52. Dickstein R. Rehabilitation of gait speed after stroke: a critical review of intervention approaches. *Neurorehabil Neural Repair.* 2008;22:649-660.



Section on Geriatrics, APTA 2009 Regional Course Offerings

CEEAA

As part of our commitment to empowering PTs and PTAs to advance physical therapy for the aging adult, the Section on Geriatrics is proud to offer a full range of outstanding continuing education, created by leaders in the field.
Join us in 2009!

Certified Exercise Expert for Aging Adults (CEEAA) Course Series

Alabama State University L. Buskey Health Sciences Building

Course 1: March 28-29, 2009
Course 2: August 29-30, 2009
Course 3: October 17-18, 2009

University of St. Augustine for Health Sciences at San Diego, CA

Course 1: July 18-19, 2009
Course 2: December 5-6, 2009
Course 3: CSM 2010

MGH Institute

Boston, Massachusetts

Course 1: November 21-22, 2009
Course 2: April 10-11, 2010
Course 3: PT 2010

* Additional Locations Will Also Be Offered Next Year

**Space is limited:
reserve your spot today!
1.800.999.2782 x8588**

**More Information at:
www.geriatricspt.org**

