ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2016;97:1072-7

ORIGINAL RESEARCH

Validity of the Timed Up and Go Test as a Measure of Functional Mobility in Persons With Multiple Sclerosis

Emerson Sebastião, PhD, Brian M. Sandroff, PhD, Yvonne C. Learmonth, PhD, Robert W. Motl, PhD

From the Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Urbana, IL.

Abstract

Objective: To examine the validity of the timed Up and Go (TUG) test as a measure of functional mobility in persons with multiple sclerosis (MS) by using a comprehensive framework based on construct validity (ie, convergent and divergent validity).

Design: Cross-sectional study.

Setting: Hospital setting.

Participants: Community-residing persons with MS (N=47).

Interventions: Not applicable.

Main Outcome Measures: Main outcome measures included the TUG test, timed 25-foot walk test, 6-minute walk test, Multiple Sclerosis Walking Scale-12, Late-Life Function and Disability Instrument, posturography evaluation, Activities-specific Balance Confidence scale, Symbol Digits Modalities Test, Expanded Disability Status Scale, and the number of steps taken per day.

Results: The TUG test was strongly associated with other valid outcome measures of ambulatory mobility (Spearman rank correlation, r_s=.71–.90) and disability status (r_s=.80), moderately to strongly associated with balance confidence (r_s=.66), and weakly associated with postural control (ie, balance) (r_s=.31). The TUG test was moderately associated with cognitive processing speed (r_s=.59), but not associated with other nonambulatory measures (ie, Late-Life Function and Disability Instrument-upper extremity function).

Conclusions: Our findings support the validity of the TUG test as a measure of functional mobility. This warrants its inclusion in patients' assessment alongside other valid measures of functional mobility in both clinical and research practice in persons with MS.

Archives of Physical Medicine and Rehabilitation 2016;97:1072-7

Persons with multiple sclerosis (MS) experience a heterogeneous presentation of physical and psychological symptoms,[1] and mobility dysfunction, particularly in the domain of walking, is a highly prevalent and burdensome feature of MS that can affect independence.[2] An estimated 75% of persons with MS reported mobility problems on the basis of population-based studies.[3] There are data from an online survey[4] of 1011 persons with MS indicating that 41% reported having difficulty walking. Another survey study[5] involving 436 persons with MS from Europe demonstrated that nearly half (45%) reported experiencing mobility difficulties within a month of diagnosis and 93% of the interviewees reported difficulties within 10 years. Walking dysfunction can yield a profound negative effect on participation, activities of daily living, employment, and ultimately quality of life.[5-8] We believe this underscores the importance of identifying and validating a measure of functional mobility (FM) that is meaningfully and closely associated with activities of daily living. Such a measure of FM is important in clinical and research settings for tracking disease progression and monitoring therapeutic progress, as well as discerning independence as effects on quality of life in persons with MS.

Independent FM requires that one must be able to, at least, get in and out of a bed or on and off a toilet or a chair, navigate around the obstacle, and walk a few feet.[9] Such tasks further require cognitive functions.[10-12] There are many measures for quantifying mobility status that are widely used in persons with MS, including both patient-reported outcomes (ie, self-report surveys) and performance tests (ie, timed objective measures),[13,14] but many of these do not map closely with independent FM. For example, the timed 25-foot walk (T25FW) test measures straight-line walking speed over 25ft, but does not capture aspects of FM such as sitting and standing or turning around; these are highly relevant in everyday life. In contrast, the timed Up and Go (TUG) test[15] is a

Disclosures: none.

0003-9993/16/$36 - see front matter © 2016 by the American Congress of Rehabilitation Medicine
http://dx.doi.org/10.1016/j.apmr.2015.12.031

performance test that has been used in several populations, including those with MS,[16] and maps closely with independent FM.[17]

Briefly, the TUG test requires that a patient stands from a chair, walks a distance of 3m, including a 180° turn around a cone, and then sits in a chair. The features of the TUG test (eg, sitting to standing, walking, and turning) are important for activities of daily living[18] and maintenance of independence. To our knowledge, no study has comprehensively validated the TUG test as a measure of FM in persons with MS, but such an outcome has discernible relevance for understanding MS and its effect on independence. Indeed, the TUG test includes elements that mimic commonly performed movements present in everyday life, which are not captured by other valid mobility measures such as T25FW test. To this end, the TUG test could be a better measure of FM that is closely associated with activities of daily living.

The TUG test, along with the T25FW test, has recently been recommended by the Multiple Sclerosis Outcome Measures Task Force to be used as a gait and walking ability outcome measure in persons with MS.[19] However, despite such a recommendation, the panel of experts selected the T25FW test over the TUG test as an outcome measure for a gait and walking ability assessment to be used in conjunction with the Multiple Sclerosis Walking Scale-12 (MSWS-12) on the basis of the observation that there is a richer body of validity evidence for the T25FW test in persons with MS.[19] However, in a recent consensus paper,[20] experts recommended the TUG test as an outcome measure for "muscle function and moving around" in studies involving exercise in persons with MS.

The validity of the TUG test as a measure of FM has been examined in frail older adults,[15] persons with unilateral lower limb amputation,[21] and persons with partial spinal cord injury.[22] There is preliminary evidence for the validity of the TUG test as a FM measure in persons with MS.[16,23] One study[16] reported strong correlations between the TUG test and the 10-meter timed walk test ($r=.83$) and the 30-meter timed walk test ($r=.85$) in 43 persons with moderate MS. Another study[23] reported that the TUG test strongly correlated with the Six-Spot Step Test ($r=.86$) in persons with MS who had mild to severe disability.

Most of the research on MS has evaluated the validity of the TUG test on the basis of associations with measures of ambulation, and there is minimal evidence of the association between the TUG test and outcome measures of balance. Of note, one study[24] examined the concurrent and discriminant validity of 6 tests of static and dynamic balance (ie, Berg Balance Scale, TUG test, Dynamic Gait Index, Hauser Ambulation Index, Dizziness Handicap Inventory, and Activities-specific Balance Confidence [ABC] scale) in persons with MS with moderate balance impairment by using the Berg Balance Scale and the Dynamic Gait Index. The authors reported correlations between the TUG test and balance outcome measures ranging from .35 (Dizziness Handicap Inventory) to .74 (Hauser Ambulation Index). That study did not include other valid, robust measures of walking mobility and/or ambulatory function that are currently used in MS research (eg, T25FW test, 6-minute walk test [6MWT], and MSWS-12) for comparison with balance outcome measures.

The TUG test seemingly provides an important outcome for measuring FM in persons with MS, and the components of this test correspond with characteristics of independent FM. To that end, the present study provides stronger evidence for the validity of the TUG test as a measure of FM in persons with MS. This was accomplished using a construct validity framework (ie, convergent and divergent validity) as an approach for validating the TUG test in persons with MS, as has been done with the Six-Spot Step Test.[20] We examined construct validity on the basis of the pattern of associations between the TUG test and other valid measures of FM (ie, T25FW test, 6MWT, MSWS-12, Late-Life Function and Disability Instrument [LL-FDI]-lower extremity function, and accelerometer-measured steps per day), static posturography (ie, objective measured balance), self-reported balance confidence (ABC scale), disability status (Expanded Disability Status Scale [EDSS], functional systems [FS]), cognitive processing speed (Symbol Digit Modalities Test [SDMT]), and self-reported upper extremity function (UEF) (LL-FDI-UEF).

List of abbreviations:

6MWT	**6-minute walk test**
ABC	**Activities-specific Balance Confidence**
ALEF	**advanced lower extremity function**
BLEF	**basic lower extremity function**
EDSS	**Expanded Disability Status Scale**
FM	**functional mobility**
FS	**functional systems**
LL-FDI	**Late-life Function and Disability Instrument**
MS	**multiple sclerosis**
MSWS-12	**Multiple Sclerosis Walking Scale-12**
SDMT	**Symbol Digit Modalities Test**
T25FW	**timed 25-foot walk**
TUG	**timed Up and Go**
UEF	**upper extremity function**

Methods

Participants

Prospective participants were recruited from an active clinical neurology practice in the Midwest portion of the United States. The inclusion criteria were clinically definitive diagnosis of MS, age of $\geq$18 years, relapse-free for the past 30 days, and ability to walk with or without assistive devices (ie, unassisted, cane/crutch/walker use, but not restricted to a wheelchair). Furthermore, participants had to be willing to complete in-person assessments and wear an accelerometer over a 7-day period. A total of 151 persons with MS were contacted, but 65 (43%) were uninterested in participating in the study; the remaining 86 persons were screened and scheduled. Of the 86 initial volunteers, 39 persons (45%) canceled the test appointment and were unavailable to reschedule. This yielded a final analytical sample of 47 persons with MS. The sample size was one of convenience rather than based on power analysis.

Measures

TUG test

The TUG test was administered as an objective measure of FM.[15,16] The primary outcome of the TUG test was the total time (in seconds) taken to complete the test.[15] The test was set up on the basis of standardized descriptions that have been previously reported (fig 1).[15] Participants were instructed to complete the course as safely and quickly as possible by standing up (without the help of hands), walking toward and around a cone/mark on the floor, walking back to the chair, and then sitting down. If needed,