Reference Values for the Timed Up and Go Test: A Descriptive Meta-Analysis

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ABSTRACT

Background and Purpose: The Timed Up and Go (TUG) test is widely employed in the examination of elders, but definitive normative reference values are lacking. This meta-analysis provided such values by consolidating data from multiple studies. **Methods:** Studies reporting TUG times for apparently healthy elders were identified through the on-line search of bibliographic databases. Study specifics and data were consolidated and examined for homogeneity. **Results:** Twenty-one studies were included in the meta-analysis. The mean (95% confidence interval) TUG time for individuals at least 60 years of age was 9.4 (8.9-9.9) seconds. Although the data contributing to this mean were homogeneous, data for individuals who could be categorized by age were more homogeneous. The mean (95% confidence intervals) for 3 age groups were: 8.1 (7.1-9.0) seconds for 60 to 69 year olds, 9.2 (8.2-10.2) seconds for 70 to 79 years, and 11.3 (10.0-12.7) seconds for 80 to 99 years. **Conclusions:** The reference values presented, though obtained from studies with clear differences, provide a standard to which patient performance can be compared. Patients whose performance exceeds the upper limit of reported confidence intervals can be considered to have worse than average performance.

Key Words: measurement, aging, physical performance, normative values

INTRODUCTION

The Timed Up and Go (TUG) test was introduced in 1991 by Podsiadlo and Richardson[1] as a modification of the Get-Up and Go Test of Mathias et al.[2] The procedure Podsiadlo and Richardson described for the TUG required documenting the time in seconds that subjects required to: "rise from a standard arm chair, walk to a line on the floor 3 meters away, turn, return, and sit down again." They and others have reported that the TUG can be performed reliably.[1,3-5] The TUG has also been shown to have validity by virtue of its correlation with measures such as the Berg Balance Scale,[1,6] gait speed/time,[1,7,8] stair climbing,[9] and functional indexes[1] and by its ability to discriminate between patients on the basis of residential status,[10] falls,[11] and mortality.[12] These facts notwithstanding, use of the TUG to characterize patient status requires the availability of normative reference values.[13] Available normative values for the TUG are typically limited to those from studies presenting reference norms derived from small samples or from studies presenting TUG data incidental to another purpose. The purpose of this meta-analysis, therefore, was to mathematically consolidate the data from these disparate studies to obtain a better sense of normal performance on the TUG.

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METHODS

Relevant literature was identified via computerized searches of PubMed/Medline, Cinahl, Embase, and Science Citation Index. The years 1990 to 2005 were searched. The terms 'timed up and go' and 'TUG' were used in the searches. Abstracts of articles identified using the key words were reviewed and apparently appropriate articles were examined in their entirety. The articles' reference lists were scanned for other relevant articles. As the purpose of the article was to consolidate normal TUG values, only studies of apparently normal individuals or with normal control groups (as opposed to patients) were used. Population based studies that might include some individuals with pathologies accompanying aging (eg, arthritis) were not excluded, but subsets of individuals with characteristics suggesting abnormality (eg, use of assistive devices, multiple falls) were excluded when identified. Only TUG data from subjects 60 years and older were included. When possible, TUG data were categorized by age (ie, 60-69, 70-79, 80-99 years). Authors were contacted as indicated and possible to obtain data in a form that would allow: (1) the exclusion of subjects with performance limiting problems (eg, fear of falling) and (2) the categorization of subjects by age.

Information was tabulated from relevant articles. Specifically recorded were descriptions of the samples, the chair and course used, instructions provided to the subjects, the actual measure used (eg, mean of 2 trials), and the mean and standard deviation for TUG times. These summary statistics, along with the associated sample size, were used in the meta-analysis. That analysis employed the SPSS (version 11.0) statistical program[14] and the meanes.sps and metaf.sps statistical syntax macros published by Wilson.[15]

RESULTS

Table 1 summarizes the specifics of the 21 studies included in the meta-analysis.[9-11,16-33] There is considerable diversity in

the samples contributing to the analysis. Most were samples of convenience, but they included subjects from North America, Asia, Europe, Australia, and the Middle East. Chairs described for use with the TUG had seat heights of anywhere from 40 to 50 cm. All described courses were either 3 meters or 10 feet. Instructions, when stipulated, usually called for moving at a normal, comfortable, or self-selected speed; but they sometimes indicated that the test should be performed 'quickly.' More than one trial was often allowed with the criterion trial following one or more practice trials. Timing usually commenced with the command 'go' or 'start' but sometimes began with movement.

Meta-analysis using the meanes.sps macro (Table 2), showed that the data from the 4395 subjects of 21 studies were homogeneous. Their mean time for the TUG (9.4 sec) had narrow confidence intervals (8.9-9.9 sec). For the subset of subjects (n = 2076) known to be within designated age groups (60-69, 70-79, 80-99), however, the metaf.sps macro showed that TUG times were not homogeneous. That is, they increased with increasing age (Q = 18.6, p = .0001). The TUG times within the age groups (8.1, 9.2, and 11.3 seconds, respectively), however, were homogeneous (Q = 1.6-12.6) and had narrow confidence intervals.

DISCUSSION

Although the TUG has been used extensively for over a decade, normative reference values from large samples of elders have not been published. This study sought to remedy this shortcoming by consolidating the findings of multiple studies conducted in diverse settings. Specifics of the studies differed, but meta-analysis suggested that the data from the studies were homogeneous. Consequently, data from the entire sample might provide a reasonable estimate of normal TUG performance. This finding notwithstanding, analysis of age subgroups identified reference values that were more homogeneous. The upper limit of the confidence intervals of these age groups can be used to note performance that is worse than average. Specifically, TUG times are worse than average if they exceed: 9.0 seconds for 60 to 69 year olds, 10.2 seconds for 70 to 79 year olds, and 12.7 seconds for individuals 80 to 99 year olds. Individuals with such slow times may warrant interventions directed at improving their strength, balance, and/or mobility.

The clinical value of the aforementioned notwithstanding, the findings have limitations. First, there were procedural differences in the studies. Although the distance walked was always 3.0 meters or 10 feet (which do not differ appreciably), the chairs used and instructions provided varied considerably. Notably, these differences did not preclude homogeneity within and between age groups. Consequently, the reference values can be used for normative purposes. Second, while the consolidation of data from multiple studies resulted in sample sizes larger than provided by individual studies, the sample size for individuals 60 to 69 years of age remained quite limited. Third, while the normative reference values presented in this study have utility, they are not substitutes for criterion values purveyed as predictors of risk for various untoward outcomes (eg, falls).[34,35]

CONCLUSION

This study provides normative reference values for the TUG. The values can be used to identify elders with deficits (possibly subclinical) in mobility and its underlying determinants (ie, strength and balance).

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Table 1. Description of Studies Reporting Timed Get Up & Go Times (seconds) for Community-Dwelling Individuals

Study	Sample	Chair & Course	Instructions	Measure	Mean±SD Time (sample)
Isles et al (2004)[16]	Random: 181 Australian women, ambulatory, without musculo-skeletal disorders requiring man- agement, substantial neurological disorders, or other problems.	Arm-chair (45 cm), 3 meters past line on floor.	Stand up, walk as quickly & safely as possible.	Timing not described. Mean of 2 trials.	7.2±1.6 (90♀, 60-69 yr) 8.5±1.6 (91♀, 70-79 yr)
Steffen et al (2002)[17]	Convenience: 96 American men & women, ambulatory without assistance of person or device.	Arm-chair (46 cm), 3 meters around cone on floor.	Arms in lap, stand up, walk comfortably and safely.	Time from "go" to back against chair after returning. Mean of 2 trials after 1 practice trial.	8.0±2.0 (15♂, 60-69 yr) 8.0±2.0 (22♀, 60-69 yr) 9.0±3.0 (14♂, 70-79 yr) 9.0±2.0 (22♀, 70-79 yr) 10.0±1.0 (8♂, 80-89 yr) 11.0±3.0 (15♀, 80-89 yr)
Lusardi et al (2003)[18]	Convenience: 54 American men & women, ambulatory, without neurologic disease or specific cardiopulmonary, musculoskeletal or other problems.	Chair not described, 3 meters around cone on floor.	Move as quickly as safely able in rising & walking.	Time for complete task. Mean of 2 trials.	8.1±0.9 (5♀, 60-69 yr) 6.8±3.4 (9♂, 70-79 yr) 8.5±2.8 (10♀, 70-79 yr) 10.1±1.5 (7♂, 80-89 yr) 11.3±2.4 (17♀, 80-89 yr) 12.1±4.6 (6♀, 90+ yr)
Bohannon & Schaubert (2005)[19]	Convenience: 19 American men & women, ambulatory without assistance of person or device.	Arm-chair (45 cm), 3 meters to line on floor.	Stand using upper limbs, walk at normal speed.	Time from command "go" to return to sitting. Time of single trial.	8.1±0.7 (3♀, 60-69 yr) 9.6±0.9 (2♂, 70-79 yr) 10.7±3.6 (10♀, 70-79 yr) 12.4±4.4 (4♀, 80-89 yr)
Bischoff et al (2003)[10]	Random: 413 Swiss women, ambulatory & able to get in & out of chair without assistance, without interfering pain, acute illness, hemiplegia, or severe dementia.	Arm chair (48 cm), 3 meters around brick on floor.	Allowed to use arms of chair, walk at comfortable fast and secure pace.	Time from instant arising to return to fully seated position. Best of 3 trials after 1 practice trial.	8.3±1.9 (413♀, 65-83 yr)
Hughes et al (1998)[9]	Convenience: 20 American men & women, ambulatory without assistance of person or device, without diagnosed cardiopulmonary condition.	Arm chair, 3 meters to marked point on floor.	Arms on arm rests.	Time to complete test, stopped when back against chair. Time of single trial.	13.0±2.6 (20♀&♂, 65-86 yr)
Shumway-Cook et al (2000)[11]	Convenience: 15 American men & women, ambulatory without assistance of person or device, no fall history.	Chair not described, 3 meters across line on floor.	Walk as quickly & safely as possible.	Timing not described. Time of single trial after 1 practice trial.	8.4±1.7 (15♀&♂, 65-85 yr)
Medley & Thompson (1997)[20]	Convenience: 187 American men & women, ambulatory without assistance of person or device, at least 5 feet tall, without lower extremity fracture, brain or spinal cord disease causing pain, numbness, or impaired mobility, or illness impairing balance.	Arm chair (43 cm), 3 meters to line on floor.	Hands on chair arms, self-selected pace.	Time from command "go" to return to start position. Time of single trial after 3 practice trials.	9.9±1.8 (61♀&♂, 65-74 yr) 10.7±1.9 (20♀&♂, 65-74 yr) 11.6±3.2 (30♀&♂, 65-74 yr) 10.3±2.1 (30♀&♂, 75-84 yr) 12.1±2.1 (16♀&♂, 75-84 yr) 13.1±2.9 (30♀&♂, 75-84 yr)
Campbell et al (2003)[21]	Convenience: 10 American men & women, no sensory impairments or neuromuscular or musculoskeletal problems affecting gait.	Arm chair (46 cm), 3 meters to 2 cones on floor.	Walk at comfortable pace.	Time from command "start" to contact of buttocks with chair. Time for single trial after 1 practice trial.	9.8±1.4 (10♀&♂, 68-86 yr)

Table 1. Continued.

Arnadottir & Mercer (2000)[22]	Convenience: 35 American women, walked independently with or without gait device but no orthotics.	Arm chair (44 cm), 3 meters to line.	Beginning with back against chair back, hands on chair arms, walk at comfortable and safe pace.	Time from word "go" to return to start position. Mean of 2 trials after practice trial.	12.8±6.4 (35♀, 65-93 yr)
Lin et al (2004)[23]	Random?: 765 Chinese men and women without ADL disability.	Standard chair (40-50 cm), 3 meters.	Normal pace.	Time from word "go" until back touched back-rest of chair.	11.5±5.0 (765♀&♂, 65-90 yr)
Daubney & Culham (1999)[24]	Convenience: 39 American men & women without falls, no low back or lower limb pathology, no vestibular or neurologic pathology, postural hypotension, interfering cognitive impairment, or other medical condition affecting participation.	Arm chair, 3 meters.	No elaboration.	Time for task.	11.1±3.7 (39♀&♂, 65-91 yr)
Wall et al (2000)[25]	Convenience: 10 elderly American men & women, no falls, gait pathology, or gait disorders.	Arm chair (46 cm), 3 meters.	Beginning with back against chair, arms on arm rests, walk at normal pace.	Time from word "go" to return to start position.	8.7±0.9 (10♀&♂, 65-90 yr)
Newton (2001)[26]	Convenience: 204 American men & women, not wheelchair bound, able to lift both arms outstretched to 90°.	Chair not described,10 feet.	At typical pace.	Timing not described.	14.4±6.4 (11,♂, 60-69 yr) 15.5±7.7 (28,♂, 70-79 yr) 16.9±15.0 (30♀, 60-69 yr) 17.1±10.8 (76♀, 70-79 yr) 26.8±14.6 (13♂, 80-89 yr) 28.3±22.3 (46♀, 80-89 yr)
Janssen (2004)[27]	Convenience: 33 Dutch women, ambulatory, vitamin D deficient.	Chair with built in timer, course not described.	No elaboration.	Timing with timer built into chair.	11.8±7.8 (33♀, 66-95 yr)
Edelberg et al (2000)[28]	Convenience: 59 American men and women, ambulatory.	Chair not described, course not described.	No elaboration.	Timing not described.	13.1±5.9 (59♀&♂, 70+ yr)
Eekhof et al (2001)[29]	Convenience: 10 Dutch men and women, able to walk 10 meters, no specific diagnoses.	Armchair (46 cm) to line.	Beginning with back against chair, arms on arm rests, walk at comfortable and safe pace.	Time for task.	14.9±1.3 (10♀&♂, 82-87 yr)
Davis et al (1998)[30]	Random: 705 Japanese-Hawaiian women.	Chair not described, 3 meters.	No elaboration.	Time for task.	10.8±4.9 (705♀, mean 74 yr)
Hill et al (1999)[31]	Convenience: 96 Australian women, regularly going outdoors, not using gait aid, no falls in past 12 months, no medical problems affecting balance or mobility.	Chair not described, course not described.	No elaboration.	Time for task.	8.8±1.2 (60♀, 70-74 yr) 9.4±1.2 (27♀, 75-79 yr) 10.4±1.2 (9♀, 80+ yr)
Rockwood et al (2000)[32]	1416 Canadian men and women.	Standard kitchen chair (without arm-rests), 3 meters to interviewer.	No elaboration.	Time for task. Best of 2 trials after a practice trial.	11.7±6.4 (449♀&♂, 70-79 yr) 14.6±11.4 (717♀&♂, 80-89 yr) 16.6±12.6 (250♀&♂, 90+ yr)
Giladi et al (2005)[33]	28 Israeli men and women.	Chair not described, course not described.	No elaboration.	Timing not described.	8.1±1.3 (28♀&♂, mean 78 yr)

Table 2. Summary of Descriptive Meta-Analysis of Timed Up and Go (TUG) Times

Category	Studies/ Groups (n)	Total Sample (n)	Seconds for TUG Mean (95% CI)	Homogeneity Q (p)
60-99 years	21/49	4395	9.4 (8.9-9.9)	45.5 (.576)
60-69 years	5/7	176	8.1 (7.1-9.0)	1.6 (.953)
70-79 years	7/12	798	9.2 (8.2-10.2)	2.6 (.995)
80-99 years	7/12	1102	11.3 (10.0-12.7)	12.6 (.318)

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