J. Phys. Ther. Sci. 35: 718–721, 2023

The Journal of Physical Therapy Science

Original Article

Differences in the Timed Up and Go Test under different measurement conditions in young healthy adults

Hironori Ohsugi, PT, PhD[1)*], Yasushi Kurihara, PT, PhD[1)], Saori Anzai, PT, PhD[1)], Yutaka Kuwae, PT, PhD[1)], Katsuyuki Madoba, PT, MS[2)]

[1)] *Department of Physical Therapy, Faculty of Social Work Studies, Josai International University: 1 Gumyo, Togane, Chiba 283-8555, Japan*
[2)] *Department of Community Relations Planning and Public Relations, Nishi-Kyoto Hospital, Japan*

Abstract. [Purpose] The purpose of this study was to verify whether Timed Up and Go (TUG) test measurements differed according to the seat height of the chair, presence or absence of armrests, and measurement location in young healthy adults, and to clarify the flexibility of the TUG settings. [Participants and Methods] Fifty-nine young healthy males and females participated in this study. The TUG test was performed under several conditions. Eight measurements were obtained at both the usual walking speed and the individual's fastest walking speed. [Results] There were no significant differences in TUG test measurements according to variation in seat height, different measurement locations, with and without the use of armrests, or at the usual walking speed or the fastest walking speed. [Conclusion] In young healthy adults, TUG test measurements were unaffected by differences in chair height, use of armrests, or the location of the measurement. If TUG measurements are found to differ according to these variables, it is necessary to consider the influence of the individual's ability rather than the measurement method.

Key words: Timed Up and Go Test, Younger, Seat height

(This article was submitted Jun. 27, 2023, and was accepted Jul. 27, 2023)

INTRODUCTION

The Timed Up and Go Test (TUG) is one of the most commonly used physical function assessments. These measurements have been reported to be useful as predictors of falls[1)] or future disability[2)] among community-dwelling older people. The TUG has also been used to determine the risk of falls in patients with Parkinson's disease[3)] and to detect changes in motor skills over time in post-stroke patients[4)]. Older people with poor results in the TUG test have a higher risk of cardiac morbidity and mortality, such as myocardial infarction and congestive heart failure[5)]. Moreover, TUG performance has been shown to be associated with the future development of dementia[6)]. In addition, the TUG is widely used to assess balance ability. It is useful for assessing the elements of the underlying motor systems, anticipatory postural control, and dynamic stability[7)].

Thus, the TUG is a measurement method used for a wide range of ages and diseases, from young to older individuals, and from musculoskeletal diseases to central nervous system diseases; however, its implementation is often ambiguous. Hafsteinsdóttir et al.[8)] pointed out that even the articles included in their systematic review poorly described how the TUG was performed. Of the 13 articles accepted for review, only five described the height of the seat. Furthermore, a meta-analysis of data from older individuals, excluding patients, showed that chair heights in the adopted papers ranged from 40 to 50 cm[9)].

It has been shown that the joint moment generated by different chair heights varies[10)] and that the seat height affects the performance of the 30-second chair stand test[11)]. The TUG test requires the participant to stand up from the chair, walk to a landmark 3 m away, turn around, return, and sit down. It is assumed that the height of the chair affects the measurements.

*Corresponding author. Hironori Ohsugi (E-mail: ohsugi@jiu.ac.jp)

Podsiadlo et al.[12], who first examined the relationship between the TUG results and functional mobility, found that the standard seat height of a chair for TUG measurement was approximately 46 cm. Siggeirsdóttir et al.[13] examined the differences in TUG measurements in older adults, based on using four different types of chairs, and found that TUG performance was affected by the type of chair, noting that it should have armrests and a seat height of 44–47 cm. Heung et al.[14] also showed that chair height has an effect on TUG measurements in post-stroke patients.

In contrast, Eekhof et al.[15] measured TUG performance in older individuals using three different types of chairs with different seat heights and types and found that the effect of the chair type on the measurements was mild. Kalula et al.[16] also examined whether two types of chairs (standard chair and folding chair) with the same seat height of 46 cm would change the time of the TUG in older individuals. They found no difference between the two chair types and reported that a portable folding chair could replace the standard chair.

Thus, there is controversy about the possible influence of chair height on TUG measurements. In addition, since previous studies have been conducted on older people and patients and since various factors affect the TUG, the difference in chair height may have affected the measurements in these participants.

Therefore, we considered that it was necessary to examine TUG performance in young healthy adults using different chair heights and with and without armrests in order to eliminate the influence of physical function. Furthermore, the location of TUG testing varies for the sake of convenience. Accordingly, we examined whether differences in TUG measurements could be observed with different measurement environments.

The purpose of this study was to verify whether TUG measurements in young healthy adults differed depending on the seat height of the chair, the presence or absence of armrests, and the measurement location, to clarify the flexibility of TUG parameters.

PARTICIPANTS AND METHODS

The participants were 59 university students (30 males and 29 females; aged 18–22 years [mean 20.3 years, standard deviation [SD]=0.8 years) from the same faculty. None of the participants had any disability that affected their daily life, and none had pain while walking. We provided all participants with written and oral explanations of the study, and each participant provided informed consent for participation. This study was approved by the ethics committee of Josai International University (approval number: 10M190054).

All participants underwent 16 TUG measurements. To examine the effects of different chair heights and armrest use, measurements were taken with three different chair heights, each with and without armrests. In addition, measurements were taken in a narrow corridor and in a large classroom to examine differences in the measurement environment. For each of the above eight patterns, TUG measurements were taken once each at normal and fastest walking speeds on the same day. All measurements were performed by one investigator. For all TUG measurements, the participants were instructed to sit with their backs against the backrest of a designated chair and with their feet in a free position. The participants wore their usual shoes. In patterns including the armrest condition, the participants were instructed to place their hands on the armrest, and in those not including the armrest condition, they were instructed to place both hands on their thighs. The participant was then instructed about the measurement conditions (whether to use the armrest or not, and the walking speed required: "usual pace" or "as fast as you can"). The participant stood up from the chair when the measurer said "start", walked forward and around a cone placed 3 m away, turned around, and sat back down on the chair. The time taken for these actions was recorded, to the nearest 0.01, with a stopwatch. The stopwatch was started at the "start" command and was stopped when the participant's buttocks touched the seat surface. It was explained to the participant ahead of time that the direction of rotation around the cone was up to the participant.

The difference in seat height was set by supplementing the bottom of the legs of the same type of armchair (seat height 39 cm, seat depth 47 cm, armrest height 61 cm). The supplementary heights were 2 cm, 5 cm, and 7 cm, respectively, to set a 41-cm, 44-cm, and 46-cm seat height, respectively. Previously, Siggeirsdóttir et al.[13] reported 44 cm to be the lower limit of the seat height, while Podsiadlo et al.[12] recommended the seat height to be 46 cm. In this study, the lowest chair height (41 cm) was set at 1 cm lower than the difference between the previously recommended heights (44 cm and 46 cm).

To test the effect of using or not using an armrest, measurements were taken either by placing the hands on the armrest to standing and sitting (with armrest), or by placing both hands on the thighs during standing or sitting (without armrest) in these three different-height chairs.

The measurement environments were a narrow corridor and large classroom. The chairs used in both measurement environments were of the same type, with a seat height of 44 cm, seat depth of 47 cm, and armrest height of 66 cm.

The order of measurement was randomly set. After performing TUG with all the conditions at the usual pace, the tests were repeated under the same conditions, in the same order, but using the fastest possible gait speed. The random function in Microsoft Excel (Microsoft Inc., Redmond, WA, USA) was used for randomization.

To examine the effects of seat height and armrest use on TUG measurements, a two-way analysis of variance (ANOVA) was performed for both the usual and fastest walking speeds. Moreover, in order to reveal the effect of differences in the measurement environment, measurements in the corridor and classroom were compared using the t-test for the usual and fastest speed conditions. IBM SPSS Statistics 23.0 (IBM Japan, Tokyo, Japan) was used for the analysis, and $p<0.05$ was considered statistically significant.

RESULTS

The characteristics of the participants are shown in Table 1, and the measured values of the TUG with each walking speed are shown in Tables 2 and 3. The two-way ANOVA showed no main effects and no significant interactions for seat height or the use of armrests for the normal or fastest walking speeds, respectively. Furthermore, no significant differences were found between TUG measurements taken in the classroom and in the corridor.

DISCUSSION

In this study, we examined whether there were differences in the TUG measurement results between various conditions in young healthy adults. We found no significant difference between the measurements taken with and without the use of armrests. There were also no statistically significant differences among the measurements obtained with the chairs of three different seat heights. Similarly, there was no significant difference between the measurements taken in a narrow corridor or in a large classroom. This indicates that the TUG measurement results were not affected by the height of the chair, the presence of armrests, or the environment in which the measurement was performed.

Siggeirsdóttir et al.[13] and Heung et al.[14] found that the type of chair and the height of the seat affected the TUG measurements, but their measurements were taken in older individuals and post-stroke patients. TUG measurements are affected by various factors[9, 17, 18], such as aging, lower limb muscle strength, balance, and cognitive function. Older individuals and post-stroke patients are more likely to show a decline in these functions. Since this study involved young healthy adults who were not receiving any special treatment for their physical or mental functions, we considered the effects of those functions to be minimal.

The fact that there was no difference in the measured values among the various measurement conditions in this study suggests that the TUG method itself is flexible in terms of the conditions used. As Bohannon et al.[9] argue, differences in chairs may not preclude homogeneity. The TUG is performed in a variety of settings, such as in the community[2], in care facilities[16], and in hospitals[14], because of its advantages in terms of the ease of measurement and lack of required specialized equipment. It is therefore plausible that TUG tests are not all performed in the same environment. However, the results of the present study suggest that the TUG measurement itself can be performed under these variable conditions and still produce homogeneous results.

This study had several limitations. First, this study focused on young healthy adults who can readily adapt to different environments in order to exclude the influence of physical and mental function factors influencing the TUG test, rather than on older individuals who are typically the actual participants of TUG measurements. In the future, we will conduct a

Table 1. Characteristics of the participants

Variables	Mean ± SD or Frequency (%), n=59
Age (years)	20.3 ± 0.8
Sex, male n (%)/female n (%)	30 (50.8%)/29 (49.2%)
Height (cm)	164.8 ± 8.5
Weight (kg)	62.3 ± 13.6

SD: standard deviation.

Table 2. Measurement values for chairs with different seat heights and with or without using armrests

Seat height	41 cm		44 cm		46 cm	
Armrests	Used	Not used	Used	Not used	Used	Not used
Usual pace (s)	7.66 ± 0.79	7.50 ± 0.75	7.57 ± 0.80	7.48 ± 0.76	7.54 ± 0.77	7.47 ± 0.75
Fastest speed (s)	5.74 ± 0.63	5.80 ± 0.66	5.71 ± 0.62	5.77 ± 0.66	5.70 ± 0.61	5.73 ± 0.66

Mean ± standard deviation.

Table 3. Measurement values in different environments

	Corridor	Classroom
Usual pace (s)	7.96 ± 0.96	7.86 ± 0.91
Fastest speed (s)	5.82 ± 0.60	5.75 ± 0.61

Mean ± standard deviation.

detailed study on older individuals to clarify whether the type of chair and the measurement environment can be ignored in the actual TUG measurement in this population. Second, the seat height setting was based on a chair and did not consider the effect of lower leg length. In this study, the chair height was used as the standard, assuming a clinical setting, but there are experimental methods that use the lower leg length as the standard[11]. The relationship between these two factors needs to be closely examined in the future.

In conclusion, TUG measurements were found to be unaffected by differences in chair height, whether or not armrests were used, or by the location of the measurement in young healthy adults. If the TUG measurements differ according to these parameters, it is necessary to consider the influence of the individual's ability rather than effects of the measurement method. This study suggests that there is some flexibility in the measurement conditions used in the TUG test and that measurements obtained under various conditions can be regarded as homogeneous.

Funding

This study was supported by Sasakawa Health Foundation.

Conflict of interest

The authors have no conflicts of interest to declare.

REFERENCES

1) Shumway-Cook A, Brauer S, Woollacott M: Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. Phys Ther, 2000, 80: 896–903. [Medline] [CrossRef]
2) Makizako H, Shimada H, Doi T, et al.: Predictive cutoff values of the five-times sit-to-stand test and the timed "up & go" test for disability incidence in older people dwelling in the community. Phys Ther, 2017, 97: 417–424. [Medline]
3) Nocera JR, Stegemöller EL, Malaty IA, et al. National Parkinson Foundation Quality Improvement Initiative Investigators: Using the Timed Up & Go test in a clinical setting to predict falling in Parkinson's disease. Arch Phys Med Rehabil, 2013, 94: 1300–1305. [Medline] [CrossRef]
4) Persson CU, Danielsson A, Sunnerhagen KS, et al.: Timed Up & Go as a measure for longitudinal change in mobility after stroke—Postural Stroke Study in Gothenburg (POSTGOT). J Neuroeng Rehabil, 2014, 11: 83. [Medline] [CrossRef]
5) Chun S, Shin DW, Han K, et al.: The Timed Up and Go test and the ageing heart: findings from a national health screening of 1,084,875 community-dwelling older adults. Eur J Prev Cardiol, 2021, 28: 213–219. [Medline] [CrossRef]
6) Lee JE, Shin DW, Jeong SM, et al.: Association between timed up-and-go test and future dementia onset. J Gerontol A Biol Sci Med Sci, 2018, 73: 1238–1243. [Medline] [CrossRef]
7) Sibley KM, Beauchamp MK, Van Ooteghem K, et al.: Using the systems framework for postural control to analyze the components of balance evaluated in standardized balance measures: a scoping review. Arch Phys Med Rehabil, 2015, 96: 122–132.e29. [Medline] [CrossRef]
8) Hafsteinsdóttir TB, Rensink M, Schuurmans M: Clinimetric properties of the Timed Up and Go Test for patients with stroke: a systematic review. Top Stroke Rehabil, 2014, 21: 197–210. [Medline] [CrossRef]
9) Bohannon RW: Reference values for the timed up and go test: a descriptive meta-analysis. J Geriatr Phys Ther, 2006, 29: 64–68. [Medline] [CrossRef]
10) Rodosky MW, Andriacchi TP, Andersson GB: The influence of chair height on lower limb mechanics during rising. J Orthop Res, 1989, 7: 266–271. [Medline] [CrossRef]
11) Kuo YL: The influence of chair seat height on the performance of community-dwelling older adults' 30-second chair stand test. Aging Clin Exp Res, 2013, 25: 305–309. [Medline] [CrossRef]
12) Podsiadlo D, Richardson S: The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc, 1991, 39: 142–148. [Medline] [CrossRef]
13) Siggeirsdóttir K, Jónsson BY, Jónsson H Jr, et al.: The timed 'Up & Go' is dependent on chair type. Clin Rehabil, 2002, 16: 609–616. [Medline] [CrossRef]
14) Heung TH, Ng SS: Effect of seat height and turning direction on the timed up and go test scores of people after stroke. J Rehabil Med, 2009, 41: 719–722. [Medline] [CrossRef]
15) Eekhof JA, De Bock GH, Schaapveld K, et al.: Short report: functional mobility assessment at home. Timed up and go test using three different chairs. Can Fam Physician, 2001, 47: 1205–1207. [Medline]
16) Kalula SZ, Swingler GH, Sayer AA, et al.: Does chair type influence outcome in the timed "Up and Go" test in older persons? J Nutr Health Aging, 2010, 14: 319–323. [Medline] [CrossRef]
17) Coelho-Junior HJ, Rodrigues B, Gonçalves IO, et al.: The physical capabilities underlying timed "Up and Go" test are time-dependent in community-dwelling older women. Exp Gerontol, 2018, 104: 138–146. [Medline] [CrossRef]
18) Ibrahim A, Singh DK, Shahar S: 'Timed Up and Go' test: age, gender and cognitive impairment stratified normative values of older adults. PLoS One, 2017, 12: e0185641. [Medline] [CrossRef]