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TIMED UP-AND-GO TEST: A POTENTIAL INDICATOR FOR SUCCESSFUL AGING OF OLDER MEN IN TAIWAN

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Abstract: *Background:* The Timed Up and Go (TUG) test has been associated with balance, falls, physical performance and health outcomes. The aim of this study was to explore the relationship of TUG, sarcopenia, and functional assessments among the oldest old Chinese men in Taiwan. *Methods:* A cross-sectional study was conducted in 2011 by recruiting residents of the Taoyuan Veteran Home in Taiwan to evaluate the relationship between demographic profiles, physical function (Barthel Index, Instrumental Activities of Daily Living), mental function (Mini-Mental State Examination, Geriatric Depression Scale), body composition (fat-free mass), physical performance (handgrip strength), and results of TUG. *Results:* Overall, 301 subjects (mean age: 85.8±5.3 years, all males), 147 (48.8%) of whom were sarcopenic, were enrolled for study. The study subjects were basically physically and mentally fit. Sarcopenia and results of TUG were significantly associated with older age, smaller body size, poorer physical function, poorer cognitive function and more depressive symptoms. The best cutoff of TUG determined by the receiver operating characteristic curve was 12.5 seconds (sensitivity: 0.72, specificity: 0.63). Multivariate logistic regression showed that older age (OR: 1.06, 95% C.I.: 1.005-1.124, P=0.033), poorer Barthel Index (OR: 1.04, 95% C.I.: 1.002-1.082, P=0.041), poorer Mini-Mental State Examination score (OR: 1.09, 95% C.I.: 1.009-1.187, P=0.030), fat free mass/height2 (OR: 1.33, 95% C.I.: 1.153-1.522, P<0.001), and abnormal TUG (OR: 2.01, 95% C.I.: 1.106-3.636, P=0.022) were all independent risk associative factors for sarcopenia, but not depressive symptoms (OR: 1.12, 95% C.I.: 0.947-1.333, P=0.181). *Conclusions:* TUG was significantly associated with poorer physical function, mental function and mood status, as well as sarcopenia, which may play an important role in community-based screening programs for successful agers and sarcopenia among oldest old people.

Key words: Aging, elderly, physical function, mental function, depression, sarcopenia.

Introduction

The "Timed Up and Go test" (TUG) was introduced by Podsiadlo and Richardson in 1991 as a basic test for function mobility, which tests different functional maneuvers, i.e. standing up, walking, turning and sitting down (1). Currently, TUG is most widely used to predict falls among older people in different settings (2-5), but did not account for patients in acute medical wards or hospital length-of-stay (6, 7). Generally speaking, TUG is a simple and reliable instrument and its correlation with Berg Balance Scale (1, 8), gait speed (9, 10), stair climbing (11), and functional indexes (1) has been well established. Beyond its association with mobility and balance, TUG was also related to the residential status (12) and mortality of older people (13). The association of adverse health care outcomes with TUG suggested a potentially broader implication for TUG in relation to the health of older people.

Moreover, the European Working Group on Sarcopenia in Older People proposed a diagnostic algorithm for sarcopenia and compared the different measures of physical performance, e.g. the Short Physical Performance Battery, usual gait speed, TUG, and the stair climb power test, suggesting that TUG can be a suitable measurement for physical performance (14). Association of sarcopenia with multiple adverse outcomes among older people, e.g. physical disability, falls, fractures, frailty, extended hospitalization, infectious and non-infectious complications at hospital admissions and all-cause mortality (15-21) had been clearly demonstrated. Therefore, TUG is more than a predictive instrument for falls in older people, and may be linked to the bio-psycho-social health of older people. "Successful aging" described as the freedom from disability along with high

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cognitive, physical, and social functioning by Rowe and Kahn has become a modern model of aging (22, 23). Due to the abovementioned associations of TUG with various health characteristics, TUG may play some roles in evaluation and screening of successful agers in their communities. Therefore, the main purpose of this study was to evaluate the relationship between TUG and other functional domains among the oldest old men in Taiwan.

Methods

Participants

This study invited all residents living in the Taoyuan Veteran Home, a veteran retirement community with similar facilities to the assisted living in the United States. The majority of Veteran Home residents were physically fit and cognitively intact (24-28). In June of 2011, all who consented to participate in this study were enrolled for examination. Subjects unable to communicate or ambulate were excluded from the study. This study has been approved by the Institutional Review Board of National Yang Ming University.

Data collection

For all participants, demographic characteristics were collected and research nurses performed anthropometric measurements, including body height and weight, handgrip strength and TUG. Handgrip strength was measured using a digital dynamometer (T.K.K.5401, Takei Scientific Instruments Co., Ltd, Niigata, Japan) when subjects were placed in an upright position with the unsupported, dominant arm parallel to the body. The highest value of 3 repeated trials was recorded for further data analysis. In addition, functional assessments such as Barthel index (BI) (29), Instrumental Activities of Daily Living (IADL) (30), Geriatric Depression Scale-15 (GDS) (31, 32) and Mini-Mental State Examination (MMSE) (33) were performed by well-trained research nurses.

Definition of sarcopenia

In this study, sarcopenia was defined by low handgrip strength (14), and the cutoff was modified from the European Working Group on Sarcopenia in Older People by the data from a Taiwanese norm (14, 34). Wu, et al. reported that the handgrip strength of men aged 65 years and older was approximately 25% lower than that of age and gender-matched Caucasians (34), so the cutoff for low handgrip strength in this study was defined as <22.5 kg based on a combination of the European consensus with modification for ethnic considerations. Moreover, the body composition of all participants was evaluated using bio-impedance analysis (TANITA 01-TT-BF049WH, Tainita, Tokyo, Japan) and estimated fat-free mass (FFM) was determined by subtracting fat mass from body weight. Accuracy of the bio-impedance analysis scale has been validated and may be applied to people aged 99 years.

Data analysis

In this study, continuous variables were expressed as the mean and standard deviation, and categorical variables were expressed as total number and percentage. Comparisons between continuous variables were performed using Student's t-test and comparisons between categorical variables were done with the Chi square test when appropriate. One-way ANOVA was used to compare the differences of all variables between the quartiles of TUG of all participants. The receiver operating characteristic curve was used to determine the optimal cutoff value of TUG to low handgrip strength. All statistical analyses were performed by commercial software (SPSS 17.0, Chicago, IL, USA). For all tests, a P-value less than 0.05 (two-tailed) was defined as statistically significant.

Results

Overall, 342 residents volunteered to participate in this study and 41 of them were excluded due to poor communication ability or inability to walk safely. Therefore, 301 subjects (mean age: 85.8±5.3 years, all males) were enrolled for study and 147 (48.8%) of them were considered sarcopenic. Table 1 showed the demographic profile and functional assessments of all participants, which disclosed that they were basically physically and mentally fit despite their advanced age (mean BI: 94.0±10.9, mean IADL score: 6.1±1.6, mean GDS score: 2.2±1.9, and mean MMSE score: 23.7±3.9, respectively). Comparisons of the demographic profile and functional assessments between subjects with and without sarcopenia showed that sarcopenia was significantly associated with older age (86.9±4.7 vs. 84.9±5.7 years, P=0.001), smaller body size (160.2±6.9 vs. 163.9±6.1 cm in body height, 56.1±9.2 vs. 64.8±10.6 Kg in body weight, P both<0.001), poorer physical function (90.5±13.4 vs. 97.2±6.2 in BI, 5.8±1.9 vs 6.6±1.1 in IADL, P both <0.001), poorer cognitive function (22.7±4.0 vs. 24.6±3.6, P<0.001) and more depressive symptoms (2.4±1.9 vs. 2.0±1.9, P=0.044). Table 2 compared the demographic characteristics and functional assessments between each quartile of TUG, showing a significant association between TUG and older age, smaller body size, poorer physical function, poorer cognitive function and more depressive symptoms as well. The best cutoff of TUG determined by receiver operating characteristic

curve was 12.5 seconds (sensitivity: 0.72, specificity: 0.63). Multivariate logistic regression showed that older age, poorer Barthel Index, poorer MMSE score, FFM/height2, and abnormal TUG were all independent risk associative factors for sarcopenia, but not depressive symptoms (Table 3).

Table 1
Demographic characteristics of older residents living in Taoyuan Veterans Home in Taiwan

	Overall (N=301)
Age (year)	85.8±5.3
Height (cm)	162.1±6.8
Weight (kg)	60.6±10.8
Body mass index (kg/m2)	23.0±3.5
Barthel Index	94.0±10.9
Instrumental Activities of Daily Living	6.1±1.6
Geriatric Depression Scale	2.2±1.9
Mini-Mental State Examination	23.7±3.9
Fat-free mass (Kg)	45.1±7.0
Fat-free mass/ht^2 (Kg/m^2)	17.1±2.1
Handgrip strength (Kg)	22.6±7.1
Timed Up-and-Go test (sec)	16.7±12.9
Walk with assistance (N, %)	66, 21.9%

Discussion

In this study, TUG was significantly associated with age, body size, physical function, cognitive function and depressive symptoms, and TUG>12.5 seconds was significantly associated with sarcopenia. Successful aging encompassed functionality in physical, mental and social domains. Results of this study disclosed that TUG was significantly associated with physical function (BI and IADL) and mental health (MMSE and GDS score), but no data concerning social function could be compared. Because all participants were residents of a Veteran Home, the social engagement and social participation were generally low in this setting (26). However, subjects with poorer TUG were less likely to actively participate in social activities, so they were presumed to have poorer social function. Therefore, TUG, a simple test, was able to vividly represent the health of the otherwise healthy oldest old men from physical, mental and social perspectives.

To the best of our knowledge, this is the first study to determine the cutoff value of TUG for sarcopenia diagnosis in Asian populations. TUG is most widely used to predict falls among older people and the cutoff values were determined in this manner. However, the

Table 2
Comparisons of older men with different quartiles of results

	1st quartile of TUG (N=70)	2nd quartile of TUG (N=82)	3rd quartile of TUG (N=77)	4th quartile of TUG (N=72)	P value
Age (yr)	83.5±5.4	85.9±4.3	86.4±4.8	87.5±5.8	<0.001
Height (cm)	164.6±5.8	162.2±5.8	161.3±7.1	160.3±7.8	0.001
Weight (Kg)	66.2±9.8	61.4±9.8	59.5±10.2	54.6±10.9	<0.001
Body mass index (Kg/m^2)	24.5±3.5	23.3±3.4	22.8±3.0	21.2±3.5	<0.001
Barthel Index	99.3±2.5	98.9±3.2	93.3±10.5	84.0±14.6	<0.001
Instrumental Activities of Daily Living	7.0±0.9	6.8±0.9	5.8±1.6	4.8±2.0	<0.001
Geriatric Depression Scale	1.2±1.5	1.8±1.5	2.6±1.8	3.0±2.2	<0.001
Mini-Mental State Examination	25.8±2.7	24.2±3.6	23.3±3.8	21.5±4.2	<0.001
Fat-free mass (Kg)	48.1±5.8	45.6±6.1	44.6±7.2	41.9±7.7	<0.001
Fat-free mass/ht^2 (Kg/m^2)	17.8±2.0	17.3±2.0	17.1±2.1	16.3±2.4	0.001
Handgrip strength (Kg)	26.8±6.5	23.4±6.6	21.6±6.4	18.2±6.2	<0.001
Timed Up-and-Go test (s)	8.1±0.9	10.7±0.8	15.7±2.2	33.1±17.7	<0.001
Walking with assistance (%)	0	2.4	24.7	62.5	<0.001

Table 3
Independent risk factors for sarcopenia among older men of the Veteran Home

	Odds ratio	95% confidence interval	P-value
Age (year)	1.06	1.005 – 1.124	0.033
Barthel Index	1.04	1.002 – 1.082	0.041
Mini-Mental State Examination	1.09	1.009 – 1.187	0.030
Fat-free mass/ht^2 (Kg/m^2)	1.33	1.153 – 1.522	<0.001
Abnormal Timed Up-and-Go test	2.01	1.106 – 3.636	0.022
Geriatric Depression Scale	1.12	0.947 – 1.333	0.181

normal reference range of TUG varied between studies. It has been reported that the mean time of TUG for otherwise healthy elderly persons was 7.36±0.95 seconds and was 18.14±4.60 seconds for the at-risk group (35). Moreover, a meta-analysis including 21 studies indicated the mean time of TUG for people aged 60-69 years, 70-79 years and 80-99 years was 8.1 seconds, 9.2 seconds, and 11.3 seconds, respectively (36). Although the study subjects were much older than previous reports, the most optimal cutoff (12.5 seconds) obtained from this study was comparable with previous reports (35, 36). A recent study found that the mean time of TUG for sarcopenic people aged 70 years and older in Mexico City was 13.33±5.61 seconds for men and 16.71±10.72 seconds for women (37), which may be the first suggested cutoff for TUG in sarcopenia diagnosis. In this study, where low handgrip strength determined using the European consensus modified for ethnic considerations was used, the cutoff value of TUG for sarcopenia was even shorter than that reported in the Mexico City study, although the subjects in this case were much older. Due to the strict exclusion criteria, the study subjects may have been healthier than in other studies, which was reflected by the results of functional assessments, so a shorter cutoff value of TUG and a relatively lower prevalence of sarcopenia was not surprising.

Despite the effort put into in study design, there were still some limitations in this study. First, the homogeneity of the study population limited the potential for the study results to be extrapolated to the general population. Compared to the reported cutoff values of TUG in previous studies, results of this study eventually were comparable, particularly when sarcopenia was considered (37). Second, body composition was determined by bio-impedance analysis, in which accuracy has been challenged, but it has been reported to correlate well with dual-energy X-ray absorptiometry if carefully operated (38). On the other hand, the trend of bio-impedance analysis measurements in this study was highly compatible with the trend of functional measurements. Therefore, results of this study supported using bio-impedance analysis for large-scaled community-based screening programs in the future, but not to replace the role of dual X-ray absorptiometry in the diagnostic algorithm. Third, this study lacks women's data for comparisons, but, not all studies reported gender-differences in TUG. Further community-based study enrolling both older men and women is needed for comparisons. In conclusion, TUG was significantly associated with physical, mental function, depressive moods and sarcopenia among the oldest old Chinese men in Taiwan, and it may play an important role in screening successful agers, and sarcopenia in their communities. Further study is needed to explore the impact of TUG on social participation, functional status of older people from both genders, and outcome-based determination of the TUG cutoff value to strengthen the clinical applications of TUG.

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