Concurrent Validity and Reliability of the Maximum Step Length Test in Older Adults

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ABSTRACT

Purpose: This study assessed concurrent validity of the Maximum Step Length (MSL) test as a measure of falls risk and balance-impairment for community-dwelling older adults. A secondary purpose was to determine intra- and interrater reliability and standard error of measurement of the MSL test.

Methods: Thirty-five community-dwelling adults aged 60 or older provided a 12-month falls history. Functional measures included the MSL test, Single Limb Stance Time, Functional Reach test, Timed Up and Go test, and a test of trunk position sense. Pearson correlation coefficient, intraclass correlation coefficient (a coefficient of relative reliability), and standard error of measurement (a measure of absolute reliability) were calculated as indices of concurrent validity and reliability of the MSL test. Minimal detectable change was also calculated; this represents actual change beyond that of measurement error or random variation in stepping performance.

Results: Correlations between MSL score and clinical balance measures and self-reported number of falls in the past 12 months ranged from fair to good. Same-day and 1-month intrarater test-retest reliability of the MSL test was excellent. Same-day interrater reliability between 2 raters was also excellent. Measurement error of the MSL test was low. Minimal detectable change for the MSL test at the 95% confidence level was 7.32 inches.

Conclusion: The MSL test appears to be a valid and reliable measure of balance-impairment and falls risk in older adults. Clinicians should consider incorporating the MSL test into their battery of falls risk assessment tools. Use of this test as a screening measure may reduce the incidence of falls in community-dwelling older adults. Real change in performance requires a difference of more than 7.32 inches between trials; differences less than this should be interpreted as being due to measurement error or random variation in stepping performance.

Key Words: balance, falls risk, maximal stepping

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INTRODUCTION

Falls are a major cause of mortality and morbidity in adults age 65 years and older; approximately 40% of older adults who live at home experience at least 1 fall per year.[1] Although many factors predispose older adults to falls, poor balance is a consistent predictor of falls in people of this age group. Clinical balance studies have identified tests that are useful in predicting which older adults may be at risk for falls[2] and injurious falls.[3] These tests vary in the components of postural control they assess; Single Limb Stance Time (SLST), for example, focuses on static balance,[4] whereas Functional Reach (FR)[5] assesses anticipatory control and Timed Up and Go (TUG)[6] considers postural control during a mobility task. Although the sensitivity and specificity of some of these tests such as TUG is known,[2] it remains unclear which balance tests are the most consistent predictors of falls in older adults. Therefore, an important focus in balance research is to elucidate valid and reliable measures of falls risk and balance impairment in older adults.

Lower extremity muscle activation patterns known as ankle and hip strategies are critical in balance and postural control.[7] These strategies involve motion primarily about the ankle and hip joints, controlling movement of the body's center of mass (CoM) forward and backward in the sagittal plane to maintain equilibrium.[7] In cases when the CoM falls outside of the anterior-posterior edges of the base of support, and neither the ankle nor hip strategy can restore equilibrium, a stepping strategy may be employed to avoid an impending fall after a loss of balance.

A few studies have shed light on stepping capabilities in older adults as a measure of balance-impairment and falls risk.[8-11] The Four Square Step Test (FSST) involves stepping over low objects (2.5 cm) and movement in 4 directions.[8] Its sensitivity of 85%, specificity of 88% to 100%, and positive predictive value of 86% in predicting fallers suggest that it is a valid measure of dynamic balance in community-dwelling adults older than 65.[8]

A second test of stepping ability, which is less complex than the FSST, is the unidirectional Maximum Step Length (MSL) test.[9-11] Participants are required to step forward as far as they can and return successfully to the starting position. Two studies have recently examined the MSL test and its relationship to balance measures.[9,10] The first examined how maximal stepping might differ among healthy young (n = 12), healthy older (n = 12), and balance-impaired older adults (n = 10), and how stepping performance relates to other measures of balance and falls risk such as SLST, lower extremity strength, and balance confidence.[9] Maximum Step Length test values were significantly greater in the healthy older adults compared with the balance-impaired older adults. There were strong and statistically significant correlations between MSL scores and falls risk measures including SLST, tandem stance time, lower extremity strength, and balance confidence. The second study involved 167 mildly balance-impaired community-dwelling older adults to determine relationships between the MSL test and standard tests of standing balance, gait, and mobility.[10] Again, there were strong correlations between MSL scores and balance measures such as TUG, SLST, tandem stance time, and balance confidence. These studies support the position that stepping performance appears to be closely related to clinical measures of balance and fall risk and the MSL test is as good a predictor of mobility performance and balance confidence as standard clinical balance tests.[9,10] A third study was conducted to determine the utility of the MSL test in predicting future falls.[11] Fifty-six community-dwelling older adults recorded daily falls for 1 year. Maximum Step Length test had a sensitivity of 70% and specificity of 69% in predicting future falls. Combining MSL with falls history increased sensitivity to 90% but decreased specificity to 58% in predicting falls.[11]

The validity of stepping tests as a measure of balance impairment and falls risk in older adults is based on a small number of studies and therefore requires further confirmation. The primary objective in this study was to assess the concurrent validity of the MSL test as a measure of falls risk and balance-impairment in community-dwelling older adults. We examined the relationships between MSL test and a series of clinical balance tests that have been validated in previous studies.[3,5,6,12] We also examined the relationship between MSL scores and number of falls in older adults. We hypothesized that better performance on the MSL test would be associated with fewer falls as well as with better performance on clinical balance measures such as SLST, FR, TUG, and trunk repositioning errors (TREs), the latter a new measure of trunk-related balance-impairment in older adults.[12] These tests were chosen as they encompassed various static (SLST) and anticipatory dynamic (FR, TRE, TUG) clinical balance tests. A secondary objective was to assess intrarater test-retest reliability (same day and approximately 30 days later) and same-day interrater reliability and to determine the standard error of measurement (SEM) of the MSL test. The minimal detectable change (MDC), a measure related to SEM, was computed for the MSL test and represents actual change beyond that accounted for by measurement error or random variation in stepping performance.

METHODS

Participants

Thirty-five community-dwelling adults age 60 years or older participated in the study. Participants were recruited from responses to flyers and person-to-person solicitation at senior community centers and health fairs. Demographic and anthropometric characteristics of the participants have previously been reported elsewhere[13] and are presented in Table 1. The majority of the sample was female (28 individuals; 80%) as the majority of attendees at our recruitment sites were female. Participants were excluded if they were medically unstable (eg, reported chest pain upon exertion, active infectious, inflammatory, or terminal conditions), had a history of neurological disease such as cerebral vascular accident that might affect balance, were unable to stand for 30 seconds, were unable to ambulate independently with or without an assistive device, reported pain that affected their ability to participate in testing, or exhibited poor concentration and memory skills based on the Short Orientation Memory Concentration test.[14] This study was approved by the Human Investigation Committee of Wayne State University, and all participants formally consented to participate in the study.

Participants provided a medical history including report of illnesses, surgeries, medications, self-perceived state of health (excellent; very good; good; fair; poor), use of assistive devices (yes; no), and amount of physical activity performed in a week (sedentary; 5-30 minutes 3 times per week; more than 30 minutes 3 times per week). Participants in this

Table 1. Participant Characteristics and Clinical Measures (N = 35)[a]

	Mean (SEM)	Range
Characteristic		
Age (years)	72.8 (1.0)	60-83
Body mass index (kg/m^2)	28.8 (1.1)	18.8-45.7
Height (m)	1.65 (0.02)	1.50-1.91
Weight (kg)	78.4 (3.0)	54.9-133.4
Male:Female (N)	7:28	—
Falls		
Number in the past 12 months[b]	0.71 (0.16)	0.0-3.0
Stepping Test		
MSL (in)[b]	27.6 (1.3)	11.7-45.7
Clinical Balance Measures		
SLST (s)[b]	12.7 (1.7)	0.0-30.0
TUG (s)[b]	12.3 (0.5)	9.17-22.4
FR (in)[b]	10.3 (0.5)	6.0-16.7
TREs (degrees)	3.6 (0.4)	0.7-9.0

Abbreviations: FR, Functional Reach; MSL, maximum step length; SEM, standard error of the mean; SLST, Single Limb Stance Time; TREs, trunk repositioning errors; TUG, Timed Up and Go.
[a]Number of falls is reported for 34 participants (excluding 1 participant reporting daily falls).
[b]Reprinted from Archives of Gerontology and Geriatrics 2010;51(1); 9-12. Schepens S, Goldberg A, Wallace M. The short version of the Activities-specific Balance Confidence (ABC) scale: its validity, reliability, and relationship to balance impairment and falls in older adults. Copyright 2009, with permission from Elsevier.

study reported a number of chronic conditions and diagnoses commonly found in older adults. Twelve individuals (34.3%) reported spinal or lower extremity musculoskeletal conditions such as chronic knee arthritis, prior ankle fractures, and lumbar disc surgery. None of these conditions were symptomatic at the time of testing, and all participants completed the study protocol. Other diagnoses that were common in this cohort were hypertension (n = 23, 65.7%), diabetes (n = 10, 28.6%), and hypercholesterolemia (n = 15, 42.9%). Self-perceived state of health was rated as excellent (n = 6, 17.1%), very good (n = 12, 34.3%), good (n = 14, 40.0%), or fair (n = 3, 8.6%). Eight individuals (22.9%) ambulated with an assistive device. The amount of physical activity performed in a week was self-reported as sedentary (n = 3, 8.6%), 5 to 30 minutes 3 times per week (n = 18, 51.4%), and more than 30 minutes 3 times per week (n = 14, 40%). Participants also reported the number of falls, defined as unintentionally falling to the floor or coming to rest at a lower level (eg, against a piece of furniture), incurred in the past 12 months. Sixteen individuals (45.7%) reported at least 1 fall during the previous 12 months. Participants physical function capabilities were assessed using 5 questions from the Nagi Scale.[15] These questions focused on a range of gross and fine motor activities including pulling and pushing large objects such as a living room chair; stooping, crouching, and kneeling; lifting/carrying weights weighing more than 10 lb such as a heavy bag of groceries; reaching above shoulder level; and writing/handling small objects. Seven individuals (20%) reported no difficulty performing any of these activities, 15 individuals (42.9%) reported difficulty with 1 activity only, and 13 individuals (37.1%) reported difficulty with 2 or more activities. Based on this information, this cohort represents a relatively high functioning group of community-dwelling older adults.

Number of falls in the past 12 months and MSL, SLST, FR, TUG, and TRE scores reflected a wide range of balance and trunk function capabilities for this cohort of community-dwelling older adults (Table 1). Based on prior research, poor balance scores on 2 of the tests performed in this study places individuals in the present study at risk for falls (n = 7 [20%] with TUG > 14 seconds)[2] or for injurious falls (n = 12 [34.3%] with SLST < 5 seconds).[3] Conversely, the observation of excellent scores on the balance tests by some individuals reflects the relatively high functioning capabilities of members of this cohort. For example, low TRE values observed here in a number of participants in the study (n = 20 [57.1%] with TREs < 3 degrees) are similar to those observed in young adults and balance-unimpaired older adults in a previous study,[12] indicating excellent trunk function in some members of this study cohort.

Maximum Step Length

Maximum step length is the maximum distance that a person can step forward and successfully return to the original position without losing balance. It is a measure of stepping ability that correlates with standard balance and functional mobility measures such as SLST (r = 0.70),[10] tandem stance time (r = 0.74),[9] and TUG (r = −0.68)[10] and is associated with significant odds of being a frequent (2 or more per year) faller (odds ratio 0.52; 95% confidence interval 0.32-0.84, *P* < .008).[10] Within-week test-retest reliability of the MSL test is 0.90.[9] These correlations suggest that MSL is a valid and reliable measure of balance capabilities in older adults. Following a practice trial, MSL was recorded as the mean of 5 trials of maximum step distance using the dominant leg and with arms remaining at their sides. Two raters independently observed and recorded the step length for each participant on 2 separate occasions: on day 1 and approximately 30 days later.

Clinical Balance Measures

A series of balance tests were conducted to assess the relationships between MSL scores and performance on clinical balance measures. The selected tests are commonly used in clinical practice and are easy to administer, have established evidence of validity and reliability, and include various tasks assessing both static and dynamic postural control.

Single Limb Stance Time

Deficits in SLST, defined as the inability to stand on 1 limb for at least 5 seconds, are predictors of injurious falls in community-dwelling older adults.[3] Single Limb Stance Time is a valid measure of clinical balance in older adults as evidenced by correlations with measures such as MSL test (r = 0.70),[10] Rapid Step test (r = −0.81),[9] and tandem stance time (r = 0.78).[10] Participants stood on their dominant leg and lifted the foot of the other leg approximately 2 inches off the ground. A practice trial preceded 2 experimental trials. The test was terminated when the participant either put the foot down or touched the adjacent wall. The best time (maximum 30 seconds) was recorded as SLST.

Functional Reach Test

The Functional Reach test is a dynamic measure of anticipatory balance control and margin of stability.[5] It correlates (r = 0.48)[16] with Tinetti's Performance Oriented Mobility Assessment,[17] a commonly used clinical balance measure, suggesting it is a valid measure of balance in older adults. It also exhibits excellent reliability (intraclass correlation coefficient [ICC] > 0.92) when administered to community-dwelling older adults.[16] The FR test requires participants to reach forward while flexing the trunk. It is the maximum distance one can reach forward beyond arm's length while maintaining a fixed base of support in standing, and is measured with a yardstick affixed to the wall at the level of the acromion. A practice trial preceded 3 experimental trials, and FR was recorded as the mean distance of 3 trials.

Timed Up and Go Test

Timed Up and Go is a test of functional mobility and dynamic balance in older adults.[6] It correlates (r = −0.55)[16] with the Tinetti Balance test, suggesting it is a valid measure of balance in older adults. It also exhibits excellent interrater reliability (ICC = 0.98) when administered to community-dwelling older adults.[2] Participants sat in a chair, rose to standing, and walked 3 m at a "comfortable and safe pace" before turning around and returning to the seated position. A practice trial preceded 2 experimental trials, and the TUG score was recorded as the mean time of 2 trials.

Trunk repositioning error

Trunk repositioning errors correlate with performance on static and dynamic balance tests such as SLST (r = −0.73) and TUG (r = 0.55) and are increased in balance-impaired community-dwelling older adults, suggesting that they are a valid measure of balance impairment.[12] Trunk repositioning errors also exhibit good to excellent reliability (ICC = 0.74-0.81).[12] Testing of trunk position sense took place in standing position. To assess TREs, a digital inclinometer (PRO-360, Irvan-Smith, North Carolina) with precision to 0.1° was held at the level of the T4 spinous process.[12] Participants flexed the trunk approximately 30° in the sagittal plane, holding the position for a count of 3 seconds (position 1). After returning to the upright position, participants attempted to duplicate the previously attained angle. Participants indicated verbally when they perceived they had reached the angle, and held their position for a count of 3 seconds (position 2). The absolute difference in degrees between positions 1 and 2 was defined as the TRE. Five trials were conducted, of which the highest and lowest were discarded and the mean of the remaining 3 trials represented the TRE score.

Statistical Analysis

Descriptive statistics and ranges were calculated for demographic and anthropometric measures, number of falls, MSL, and clinical balance measures (SLST, TUG, FR, TREs). Standard errors of the means are presented as reflections of uncertainty around the estimate of the mean and can be used to calculate confidence intervals (CIs) (the 95% CI is standard error of the mean × 1.96 both sides of the mean).[18] The relationships between MSL test and clinical balance measures and number of falls were calculated using the Pearson correlation coefficient. We used the following guidelines in interpreting the strength of relationships and associations between variables: Pearson correlation coefficients between 0.00 and 0.25 (little or no relationship); 0.25 and 0.50 (fair relationship); 0.50 and 0.75 (moderate to good relationship); and above 0.75 (good to excellent relationship).[19] Intraclass correlation coefficients[20] were calculated to assess the inter- and intrarater test-retest reliability of the MSL test in a subset of the sample (11 individuals). Each participant performed 5 trials of maximum stepping at the initial session and 5 trials of maximum stepping at the second session (approximately 30 days later). All MSL trials were recorded concurrently by 2 raters, who were blinded to each other's recordings. Same-day and approximately 30-day intrarater test-retest reliability was assessed. Same-day interrater reliability between the 2 raters was also assessed. ICC models 3,1 and 2,1 were used for computations of intra- and interrater reliability, respectively.[19] Standard error of measurement, a measure of absolute reliability that quantifies measurement error in the same units as the original measurement, was calculated as the square root of the mean square error term from ANOVA tables generated in the reliability calculations.[21] Minimal detectable change is computed using the equation: $z \times \text{SEM} \times \sqrt{2}$.[21] The MDC at the 95% confidence level (MDC_{95}) was computed for the MSL test using a value of 1.96 for z (1.96 is the z-score associated with the 95% CI).

RESULTS

Relationships of MSL With Clinical Measures

Maximum step length correlated with each of the clinical balance measures conducted, such that better performance on the MSL test was associated with better performance on clinical balance tests (Table 2). Although the relationship between MSL score and TREs was fair (Pearson's r = −0.39; $P = .02$), the relationships between MSL score and the remaining clinical balance measures (SLST, TUG, FR) were good (Pearson's r = 0.65-0.68; $P < .01$). The relationship between MSL score and self-reported number of falls in the past 12 months was fair (Pearson's r = −0.32; $P = .06$), with higher MSL scores being associated with fewer falls. These data suggest that MSL test is a valid measure of balance-impairment and falls risk in older adults.

Rater Reliability, Standard Error of Measurement, and Minimal Detectable Change

Intrarater reliability of the MSL tested on the same day (ICC 0.96 each rater) as well as 1 month (ICC 0.90 rater 1 and 0.91 rater 2) was excellent. Same-day interrater reliability between 2 raters was also excellent (ICC = 0.95) (Table 3). SEM for the MSL scores were low, ranging from 1.75 to 2.64 inches, depending on whether the SEM calculation was based on MSL measurements from 1 or both raters, and whether the MSL test was conducted on 1 day or 1 month apart (Table 3). Using same-day SEM values, the MDC_{95} of the MSL test was computed as 5.18 inches and 5.07 inches for raters 1 and 2, respectively. Using SEM values based on

Table 2. Correlations Between Maximum Step Length (MSL) and Clinical Measures[a]

	MSL	*P*
Clinical Balance Measures (N = 35)		
SLST	0.68	<.01
TUG	−0.65	<.01
FR	0.65	<.01
TRE	−0.39	.02
Falls (N = 34)		
Number of falls in past 12 months	−0.32	.06

Abbreviations: FR, Functional Reach; SLST, Single Limb Stance Time; TRE, trunk repositioning error; TUG, Timed Up and Go.
[a]Values are Pearson's r. MSL and FR were normalized for body height prior to computation of Pearson's r. The correlation between MSL and falls was calculated based on 34 participants (excluding 1 participant who reported daily falls).

Table 3. Reliability Coefficients for Maximum Step Length Measures (N = 11)

	ICC	95% CI[a]	SEM
Intrarater reliability: Same day			
Rater 1	0.96	0.90-0.99	1.87
Rater 2	0.96	0.90-0.99	1.83
Intrarater reliability: 1 month			
Rater 1	0.90	0.81-0.97	2.64
Rater 2	0.91	0.82-0.97	2.63
Interrater reliability			
Rater 1 and rater 2	0.95	0.89-0.98	1.75

Abbreviations: CI, confidence interval; ICC, intraclass correlation coefficient (ICC models 3,1 and 2,1 were used for computation of intra- and interrater reliability, respectively); SEM, standard error of measurement (inches).
[a]The 95% confidence interval is the confidence interval for the ICC.

longer intertest intervals (approximately 30 days), MDC_{95} values increased to 7.32 inches and 7.29 inches for raters 1 and 2, respectively.

DISCUSSION

Stepping is an important strategy frequently employed by the older adult to avoid an impending fall after a loss of balance. Few studies have investigated the relationship between performance on stepping tests and balance capabilities and falls risk in older adults.[8-11] These studies highlighted strong relationships between stepping capabilities and measures of balance and falls risk in older adults. In this study, concurrent validity of the MSL test as a measure of falls risk and balance-impairment in older adults was assessed by investigating the correlation of the MSL score with other commonly used balance measures, as well as with number of falls reported in the past 12 months. Our hypotheses that better performance on the MSL test would be associated with fewer previous falls and better performance on clinical balance tests were supported by these data. In this study we observed a fair relationship between MSL scores and number of falls, as well as between MSL scores and a measure of trunk-related balance-impairment in older adults, TREs. We observed good relationships between MSL scores and 3 commonly used clinical balance tests (SLST, TUG, FR). Our findings of a positive correlation between MSL scores and SLST (Pearson's r = 0.68; $P < .01$), and a negative correlation between MSL scores and TUG score (Pearson's r = −0.65; $P < .01$) are similar to those in a previous study.[10] These findings add to a growing body of knowledge suggesting that the MSL test may be a valid measure of underlying balance-impairment and falls risk in older adults.[9,10]

The high rater reliability values (ICCs > 0.90) observed here are similar to those of others, who have proposed that only 1 trial is necessary to obtain a valid MSL score.[22] Intraclass correlation coefficient values ranging from 0.90 to 0.96, and SEM values ranging from 1.75 to 2.64 inches, indicate that MSL scores exhibit excellent inter- and intrarater test-retest reliability, as well as low measurement error, with scores being stable and consistent across time periods as long as 1 month.

To the best of our knowledge, this is the first study to quantify the MDC for the MSL test. The MDC_{95} computed in this study suggests that 95% of truly stable community-dwelling older adults will display random variation of less than or equal to 7.32 inches on subsequent trials of maximum stepping. As change exceeding the MDC is interpreted as true change,[21] clinicians should use a minimum of 7.32 inches as evidence of a true change in step length. This information may be useful to clinicians in clinical decision making, as well as to researchers conducting studies utilizing MSL as an outcome variable.

The MSL test appears to be more challenging than other dynamic clinical balance tests. Some dynamic trunk-based balance tests do not demand lower extremity movement away from the original base of support such as the case for the FR test requiring participants to flex the trunk while reaching forward with an outstretched arm,[5] as well as the test of trunk position sense requiring only trunk flexion.[12] As the MSL test requires participants to alter their base of support while stepping, as well as to control the trunk and CoM bi-directionally over a moving base of support, it is a much more challenging task compared with dynamic trunk-based tests that are conducted over a stable base of support. The dynamic and complex nature of the MSL test likely enhances its utility as a measure of falls risk in community-dwelling older adults.

We found good correlations between MSL and SLST (a test of static balance requiring lower extremity strength), and fair to good correlations between MSL and FR, TUG, and TREs (the latter 3 being tests of anticipatory dynamic balance requiring both lower extremity and trunk strength, and both lower extremity and trunk joint range of motion). This suggests that the MSL test as a measure of stepping abilities is dependent not only on balance capabilities but also on lower extremity and trunk function (strength and range of motion). Taking a maximal step is a complex activity, very likely requiring coordinated activity of proximal and distal lower extremity, as well as trunk musculature. Electromyogram studies are needed to determine which muscles are activated during the stepping phase as well as during the return phase of the test. Studies are also needed to determine the relative contribution of proximal versus distal leg strength to performance on the MSL test. This would facilitate the design of appropriate muscle-specific programs to increase MSL.

Studies have shown that step training improves aspects of stepping capabilities such as speed of stepping initiation in older adults,[23] and a 10-week intervention program of combined balance and step training improves stepping capabilities (MSL and Rapid Step test) and reduces falls risk in balance-impaired older adults.[24] Whether step training to improve MSL is a useful intervention in reducing falls in older adults remains to be seen. The effect of step training on balance confidence and fear of falling also warrants investigation.

One limitation of this study is recall bias: participants were asked to recall the number of falls experienced over the past 12 months, a method of recall that may be inaccurate.[25] Another limitation of this study is that although we found a correlation between MSL and falls, this study did not address issues such as the sensitivity and specificity of MSL as a predictor of falls. Finally, as the study's participants were a convenience sample of relatively high functioning community-dwelling older adults, they do not represent the entire population of older adults. Caution should therefore be used in applying these results to other groups of older adults, such as those who are frail and lower-functioning. More prospective studies are needed to evaluate whether MSL is useful as a predictor of falls in older adults, as well as to determine the sensitivity and specificity of MSL as a predictor of falls. Advantages of the MSL test are its minimal equipment or space requirements, as well as its ease of administration. It takes approximately 3 minutes to perform the test, making it particularly useful for busy clinical settings.

CONCLUSION

The observation that the MSL test is a valid measure of underlying balance-impairment and falls risk in older adults, coupled with its excellent reliability, including low measurement error, and ease of administration, suggests that clinicians should consider incorporating the MSL test into their battery of falls risk assessment tools. Use of this test as a screening measure in clinical geriatric settings may reduce the incidence of falls in community-dwelling older adults. Clinicians should recognize that for community-dwelling older adults, only change exceeding 7.32 inches on subsequent MSL trials is considered true change. Change less than or equal to 7.32 inches should be interpreted as being due to measurement error or random variation in stepping performance.

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