The Relationship of Knee-Extensor Strength and Rate of Torque Development to Sit-to-Stand Performance in Older Adults

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ABSTRACT

Purpose: To investigate the association of knee-extensor strength and power to performance in the 30-second sit-to-stand test (30sSTS) in healthy older adults. **Method:** In a cross-sectional study of 29 healthy older adults aged 60–82 years (12 male, 17 female), hierarchical regression was used to determine the relationship of knee-extensor concentric and eccentric strength, peak rate of torque development (peak RTD) using isokinetic dynamometry, and momentum variables with the number of sit-to-stand repetitions completed in 30 seconds (30sSTSreps). **Results:** Concentric (180°/s) and eccentric (90°/s) knee-extensor strength were significant independent predictors of 30sSTSreps after controlling for physical activity level, height and weight (adjusted $R^2 = 0.425$, $p = 0.004$; adjusted $R^2 = 0.427$, $p = 0.004$ respectively), as was concentric (90°/s) knee-extensor peak RTD (adjusted $R^2 = 0.424$, $p = 0.004$). Peak linear vertical momentum (PLVM) (adjusted $R^2 = 0.615$, $p < 0.001$) accounted for 36% of the variance. **Conclusions:** Generation of PLVM is an important predictor of 30sSTSreps; knee-extensor concentric and eccentric strength and power are associated with improved performance in this common functional task. Focusing on these parameters in exercise interventions may improve functional performance and give insight into specific factors related to success on the test.

Key Words: aged; biomechanics; muscle strength; muscle strength dynamometer; risk factors; sit-to-stand.

RÉSUMÉ

Objectif : Étudier le lien entre la force et la puissance de l'extenseur du genou et le rendement au cours d'un test assis-debout de 30 secondes (TAD30s) chez des adultes âgés en bonne santé. **Méthode :** Au cours d'une étude transversale portant sur 29 adultes en bonne santé âgés de 60 à 82 ans (12 hommes, 17 femmes), on a utilisé une régression hiérarchique pour déterminer le lien entre la force concentrique et excentrique de l'extenseur du genou, le taux maximal de production du moment de force (RTD maximal) au moyen de la dynamométrie isokinétique, et les variables de la quantité de mouvement en fonction du nombre de répétitions assis-debout complétées en 30 secondes (répTAD30s). **Résultats :** La force concentrique (180°/s) et excentrique (90°/s) de l'extenseur du genou constituait un prédicteur indépendant significatif de répTAD30s compte tenu du niveau d'activité physique, de la taille et du poids (R^2 rajusté = 0,425, $p = 0,004$; R^2 rajusté = 0,427, $p = 0,004$ respectivement), tout comme l'était le RTD de pointe concentrique (90°/s) de l'extenseur du genou (R^2 rajusté = 0,424, $p = 0,004$). La quantité de mouvement vertical linéaire de pointe (MVLP) (R^2 rajusté = 0,615, $p < 0,001$) a représenté 36 % de la variation. **Conclusions :** La production du MVLP constitue un prédicteur important des répTAD30s. On établit un lien entre la force et la puissance concentriques et excentriques de l'extenseur du genou et une amélioration du rendement dans cette tâche fonctionnelle courante. La concentration de l'attention sur ces paramètres au cours d'intervention basées sur l'exercice peut améliorer le rendement fonctionnel et donner une idée de facteurs particuliers liés à la réussite au test.

The 30-second sit-to-stand test (30sSTS) is a sensitive and valid tool to predict functional ability in older adults.^{1,2} Because muscle strength, endurance, power, and mobility are all correlated with this functional activity, it is not conclusively known which parameters are

most likely to alter performance.^{2,3} To understand the validity of the 30sSTS, which measures the number of full repetitions a person can complete in 30 seconds (30sSTSreps), it is important to determine the main contributing variables associated with better test perfor-

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mance. This test was designed as an independent screening tool for lower-extremity strength, mobility, and function and has demonstrated reasonably good criterion-related validity relative to fall risk.² Therefore, determining the main contributors to success may help clinicians choose exercises best suited to improve sit-to-stand (STS) performance and prevent falls.

There is conflicting evidence on the variables that best predict 30sSTS performance.^{2,4,5} Knee-extensor concentric strength is associated with ability to rise from a chair, but the rate at which one generates force and the knee-extensor eccentric strength required in descent may also be important variables for success on the 30sSTS, and these factors have not been studied. Lower-extremity muscle strength, defined as the ability to produce maximal muscle force at a specific velocity during a contraction,^{6,7} is associated with walking performance, ability to get in and out of a chair, step-climbing speed, and rate of falls in older adults.^{6,8,9} Eccentric strength is an important factor in the 30sSTS, as it is required to control the trunk and hip muscles, preventing forward or backward falls during the momentum-transfer phase of standing.³ Muscle power is defined by the product of muscle force and velocity, and therefore rate of torque development (RTD) can be considered a surrogate of muscle power, although few studies have examined this.^{10,11} Peak muscle power is correlated with stair climbing and sit-to-stand (STS).

Loss of muscular performance in older adults impairs their ability to perform activities of daily living and leads to loss of independence.¹⁰ Maximum joint torque and RTD are also compromised in the lower extremities of older adults, particularly among fallers.¹⁰ Relatively few studies have focused on changes in muscle RTD with age, but there is an estimated 3.5% decrease per year in muscle power after age 65.⁵ The importance of RTD to fall prevention has been reported in the literature; higher contraction velocities have been found to be a stronger predictor than muscle strength of performance on lower-intensity functional tasks.^{4–6,11–14} Researchers have suggested that among older adults, the ability to produce torque rapidly may be more important than strength training in terms of improving function, since functional tasks such as walking and catching oneself from a trip depend more on speed than on strength.¹¹ If RTD is an important factor to consider in fall risk assessment and intervention, more research is needed to understand the relationship of RTD to functional performance in fall risk assessment measures; to our knowledge, however, this relationship has not been reported in the literature.

The primary purpose of this study was to examine the association of knee-extensor concentric and eccentric strength (peak torque), rate of peak torque development (peak RTD), and horizontal and vertical momentum to performance on the 30sSTS.

We hypothesized that higher concentric and eccentric peak torque values and peak RTD values would independently predict improved performance on the 30sSTS and that peak RTD would be a stronger predictor. The relationship of 30sSTS performance and momentum, as measured with motion analysis, is exploratory; therefore, we set no specific hypothesis for this variable. Data will be useful in determining effective strategies for the STS movement.

METHODS

Study design

We used a cross-sectional design and randomly allocated participants to begin at one of two testing stations: knee-extensor strength testing or 30sSTS. All participants performed strength testing and the 30sSTS consecutively on the same day.

Participants

Participants were recruited from the community through advertisement in a local newspaper. Volunteers were eligible for inclusion in the study if they were at least 60 years old and could ambulate independently in the community, with or without a gait aid. The exclusion criterion was the presence of any significant medical, neurological, or musculoskeletal condition that would jeopardize safety or ability to participate in the test (e.g., significant pain or arthritis in the lower extremities, stroke, Parkinson disease). Participants were screened through a telephone interview, and informed consent was obtained before testing. Ethics approval was obtained from the University of Saskatchewan's Biomedical Ethics Review Board (Bio#09–38).

Procedures

Weight and height were measured using a standardized scale and ruler. A medical information questionnaire (developed for this study) and the Physical Activity Scale for the Elderly (PASE)¹⁵ were completed at the time of testing. The same three testers performed the isokinetic dynamometer testing for all participants, and the same two testers applied the surface markers for kinematic analysis and conducted the 30sSTS.

Measures

Isokinetic dynamometry

Knee-extensor strength was measured using an isokinetic dynamometer (Humac NORM 2008, Computer Sports Medicine Incorporated [CSMi], Stoughton, MA). A standard protocol for positioning was used: the participant sat upright in a chair set at an 85° angle, using both chest and hip straps for support, with the back of the knees positioned at the end of the seat. The lever arm was strapped to the participant's leg at mid-shank, using a cushioned pad, with the knee joint at 90° flexion. The

dynamometer was aligned to the joint axis of rotation. Torque measurements were gravity corrected, and the dynamometer protocol was performed following the manufacturers' guidelines.

Concentric and eccentric knee extension were measured between 15° and 80° of knee flexion, allowing a standardized 65° range of motion (ROM). Based on pilot testing and on other studies of older adult populations within our research lab, and given the restrictions of end-range passive knee ROM that are more common in the population studied, this was determined as a functional range that we could successfully measure. Iso-kinetic concentric knee-extensor torque was measured at 90°/s (Con90°/s) and 180°/s (Con180°/s). Eccentric knee-extensor torque was measured within the same range at 90°/s (Ecc); eccentric 180°/s was not measured, as pilot testing found this speed to be difficult or impossible for participants. Each test consisted of three maximum voluntary contractions separated by 1-minute recovery periods. The order of contraction type (Con90°, Con180°, Ecc) was randomized for each participant; starting leg was also randomized, and all measures were completed on the starting leg before the opposite leg was tested. Each participant took part in a generalized warm-up consisting of 10 repetitions of concentric and eccentric contractions, as well as a specific warm-up (8 repetitions) before each contraction type, to maximize familiarity and subsequent performance during testing.

Peak rate of torque development

Dynamometer data on torque, position, and velocity were retrieved from the Humac NORM system (Humac2007, v.7.5.0, CSMi, Stoughton, MA). From these data, we calculated maximal torque ($\tau = \text{force} \times \text{length of lever arm}$) for each trial of each type of contraction for all participants. Peak rate of torque development (peak RTD) was calculated by dividing maximal torque by the time from onset of movement (determined by a change in joint angle position) to maximal torque development, extracting the peak slope from the ascending phase of the torque time curve. The slope was not consistently linear for all participants, however; in some cases, we observed a plateau before peak torque was achieved. If this occurred, the calculation included the uppermost value of maximal torque to the point of plateau. Peak RTD is a surrogate measure for power, as it applies to the speed or rate at which muscle force (mass $\times$ acceleration) is generated, where power = force $\times$ velocity.^{10,11,16,17} The highest of three trials for each type of contraction was used for analysis.

30sSTS

Participants sat with arms crossed on a rigid, height-adjustable bench (with no armrests and no back support) and were asked to move from sitting to standing as many times as possible in 30 seconds. Initial foot

placement and chair height were adjusted so that initial hip and knee angle was 90° for all participants. Participants were instructed to keep their feet flat on the floor and not move their feet during the test, to reach full hip extension upon standing, and to return to the starting position of full sitting for each repetition.

The STS movement was demonstrated by the tester, and each participant completed one trial as a warm-up. On the command "go," participants began the test. When 30 seconds had elapsed, the participant was instructed to stop and the number of completed full STS motions was recorded.

Momentum

Prior to the 30sSTS, 50 reflective spheres (14 mm in diameter) were fixed with double-sided tape onto predetermined anatomic landmarks on the participant's body. An eight-camera commercial motion-capture system (Vicon Motion Systems, Centennial, CO), operating at 100 Hz, was used to track the three-dimensional locations of the reflective spheres to record the three-dimensional kinematics of the head, arms, torso, pelvis, and lower limbs during the STS movements. Using kinematic data combined with published anthropometric information,^{18–21} we calculated the location of the total body centre of mass (COM) during the STS movements. We then calculated horizontal and vertical velocity of the COM, using standard finite difference methods, and multiplied these values by the participant's mass to obtain horizontal and vertical momentum. Peak values of horizontal and vertical momentum were identified for each STS cycle during the 30sSTS and averaged across the test.

Statistical analyses

We estimated that a sample of 28 would be needed to detect a large effect size with a power level of 0.80 and $p < 0.05$.^{22,23} Descriptive data were generated for all variables, as well as relevant medical and demographic information. We first examined relationships using the Pearson product-moment correlation coefficient, to determine other potential confounding variables affecting performance. Significant differences in 30sSTSreps between men and women were determined using independent t -tests. We then calculated separate hierarchical multiple linear regression equations for each variable of interest to determine the independent relationships between 30sSTSreps and knee-extensor strength, peak RTD, and momentum, after entering other demographic factors known to affect STS performance (physical activity, height, weight) into the regression equations as covariates. All statistical analyses used the Statistical Package for the Social Sciences, version 16.0 (SPSS Inc., Chicago, IL), with Bonferroni correction; significance was set at $p < 0.006$.

Table 1 Descriptive Demographic Data and Sit-to-Stand Variables of Study Sample ($n = 29$)

Variable	Mean (SD)	Range
Age, y	67.3 (5.5)	60–82
Height, cm	165.25 (9.3)	150–185.5
Weight, kg	72.8 (10.7)	51.15–89.60
30sSTSreps, no.	14.0 (3.6)	8–23
PASE score	157.1 (82.7)	47–447
Max strength, Nm		
Con90°	144.7 (42.9)	84–273
Con180°	70.6 (21.5)	36–133
Ecc	183.1 (54.9)	99–317
Peak RTD, Nm/s		
Con90°	393.1 (159.7)	208.2–759.4
Con180°	396.7 (135.2)	227.1–799.0
Ecc	287.0 (92.2)	151.3–466.5
Peak RTD		
Con90°	71.3 (65.4)	0.5–328.8
Con180°	86.8 (88.6)	3.7–359.7
Eccentric	60.6 (62.4)	1.0–236.2
Momentum, kg*m/s		
PLHM	32.8 (9.7)	8.1–50.0
PLVM	56.5 (16.2)	37.4–107.7

30sSTSreps = number of sit-to-stand repetitions in 30-second sit-to-stand test; PASE = Physical Activity Scale for the Elderly; Con = concentric; Ecc = eccentric; peak RTD = peak rate of torque development; PLHM = peak linear horizontal momentum; PLVM = peak linear vertical momentum.

RESULTS

A total of 29 older adults (12 men, 17 women) aged 60–82 years participated in the study. The majority of participants (80%) performed in the *good* (4 participants), *average* (11), or *fair* (9) range on the 30sSTS; 3 participants (10%) scored in the *excellent* range, and 2 (6.7%) scored in the *poor* range, according to normative values for sex and age.²⁴ Table 1 shows relevant descriptive data. Of the demographic and physical variables of interest (age, sex, height, weight, PASE score), only PASE score was significantly correlated with 30sSTSreps (Pearson $r = 0.507$, $p = 0.005$). Height and weight are known to affect STS kinematic performance; both were highly correlated with vertical momentum and other strength measures (values of r ranged from 0.433 to 0.748, p -values from 0.019 to < 0.001); therefore, these variables were entered first into the regression models used to test the hypotheses. We did not observe a relationship between 30sSTSreps and either age ($r = -0.32$, $p = 0.09$) or sex ($r = -0.06$, $p = 0.75$). We also found no significant difference in 30sSTSreps between men and women ($t = 0.145$, $p = 0.89$); we therefore included both men and women in the regression analysis.

Strength

Con90°/s knee-extensor strength was not a significant independent predictor of 30sSTSreps after controlling for physical activity (represented by PASE score), height, and weight. However, Con180°/s and Ecc knee-extensor

Table 2 Hierarchical Linear Regression Model for Predictors of Sit-to-Stand Repetitions, Accounting for PASE, Height, and Weight

Independent variable	Adjusted R^2	R^2 change	Standardized β	p -value
Co-variables	0.210			
PASE			0.513	0.005
Height			-0.062	0.74
Weight			-0.160	0.40
Regression equations:				
1. Max strength Con90°	0.277	0.086	0.418	0.08
2. Max strength Con180°	0.425	0.212	0.666	0.004
3. Max strength Ecc	0.427	0.214	0.741	0.004
4. Peak RTD Con90°	0.424	0.211	0.623	0.004
5. Peak RTD Con180°	0.249	0.062	0.473	0.14
6. Peak RTD Ecc	0.209	0.027	0.200	0.34
7. PLHM	0.272	0.075	-0.296	0.13
8. PLVM	0.615	0.362	0.928	<0.001

PASE = Physical Activity Scale for the Elderly; Con = concentric; Ecc = eccentric; Peak RTD = peak rate of torque development; PLHM = peak linear horizontal momentum; PLVM = peak linear vertical momentum.

strength (90°/s) were significant independent predictors of 30sSTSreps (adjusted $R^2 = 0.425$, $p = 0.004$; adjusted $R^2 = 0.427$, $p = 0.004$, respectively). After we controlled for PASE, height, and weight, Con180°/s and Ecc knee-extensor strength each accounted for an additional 21% of variance in the prediction of 30sSTSreps in separate regression models (see Table 2).

Peak RTD

Con90°/s knee-extensor peak RTD was the only significant independent contributor to the model predicting 30sSTSreps (adjusted $R^2 = 0.424$, $p = 0.004$), explaining an additional 21% of variance after PASE scores, height, and weight were accounted for. Con180°/s and Ecc knee-extensor peak RTD were not significant independent contributors to the model (see Table 2).

Momentum

Peak linear horizontal momentum (PLHM) was not a significant contributor in predicting 30sSTSreps ($R^2 = 0.389$, $p = 0.13$). However, peak linear vertical momentum (PLVM) was a significant predictor of 30sSTSreps, accounting for the highest additional variance (36%) in the number of 30sSTSreps and significantly improving the model ($R^2 = 0.615$, $p < 0.001$) (see Table 2).

DISCUSSION

We hypothesized that higher concentric and eccentric peak torque values and peak RTD values would predict better performance on the 30sSTS and that peak RTD would be a stronger predictor. This hypothesis was primarily supported, as both concentric and eccentric peak torque were significant predictors; however, concentric peak torque was a significant predictor only at the higher

velocity (Con180°/s), which suggests that strength is associated with the functional task only at the approximate speed of the task (specificity). Con90°/s knee-extensor peak RTD was also a significant predictor, but the strength of the association was similar to those of the concentric and eccentric torque values. PLVM was the strongest independent predictor of performance on the 30sSTS.

There is limited evidence on the relationship of muscle performance and whole-body motion to functional activities such as STS in the older adult population. Previous studies have focused on single muscle-strength parameters, such as concentric or isometric knee-extensor strength, and their relationship to rapid STS performance.^{25,26} Rapid STS motion requires the complex combination of force production, speed, and rapid shifting of the COM; therefore, more detailed analysis of these parameters is required to understand the relationship of this functional task to fall risk factors. The strength of our study is the expansion of measures to include muscle power, eccentric and concentric strength at two different speeds, and generation of force and speed through momentum as related to performance on the 30sSTS.

Previous research has found an association between knee-extensor muscle function and performance of a rapid STS test in older adult women at risk of falls; however, knee-extensor torque measures were limited to isometric and concentric.^{25–28} One study reported that eccentric strength is less affected by age than isometric or concentric strength;⁴ however, there has been limited study of eccentric strength and its role in functional performance in older adults. We found that both concentric peak torque at 180°/s and eccentric peak torque at 90°/s were significant predictors of 30sSTSreps in healthy older adults. It is not clear why concentric peak torque at 90°/s was not a significant predictor, but it could be due to the specificity of strength as it relates to the speed of the movement. The average velocity of motion of STS performance across the pool of participants was approximately 180°/s; concentric strength at the speed of the movement predicted performance, but strength at 90°/s and eccentric RTD and peak RTD at 180°/s did not. These factors may be important in designing exercise programmes to address improvement in STS performance, as our findings suggest that the speed of the concentric contraction should match the speed of the functional task trained.

Our results support the notion that slower eccentric contractions significantly predict STS performance, but we were not able to safely measure higher-speed eccentric contractions in this sample. Eccentric measurements were taken only at 90°/s, because it was difficult for participants to learn and perform maximal eccentric torque at 180°/s. Eccentric and concentric muscle strength appear to be equally related to performance, but few

studies have investigated eccentric strength or training in the older adult population. We recommend that future studies investigate eccentric training and the relationship of eccentric strength at varying speeds to functional performance in older adults. In addition, further exploration of the impact of more focused practice sessions before eccentric strength testing would help us to understand eccentric training ability in this population.

Although eccentric strength was a significant contributor to the model predicting 30sSTSreps, eccentric RTD was not. The slower velocity of eccentric contractions may also have been responsible for these findings. It is possible that RTD becomes a more important predictor during isokinetic contractions at higher velocities than those we measured in this study. Previous studies have suggested that ageing decreases the maximal RTD of fast voluntary contractions as a result of age-related decline in maximal motor-unit discharge frequency and slowing muscle contractile properties.^{29,30} The decline in power may be attributable to muscle atrophy, but it may also be due to reduced relative force output per muscle fibre, slower shortening velocity, or reduced neural drive to the muscle.¹⁰ While eccentric strength is often greater than concentric strength for a range of velocities, eccentric power may be greater than concentric power only at higher velocities (e.g., 120°/s and 180°/s).³¹ Other studies demonstrate that both strength and power are related to functional performance in older adults and suggest that power training may be an effective addition to training programmes for older adults (as opposed to strength training alone).³²

Our study used peak RTD, calculated from the torque measurements, as a surrogate for power.^{11,16,17} Our calculation of peak RTD assumed a linear and constant slope of the torque–time curve, when in fact there may be slight deviations from a linear slope as torque increases. However, this approach does provide an effective way to measure how quickly torque is generated during maximal muscle contractions, and the majority of participants did exhibit a linear slope. Although power with concentric knee-extensor contraction at 90°/s showed a significant relationship with performance on the 30sSTS, a weaker relationship with power at higher velocity of contraction may be attributable to diminished neural drive, especially given the unfamiliar nature of isokinetic knee extension on a dynamometer, particularly during eccentric actions.

Our results show that PLVM predicted performance on the 30sSTS better than PLHM. This finding is consistent with previous research investigating momentum variables with the STS task;³³ to our knowledge, however, this has not been investigated with the 30sSTS. The speed of ascent affects the direction and timing of the trajectory of COM during an STS task;³³ PLVM becomes more relevant to STS performance as the speed of

STS increases, since a better performance on the 30sSTS indicates a higher number of repetitions.

We chose to evaluate this functional test because it has been used as a screening tool for fall risk, which means that understanding the relationship of various muscle parameters to performance may increase our understanding of training programmes to decrease fall risk. Fallers have been reported to present reduced knee isokinetic peak torque irrespective of testing speed, but isometric strength assessments do not seem to detect differences in peak torque between fallers and non-fallers.¹¹ Therefore, future researchers may benefit from using our testing procedure to assess a population at risk of falls. Previous research has indicated that strength gains have a greater impact on performance of STS in lower-functioning than in higher-functioning individuals.⁹ Importantly, the majority of participants in our study were healthy older adults who were not at risk of falling and performed within the normal ranges for the 30sSTS,³⁴ and it is therefore difficult to draw conclusions about the impact of the variables specific to fall risk. Future research should include a larger group at risk of falling to increase generalizability to the population with which this test would likely be used clinically.

LIMITATIONS

A major limitation of our study is the small sample size. However, we did take several steps to limit the impact of the sample size on the analysis. A hierarchical regression model was used to conserve power and evaluate the independent contribution of each variable of interest.³⁵ Although we estimated a sample size of 28 as adequate to detect a larger effect size, we recognize that a sample closer to 50 would be better suited to determine a moderate effect size,^{22,23} which is better suited for these functional measures. A larger sample would also allow for age and sex comparisons. This information can help to direct future studies in choosing sample sizes for similar studies. We also used a conservative correction for multiple analyses, with a Bonferroni-adjusted *p*-value, to correct for Type I error. As our findings were still significant, we believe that the results are valid for this healthy older-adult population.

Another limitation is that we collected and analyzed isokinetic measures of muscle performance rather than isotonic measures, which more directly measure muscle power. Although isotonic tasks seem to better resemble real-life activities, the isokinetic measures do give a good indication of eccentric and concentric strength and RTD. We recognize that RTD is only one method to estimate power and has not been used extensively in this population; however, other studies have found it to be moderately reliable for knee extension (ICC = 0.61) as a surrogate measure,³⁶ and we would recommend further investigation of the reliability and validity of RTD as an estimate of power in older adults.

CLINICAL IMPLICATIONS

The results of this study assist in determining muscle performance factors and whole-body motion factors related to success on the 30sSTS in community-dwelling older adults. Training programmes for community-dwelling older adults to prevent deficits that may lead to fall risk may need to be individualized based on deficits in both power and strength, which are important contributors to PLVM, an important driving factor in STS motion. Testing both concentric and eccentric muscle strength at different velocities and measuring muscle power in a fall-risk population may shed further light on the best predictors of fall risk in older adults. Our findings suggest that improving success on the 30sSTS should target faster concentric contractions, incorporate eccentric contractions, and focus on training at specific velocities to improve functional status related to fall risk.

CONCLUSIONS

Multiple performance factors are related to success in the 30sSTS for older adults. Concentric strength at higher velocity, eccentric strength, and RTD were important contributors to STS performance.

The 30sSTS has demonstrated a relationship with fall-risk in elderly individuals; conflicting evidence exists regarding associations between this functional test and lower extremity muscle strength and power.

Success on the 30sSTS incorporates multiple factors including strength, power, and movement strategies. Knee extensor concentric strength specific to the velocity of the STS motion, eccentric strength, and concentric RTD were important muscle performance contributors to performance on the 30sSTS. Higher values in these muscle parameters appear to be directly associated with the ability to generate peak linear vertical momentum, a key predictor of performance on the 30sSTS in healthy older adults.

Treatment strategies to improve rapid chair stand performance in older adults should focus on concentric and eccentric strengthening and training at the specific speed of movement relevant for various functional tasks.

KEY MESSAGES

What is already known on this topic

The 30sSTS is a screening tool for fall risk. It measures the number of full sit-to-stand motions an individual can complete in 30 seconds, giving the assessor an indication of functional ability. However, it is not clear what parameters this test is actually measuring.

What this study adds

This study identifies strength, RTD, and momentum variables that predict STS performance in older adults. This information can help clinicians focus their treatment strategies to improve success in rapid sit-to-stand performance among healthy older adults. These predictive factors for 30sSTS performance may also lead to

future research investigating a population at risk of falling, to determine intervention strategies to decrease fall risk.

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