

Annotated Bibliography of Primary Sources  
Physical Performance Tests for Fall Risk Assessment  
Anthony Augliera

Chun, S. H., et al (2017). Performance on physical function tests and the risk of fractures and admissions: Findings from a national health screening of 557,648 community-dwelling older adults. *Archives of Gerontology and Geriatrics*, 68: 174-180.

Summary: This study evaluated associations between inferior physical function test results and overall fractures, femoral fractures, and admissions due to femoral fracture. 557,648 community-dwelling older adults aged 66+ participated in the screening program between 2007 and 2010. The physical function tests utilized to measure progress were the Timed Up and Go (TUG) and Unipedal Stance Test (UST). After median follow up of 1.42 years, subjects who performed poorly on one or both of the two physical function tests experienced higher number of overall fractures, femoral fractures, and admissions due to femoral fractures compared to subjects with normal results on both tests.

Relevance: The incidence of fall and fall-related injuries, such as fractures, increases with age. This study shows that poor performance on physical performance tests is associated with worse health outcomes related to fracture risk and hospital admissions. This study also validates the use of the TUG as a means to identify community-dwelling older adults who are at an increased risk for falls and fractures.

Rosengren, B. E., et al (2012). Inferior physical performance test results of 10,998 men in the MrOS Study is associated with high fracture risk. *Age and Ageing*, 41(3): 339–344.

Summary: This cross-sectional study assessed whether physical performance tests and estimates of levels of physical activity could discriminate fallers with a fracture from fallers with no fractures and non-fallers. Physical performance tests included; hand dynamometer grip strength, 5 Times Sit to Stand, and 6-meter Walk Test. The study found that right-hand-grip strength test and the 6-meter walk test could be used to discriminate fallers with a fracture from fallers with no fractures and non-fallers. Through analyzing self-report data, the study also showed that fallers with a fracture were more sedentary than both fallers with no fractures and non-fallers. Ultimately, at a group level, results indicate that physical performance tests in elderly men can discriminate fallers with a fracture from both fallers with no fractures and non-fallers.

Relevance: This study confirms that physical performance tests can identify individuals who are at risk for falling and suffering fall-related fractures. Additionally, results show that fallers with fractures may be less mobile and more sedentary than fallers with no fractures and non-fallers. Therefore, fall prevention strategies should include physical performance tests that assess balance, mobility, and strength, as well as interventions that increase physical activity level.

Kim, M. & Shinkai, S. (2017). Prevalence of muscle weakness based on different diagnostic criteria in community-dwelling older adults: A comparison of grip strength dynamometers. *Geriatr Gerontol Int*, 17: 2089–2095.

Summary: This study compared the performance of the Jamar and Smedley dynamometers for the measurement of grip strength. The two dynamometers were used to determine the prevalence of weakness in a large, community-dwelling older adult population aged 69-89. The study shows that despite excellent correlation between the two dynamometers, there is a statistically significant difference in grip strength measurements. The Smedley dynamometer showed a higher prevalence of weakness than did the Jamar dynamometer.

Relevance: The results of this study are useful for clinicians planning to implement a fall prevention program that incorporates grip strength to measure frailty. Grip strength can identify clinically relevant weakness and frailty phenotypes that increase the risk of falling. However, the prevalence of weakness can vary depending on the choice of dynamometer or the measurement protocol used. Therefore, this study shows the importance of choosing appropriate testing dynamometers for grip strength to accurately identify at risk older adults.

Roberts, H., et al (2011). A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. *Age and Ageing*, 40(4): 423–429.

Summary: This literature review was conducted to review protocols for the measurement of grip strength. The study found that there is wide variability in the choice of equipment and protocol for measuring grip strength. While the review found the Jamar hand dynamometer to be the most widely used instrument with established test–retest, inter-rater and intra-rater reliability, there is considerable variation in how it is used. The review found protocol variations include differences in recording maximum or mean values, utilizing one, two, or three attempts, and differences with either hand or the dominant hand alone.

Relevance: As an assessment measure, grip strength has been shown to have predictive validity, with low values being associated with falls, disability, impaired health-related quality of life, prolonged length of stay in hospital, and increased mortality. However, the use of differing protocols can lead to confusion among clinicians regarding best practice, and the variation in approach can affect the values recorded. The study recommends the use of standardized testing methods and reference values to better assess sarcopenia and accurately identify individuals at increased risk of adverse outcomes.

Ibrahim, A., et al (2017). Timed up and go test combined with self-rated multifactorial questionnaire on falls risk and sociodemographic factors predicts falls among community-dwelling older adults better than the timed up and go test on its own. *Journal of Multidisciplinary Healthcare*, 10: 409–416.

Summary: In this study of 1,086 participants, the TUG test was examined independently and combined with multifactorial falls questions and socio-demographic data in order to determine the most effective method to identify fallers among community-dwelling older adults. The study identified six risk factors significantly associated with falls among community-dwelling older adults using multivariate logistic regression test. These factors included the TUG test, gender, cataract/glaucoma, joint pain, history of falls, and worrying

of falls. The study findings also showed that a higher TUG test time was associated with higher risk of falls, consistent with findings from previous studies.

**Relevance:** The study demonstrates the importance of comprehensive assessment and management in addition to physical performance testing like the TUG. Additionally, the study validates the use of the TUG to screen for falls, as it measures functional balance in relation to activities associated with falls, such as walking forward, standing, stand-to-sit motion, initiation of walking, and sit-to-stand motion. Finally, the study bolsters the use of the TUG with the assessment of socio-demographic factors and a multifactorial questionnaire to most effectively screen for falls in older adults in community settings.

Applebaum, E. V., et al (2017). Modified 30-second Sit to Stand test predicts falls in a cohort of institutionalized older veterans. *PLoS ONE*, 12(5).

**Summary:** The objective of this observational cohort study was to determine if a modified 30-second Sit to Stand test (allowing upper extremity use) and Timed Up and Go test predicted falls in 53 subjects residing in a long-term care hospital. The number of falls over one year was collected and the ability of the 30-second Sit to Stand or Timed Up and Go to predict falls was examined using logistic regression. The ability of these tests to predict the number of falls was examined using negative binomial regression, controlling for age, cognition, comorbidities, and history of falls. The modified 30-second Sit to Stand was significantly related to fall incidence. Decreased sit-to-stand repetitions were also associated with increased number of falls.

**Relevance:** This study shows that the modified 30-second Sit to Stand is an effective alternative for fall risk screening in older adults in long-term care. Rather than assigning “no score” for a participant unable to perform a single sit-to-stand, the modified test allows for arm use, which provides a more realistic evaluation of motor performance. The study shows that despite the modifications, fewer sit-to-stand repetitions are still associated with more falls.

Mcguigan, F. E. (2017). Musculoskeletal health and frailty. *Best Practice & Research Clinical Rheumatology*, 31(2): 145-159.

**Summary:** This article serves to clarify a core set of variables relating to frailty, and describes how to best define frailty in a clinical setting. By describing frailty presentations, this article provides methods for evaluating many aspects associated with musculoskeletal health, determining progression and personalized interventions, and planning rehabilitation. In addition to describing frailty in relation to musculoskeletal health, the article also educates readers about additional physical domains such as nutrition and energy, psychological, and social factors that are affected by frailty.

**Relevance:** It is clear that frailty is closely linked to musculoskeletal health, particularly age-related musculoskeletal conditions such as osteoporosis, fractures, osteoarthritis, spinal conditions, and falls. This article bolsters the importance of using grip strength to assess frailty in fall prevention programs, as it is an effective tool for prediction and prognosis.

Cho, B., et al (2004). Tests of Stepping as Indicators of Mobility, Balance, and Fall Risk in Balance-Impaired Older Adults. *Journal of the American Geriatrics Society*, 52: 1168–1173.

Summary: This study assessed the relationship between stepping ability and performance on standard balance, gait, and mobility tests in a group of at-risk older adults. Physical performance tests included timed tandem stance, tandem walk, timed single leg stance, TUG, 6-Minute Walk, as well as other objective and subjective measures of balance. Stepping ability was classified by maximal step length, and rapid stepping, with maximum step length being associated with an increased risk of falling. Additionally, maximal step length and unilateral stance both appeared to be good measures of standing balance and predictors of falls.

Relevance: Testing tandem stance and unilateral stance in fall prevention programs are a valid measure for balance assessment. Additionally, maximum step length is a reliable predictor of fall risk in older adults, and should therefore be assessed in conjunction with other standardized physical performance measures. Finally, similar to the 30-Second Chair Stand test, maximum step length might be a good alternative measure of how much strength and power a participant can consistently generate.

Lusardi, M., et al (2017). Determining Risk of Falls in Community Dwelling Older Adults: A Systematic Review and Meta-analysis Using Posttest Probability. *Journal of Geriatric Physical Therapy*, 40(1): 1–36.

Summary: The purpose of this systematic review and meta analysis is to evaluate the predictive ability of history questions, self-report measures, and performance-based measures for assessing fall risk of community-dwelling older adults through posttest probability (PoTP) calculations and comparing values for individual test/measures. The analysis found that the combination of 5 medical history questions, and 2 performance-based measures (single-limb stance <6.5 seconds, and self-selected walking speed <1.0 second) might be a useful for identifying those in need of thorough balance examination. Additionally, the study found that combining physical performance measures, like the TUG and repeated sit-to-stands, can provide the opportunity to identify possible modifiable risk factors to inform intervention.

Relevance: This study bolsters the use of multiple fall risk assessment tools, given the fact that falls are multi-factorial in nature. Additionally, this study provides cut-off scores that will be useful for providers establishing fall prevention programs, as they will be able to more accurately identify high-fall risk individuals and subsequently, plan appropriate interventions.

Perell, K., et al (2001). Fall Risk Assessment Measures: An Analytic Review. *The Journals of Gerontology*, 56(12): 761–766.

**Summary:** The purpose of this review was to summarize existing fall risk assessment scales in order to enable clinicians to make more informed choices regarding their selection and use of tools. The review found that the use of quick, reliable, and valid fall risk screening tools is important for fall risk assessment in each clinical setting. The study recommends that assessment tools with high sensitivity, specificity, and inter-rater reliability be used clinically. Additionally, tools should be used in the similar setting in which they were developed and studied, and written procedures should be followed explicitly.

**Relevance:** This source is especially useful for healthcare providers developing their own community-based fall prevention program. The study provides recommendations for selecting fall risk assessment tools, and emphasizes the importance of using reliable, efficient, and standardized physical performance tests to accurately detect fall risk.