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Original research

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Original Article

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5.

J. Phys. Ther. Sci. 35: 384–388, 2023

The Journal of Physical Therapy Science

SPTS

Original Article

Relationship between toe grip strength and dynamic balance in older adult patients with femoral neck fracture

Successful 10-second one-legged stance performance predicts survival in middle-aged and older individuals

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ABSTRACT

Objectives Balance quickly diminishes after the mid-50s increasing the risk for falls and other adverse health outcomes. Our aim was to assess whether the ability to complete a 10-s one-legged stance (10-second OLS) is associated with all-cause mortality and whether it adds relevant prognostic information beyond ordinary demographic, anthropometric and clinical data.

Methods Anthropometric, clinical and vital status and 10-s OLS data were assessed in 1702 individuals (68% men) aged 51–75 years between 2008 and 2020. Log-rank and Cox modelling were used to compare survival curves and risk of death according to ability (YES) or inability (NO) to complete the 10-s OLS test.

Results Overall, 20.4% of the individuals were classified as NO. During a median follow-up of 7 years, 7.2% died, with 4.6% (YES) and 17.5% (NO) on the 10-s OLS. Survival curves were worse for NO 10-s OLS (log-rank test=85.6; p<0.001). In an adjusted model incorporating age, sex, body mass index and comorbidities, the HR of all-cause mortality was higher (1.84 (95% CI: 1.23 to 2.78) (p<0.001)) for NO individuals. Adding 10-s OLS to a model containing established risk factors was associated with significantly improved mortality risk prediction as measured by differences in −2 log likelihood and integrated discrimination improvement.

Conclusions Within the limitations of uncontrolled variables such as recent history of falls and physical activity, the ability to successfully complete the 10-s OLS is independently associated with all-cause mortality and adds relevant prognostic information beyond age, sex and several other anthropometric and clinical variables. There is potential benefit to including the 10-s OLS as part of routine physical examination in middle-aged and older adults.

INTRODUCTION

Ageing is associated with a progressive decline in physical fitness[1–3] and reductions or impairments in components of aerobic[4 5] and non-aerobic fitness, including muscle strength/power, flexibility, balance and body composition.[6–11] It is also well-established that the combination of sarcopenic obesity and loss of flexibility and balance are detrimental for overall health, placing older adults with frailty more prone to falls and other serious adverse medical sequelae.[12] Indeed, falls are the second leading cause of unintentional injury-based deaths worldwide.[13] Unlike aerobic fitness,[2 14] muscle strength[9] and flexibility,[8] balance tends to be reasonably preserved until the sixth decade of life, when comparatively, it starts to diminish quickly.[15 16]

Nevertheless, balance assessment is not routinely incorporated in the clinical examination of middle-aged and older individuals.[17] This may be partly attributable to the poor standardisation of balance testing as well as to the relative paucity of data-relating balance results to clinical outcomes other than falls, such as mortality, when compared with, for example, aerobic fitness.[16 18 19]

In this context, the availability of simple, inexpensive, reliable and safe balance assessment tools[11] that could help predict survival would potentially be beneficial to health professionals evaluating and treating older adults. Therefore, the aims of our study were: (1) to assess whether the ability to complete a 10-s one-legged stance (10-s OLS) test was independently associated with all-cause mortality in middle-aged and older men and women and (2) whether the 10-s OLS added relevant prognostic information beyond ordinary demographic, anthropometric and clinical data. If the ability to perform this simple physical task were shown to be a good prognostic indicator for risk of all-cause mortality, it might be a useful complement to routine evaluations among middle-aged and older subjects.

METHODS

This was a prospective cohort study using data from the CLINIMEX Exercise open cohort/evaluation protocol (see online supplemental materials).[11 20 21] Briefly, the CLINIMEX Exercise cohort study was set up in 1994 to assess the relationships of various measures of physical fitness and other exercise-related variables, as well as conventional cardiovascular risk factors with all-cause and cause-specific mortality outcomes. The sample size of 1593 participants was calculated based on the following parameter specifications: (1) level of significance, two-sided test at $\alpha=0.05$; (2) power $(1-\beta)$ of 80%; (3) 7% of study participants dying during follow-up; (4) an SD of 0.5 for the exposure (given that the binary exposure follows a Bernoulli distribution with the probability of a subject achieving success, p, assumed to be equal to 0.5, the SD was calculated from the formula: $(p^*(1-p))^{0.5}$ and (5) effect size: the minimum HR considered to be clinically important, in this case, 1.7. The current analysis included 1702 participants aged 51–75 years at

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Original Article

Can handgrip strength measurements predict postural balance performance in older women?

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Abstract

Objectives: The link between handgrip strength and postural balance in older adults is not well understood. This study aimed to examine the correlations between postural balance performance and handgrip peak force and rate of force development (RFD) measurements in older women. **Methods**: Twenty older women (67 ± 5 years) participated in this study. Handgrip contractions were used to assess peak force, peak RFD, and RFD at 0-100 (RFD100) and 0-200 (RFD200) ms. Postural balance was evaluated using a commercially designed balance testing device, which provides a measurement of static stability based on the sway index. **Results**: There were significant correlations between sway index and handgrip peak force (r = -0.497, P = 0.026), peak RFD (r = -0.552, P = 0.012), RFD100 (r = -0.539, P = 0.014), and RFD200 (r = -0.499, P = 0.025). Stepwise multiple regression analysis indicated that handgrip peak RFD was the single best predictor of sway index (R^2 = 0.305). The other variables, including peak force, did not add any unique variance to the stepwise prediction model. **Conclusion**: These findings suggest that handgrip strength, and in particular peak RFD, may be an effective parameter at predicting postural balance performance in older women.

Keywords: Contraction, Falls Risk, Peak Force, Rate of Force Development, Sway Index

Introduction

Age-related decreases in postural balance performance are commonly reported in older adults[1]. Decreases in postural balance have been associated with a higher incidence of falls and fall-related injuries[2], which may lead to an elevated risk of future disability and mortality. Postural sway measurements are often used to evaluate balance performance and can be obtained from devices like force platforms[3] and computerized balance testing systems[4,5]. Although these devices have been reported to be reliable tools[6,7], they are expensive and may not be readily available in clinical settings. Thus, the prospect of identifying physiological measurements from a less expensive device that can successfully predict postural sway may be advantageous in the testing and evaluation of balance performance in older populations.

Handgrip strength measurements, such as peak force and rate of force development (RFD), are typically assessed from the force signal produced during a maximal voluntary contraction (MVC) with the dominant hand[8] and do not require large or expensive equipment[3]. These measurements have been shown to be significantly associated with the strength capacities of the lower-body musculature[8,9]. Because lower-body strength is critical to postural balance[10], handgrip peak force and RFD may be related to the sway values produced during quiet standing. Previous studies investigating the correlation between handgrip peak force and postural balance performance in older adults have reported conflicting results, with some research reporting a significant correlation[11] and other research demonstrating no correlation between these variables[3,12]. Such discrepancies are likely due to the different handgrip testing devices used in each study. Moreover, because peak force takes greater than 300 ms to be achieved[13], it may not be the best measurement at characterizing the explosive actions required for balance-related tasks. When a disruption in balance occurs, rapid muscle actions and quick response times of less than 150 ms

Ty B. Palmer co-invented the Dynamo Torque Analyzer. The remaining authors declare no conflict of interest.

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ORIGINAL ARTICLE

Reduced Body Flexibility Is Associated With Poor Survival in Middle-Aged Men and Women: A Prospective Cohort Study

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Keywords: Flexitest | joint motion | mortality studies | physical fitness | stretching

ABSTRACT

Objectives: Flexibility is recognized as one of the components of physical fitness and commonly included as part of exercise prescriptions for all ages. However, limited data exist regarding the relationship between flexibility and survival. We evaluated the sex-specific nature and magnitude of the associations between body flexibility and natural and non-COVID-19 mortality in a middle-aged cohort of men and women.

Design: Prospective cohort study.

Methods: Anthropometric, health and vital data from 3139 (66% men) individuals aged 46–65 years spanning from March 1994 to October 2022 were available. A body flexibility score, termed Flexindex, was derived from a combination of 20 movements (scored 0–4) involving seven different joints, resulting in a score range of 0–80. Kaplan–Meier survival curves were obtained, and unadjusted and adjusted hazard ratios (HRs) for mortality estimated.

Results: During a mean follow-up of 12.9 years, 302 individuals (9.6%) comprising 224 men/78 women died. Flexindex was 35% higher in women compared to men (mean ± SD: 41.1 ± 9.4 vs. 30.5 ± 8.7; $p < 0.001$) and exhibited an inverse relationship with mortality risk in both sexes ($p < 0.001$). Following adjustment for age, body mass index, and health status, the HR (95% CI) for mortality comparing upper and bottom of distributions of Flexindex were 1.87 (1.50–2.33; $p < 0.001$) for men and 4.78 (1.23–31.71; $p = 0.047$) for women.

Conclusions: A component of physical fitness—body flexibility—as assessed by the Flexindex is strongly and inversely associated with natural and non-COVID-19 mortality risk in middle-aged men and women. Future studies should assess whether training-induced flexibility gains are related to longer survival.

Claudio Gil S. Araújo is the first and senior author.

PLOS ONE

RESEARCH ARTICLE

Age-related changes in gait, balance, and strength parameters: A cross-sectional study

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Abstract

Background

Longevity is increasing worldwide due to improvements in healthcare and living standards. Aging is often associated with disability and multiple health concerns. To address these challenges, effective interventions are essential. This study investigated potential age-related declines in gait, balance, and strength. We also sought to assess any relationships between these three parameters and explore potential differences between women and men.

Methods

Healthy individuals over 50 years of age were recruited for this cross-sectional study. Upper extremity (grip) strength and lower extremity (knee) strength of the dominant side were measured. Static balance was performed on the force plate in different situations each for 30 seconds: bilateral stance with eyes open, bilateral stance with eyes closed, as well as dominant leg and non-dominant leg unilateral stance with eyes open. Gait was measured during level walking using an optical motion capture system. Additionally, the dynamic stability margin (DSM) was calculated for the level walking trials.

Results

The study results indicated that gait parameters were not significantly affected by age ($p \geq 0.12$), while knee and grip strength, along with several balance parameters, showed a significant decline with age. All individuals were able to maintain their bipedal balance, but their center of pressure movement increased significantly by age ($p \leq 0.028$). Z-scores were calculated to compare significant age parameters. Unipedal stance time was found to be the most affected by age compared to other contributing factors ($p \leq 0.001$). The duration of unipedal balance showed the most significant change per decade (non-dominant: -0.62 SDs;

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Original Article

Relationship between toe grip strength and dynamic balance in older adult patients with femoral neck fracture

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Abstract. [Purpose] Femoral neck fractures are a common problem resulting from balance impairment. Toe grip strength is related to balance function. This study aimed to confirm the type of balance function that is highly related to toe grip strength. [Participants and Methods] The participants included 15 patients who were examined for differences in toe grip strength between the affected and nonaffected side. The relationship between toe grip strength and functional balance scale (FBS) and index of postural stability (IPS) was analyzed. [Results] The result showed no significant difference between the nonaffected and affected sides. A correlation exists between toe grip strength and FBS and IPS. In addition, the data from the center-of-gravity sway meter showed a correlation only between the toe grip strength and anteroposterior diameter of the stable area but not between the right and left diameters of the stable area and anterior and posterior trajectory lengths. [Conclusion] No significant difference was found between the affected and nonaffected sides. The results suggest that toe grip strength is related to the ability to move the center of gravity forward and backward rather than to sustain the center of gravity.

Key words: Functional balance acale, Index of postural stability, Toe grip strength

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INTRODUCTION

Femoral neck fractures are a common problem resulting from muscle weakness in the lower extremity, cognitive decline, impaired balance function, and other environmental factors[1)]. Balance impairment is a particularly major cause of falls[2)]. Training to improve balance function is important to prevent recurrent falls after fracture surgery[3)]. Toe grip strength is related to balance function[4)]. Toe grip strength is related to quadriceps muscle strength, and it has been reported that older adult patients with decreased toe grip strength are at higher risk of falling[5)]. We examined the toe grip strength of 20 older adult patients with femoral neck fractures in our convalescent rehabilitation ward and found that the average weight was 5.9 kg, which was lower than that of healthy women of the same age group, suggesting that older adult patients with femoral neck fractures may have decreased toe grip strength[6)]. However, there have been no reports on the difference in grip strength between the affected side and the nonaffected side in convalescent rehabilitation wards.

We used the Index of Postural Stability (IPS) to measure dynamic balance[7)]. The IPS includes two finger drifts; the stability area, which is the range of adaptation without posture loss in the base of support; and the area of the center of gravity sway, which expresses the degree of instability of postural adjustment[7)]. The IPS values for healthy participants, including the older adult, are 2.1 and 1.6 for outdoor activities and 1.4 for independent indoor walking[7)]. IPS was shown to have an intraclass correlation coefficient of 0.99 and a correlation with the Functional Balance Scale (FBS) of r=0.88[7)]. IPS is also considered

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