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THE ASSOCIATION BETWEEN HEEL RISE PERFORMANCE AND STATIC BALANCE IN COMMUNITY DWELLING OLDER ADULTS

[1,2]Rami Hashish, [1]Sachithra Samarawickrame, [1]Man-Ying Wang, [1]Sean S-Y Yu, and [1]George Salem
[1]University of Southern California, Division of Biokinesiology and Physical Therapy
[2]email: rhashish@usc.edu, web: pt.usc.edu/rhashish

SUMMARY
The unilateral heel rise (UHR) test is a measure of both plantar flexor strength and endurance; both of which are fundamental components of balance. This study examined the association between UHR performance and measures of static balance. Twenty-two community dwelling healthy older adults (HOA) completed two testing sessions one-week apart, consisting of UHR performance and a biomechanical assessment of static balance. UHR performance was significantly associated with COP motion during double-leg standing. It is suggested that the UHR test be incorporated as a measure of plantar flexor muscle performance within a comprehensive analysis of balance in HOA.

INTRODUCTION
Ankle planter-flexor strength influences balance, gait, and turning; essential facets of activities of daily living.[1] The manual muscle test (MMT) is the most common clinical assessment tool for ankle strength. It grades patients according to their ability to resist a force applied by the practitioner.[2] MMT, however, is not discriminative in its ability to measure force generation in individuals with normal strength.[3] As a result, the UHR test has been implemented as a surrogate to MMT.[1,2,4]

The UHR test includes several aspects of motor control, including balance and coordination.[4] Balance performance includes the ability to stand motionless and to react to postural challenges and is imperative for functional mobility and independence.[5] Prior studies have reported a significant positive association between balance and plantar flexor strength,[6] and a negative association between balance and plantar flexor fatigue.[7] However, no single test that incorporates both strength and endurance (i.e. UHR) has been examined in relation to balance performance in community-dwelling seniors.

The displacement of the center of pressure (COP) that occurs during a standing task may be used to quantify static balance capabilities.[8-10] Therefore, in order to assess the association between plantar-flexor performance and balance ability, we examined the relations between COP motion and UHR repetitions in HOA.

METHODS
Subjects in this examination were part of the Yoga Empower Seniors Study (YESS): a non-controlled, 32-week intervention study examining the biomechanics associated with yoga participation in seniors. Twenty-two (6 males and 16 females) community-dwelling seniors participated in the baseline assessment; their average age, height, and weight was 71.0 ± 4.3 years, 1.67 ± 0.09 m, and 71.1 ± 15.9 kg, respectively.

As part of the baseline YESS protocol, participants completed two visits, one-week apart, at the Musculoskeletal Biomechanics Research Laboratory at the University of Southern California Health Science campus. The first visit consisted of functional performance measures, including UHR performance; the second visit consisted of a biomechanical assessment of balance (as well as yoga performance).

The UHR testing procedure and criteria for a successful repetition was predicated upon previous investigations by Lunsford and Perry (1995) and Jan et al (2005).[1,2] The UHR test was performed barefoot on the dominant limb, operationally defined as the leg with which they kicked a ball.

For static balance, the subjects were instructed to stand with their feet together, as still as possible, on a force plate, with their arms at their sides. The participants were instructed to look straight ahead throughout the trial. Each static balance task was initiated by the examiner by verbalizing the word "go" to the participant. Each individual attempted to complete three, 20-second trials.

Static balance was assessed using four variables of COP motion[8-10]: Mean COP deviation (MD), root mean square (RMS) values of COP excursion in the ML and AP directions, as well as the RMS value of total COP excursion (RMS T). MD was measured as the distance relative to the average of all data points (the centroid) of the COP excursion.

The number of complete heel rises achieved during the UHR test, and the mean of the aforementioned static balance variables were used for statistical analysis. UHR performance was correlated with the respective balance variables using Pearson product-moment correlation coefficients. All statistical calculations were conducted using SPSS Version 18.0 (IBM Corporation; New York, USA).

RESULTS AND DISCUSSION
Mean UHR performance across participants was 21.3 +/- 6.1 repetitions. There were significant correlations at the $\alpha < .05$ level between UHR performance and MD (-.361), RMS ML (-.407) and RMS T (-.374), but not RMS AP.

The UHR test demonstrated significant associations with 3 variables of COP motion. In each of these negative correlations, better performance of UHR was associated with reduced COP excursion. These findings indicate that healthy seniors with better UHR performance present with better static balance.

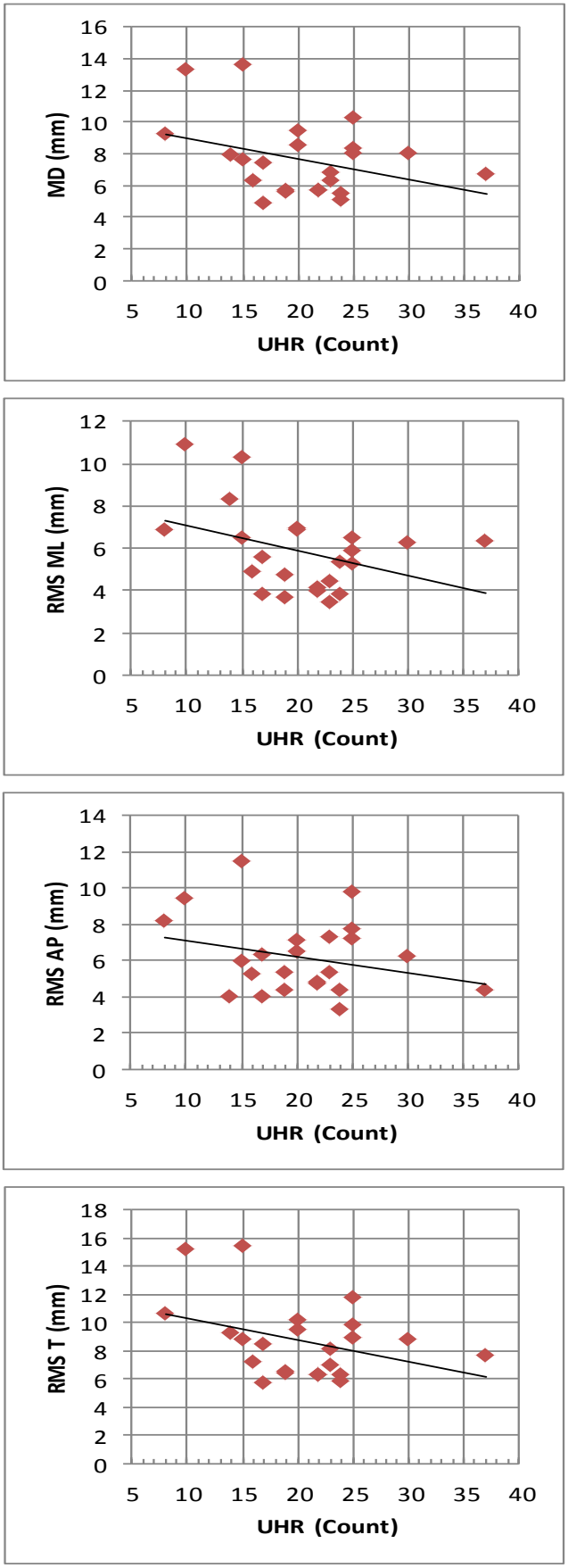

Figure 1: Best fit line of the static balance measures against heel-rise count.

CONCLUSIONS

To our knowledge, this study is the first to investigate the association between UHR performance and COP excursion in community dwelling older adults. The significant correlations between UHR and COP motion suggest that plantar-flexor muscular endurance is associated with static balance performance. Therefore, it is suggested the UHR test be incorporated in comprehensive evaluations of static balance in HOA. This information may be used to identify potential muscular-performance deficits contributing to poor balance capabilities in HOA.

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