Single-Leg Stance is the Best Predictor of Aging

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Summary

Good balance, muscle strength and an efficient gait contribute to people's independence and well-being as they age. This cross-sectional study collected established markers of age-related declines in gait, balance, and strength from 40 community dwelling older adults. Standing on the non-dominant leg showed the highest rate of decline with age. Knowledge of these changes can help clinicians develop programs to ensure healthy aging**.**

Introduction

Longevity is increasing worldwide because of improvements in healthcare and living standards. Gradual loss of physical capabilities is a characteristic of aging. While aging is not a disease, it is associated with disability and multimorbidity. Adequate muscle strength, efficient gait, and good balance, which all decline with age, are crucial contributors to independence and well-being.

Despite previous studies investigating the age-related factors of gait, balance, and strength, a hierarchy for these measures has not been determined. Our aim was to investigate how aging affects gait, balance, and strength in a healthy, independent adult cohort, compare the rates of age-related decline of these parameters, and establish a hierarchy across the study measures. Additionally, we sought to explore if there were any sex differences in aging.

Methods

A convenience sample of 40 healthy community-dwelling individuals over 50 years of age were tested in this cross-sectional study. Upper extremity (grip) strength and lower extremity (knee) strength of the dominant side were evaluated. Static balance was performed on a force plate for 30 seconds in different situations: bilateral stance-eyes open, bilateral stance-eyes closed, as well as dominant leg and non-dominant leg unilateral stance-eyes open. Gait was measured during level walking using an optical motion capture system. All outcome measures were normalized using appropriate body scaling parameters [1] to adjust for different anthropometrics. A z-score was calculated for the outcome measures that were significantly related to age. These z-scores were then compared to identify the hierarchy of outcome measures related to aging. All statistical analyses were performed in R.

Results and Discussion

There were several significant age-related reductions in strength and balance. There were no sex-related differences for any parameters, except for strength. Knee strength declined at a rate of 1.4% (Nm/Nm) per decade. Grip strength declined at a rate of 3.7% (kg/kg) per decade for both sexes. Men had 27% higher knee strength and 30% higher grip strength. Balance showed the greatest changes with age. When standing on both legs, the COP sway increased 6% per decade with eyes open and 10% per decade with eyes closed. Unipedal standing duration significantly declined at the rate of 17% per decade on the dominant side and 22% per decade on the non-dominant side for both sexes (Figure 1). Gait-including walking speed and stride length-were not significantly affected by age.

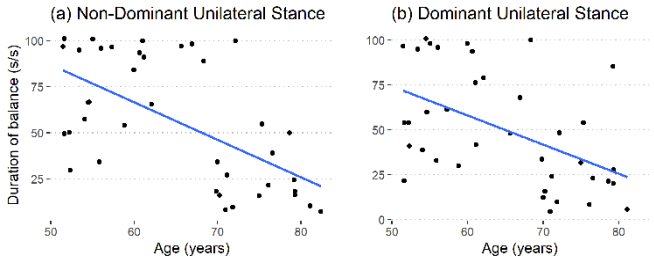

Figure 1: Unipedal stance time declines with age for the (a) non-dominant (r^2=0.38, p<0.001) and (b) dominant sides (r^2 =0.27, p=0.004).

Unipedal stance time is a valid measure of frailty, independence, and fall status [2, 3]. The significance of unipedal stance arises from the fact that it requires multiple sensory inputs and neuromuscular control, in addition to adequate muscle strength. This is why balance on one leg undergoes the fastest decline, as demonstrated in this healthy cohort of older adults.

Conclusions

The duration an older adult can maintain balance on one leg emerged as the most reliable determinant of aging, surpassing strength, gait, and other balance parameters. Unipedal balance testing in community-dwelling individuals, regardless of sex, should be performed as a standard of care.

Acknowledgments

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