Assessing Ways to Gauge Aging Status

Grip strength, knee strength, and balance—especially the ability to stand on just one leg—decline significantly in the decades after age 50.

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Medical advances and improved resources have been helping people around the world live longer than ever. But longevity is linked to a gradual decline in physical abilities. Muscle mass and strength tend to wane over time. So do balance and other factors related to walking. These are all important to independent living and well-being. But it has not been clear which of these characteristics decline more quickly with age, and at what rates.

To learn more, a research team led by Drs. Asghar Rezaei and Kenton Kaufman of the Mayo Clinic set out to assess gait, balance, and strength in healthy people over age 50. Their study enrolled 40 participants. Half were between ages 50 and 64. The rest were ages 65 or older. In each group, half of the participants were female, and half were male.

Each participant underwent a series of tests in a motion analysis lab. Reflective markers were attached to specific locations on each participant's feet, thighs, pelvis, head, and more. To assess gait, a 14-camera motion capture system recorded marker movements as people walked back and forth on an eight-meter-long walkway. Force plates on the floor measured ground reaction forces to detect changes in the center of pressure. Balance tests similarly used force plates to record movements and center of pressure data. The balance tests assessed the body's sway as people stood on one leg with eyes open and on both legs with eyes open and closed. Grip strength and knee strength were measured by using specialized devices. Results were reported on October 23, 2024, in PLOS ONE.

The researchers found that gait characteristics—including walking speed and stride length—were not significantly affected by age. In contrast, several measures of balance and strength showed significant age-related reductions.

No sex differences were observed for any parameters, except for strength. Grip strength was 30% higher in men than in women, and knee strength was 27% higher in men. But in both sexes, strength declined at similar rates over time. Regardless of sex, grip strength in the dominant hand dropped by 3.7% per decade of age, and knee strength by 1.4%.

Balance showed the greatest reduction with age, especially the ability to stand on one leg for at least 30 seconds. Single-leg standing time on the non-dominant leg dropped by 21% per decade of

age, and on the dominant leg by 17% per decade.

The researchers also found that when standing on both feet, participants who were older tended to move or sway more (their center of pressure changed more). When standing with eyes closed, standing movements increased at a rate of 10.4% per decade of age. When standing with eyes open, the rate of movement rose by 6.3% per decade.

The findings suggest that how long a person can stand on only a non-dominant leg may be a reliable and easy-to-assess measurement of health in aging populations. The measures in this study may also help guide evidence-based training programs that improve balance and strength to help aging people delay or avoid disability.

“Changes in balance are noteworthy. If you have poor balance, you’re at risk of falling, whether or not you’re moving. Falls are a severe health risk with serious consequences,” Kaufman says. But he notes that people can take steps to train their balance. “If you don’t use it, you lose it. If you use it, you maintain it.”

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