CHANGES IN WALKING MECHANICS
Aging adults have noticeable changes in gait patterns. These changes can consist of a shorter stride length, decrease in step frequency, longer stance time, and a shorter swing time; all of which can change the way an older adult functions in their day-to-day lives. More specifically, their ability to perform activities of daily living (e.g., dressing and undressing, getting into and out of bed, ambulation, etc.) and moving quickly from one place to the next can be significantly affected.

One factor that contributes to this change in gait parameters is a decrease in muscular power. Research by Faulkner et al. indicates that the number of muscle fibers in an older adult will decrease by 50% between the ages of 50 – 80 (12). Metter et al. suggest that power and strength will be maintained up to the age of 40, and that power will start to decline at a rate that is 10% more than strength (23). Others suggest that total power will decrease 6 – 11% per decade from young adulthood to old age, which can affect physical performance and overall function during activities of daily living (5,8,13,15,21,22). Research by Izquierdo et al. suggests that explosive force decreases with age and recommends strengthening and explosive exercises (18). These studies suggest that a decrease in power may affect the way older adults walk, and that improving power may slow down or eliminate some of these adverse effects.

The decrease in power can have serious consequences on the gait cycle. Research by Beauchet et al. compared specific gait measures (e.g., stride time, stride length, stance time, swing time, and stride width) between healthy young adults and healthy older adults (1). After an exercise intervention, their research showed that the only significant difference between the two groups was in the stride width variable (1). They also mentioned that stride length was different; however, this was due to a slower walking speed in the older adults (1). The authors concluded that decreased stride width is linked with increased falls in older adults (1). Similarly, research by Kerrigan et al. examined the contribution of hip extension mobility on stride length in older adults and found that hip extension mobility deficits were associated with an increased number of falls (19). The authors suggested flexibility interventions to increase range of motion at the hip joint. However, other research indicates that limited hip extension in walking is a dynamic, rather than postural, phenomenon (20).

Although research by Beauchet et al. indicated that stride width is different between younger and older adults, they did not test whether resistance training can affect walking ability in older adults (1). Research by Persch looked at whether resistance training can alter walking ability in older adults (26). After an exercise intervention, results showed that measures of gait speed, stride length, cadence, and toe clearance improved in the experimental group. The authors concluded that the muscles acting on the knee are strongly correlated to gait performance, and that an increase in knee flexor and extensor strength will greatly improve gait speed and stride length (26). In fact, the knee joint attributed to 44% of the improvement in gait speed as compared to 17% at the hip joint (26). However, hip extensors should not be ignored because results have also
shown that strengthening the hip extensors may improve stride characteristics, including walking velocity, stride length, and cadence, in elderly individuals (7).

One remedy to slowing the inevitable change in power output is through resistance training programs. Research has indicated that high-velocity resistance training (e.g., power training) can improve physical performance and functional measures in older adults (2, 3,6,9,10,11,14,16,17,24,25,28). Sayers et al. states that high-velocity training is a better form of exercise because it mimics the speed of activities of daily living (28). Based on the findings of a meta-analysis, a power-based training program appears to have a slight advantage over strength-based programs for improving overall function in older adults.

Therefore, it seems likely that a high-velocity resistance training program that emphasizes movements for the lower extremities would improve gait speed and stride width. The following will provide information about exercises that could be incorporated into a high-velocity resistance training program, as well as tests that can be used to help determine improvements at the conclusion of a training intervention.

**EXERCISES**

Some suggested exercises include hip flexion, hip hyperextension, calf raises, chair stands, medicine ball slams, medicine ball bounce passes with a partner, and sit-to-stand squat presses with a medicine ball. All of these exercises can be supplemented by some type of external resistance (e.g., wearing a weighted vest, using a medicine ball, or wearing ankle weights). The following are exercises with suggested protocols for implementation with an elderly population.

**Medicine Ball Exercises:** The medicine ball exercises can be performed with a 6-, 8-, or 10-lb medicine ball. As the weeks in the training program progress, repetitions can be increased in increments of two, starting at eight and ending at 20, for example. Three sets of every exercise can be performed during each training session with the prescribed high-velocity movement, which could consist of a concentric phase performed as fast as possible and the eccentric phase within 2 – 3 s.
**Hip Flexion**: Participants should stand next to a chair to aid in balance. An ankle weight (either two or four pounds) can be attached to their ankle as they perform hip flexion by kicking their leg forward (anteriorly) to the end of their range of motion (as fast as possible), and then slowly lower the leg back to standing position within 2 – 3 s.

**Hip Hyperextension**: The participants should perform the same procedure as hip flexion, except their leg should be kicked backward (posteriorly) instead of forward.

![Figure 3. Hip Flexion – Start](image1)

![Figure 5. Hip Hyperextension – Start](image2)

![Figure 4. Hip Flexion – Finish](image3)

![Figure 6. Hip Hyperextension – Finish](image4)
Calf Raises: Participants should stand (wearing a weighted vest) behind a chair and perform standing calf raises. During the up phase (plantar flexion), they should move as fast as possible. During the down phase (dorsiflexion), they should move at a pace of 2 – 3 s.

Chair Stands: Participants should start in a seated position (wearing a weighted vest). They should stand up as fast as possible, and then slowly lower back to a sitting position within 2 – 3 s.
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**Medicine Ball Slams:** Participants should bounce the ball to themselves by slamming it onto the ground directly in front of them. When slamming the ball, they should raise the medicine ball up over their head and then throw it down as fast as possible. They should focus on catching the ball on its way back up.

**Medicine Ball Bounce Passes with a Partner:** The participants should bounce a medicine ball to a partner. They should stand about 10 – 15 ft apart and bounce the ball as fast as possible back and forth between each other.

**Medicine Ball Sit to Stand Shoulder Presses:** The participants should start in a seated position with the medicine ball at their feet. The movement is initiated by bending forward and picking up the medicine ball from the floor. Then they should stand up with the ball at shoulder level, and push it up over their head as fast as possible. The exercise ends with the participants lowering the ball back to shoulder height, returning to the seated position, and placing the ball back on the ground.
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FIGURE 14. MEDICINE BALL SIT TO STAND SHOULDER PRESS – FORWARD REACH

FIGURE 15. MEDICINE BALL SIT TO STAND SHOULDER PRESS – STAND

FIGURE 16. MEDICINE BALL SIT TO STAND SHOULDER PRESS – SHOULDER LEVEL

FIGURE 17. MEDICINE BALL SIT TO STAND SHOULDER PRESS – PRESS OVERHEAD
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TESTS TO MEASURE PERFORMANCE
In order to determine whether walking mechanics improve, the older adults can be tested on various measures of performance at the beginning and end of a training intervention. Specifically, they can be tested on gait velocity, stride length, chair stands, arm stands, and the eight-foot up-and-go (27). The procedures for the chair stand, arm curl, and the eight-foot up-and-go are previously published as part of the Rikli and Jones Senior Fitness Test Manual (27). The following are methods to test gait velocity and stride length.

Measuring Gait Velocity: The gait velocity test uses a multi-function timer to record how fast the participants walk a distance of 25 ft. To perform the test, participants should start five feet in front of the start line and walk as quickly as possible, without running, until the end of the 25-ft course (4).

Measuring Stride Length: To measure stride length, a reflective marker should be placed on the calcaneus of the participants prior to the gait velocity test. Using the reflective marker and a high-speed video camera, the participants’ stride length can be analyzed as they perform the gait velocity test.

CONCLUSION
By using inexpensive and simple equipment, such as medicine balls, weighted vests, and ankle weights, older adults can improve measures of gait through high-velocity training. As compared to the high cost of pneumatic exercise equipment (or other machines commonly found in fitness facilities), this appears more practical for senior centers, independent or dependent living facilities, and nursing homes, as long as the high-velocity component is properly incorporated. Activity directors, personal trainers, and practitioners who work with older adults and do not have a significant amount of money to put into expensive exercise equipment can benefit from this type of training intervention. By using inexpensive equipment and functional movements, older adults can improve on measures of gait velocity, strength, and function through high-velocity training.

REFERENCES


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**ABOUT THE AUTHORS**

Tim Leszczak is an Associate Professor at Austin Peay State University. He received his Bachelor of Science degree in Accounting from Rowan University, and his Master's and PhD degrees from the University of Arkansas. He teaches courses in the Exercise Science Program and also coordinates the Graduate Program. His research interest consists of improving function in older adults as well as exploring different exercise modalities to improve performance measures in college-aged students-athletes.

Lisa Henning is a PhD student, as well as a graduate teaching and research assistant in the Sports Medicine and Movement Laboratory in the School of Kinesiology at Auburn University. She completed her Bachelor of Science degree in Biology from Austin Peay State University. She has published peer-reviewed research in the realm of sports biomechanics. Her primary research interests include rehabilitation and clinical tests of lumbopelvic stability.