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Strength and Speed Training for Elders With Mobility Disability

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Abstract

The purpose of this study was to pilot test a function-focused exercise intervention consisting of strength and gait-speed training in elders with reduced walking speed, decreased walking endurance, and functional impairment. Twelve participants, 77.2 years old (± 7.34), whose usual gait speed was <0.85 m/s, with walking endurance of <305 m in 5 min, and who were functionally impaired participated in a moderate-intensity exercise intervention. The training occurred 3 times per week, 75 min per session, for 3 months and combined 4 weeks of gait-speed training, walking exercise, and functional strengthening. The participants demonstrated mean usual gait speeds (≥1.0 m/s), endurance (≥350 m), and functional ability (≥10 score on performance battery) that were within normal limits after 12 weeks of training. Fastest gait speed (≥1.5 m/s) and muscle strength also improved significantly. Improvements were maintained during follow-up testing after 3–6 months. In summary, a 12-week intervention for frail, mobility-disabled participants led to improvements in walking, function, and strength.

Keywords

aging; gait; treadmill; energy costs

Loss of gait speed is one of the main changes in walking as people age (Bohannon, 1997; Hageman & Blanke, 1986; Larish, Martin, & Mungiole, 1988; Maki, 1997; Nigg, Fisher, & Ronsky, 1994, Okuzumi et al., 1995). Self-selected, usual walking speeds for well, noncompromised individuals 65 years of age or older are 1.0 m/s or above (Bohannon). The average usual walking speed for 70-year-olds has been reported as 1.17 ± 0.17 m/s for women and 1.33 ± 0.17 for men (Bassey, Bendall, & Pearson, 1988). Age-related reduction in walking speed has been reported as being 12–16% annually after the sixth decade (Judge, Whipple, & Wolfson, 1994). Declines in gait speed correlate with increasing disability among elders and might be a component of preclinical disability (Fried, Herdman, Kuhn, Rubin, & Turano, 1991; Guralnik et al., 2000).

General conditioning and strengthening exercises might be ineffective if not sufficiently intense or targeted on each participant's specific impairments. Several researchers have reported that greater improvements were possible if the corresponding interventions were more precisely targeted on the modifiable risk factors of individuals (Maki, 1997; Rubenstein & Josephson, 1990; Tinetti, Baker, & McAvay, 1994). Older persons' functional mobility performance and independence can be improved by enhancing lower extremity muscle function (Chandler, Duncan, Kochersberger, & Studenski, 1998; Fiatarone et al., 1990, 1994; Judge, Underwood, & Gennosa, 1993; McMurdo & Rennie, 1993; Sauvage et al., 1992). Improvements in gait speed are associated with improvements in lower extremity muscle strength and increased function (Binder et al., 2002). Many studies have investigated the strength–function relationship using different tasks in elders (Bendall, Bassey, & Pearson, 1989; Brown, Sinacore, & Host, 1995; Daubney & Culham, 1999; Rantanen, Era, & Heikkinen, 1994; Rantanen et al., 1998). In addition, studies have demonstrated that exercise, even low-intensity exercise, can improve gait speed in elders (Brown et al., 2000; King et al., 2002; Judge et al., 1993; Lord et al., 1996). Most of these studies were conducted with individuals without slowed normal speed. A study by Chandler and Hadley (1996) suggested that the effects of strength training on the timed walking test are only evident when gait speed is habitually below 1 m/s. Few exercise-intervention studies have included a community-dwelling population with gait speeds below this level. Judge (2003) also suggested that traditional resistance-training approaches using seated exercise with ankle weights might not have sufficient training specificity to improve measures of physical function such as stair climbing, chair rise, or gait speed. No study has included specific gait-speed training in combination with a function-focused strength-training intervention for mobility-disabled elders.

We conducted a pilot study of an exercise intervention that combines function-focused lower extremity strength training with an innovative program of gait-speed training for individuals 70 years of age or older who demonstrated a mobility disability, as characterized by a usual gait speed of <0.85 m/s and/or gait endurance of <305 m during a 5-min walk (Murphy, Olson, Protas, & Overby, 2003).

Methods

Participants

Twelve participants who were recruited from the community participated in the exercise training (2 men, 10 women; age 77.2 ± 7). A walking speed less than 0.85 m/s or a 5-min-walk distance less than 305 m was used to select participants who met the criteria for mobility disability. These cutoff points (speed or distance) were chosen based on the highest combined sensitivity and specificity values developed for fall risk by Murphy et al. (2003). In addition, only participants with a Short Physical Performance Battery (SPPB) score of ≤9 were included, to select participants who were functionally impaired (Guralnik et al., 1994). We excluded participants who had cognitive impairment as demonstrated by a score ≤23 on the Mini-Mental State Exam (Folstein, Folstein, & McHugh, 1975), were dependent in more than one activity of daily living (Katz, Ford, Moskowitz, Jackson, & Jaffee, 1963), had any medical contraindication to exercise (such as recent heart attack, abnormal stress test), had a lower extremity amputation, had a history of hip- or knee-joint replacement or repaired fractured hip, or had Parkinson's disease requiring antiparkinsonian medication. The exclusion of prior lower extremity orthopedic and neurologic conditions was to reduce situations that might attenuate the response to the intervention. Participants currently enrolled in rehabilitation or an aerobic-exercise program were also not included. All participants provided written informed consent as approved by the institutional review board of the University of Texas Medical Branch.

Procedures

Mobility-disabled participants engaged in a task-specific, function-focused intervention consisting of lower extremity strength training and walking exercise combined with speed training on a treadmill. Training occurred in a group session three times per week, 75 min each session, for 3 months.

Exercise Intervention—The first 15 min of exercise consisted of a warm-up activity of walking around an indoor track at a slow pace of low intensity, followed by 5- to 10-s bouts of fastest walking interspersed with standing rests and a 5-min walk of moderate intensity (Borg ratings of perceived exertion 12–14; (Borg, 1982). A 60-min progressive resistance-exercise period followed the warm-up, consisting primarily of closed kinetic chain exercises using body weight as resistance for all major muscle groups of the lower extremity. This exercise intervention was modified from exercise interventions suggested by Olson, Wang, and Protas

(2001); Protas et al. (2001); and King et al. (2002). Exercises were selected to include function-focused activities, such as standing from a chair or the floor and stepping up, that are specific to tasks commonly performed in daily life. Intensity was increased by the number of repetitions, by performing unilateral activities, or by adding weight to vests (Table 1). The remaining 15 min of the 75 min were used for rest as needed throughout the exercise session.

Speed Training—Participants underwent an exercise-tolerance test in the Division of Cardiology to screen for normal cardiovascular responses to exercise before undergoing speed training. The speed-training approach was reported by Pohl, Mehrholz, Ritschel, and Ruckriem (2002) as a method to increase gait speed in older individuals after a stroke. The participants were placed in a harness attached to a standing frame over the treadmill for safety and in case of a fall (TreadSafely, Health Solutions, Inc., Clear Lake, TX). Each participant's fastest gait speed was noted from the preliminary gait-speed test and designated as S_1 for the first trial. The treadmill speed was increased over 1–2 min to that speed, and the participant walked at that speed for 10 s. The participant was allowed a short rest of 1–2 min before beginning the next trial. The speed of this trial was increased another 10% over S_1. The speed continued to be increased each trial by another 10% over the previous trial for five trials, unless the participant was unable to maintain the speed. In this case, the speed from the previous trial was maintained. The next session started with the fastest speed from the previous session. To ensure that the participants were properly conditioned before beginning this training, the speed training occurred during the last 4 weeks of training only.

Compliance—If a participant missed more than three consecutive exercise sessions for medical or other reasons, the participant was dropped from the study. If an occasional session was missed, the participant was allowed the make up the session until a total of 36 training sessions had occurred before posttesting.

Measures

Participants were tested for gait speed, gait endurance, function, and lower extremity muscle strength. Testing occurred 1 week preintervention, after 6 and 12 weeks of intervention, and at follow-up (3–6 months) for gait speed, 5-min-walk distance, and function. Oxygen costs and muscle strength were only tested before and after 12 weeks of intervention. Demographic information, medical history, medications taken, and level of depression were also collected at the beginning of the study.

Gait Speed—An instrumented walkway (GaitRite, CIR Systems, Havertown, PA) was used to measure gait speed. Each participant's leg length was measured from the greater trochanter to the lateral malleolus and entered into the system along with age, gender, height, and weight. The participant was given verbal directions and asked to step on the end of the gait mat. Participants were instructed to walk at their usual gait speed. There were two consecutive trials, and participants could rest between trials if necessary. The two trials were averaged to determine self-selected, usual gait speed. After a short rest, the participants were asked to walk at their fastest safe speed. Again, two trials were conducted and averaged to determine fastest speed. This test has been found to be reliable for repeated tests on individuals with and without neurologic deficits (Cutlip, Mancinelli, Huber, & DiPasquale, 2000; McDonough, Batavia, Chen, Kwon, & Ziai, 2001; Urquhart, Morris, & Iansek, 1999). The primary variables of interest were usual and fastest gait speed (m/s). A cutoff score for usual gait speed of ≤0.85 m/s has been identified as being specific and sensitive to elders who fall (Murphy et al., 2003).

Gait Endurance—The 5-min-walk test was used to assess gait endurance by recording the distance walked during a 5-min period (Protas, 1997). Stanley and Protas (1991) have reported that, in elderly women, the 5-min walk provided moderately better estimates of maximal exercise performance than a 3-min walk. The 5-min-walk test distance has excellent test–retest reliability (r = .92; Peloquin, Gauthier, Bravo, Lacombe, & Billiare, 1998) and responsiveness (Peterson et al., 1993; Price, Hewett, Kay, & Minor, 1988). Participants were asked to walk as far and fast as possible in 5 min on an indoor circular track. Each participant was accompanied by a tester who was timing the walk with a stopwatch and using a wheeled measuring device to record the distance (MeterMaster Measuring Wheel). A cutoff score of 305 m has been identified as being sensitive and specific for fall detection in elders (Murphy et al., 2003).

Gait Energy Costs—Before beginning the walk test, each participant was fitted with a portable gas analyzer, a facemask, and a chest-band heart-rate transmitter. Samples of oxygen consumption (VO_2) were recorded every 20 s, and three recordings were averaged to obtain the amount of oxygen consumed for each minute (Medical Graphics model VO2000, Minneapolis, MN). Values for the last 2 min were used to ensure a steady state for VO_2. These values were averaged and recorded in milliliters of O_2 per kilogram of body weight per minute walked (ml $O_2 \cdot kg^{-1} \cdot min^{-1}$). The oxygen consumed per meter walked, the gait energy cost (C), was also calculated. C was obtained by dividing the average VO_2 for the last 2 min by the average number of meters walked per minute during the last 2 min of the walk test (total distance divided by 2). C was recorded in ml $O_2 \cdot kg^{-1} \cdot m^{-1}$. C has been shown to be a reliable measure during walking in healthy normal and older individuals (Cunha, Henson, Wankadia, & Protas, 2003; Cunha, Henson, et al., 2003).

Muscle Strength—Dynamic concentric knee-extensor and knee-flexor strength were determined for each leg as the maximal load a participant could lift a single repetition with proper form through a full range of motion (one-repetition maximum [1-RM]). All tests were unilateral. Participants were familiarized with the testing procedure to ensure that a maximum value was obtained. They were instructed about proper breathing and lifting techniques and warmed up with stretching exercises of the lower limbs followed by small loads on the resistance apparatus. An initial weight was chosen that was estimated to represent approximately 80% of the participant's 1-RM and was progressively increased until the participant could not, on at least two attempts, move the lever arm through the full range of motion. To minimize the effects of fatigue, 1 min of rest was allowed between attempts, and 3–5 min between each movement. A physical therapist supervised all strength testing. Ankle plantar-flexor strength was tested by asking the participant, standing on one lower extremity, to rise onto the toes and back down as many times as possible in 30 s. The participant was allowed to hold onto a chair lightly to keep his or her balance (Lunsford & Perry, 1995). The number of repetitions was recorded. This measure has been shown to be sensitive in exercise interventions in frail elders (Chandler, Duncan, & Studenski, 1997).

Function—To capture aspects of mobility function other than gait, we also used a timed step test, a timed floor transfer, and the SPPB. For the timed step test, the participant was asked to step up onto and down from an 8.8-cm step as fast as possible for five consecutive steps while being timed by a tester with a stopwatch. This test was scored as the number of steps per second, so better performance is reflected as a higher number. For the floor transfer, the participant was asked to move from complete standing down to a long sitting position on a mat and back up to complete standing. A chair was placed nearby, and the participant was told that it could be used for support if needed during this task. The inverse of this value was used (1 transfer/ x seconds), so higher scores reflect better performance. These variables discriminate between elders who fall and those who do not report falls and between elders who do not report mobility disability and those who do (Murphy et al., 2003; Wang, Olson, & Protas, 2005). The SPPB (Guralnik et al., 2000, 1994) included a timed test of five chair stands, a timed 4-m walk, and a timed tandem or semitandem stand. Each of the three tests was scored on a 5-point ordinal scale from 0 to 4, with 4 being the best performance. These scores are summed for a final score ranging from 0 to 12. Scores of 10 or lower have been used to define elders with lower extremity disabilities (Bean et al., 2004).

Statistical Analysis

Means and standard deviations were calculated for pretraining, after 6 and 12 weeks of training, and at follow-up and compared with an analysis of variance with repeated measures for time. If a significant *F* ratio resulted, post hoc comparisons with paired *t* tests were performed between baseline and 6 and 12 weeks and follow-up, and between the 12-week and follow-up values. We selected an α level of .05 with a Bonferroni correction (.05/4 = .013). Variables measured twice (oxygen costs and strength) were compared with paired *t* tests.

Results

Twelve participants engaged in the exercise training (2 men, 10 women; age 77.2 ± 7; MMSE 27.1 ± 4; Geriatric Depression scale 9.3 ± 4.8; SF 36 69.4% ± 10.5%; comorbidity 5.6 ± 1; number of medications 3.8 ± 3; Table 2). Nine completed the 12 weeks of training. Three participants dropped after 4, 7, and 8 weeks, respectively. The participant who dropped after 4 weeks was diagnosed with lung cancer and dropped the study to undergo treatment. This participant was unavailable for any further testing. The participant who dropped out after 7 weeks developed a lung infection before dropping out and subsequently died. The participant who dropped out after 8 weeks had a 45-min drive and had a transportation problem. All participants who completed the exercise training initially demonstrated mobility disabilities at the baseline but had mean usual gait speeds and 5-min-walk distance values that were within normal limits after 12 weeks of training (Table 3 and Figure 1). Fastest gait speed also improved significantly. Walking efficiency as measured by O_2 costs per meter walked did not change, although participants were walking farther and faster after the training. Improvements in strength and the other measures of function also occurred. Seven of the 9 participants were retested 3–6 months after the training ended. The range of the follow-up period varied depending on the availability of the participants, but the average was 5 months. Improvements in usual and fastest gait speed, gait endurance, and the functional measures of timed chair stands and the timed step test were maintained at follow-up. After completing the training, participants reported that they could continue many of the exercises at home and that they walked on 3–7 days/week. Several participated in senior exercise classes weekly. None of the participants had participated in exercise before the study. Two of the 3 participants (out of 12) who stopped training also showed functional improvements (Table 4). We had only pretest data available for the participant who dropped out after only 4 weeks and was unavailable for the 6-week test. Compliance was good with the remaining 9 participants. Participants missed from 0 to 3 sessions but finished all 36 sessions.

Discussion

A 12-week moderate exercise intervention including walk training and functionally focused strength training together with 4 weeks of speed training produced significant improvement in lower extremity strength, as well as improvements in gait and function, in mobility-disabled elders. Gait and functional improvements were maintained at follow-up. A recent study comparing functional-task exercise versus resistance-strength exercise to improve daily function in community-dwelling older women without mobility disabilities demonstrated task-specific results (de Vreede, Samson, van Meeteren, Duursma, & Verhaar, 2005). Daily activity improved more with the functional-task exercise than with the strength training or the control, whereas strength improved more with strength training than in the other two groups. Furthermore, function remained improved 6 months after training stopped in the functional-task group; however, knee-extensor strength had returned to baseline values for the resistancetrained group. Two other studies have used task-specific approaches with more disabled elders (Alexander et al., 2001; Ouslander et al., 2005). Both studies demonstrated improved mobility, ability to stand from a chair, and muscle strength in frail elders. A recent randomized, controlled trial of quadriceps exercise used participants whose mean age was 79 and who demonstrated slowed walking speed or a median, average walking speed of 0.47 m/s (Latham et al., 2003). After an exercise program with ankle weights representing 51% of a 1-RM undertaken three times per week for 10 weeks, no significant increase in quadriceps strength or gait speed occurred compared with an attentional control. Because the first 2 weeks of this study consisted of reduced resistance intensity of 30–40% of 1-RM, this study duration was closer to 8 weeks of training with an adequate intensity. Perhaps the duration was not sufficient, the intensity not adequate, or both (Judge, 2003). These findings, together with our data, suggest the importance of targeted, function-oriented exercise training to improve mobility and function in the elderly.

By combining function-focused strengthening with gait-speed training on a treadmill, we increased usual and fastest gait speed in elders who initially demonstrated gait-velocity impairment. A task-specific aspect of our exercise intervention was the gait speed used during training. Several studies have suggested that high velocity might be an important component of improving muscle strength and power in both highly functioning elders and those who report physical-functional impairments (Bean et al., 2004; Earles, Judge, & Gunnarson, 2001; Fielding et al., 2002). Other studies used exercise machines, and the activities were performed at high velocity (Earles et al.; Fielding et al.). Although these approaches improve muscle strength and power, some investigators have questioned the link between this form of training and improved mobility in elders (Bean et al.; Foldvari et al., 2000). One small pilot study compared weighted vests and functional tasks designed to be specific to mobility-related tasks, with an emphasis on increased velocity of performing the tasks with seated, low-resistance exercises performed three times per week for 12 weeks (Bean et al.). The participants at baseline had physical-performance limitations based on SPPB scores of 7.5 (out of 12), average gait speeds of 0.75 m/s, and five-chair-stand times of 19 s (<11 s is normal). It is interesting that both groups improved function in that their SPPB scores increased and the time for five chair stands decreased. Only the velocity-trained group improved gait speed. Another approach to velocity training for gait is specific speed training on a treadmill (Pohl et al., 2002). This approach involves short bouts of walking on the treadmill with gait speeds increasing from fastest overground walking speed by 10% on each bout so that the speed increases 40–50% by the end of a single training session. Pohl et al. were the first group to report normalized gait speeds after 4 weeks of training three times per week in individuals with stroke who had a walking impairment at baseline. These findings support the idea that speed or velocity training might be important in improving gait function in elders with a gait deficit.

This study had limitations that restrict the generalizability of our findings. The small sample size of community-dwelling, mobility-impaired elders is a distinct limitation. Small samples can produce spurious results by large changes in a few participants or missing adverse events important to the intervention. Although the average weight of the study dropouts was higher than those who completed the study, one of the participants who dropped out (Participant 15) was obese (120 kg). We also did not have a no-intervention control group to compare with the participants who completed the exercise training. A comparison with a control group would provide greater confidence in the outcomes of the intervention. Further studies on a larger population and with a control group design will be necessary to confirm these results. The measures used have excellent psychometric properties that represent a variety of mobility functions and strength characteristics. These measures promise to further describe the relationship between strength and function. We were unable to include all of our participants in the follow-up tests, so further study is needed to define the longer term carryover of our findings. We also had a variable follow-up period because of the availability of the participants. The participants reported that they were walking better and that this enabled them to be more active and to travel. One limitation to supervised exercise programs for elders is that the participants often do not continue the activity after the formal program ends. We selected activities, with the exception of the speed training, that the participants could continue on their own. This might have contributed to the maintenance of improved function at follow-up.

Conclusion

Task-specific intervention can improve function and strength in elders with mobility disability. Speed training might be an important component in improving gait function in this population. Finally, functional status can be retained for 3–6 months after formal training ceases.

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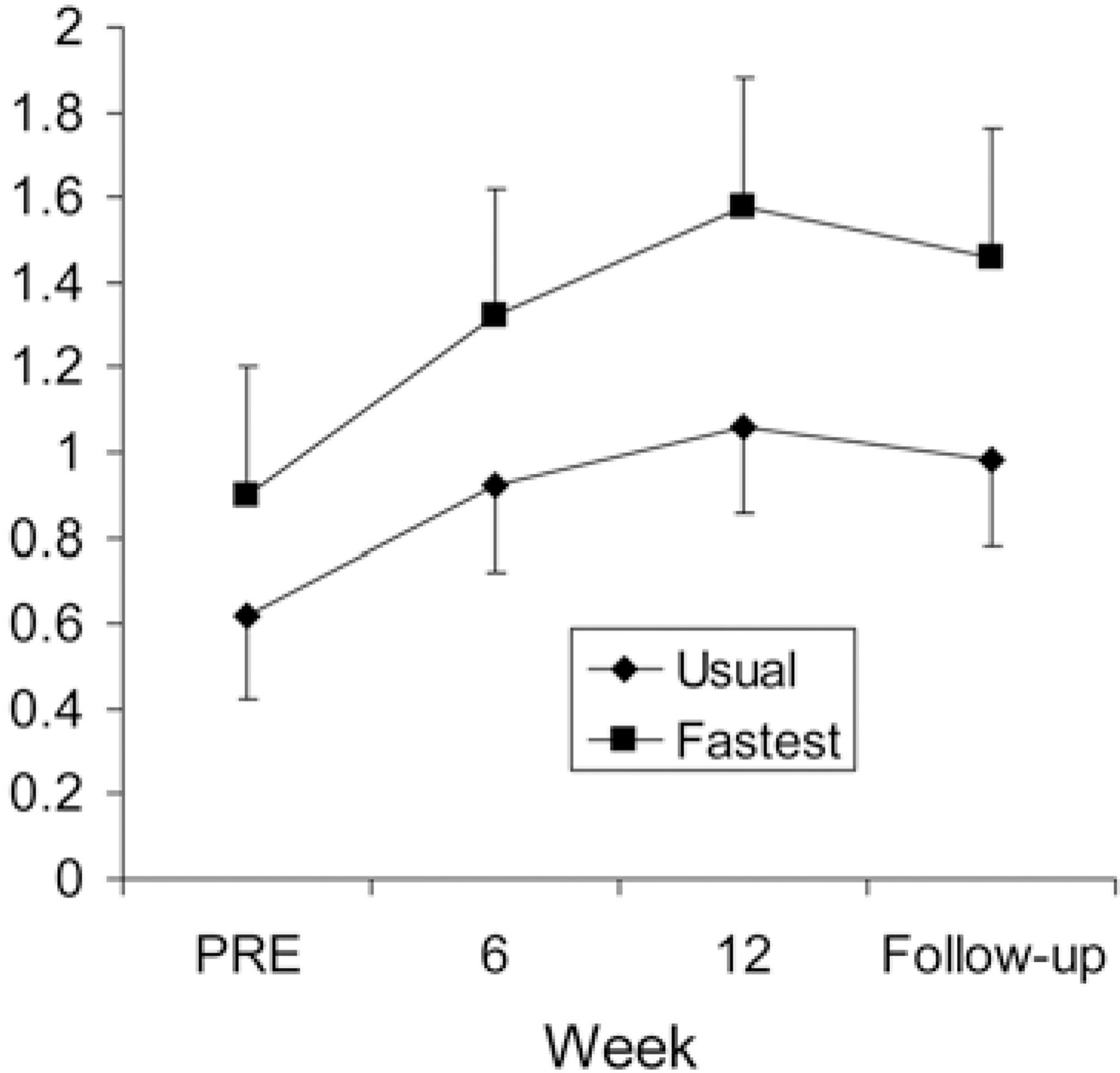

Figure 1.
Usual and fastest gait speed (m/s) in mobility-disabled elders before and after function-focused and gait-speed training. PRE = preintervention.

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Table 1

Function-Focused Exercise Intervention

Exercise	Type	Description	Duration (min)	Intensity	Progression	Targeted effects
Slow walk	Warm-up	Slow walking speed on track.	5	Mild		
Usual to fast walk	Endurance	5-min walk around track.	5	RPE 12–14	Increase distance walked, add weighted vest (0.9–1.4 kg).	Walking endurance
Brisk walk	Speed	Fast walk on track for 10-s bouts, standing rests.	5	RPE 12–14	Increase speed, add weighted vest (0.9–1.4 kg).	Walking and speed
Steps	Strength, endurance	Step up and back down an 8.8-cm step.	5	2–6 bouts of 10 steps	Increase speed, number of bouts, add weighted vest (0.9–1.4 kg).	
Sit-to-stands	Strength	Rise from a 20-in. chair as rapidly as possible without arm support.	5	10–12 reps	Decrease chair height to 17 in., then 15 in. Add additional bouts of 10–15 stands, add weighted vest.	Hip- and knee-extensor strength
Lunges	Strength	Using upper extremity support, take a large step and go into a partial kneel.	5	10–15 reps	Add additional bouts, add weighted vest (0.9–1.4 kg).	Hip- and knee-extensor strength
Ankle Plantar flexion	Strength	Using upper extremity support, rise up on toes and slowly lower body weight.	5	10–20 reps	Stand on 3.8-cm block, perform unilaterally Add bouts, add weighted vest (0.9–1.4 kg).	Plantar-flexor Strength
Bridging	Strength	Lying supine on mat, slowly lift buttocks off mat and slowly descend.	5	10–20 reps	Add bouts, perform unilaterally.	Hip- and knee-extensor strength
Floor transfer	Strength	From standing, go down to a sitting position on the floor and stand up again.	5	1–5 reps	Add bouts, add weighted vest (0.9–1.4 kg).	Hip and knee strength
Knee bends	Strength	With upper extremity support, slowly lower body weight and return to standing.	5	10–15 reps	Perform unilaterally, add weighted vest (0.9–1.4 kg).	Hip and knee Strength
Gait speed training	Speed	On treadmill, walk fastest overground speed, increase each trial.	10	5 trials	Increase speed by 10% every trial, up to 5 trials and 50%.	Walking speed
Usual walk	Cooldown	Usual walk on track.	5			

Note. RPE = rating of perceived exertion.

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Table 2

Participant Characteristics

	n	Age	Sex	Height (m)	Weight (kg)
Participated in the study	12	77.2 ± 7.36	2 men, 10 women	1.6 ± 0.09	75.2 ± 18.7
Completed the study	9	78 ± 7.5	1 man, 8 women	1.6 ± 0.07	69.4 ± 12.7
Dropped out of the study	3	75 ± 7.5	1 man, 2 women	1.6 ± 0.1	92.8 ± 25.9

Table 3

Gait, Function, and Strength Results for Mobility-Disabled Participants, *M* ±*SD*

	Week			
	0 (*n* = 9)	**6 (*n* = 9)**	**12 (*n* = 9)**	**Follow-up (*n* = 8)**
Gait				
usual gait speed (m/s)	0.70 ± 0.11	0.94 ± 0.18*	1.06 ± 0.15**	0.98 ± 0.22*‡
fastest gait speed (m/s)	1.03 ± 0.16	1.40 ± 0.27**	1.58 ± 0.25**	1.46 ± 0.30*‡
5-min-walk distance (m)	233.4 ± 54.3	333.9 ± 68.1**	359.3 ± 52.5**	358.1 ± 106.0*
Oxygen costs ($ml \cdot kg^{-1} \cdot min^{-1}$)	11.09 ± 2.17		15.04 ± 3.01	
Oxygen costs ($ml \cdot kg^{-1} \cdot m^{-1}$)	0.23 ± 0.05		0.21 ± 0.07	
Function				
chair stands (s; *n* = 8)	17.9 ± 7.9	8.2 ± 1.9*	8.6 ± 1.9	8.7 ± 2.0‡
5-step test (steps/s)	0.32 ± 0.08	0.57 ± 0.16**	0.58 ± 0.11**	0.55 ± 0.11**‡
floor transfer (1/s)	0.028 ± 0.008	0.057 ± 0.025	0.071 ± 0.017*	0.05 ± 0.03**‡
SPPB score	6.83 ± 0.86	10.83 ± 0.43*	11.17 ± 0.13**	10.10 ± 0.73**
chair-stand score	2.00 ± 0.89	4.00 ± 0.00*	4.00 ± 0.00*	3.20 ± 1.70**
balance score	2.13 ± 0.89	3.00 ± 0.89	3.17 ± 0.40	2.10 ± 0.00**
8-ft-walk score	2.70 ± 0.82	3.83 ± 0.40	4.00 ± 0.00*	3.80 ± 0.50**
Strength				
1-RM score (sum both legs)	231.0 ± 110.4		307.9 ± 112.5*	
toe raises (sum both legs)	13.5 ± 11.9		42.2 ± 7.4*	

Note. SPPB = Short Physical Performance Battery; 1-RM = one-repetition maximum.

* $p < .01$

** $p<.001$ from 0

‡ not significantly different from 12 weeks.

Table 4

Gait and Function of Study Dropouts

	Week			
	0		6	
Participant	11	15	11	15
Gait				
usual gait speed (m/s)	0.28	0.25	0.68	1.00
fastest gait speed (m/s)	0.28	0.30	0.68	1.30
5-min-walk distance (m)	70	100	120	200
Function				
chair stands (s)	0.0	18.6	0.0	12.0
5-step test (steps/s)	0.07	0.14	0.28	0.39
Floor transfer (1/s)	0.00	0.05	0.00	0.05
SPPB score	1	2	3	7
chair-stand score	0	1	0	3
balance score	0	0	0	1
8-ft-walk score	1	1	3	3