



Original Research

Evaluating the Feasibility and Effects of a Short-Term Task Specific Power Training With and Without Cognitive Training Among Older Adults With Slow Gait Speed: A Pilot Study



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List of abbreviations: InVEST, Increased Velocity Exercise Specific to Task; SPPB, Short Physical Performance Battery; TAPAT, tonic and phasic alertness training; VABHS, Veterans Affairs Boston Healthcare System.

Presented to the 2019 Annual Scientific Meeting of the Gerontological Society of America, November 13-17, 2019, Austin, TX.

Supported by resources, internal funds, and the use of facilities at the VA Boston Healthcare System. The sponsor had no role in the design of the study; in the collection, analysis, and interpretation of data; in the preparation of the manuscript; or the review or approval of the manuscript. The contents do not represent the views of the U.S. Department of Veterans Affairs or the United States Government. This work was supported by Harvard Catalyst. The content is solely the responsibility of the authors and does not necessarily represent the official views of Harvard Catalyst, Harvard University and its affiliated academic health care centers, or the National Institutes of Health.

Clinical Trial Registration No.: NCT04446455.

Disclosures: none.

Cite this article as: Arch Rehabil Res Clin Transl. 2021;3:100118

<https://doi.org/10.1016/j.arrct.2021.100118>

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KEYWORDS

Cognition;
Mobility limitation;
Rehabilitation;
Resistance training

Abstract Objective: To investigate the feasibility and efficacy of short-term functional power training and further examine whether the addition of cognitive training targeting sustained attention and inhibitory control would augment the effect on the outcomes.

Design: Randomized pilot study.

Setting: Clinical research facility.

Participants: Community-dwelling primary care patients (N=25) aged >65 years with mobility limitation within the VA Boston Healthcare System.

Interventions: Participants were randomly assigned to either functional power training (n=14) or functional power+cognitive training (n=11), offered 3 times a week for 6 weeks. Session durations were either 70 minutes (functional power+cognitive training) or 40 minutes (functional power training).

Main Outcome Measures: We evaluated feasibility (dropouts, attendance), mobility performance (Short Physical Performance Battery [SPPB]), leg power [stair climb test], dynamic balance [figure-of-8], and gait characteristics [gait speed, stance time, step width, swing time, step length, variabilities under single-task and dual-task conditions]. Nonparametric analyses were used to compare overall pre-post changes and between-group differences.

Results: Of the 39 veterans screened, 25 were randomized and enrolled. Twenty-one men with a mean age 76 ± 7 years completed the study; 86% were white. Participants had a mean SPPB score of 8.3 ± 1.6 out of 12. For those completing the study, overall attendance was 79%. Among all participants, clinically relevant and/or statistically significant median change in mobility performance ($\Delta 1$ point), leg power ($\Delta 25.0W$), dynamic balance ($\Delta -1.1s$), and gait characteristics (gait speed [$\Delta 0.08s$, $\Delta 0.09s$], step length [$\Delta 1.9cm$, $\Delta 3.8cm$], and stance time [$\Delta -0.02s$, $\Delta -0.05s$] under single- and dual-task, respectively) were observed after 6 weeks of training. There were no statistically significant group differences in dropouts, attendance rate, or any of the outcomes based on cognitive training status.

Conclusions: Short-term functional power training with or without a cognitive training led to clinically meaningful improvements in mobility performance, leg power, dynamic balance, and gait characteristics. These findings add to the body of evidence supporting the benefits of functional power training on clinically relevant outcomes. Additional cognitive training did not have an added effect on the study outcomes from our study. Further research is needed.

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Slow gait speed affects older adults' independence, quality of life, and is predictive of future disability and hospitalization.¹ A gait speed <1.0 m/s and a 0.1 m/s reduction in gait speed are both associated with an increased risk for mobility limitations, disability, worsening health status, and higher health care utilization.² Thus, older adults with slow gait speed are at higher health risk and could potentially benefit from training to improve gait speed.

Functional power training, Increased Velocity Exercise Specific to Task (InVEST), is a progressive task-specific training that is beneficial for improving slow gait speed. InVEST targets mobility skills and leg power among older adults. Although previous studies of 12-16 weeks of InVEST training have demonstrated clinically meaningful improvements in gait speed (>0.1 m/s), mobility (>1.0 units on the Short Physical Performance Battery [SPPB]), and leg power ($>10\%$) among mobility-limited older adults,^{3,4} the length of treatment may not be feasible for payors or providers in busy ambulatory rehabilitation settings. Therefore, it is valuable to examine whether similar results could be obtained with a shorter duration of functional power training, which may be more clinically relevant and implementable in routine care. As far as we know, the efficacy of short-term functional power training on clinically relevant outcomes is unknown.

In addition, the feasibility of a short-term functional power training among veterans within the Veteran Affairs setting has never been evaluated.

In addition to examining gait speed, there is a substantial growing interest in investigating spatial and temporal gait characteristics such as step length, step width, swing time, and their variabilities.^{5,6} Gait characteristics can help identify underlying causes of gait dysfunction that are associated with injuries, falls, and reduced quality of life⁷ and are also amenable to training.^{8,9} Furthermore, stance time variability (ie, step-to-step variability in the time from initial foot contact until final foot contact) of >0.034 seconds is associated with greater risk for future disability.¹⁰ However, the effects of functional power training on gait characteristics are not known.

Furthermore, although walking is a mobility task, emerging evidence suggests that higher-level cognitive processes such as executive function and attention are involved, especially during challenging walking conditions.^{11,12} Gait dysfunction and cognition are interrelated; hence, impaired gait characteristics are more common in older adults with cognitive impairment compared with cognitively healthy older adults.¹³ Given these relationships, cognitive training may influence mobility outcomes and gait characteristics.

For example, a previous randomized controlled trial studying 10-week computer-based cognitive training observed slower decline in balance and improved dual-task gait speed over the controls.¹⁴ Tonic and Phasic Alertness Training (TAPAT) is a validated computerized cognitive training shown to improve nonspatial and spatial attention and executive functions in populations such as patients with stroke, traumatic brain injury,^{15,16} and healthy older adults.¹⁷ However, the feasibility or the effects of TAPAT on mobility performance on mobility-limited older veterans have never been studied.

Therefore, the objectives of this study were: (1) to examine the feasibility of functional power training with and without the addition of cognitive training; (2) to examine the efficacy of a short-term, 6-week functional power training on mobility performance, leg power, dynamic balance, and gait characteristics among all participants; and (3) to discover whether the addition of TAPAT would augment the effect on outcomes. We hypothesized that it is feasible to deliver short-term functional power training among mobility-limited community-dwelling older veterans and that it would produce clinically meaningful improvements in clinically relevant outcomes. In addition, we hypothesized that cognitive training would also be feasible and would produce significantly greater improvements after 6 weeks of training.

Methods

This 6-week randomized pilot trial was conducted at the New England Geriatric Research, Education and Clinical Center at Veterans Affairs Boston Healthcare System (VABHS). The Institutional Review Board of VABHS approved this protocol, and all study participants provided written informed consent. The protocol was registered retroactively with the Clinical Trials Registry (NCT04446455, clinicaltrials.gov).

Recruitment and eligibility

Potentially eligible primary care patients within VABHS were identified through an electronic patient database. The computer algorithm guided the database search based on study inclusion criteria. A letter was sent to those who were identified as potentially eligible participants describing the study and that they had the opportunity to opt in and undergo a phone screening. Participants were initially screened over the phone and then scheduled for a final screening and assessment visit at the clinical research laboratory. Inclusion criteria for the study were: (1) aged 65-90 years; (2) at least 1 of the following: >1 or more falls in the past year, difficulty or task modification when climbing 1 flight of stairs, or difficulty or task modification when walking 0.5 mile; and (3) ability to speak and understand English. The exclusion criteria for the study were: (1) presence of a terminal disease; (2) major medical problem interfering with safe and successful testing; (3) major surgery in the previous 3 months; (4) planned major surgery; (5) baseline SPPB <4 or >10; (6) probable dementia (Modified Mini Mental Status ≤ 77)¹⁸; and (7) inability to safely complete the 400-meter walk test.

Randomization and training

Participants were randomly assigned to either 6-week InVEST training plus TAPAT (InVEST+TAPAT) or InVEST training only (InVEST only) with an allocation ratio of 1:1. A random allocation sequence was generated by the study statistician, and randomization was stratified according to baseline mobility using an SPPB cutoff point of 9. The permuted block design was used to preserve blinding of participants to their assignment while guarding against bias. A study coordinator (R.H.) enrolled and assigned groups. For participants in the InVEST+TAPAT group, training sessions began with approximately 30 minutes of TAPAT using a desktop computer. Both groups participated in a 40-minute InVEST training session that included warm-up and cool-down exercises. Participants engaged in 3 training sessions per week for a maximum of 18 training sessions. All assessments and training were conducted at clinical research facility in VABHS.

InVEST training consisted of progressive resistance training exercises that mirror functional tasks.^{3,4} Some exercises were performed with concentric action performed as quickly as possible to optimize force production and speed of movement, whereas others emphasized the endurance of trunk muscles and limb range of motion. Exercises were performed wearing a weighted vest and progressed over the course of training by changing the number of sets, repetitions (maximum, 3 sets \times 10 repetitions), and/or weight in the vest.⁴ Throughout the supervised training, each participant's exercise intensity (15-point Borg Rating for Perceived Exertion, Borg Rating for Perceived Exertion¹⁹) was recorded and used to guide the individual progression of the functional power training. Progression and resistance used in the InVEST training were standardized across all participants.

TAPAT was designed to improve participants' intrinsic regulation of alertness and executive function. Specifically, TAPAT trains sustained attention by responding to stimuli continuously and trains response inhibition during infrequently presented no-go trials (phasic, transient acts of inhibitory control). In each round, participants were familiarized with 20 color images from a category of objects (eg, chairs, sunsets, bears) and were instructed to press for all 19 of the 'nontarget' images, sustained attention, but withhold their response for the 1 specific 'target' image, inhibition control. The object category was changed for each round (24 object categories in total) and progressed from the easiest to discriminate to the most difficult to discriminate. Each training session was composed of two 12-minute sessions of TAPAT.

Each TAPAT round consisted of 360 images presented in randomized order with each shown for 500 milliseconds with intertrial intervals of 1, 1.5, and 2 seconds. At the start of training, the target image frequency was 20% of trials, a moderate level of difficulty. After each round, the target frequency was adjusted to the participants' level of performance to ensure training was adequately challenging for every participant. For example, if the target withholding accuracy was >90%, we decreased the target frequency by 5%, making the task more challenging. If the target withholding accuracy was <75%, we increased the target frequency by 5%, making the task easier.

Measurements

Study feasibility was evaluated by the number of study participants that we recruited and retained in the study and by the percentage adherence to treatment. Attendance was recorded for each treatment session.

We examined mobility performance using the SPPB. The SPPB measures 3 domains of mobility: balance, gait speed, and chair stand.²⁰ Changes in SPPB of 0.5 units and 1.0 units are characterized as a small and large clinically meaningful change, respectively.^{21,22} Leg power was assessed using the modified stair-climbing-test. For this test, participants were instructed to ascend 1 flight (4 steps) of stairs as quickly as possible. Lower body power was calculated with the following formula: $\text{power} = (\text{body weight [kg]} \times 9.8 \text{ m/s}^2) \times (\text{stair height [m]} / \text{time[s]})$.²³ Changes of 9%-10% of lower body power were characterized as clinically meaningful changes.²⁴ The figure-of-8 was used to assess dynamic balance by measuring the time to walk a curved path around 2 cones positioned 5 feet apart.²⁵

Gait characteristics were examined under usual walking (single-task) and walking while talking (dual-task) conditions. Participants walked on a sensored Zeno Walkway^a under 2 walking conditions. For the dual-task, participants recited the letters of the alphabet aloud (eg, a, b, c, etc) while walking.²⁶ Walking speed for all 3 conditions were self-selected. Changes in gait speed of 0.05 and 0.10 m/s were characterized as small and large clinically meaningful differences, respectively.^{21,22} Spatial gait characteristics, including step length and step width, and temporal gait characteristics, including stance time and swing time, were examined. For each gait characteristic, standard deviations derived from all steps were used as measures of variability.²⁷ The clinically meaningful change in gait variability was 0.01 seconds for stance time and swing time variability and 0.25 cm for step length variability.²⁸ Stance time variability was associated with impairments in the cognitive function and central processing and step width variability was associated with balance and sensory impairment among a large sample of diverse community-dwelling older adults.²⁷ Performance measurements were collected at baseline and after the 6-week program.

Participants' sociodemographic information, including age, sex, race, and educational attainment, was obtained at baseline. Height and weight were measured, and body mass index was calculated. Global cognition was assessed using Modified Mini Mental Status,¹⁸ and comorbidity was assessed using a questionnaire.²⁹ Depression was measured by the 10-item Center for Epidemiologic Studies-Depression Scale.³⁰

Statistical analysis

Statistical analyses were performed using STATA software (version 15).^b The distribution of all variables was inspected using descriptive statistics. Demographic, health characteristics, and study outcomes were examined according to training allocation. Nonparametric tests were used to evaluate the effect of treatments because of the small sample size. The Wilcoxon signed-rank test was used to evaluate pre-post changes for all, and 2-sample Wilcoxon rank-sum test was used to examine the between-group differences.

Pre-post changes were expressed in median changes to observe the effect in the original units. Sensitivity analysis was conducted using a multivariate linear regression model adjusting for baseline value. Statistical significance was determined with 2-sided tests at a *P* value of <.05 for mobility performance, leg power, and dynamic balance; however, we used a corrected *P* value <.01 for gait characteristics because of the potential for type I error due to a large number of variables evaluated. Given that this was a pilot study, our findings were also interpreted in terms of clinically meaningful changes.

Results

We present our Consolidated Standards of Reporting Trials diagram for screening, enrollment, and follow-up in [figure 1](#). Of the 39 older veterans assessed for eligibility, 25 were eligible, consented to participate, and were randomized (14 to the 6-week InVEST only group, 11 to the InVEST+TAPAT group). To meet our timeline for this pilot study within budget, we terminated our recruitment after 25 participants were enrolled. One participant was unable to complete the gait assessment. There were no baseline differences between participants who completed the study and participants who dropped out of the study. The reasons for dropping out of the study are shown in [figure 1](#).

The average age of the 21 participants was 76 years (range, 66-90y). All participants were men, 57% had a college degree, and 86% were White. [Table 1](#) describes the baseline characteristics of the 21 participants who completed either the InVEST+TAPAT training (n=11) or InVEST only training (n=10). Study variables exhibited skew. No statistically significant differences (*P*<.05) in baseline demographics, health characteristics, and primary outcomes were identified between the training groups. Certain gait variability characteristics (swing time, stance time, step length) were statistically and clinically different between the groups at baseline. Among those who completed the study, overall exercise class attendance rate was 79%, with 76% for the InVEST only and 82% attendance for the InVEST+TAPAT groups. There were no statistical differences in the dose of the functional power training between the 2 groups. [Table 2](#) presents mobility performance before and after InVEST training. We observed statistically significant pre-post changes in leg power and figure-of-8. With the SPPB, we observed a clinically meaningful median change of 1, which did not achieve statistical significance (*P*=.13).

[Table 3](#) presents gait characteristics before and after the InVEST training under single- and dual-task conditions. The 6-week InVEST training led to improvements in several gait characteristics. We observed statistically significant improvements in median gait speed, step length, and stance time under both single- and dual-task. We observed marginal median changes in stance time and swing time variabilities under certain walking conditions. Other changes in gait variability measures were not statistically significant.

We did not observe any statistically significant differences between training groups on any of the outcomes ([tables 4 and 5](#)). However, we observed clinically meaningful changes in SPPB in the InVEST+TAPAT (≥ 1 score, effect size=0.25) group and greater change in the InVEST only group in gait

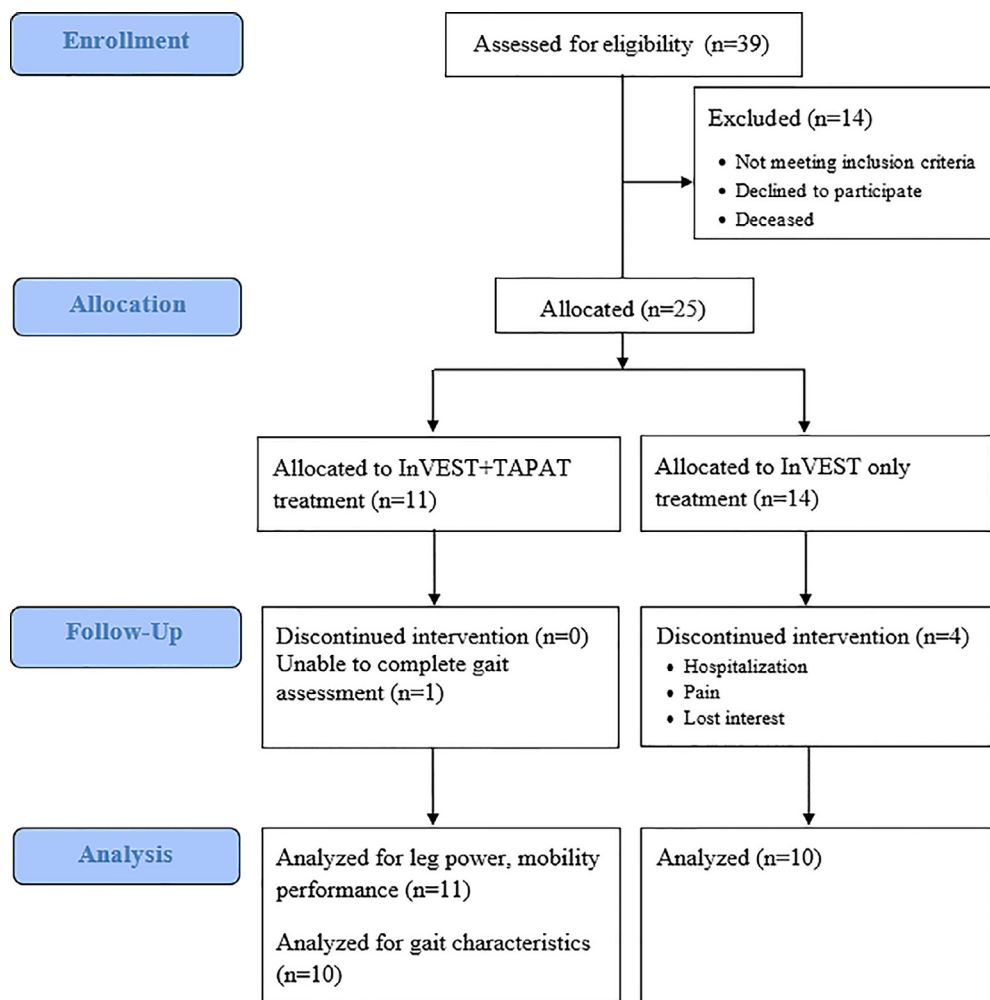


Fig 1 Enrollment and participation flow diagram.

speed and figure-of-8. Further adjustment for baseline values did not materially alter the findings.

Discussion

The major findings of this study demonstrate that, as hypothesized, the retention and adherence rates for the short-term InVEST functional power training with and without cognitive training were acceptable, suggesting that this type of training is feasible to be delivered in the VA setting. In addition, the functional power training produced statistically and/or clinically meaningful changes in mobility, leg power, dynamic balance, and gait characteristics. Contrary to our hypothesis, we did not observe any statistically significant difference in study outcomes based on cognitive training status.

Although the functional power training with cognitive training group had a high attendance rate (82%), the amount of time dedicated to familiarizing the veterans with how to use the TAPAT was substantial. TAPAT cognitive training was not originally designed for older adults. For the older veterans who were included in this study, multiple visits were required before they understood how to use the TAPAT. Thus, teaching time on how to use TAPAT may be greater for

older veterans compared with younger individuals. This suggests that TAPAT cognitive training may need to be further modified to meet the needs of aging veterans.

Previous studies of 12-week⁴ and 16-week³ InVEST protocols demonstrated increased SPPB score, leg power, and gait speed. Although the short-term 6-week InVEST training had smaller mean changes compared with the 12-week InVEST training conducted in the mobility-limited civilian sample for SPPB score ($\Delta 2.7$ vs $\Delta 0.7$) and gait speed ($\Delta 0.13$ m/s vs $\Delta 0.07$ m/s), the improvements exceeded thresholds that are deemed clinically meaningful in similar populations.²¹ Additionally, our observed smaller magnitude of changes may have been owing to the shorter duration of training, the fact that these prior studies targeted patients with greater severity of mobility limitations, and/or that these studies also included women.^{3,4} The short-term functional power training produced statistically significant and clinically meaningful improvements in leg power from baseline (13%)²⁴ and also improved dynamic balance. The improvement in figure-of-8, a measure of dynamic balance, was similar to changes observed within a prior 12-week study targeting the timing and coordination of gait.³¹

In this study, after 6 weeks of functional power training, we observed statistically significant improvements in several gait characteristics under both single- and dual-task

Table 1 Baseline characteristics of veterans aged ≥ 65 years with slow gait speed randomized to either InVEST+TAPAT training or InVEST only training

| Characteristic | All (n=21) | InVEST+TAPAT (n=11) | InVEST Only (n=10) | P Value* |
|--|--------------------|---------------------|--------------------|----------|
| Mean \pm SD | | | | |
| Age, y | 75.71 \pm 6.68 | 74.91 \pm 6.04 | 76.60 \pm 7.55 | .57 |
| BMI, kg/m ² | 30.60 \pm 8.17 | 31.08 \pm 4.85 | 30.07 \pm 11.02 | .18 |
| No. of chronic conditions | 6.48 \pm 3.56 | 6.64 \pm 3.64 | 6.30 \pm 3.65 | .72 |
| 3MS score | 94.33 \pm 4.52 | 94.91 \pm 2.88 | 93.70 \pm 5.94 | .86 |
| Depression score | 0.52 \pm 0.98 | 0.55 \pm 1.04 | 0.50 \pm 0.97 | .97 |
| Mobility, leg power, and dynamic balance | | | | |
| SPPB score | 8.30 \pm 1.60 | 8.70 \pm 0.90 | 7.90 \pm 2.10 | .63 |
| Leg power, W | 214.40 \pm 57.98 | 220.92 \pm 60.60 | 206.43 \pm 57.13 | .62 |
| Figure-of-8, s | 11.85 \pm 4.21 | 10.52 \pm 3.12 | 13.30 \pm 4.90 | .23 |
| Single-task gait characteristics | | | | |
| Gait speed, m/s | 0.95 \pm 0.20 | 1.01 \pm 0.17 | 0.89 \pm 0.22 | .26 |
| Stance time, s | 0.83 \pm 0.23 | 0.79 \pm 0.07 | 0.87 \pm 0.16 | .21 |
| Swing time, s | 0.41 \pm 0.04 | 0.40 \pm 0.02 | 0.42 \pm 0.05 | .17 |
| Step length, cm | 57.26 \pm 9.27 | 58.72 \pm 7.38 | 55.80 \pm 11.06 | .71 |
| Step width, cm | 10.14 \pm 4.22 | 9.69 \pm 3.40 | 10.59 \pm 5.06 | .82 |
| Stance time SD, s | 0.04 \pm 0.02 | 0.03 \pm 0.01 | 0.05 \pm 0.02 | .02 |
| Swing time SD, s | 0.03 \pm 0.01 | 0.02 \pm 0.01 | 0.03 \pm 0.01 | .05 |
| Step length SD, cm | 3.74 \pm 1.40 | 2.95 \pm 0.76 | 4.53 \pm 1.46 | .01 |
| Step width SD, cm | 2.83 \pm 0.90 | 2.64 \pm 0.82 | 3.02 \pm 0.97 | .45 |
| n (%) | | | | |
| White | 18 (85.71) | 10 (90.91) | 8 (80.00) | .48 |
| College graduate | 12 (57.14) | 6 (54.55) | 6 (60.00) | .80 |

* Two-sample Wilcoxon rank-sum (Mann-Whitney) test or chi-square test for InVEST+TAPAT vs InVEST.
Abbreviations: BMI, body mass index; 3MS, Modified Mini-Mental State.

conditions. The 6-week functional power training resulted in similar improvements in step length observed from a 24-week dual-task treadmill training program that combined treadmill walking with tasks³² but lesser magnitude of change compared with a 6-week progressive dual-task treadmill training program that combined treadmill and virtual reality display conducted in community-dwelling older adults.⁹ In general, improvements in gait variability measures were not consistent and did not reach clinically meaningful thresholds.^{33,34}

Given the interrelatedness between gait and cognition, we hypothesized that additional cognitive training via TAPAT would produce additional benefits in outcomes. However, there were no statistically significant differences in outcomes based on TAPAT status. Despite the lack of statistical significance, we observed clinically meaningful changes in SPPB score (≥ 1 score) favoring the InVEST+TAPAT group and greater improvements in gait speed and dynamic balance favoring the InVEST only group. Thus, further research is

needed to examine the effect of additional cognitive training on mobility.

Furthermore, there are other reasons that we may not have seen significant differences based on cognitive training status. For example, among our sample of older veterans with mobility limitations, there was minimal prior experience with computers. As previously mentioned, participants may have been familiarizing themselves with computer usage for the first several weeks, hence our 6-week training period may not have had sufficient time to observe an effect. In addition, prior studies that used cognitive-based intervention on mobility performance used cognitive training programs trained executive function specifically in the domains of visuospatial working memory, processing speed, and inhibition.^{14,34} Thus, although TAPAT focused on attention, sustained attention, and inhibition,¹⁵ other untrained aspects of executive function may affect mobility performance more strongly.

Table 2 Observed changes in leg power and mobility performance outcomes in response to InVEST training (n=21)

| Variable | Pre* | Post* | Change* | P Value [†] |
|----------------|-------------------------|-------------------------|----------------------|----------------------|
| SPPB score | 9 (8; 9) | 9 (9; 11) | 1 (−1; 3) | .129 |
| Leg power, W | 197.67 (185.89; 229.29) | 225.85 (207.61; 260.66) | 24.98 (10.34; 38.77) | .008 |
| Figure-of-8, s | 11.06 (8.90; 13.88) | 9.68 (7.18; 11.28) | −1.10 (−3.29; −0.18) | .027 |

* Values are median (quartile 1; quartile 3).

[†] Wilcoxon signed-rank testing within group.

Table 3 Observed changes in gait characteristics under single- and dual-task conditions in response to InVEST training (n=20)

| Variable | Single-Task* | | Dual-Task* | |
|-----------------|----------------------|-----------------------------------|----------------------|-----------------------------------|
| | Pre | Post | Pre | Post |
| Gait speed, m/s | 0.98 (0.84; 1.08) | 1.06 (0.89; 1.16) [‡] | 0.87 (0.78; 0.99) | 0.98 (0.84; 1.11) [‡] |
| Stance time, s | 0.81 (0.75; 0.85) | 0.77 (0.74; 0.81) [‡] | 0.85 (0.78; 0.91) | 0.79 (0.74; 0.86) [‡] |
| Swing time, s | 0.40 (0.37; 0.42) | 0.40 (0.39; 0.42) | 0.41 (0.39; 0.45) | 0.41 (0.39; 0.43) |
| Step length, cm | 57.64 (52.83; 63.87) | 59.37 (57.37; 64.77) [‡] | 55.79 (50.11; 60.33) | 58.1 (54.05; 63.95) [‡] |
| Step width, cm | 9.59 (6.77; 13.11) | 9.92 (7.48; 13.87) | 9.49 (7.04; 12.61) | 9.90 (7.09; 13.42) |
| Stance time SD | 0.038 (0.031; 0.049) | 0.033 (0.028; 0.048) [†] | 0.047 (0.033; 0.087) | 0.044 (0.027; 0.056) [†] |
| Swing time SD | 0.021 (0.015; 0.033) | 0.021 (0.015; 0.031) | 0.028 (0.020; 0.054) | 0.023 (0.018; 0.029) [†] |
| Step length SD | 3.265 (2.746; 4.769) | 3.302 (2.980; 6.041) | 3.451 (2.833; 4.011) | 3.569 (2.565; 4.569) |
| Step width SD | 2.798 (2.107; 3.315) | 2.613 (2.079; 3.129) | 2.718 (2.078; 3.260) | 2.736 (2.211; 3.120) |

* Values are median (quartile 1; quartile 3).

[†] Wilcoxon signed-rank testing within group, pre-post changes $P < .05$.

[‡] Wilcoxon signed-rank testing within group, pre-post changes $P < .01$.

Table 4 Observed changes in mobility performance outcomes in response to either InVEST+TAPAT training or InVEST only training (n=21)

| Variable | InVEST+TAPAT | InVEST Only | P Value* |
|----------------|------------------|-------------------|----------|
| SPPB score | 1 (0; 3) | 0 (-1; 1) | .250 |
| Power, W | 23.4 (12.7; 2.5) | 25.2 (7.5; 38.2) | .621 |
| Figure-of-8, s | -0.6 (-2.8; 1.2) | -1.7 (-4.1; -0.7) | .181 |

NOTE. Values are median change (post-pre) (quartile 1; quartile 3).

* Two-sample Wilcoxon rank-sum (Mann-Whitney) testing between-group differences.

Interestingly, among the gait variability measures, we observed the most improvement in stance time variability, which is associated with central processing and psychomotor function.¹⁰ At baseline, the average stance time variability for all participants exceeded a clinically relevant threshold associated with developing future disability (0.034s).¹⁰ However, with training, stance time variability decreased (improved) and the sample average was no longer above this threshold. Brach et al¹⁰ also observed improvements in stance time variability after 12 weeks of timing and

coordination training that was coupled with standard strength training. Prior InVEST studies showed that InVEST produces greater improvements in leg power and mobility than traditional strength training.^{3,4} Given the favorable benefits on gait variability from timing and coordination training, perhaps coupling InVEST training with timing and coordination training may be a more effective training combination.

Study limitations

There are limitations to our study that need to be considered. This pilot study was retroactively registered to ClinicalTrials. However, we examined the objectives that were originally proposed to limit the potential bias in publication. In addition, we did not have a control group or a standard strength training group for comparison; thus, it is possible that significant changes in mobility performance could be the result of a practice effect. However, prior InVEST studies demonstrate superiority beyond standard resistance training on similar outcomes but did not study gait characteristics. In addition, given the nature of our pilot study, the sample size was relatively small; thus, our nonsignificant findings that exceeded clinically meaningful thresholds could be owing to a lack of statistical power. Also, our participants were all

Table 5 Observed changes in gait characteristics under single- and dual-task conditions in response to either InVEST+TAPAT training or InVEST only training (n=20)

| Variable | Single-Task | | Dual-Task | |
|-----------------|------------------------|-------------------------|-----------------------|-------------------------|
| | InVEST+TAPAT | InVEST Only | InVEST+TAPAT | InVEST Only |
| Gait speed, m/s | 0.06 (0.02; 0.10) | 0.09 (-0.01; 0.15) | 0.07 (0.02; 0.15) | 0.12 (0.07; 0.22) |
| Stance time, s | -0.01 (-0.04; 0.01) | -0.04 (-0.05; -0.01) | -0.05 (-0.06; 0.03) | -0.06 (-0.15; -0.02) |
| Swing time, s | 0.002 (-0.006; 0.007) | -0.016 (-0.030; -0.001) | 0.002 (-0.03; 0.02) | -0.005 (-0.05; 0.01) |
| Step length, cm | 1.36 (-0.51; 2.33) | 3.46 (-0.35; 5.09) | 2.91 (0.55; 5.80) | 5.61 (2.98; 6.31) |
| Step width, cm | 1.06 (0.10; 1.42) | 0.18 (-0.38; 0.75) | 0.56 (0.27; 1.23) | 0.66 (-0.47; 1.47) |
| Stance time SD | -0.003 (-0.005; 0.002) | -0.006 (-0.011; -0.004) | -0.005 (-0.02; 0.01) | -0.017 (-0.04; -0.01) |
| Swing time SD | -0.001 (-0.002; 0.001) | -0.002 (-0.005; 0.001) | 0.001 (-0.003; 0.003) | -0.009 (-0.022; -0.002) |
| Step length SD | 0.08 (-0.65; 0.83) | 0.35 (-0.23; 1.61) | 0.14 (-0.39; 0.82) | 0.002 (-0.30; 0.59) |
| Step width SD | -0.02 (-0.43; 0.32) | -0.35 (-0.53; -0.23) | -0.02 (-0.26; 0.31) | -0.09 (-0.69; 0.53) |

NOTE. Values are median change (post-pre) (quartile 1; quartile 3). Two-sample Wilcoxon rank-sum (Mann-Whitney) testing between-group differences. There were no significant differences in any of the gait characteristic outcomes between the training groups.

men, mostly White, and relatively high functioning. We also had treatment dropouts. Thus, we are limited in generalizing our findings, although they are consistent with what has been observed in more diverse samples.^{3,4} Furthermore, none of the participants in the pilot study were cognitively impaired. Hence, the reasons for TAPAT cognitive training not resulting in additional benefits may be because of the participants' baseline cognition. Lastly, gait speed was calculated from the Zeno Walkway, which can differ from gait speed measurement that includes an acceleration phase by starting from standing.

Despite these limitations, several strengths of this study are noteworthy. Our study outcomes were measured using validated and well-studied instruments, which have established clinically meaningful values for the majority. This study was the first to document the efficacy of short-term functional power training on clinically valuable outcomes. Although we did not observe the same magnitude of efficacy observed with longer-term training, this duration of care produced clinically meaningful improvements and informs the clinical utility of short-term care.

Conclusions

In conclusion, it was found that short-term functional power training produced meaningful changes in clinically relevant outcomes among older male veterans with mobility limitations. Additional cognitive training did not have an added effect on the study outcomes from our study, and further research is needed. This study reinforces the contention that functional training is a beneficial treatment for patients with mobility limitations.

Suppliers

- a. Zeno Walkway; ProtoKinetics LLC.
- b. STATA software, version 15; StataCorp.

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