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Perturbation-based balance training of older adults and effects on physiological, cognitive and sociopsychological factors: a secondary analysis from a randomised controlled trial with 12-month follow-up

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ABSTRACT

Background Perturbation-based balance training (PBT) has shown promising, although diverging, fall-preventive effects; however, the effects on important physical, cognitive and sociopsychological factors are currently unknown. The study aimed to evaluate these effects on PBT at three different time points (post-training, 6-months and 12-months) in community-dwelling older adults compared with regular treadmill walking.

Methods This was a preplanned secondary analysis from a randomised, controlled trial performed in Aalborg, Denmark, between March 2021 and November 2022. Community-dwelling older adults aged ≥65 were randomly assigned to participate in four sessions (lasting 20 min each) of either PBT (intervention) or regular treadmill walking (control). All participants were assigned to four testing sessions: pretraining, post-training, 6-month follow-up and 12-month follow-up. At these sessions, physical, cognitive and sociopsychological measures were assessed.

Results In total, 140 participants were randomly allocated to either the PBT or control group. Short-term (pretraining to post-training) between-group differences were seen for choice stepping reaction time (−49 ms, 95% CI −80 to −18), dual-task gait speed (0.05 m/s, 95% CI 0.01 to 0.09) favouring the PBT group. However, these improvements were not sustained at the 6-month and 12-month follow-up. No significant between-group differences were found in other physical, cognitive or sociopsychological factors.

Conclusions This study showed that PBT, in the short term, improved choice stepping reaction time and dual-task gait speed among community-dwelling older adults. Yet, these improvements were not retained for 6- or 12-months. The healthy state of the study's population may have imposed a ceiling effect limiting the ability to show any clinically relevant effects of PBT.

Trial registration number NCT04733222.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This randomised controlled trial was preregistered in ClinicalTrails.gov, a protocol was published, and it followed CONSORT statement.
⇒ Due to practical limitations and the nature of training interventions, the outcome assessor of these secondary outcomes and participants were not blinded for group allocation.
⇒ The study population was a convenience sample of low-risk older adults with no specific physical, cognitive or sociopsychological problems.

INTRODUCTION

Ageing leads to deteriorations in physical and cognitive functions, increasing the risk of falls and fall-related injuries, such as fractures.[1–3] However, falls not only lead to physical but also psychological consequences, as falling has been associated with developing concerns about falling.[4] These physical and cognitive consequences of falls collectively lead to disability and loss of independence, which greatly impact the quality of life of older adults.[5] Additionally, society is substantially burdened by fall-related costs, accounting for approximately 1% (0.8% to 1.5%) of healthcare expenses in developed countries.[6] Thus, effective and sustainable fall-preventive interventions are needed to improve the well-being of older adults and limit societal costs.[7]

Currently, physical exercise is considered the most effective fall-preventive intervention.[8] A systematic review of 64 randomised, controlled trials on general physical exercise identified a 23% reduction in fall rates.[9] Most of the studies in this review employed conventional training approaches targeting specific physical functions associated with fall risk such as muscle strength or balance.[9] Thus, besides preventing falls, they also help maintain activities of daily life function which is important for preserving the independence and quality of life of older adults.[10 11] However, indirectly targeting falls by improving risk factors may not be the most effective approach.[9] Indeed, the well-established principle of task-specificity states that training paradigms are most effective when they closely simulate the desired task.[12–14] Among community-dwelling older adults, most falls are caused by slips and trips during walking.[2 15 16] Hence, interventions emphasising rapid compensatory reactions following slips and trips may prove more effective in fall-prevention compared with conventional approaches.[15 17]

One such intervention is perturbation-based balance training (PBT), in which the participants are exposed to repeated, unexpected postural disturbances while wearing a body harness to ensure their safety.[18] It is well documented that PBT leads to considerable reactive balance adaptations after even short exposures, which can be retained for up to a year in laboratory settings.[18–21] Yet, divergent effects of PBT on daily life falls have been reported, with some showing an approximate 50% decrease while others find no effects, including the primary analysis from the current study, which showed a non-significant decrease in fall rates of 22% (Incidence Rate Ratio 0.78, 95% CI 0.44 to 1.39).[18 22–24] Moreover, additional benefits of PBT on other physical, cognitive and sociopsychological factors are vastly unknown. Considering that the laboratory reactive balance adaptations are long-lasting, evaluating the long-term (> 6 months) maintenance of additional adaptations is of special interest. The long-term effects of PBT have previously been explored in patients with Parkinson's disease and spinal cord injury[25–28] and short-term effects in community-dwelling older adults[29] Therefore, this preplanned secondary analysis of a randomised, controlled trial with a 12-month follow-up aimed to evaluate the short-term and long-term effects of a four-session PBT intervention on physical (gait, static balance, choice stepping reaction time, lower extremity performance), cognitive (executive function) and sociopsychological (concerns about falling and quality of life) measures among community-dwelling older adults aged 65 years or older, compared with regular treadmill walking.

METHODS

Trial design

This article reports secondary results from a parallel group (1:1 ratio), randomised, controlled trial with a 12-month follow-up. A trial protocol and statistical analysis plan have been preregistered at ClinicalTrials.gov (NCT04733222), and a protocol has been published.[30] The primary outcome was fall rates and these results have already been reported.[31] There were no deviations from the protocol. The reporting of this article adheres to the Consolidated Standards of Reporting Trials (CONSORT) 2010 guidelines.[32]

Participants

Eligible participants had to be (1) 65 years or older, (2) community-dwelling and (3) able to walk without a walking aid. Individuals were excluded if they (1) had an unstable medical condition that prevents safe participation, (2) had a severe cognitive impairment (defined as a score of 8 or less on the Short Orientation-Memory-Concentration test), (3) were currently participating in another fall-preventive trial or (4) had any of the following self-reported conditions: orthopaedic surgery within the past 12-months, osteoporosis or history of osteoporosis-related fractures (low impact hip, spine and wrist fracture) or progressive neurological disease (eg, Parkinson, multiple sclerosis).

The participants were recruited through advertisements on local radio and national television spots. Testing and training sessions were conducted at a laboratory at Aalborg University (Department of Health, Science and Technology, Fredrik Bajers Vej 7A2-107, DK-9000, Aalborg, Denmark).

Interventions

All participants were assigned to four training sessions (see figure 1). The initial two sessions were conducted on the first day at the laboratory. A week later, the third training session was performed while the fourth served as a booster session 6 months after the third session.

The training interventions were performed on the same Woodway split-belt treadmill, moving uniformly (Split 70/157/ASK; Woodway, Weil am Rhein, Germany). Before training commencement, the preferred treadmill walking speed was determined by increasing and decreasing the belt speed until the upper and lower boundary of comfortable walking was identified. The preferred walking speed was then defined as the average of this upper and lower boundary.

Perturbation-based balance training (intervention)

A detailed description of the PBT protocol has been published elsewhere.[30] In brief, participants allocated to the PBT group were exposed to 40 perturbations applied bilaterally at each session. The first session consisted only of slips, the second only trips while the third and the fourth had randomly mixed slips and trips. The timing (10–50 steps) and side (left or right) of the perturbations were randomised to enhance their unpredictability. The slips (backward loss of balance) were induced by a sudden forward acceleration resulting in a reversal in the belt movement direction at the heel strike. The trips (forward loss of balance) were provoked by an initial small deceleration followed by a larger backward acceleration at the mid-swing phase of the gait cycle. The perturbations were triggered by a heel contact placed under the sole of the left foot using the computer software Mr. Kick III (Knud Larsen, Department of Health, Science and Technology, Aalborg University, Denmark).

The perturbation intensity depended on the preferred walking speed and was divided into five levels with

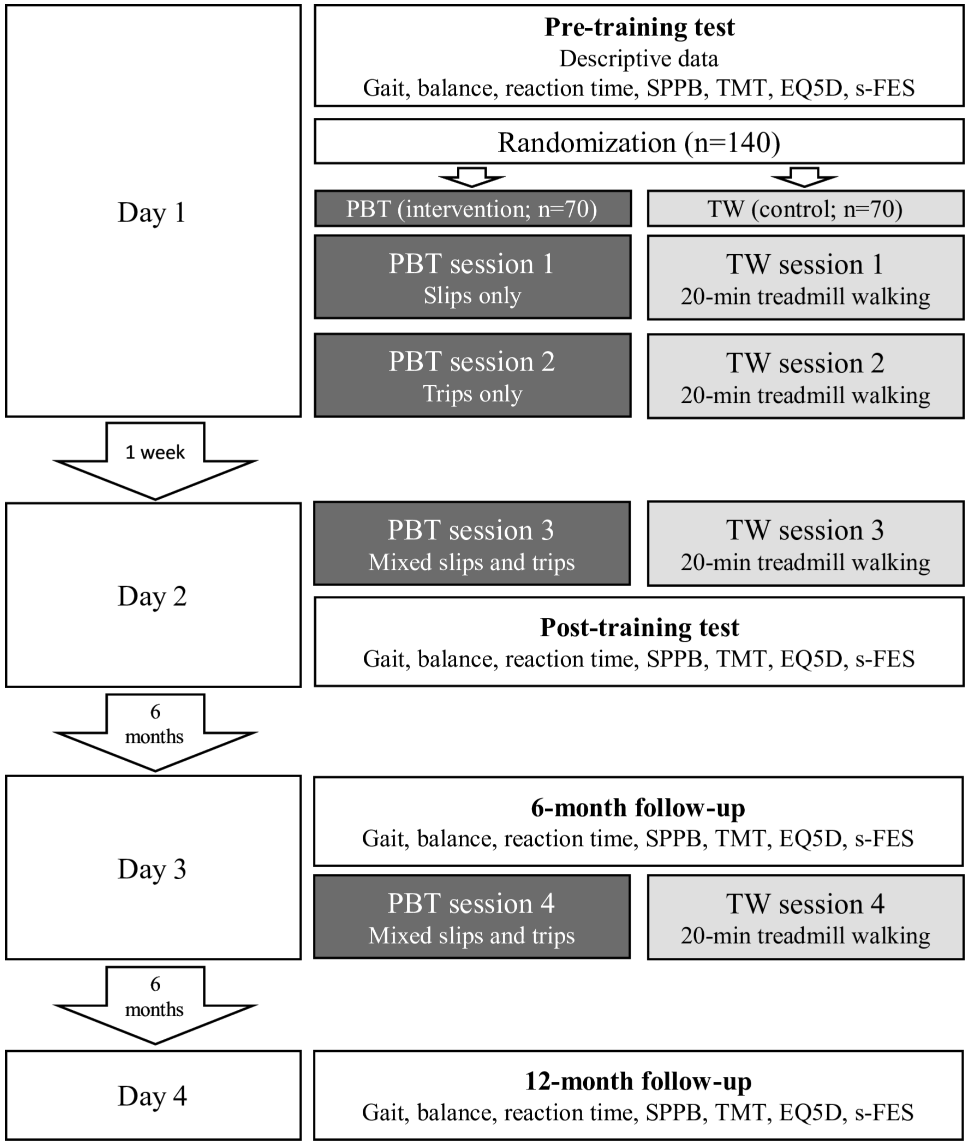

Figure 1 The study design. Dark grey boxes show the flow of the PBT group. Light grey boxes show the flow of the control group. White boxes indicate that all participants were assigned. EQ5D, EuroQoL 5-dimensions, 5-levels; PBT, Perturbation-based balance training; s-FES, Short falls efficacy scale; SPPB, Short physical performance battery; TMT, Trial making test; TW, Treadmill walking.

progressively increasing duration for the slips and acceleration for the trips. After every fourth perturbation, participants rated the perceived anxiety and difficulty of the previous perturbations on a scale from 1 to 5, with a higher score indicating higher perceived anxiety and difficulty. The intensity was increased if three criteria were fulfilled: (1) the combined perceived anxiety and difficulty were rated four or less, (2) the participant successfully recovered from the four prior perturbations and (3) the participant was willing to increase the difficulty. If any criteria were violated, the training intensity would remain at the highest tolerable level.

Treadmill walking training (control)

Participants allocated to the treadmill walking group walked for 20 min at their preferred walking speed, matching the time spent on the treadmill by the PBT group.

Outcomes

This study reports preplanned secondary outcomes, including physical, cognitive and sociopsychological measures collected at the pretraining, post-training, 6-month follow-up and 12-month follow-up test (see figure 1). All outcomes were assessed by the same researcher, who was not blinded for group allocation. A detailed description of the tests and the instructions provided is available in online supplemental material 1.

The physical outcomes are all associated with fall risk and include single and dual-task gait, single and dual-task static balance, choice stepping reaction time and lower extremity performance.[33–38] The gait assessment consisted of three single-task and three dual-task trials of 8 m walking at a preferred walking speed, with the middle 6 m timed using a handheld stopwatch.[37 39 40] As the dual-task, the participants were instructed to count backwards in threes from a random three-digit number. No instructions to either prioritise the walking or counting task were provided. The average gait speed of the three trials was used in the analyses. The balance assessment was conducted on a Wii balance board using the FysioMeter software (FysioMeter, V.1.2.1.4, Denmark).[41–43] Participants were instructed to stand as still as possible for 30 s, three times as a single-task and three times as a dual-task. The dual-task involved naming items from specific grocery store sections (dairy, produce and butchery), with no instruction to focus on the balance or cognitive task. The average centre of pressure displacement area and speed from the three trials were used in the analysis. The choice stepping reaction test was also conducted using the Wii balance board and involved reacting as fast as possible to visual clues given on a computer screen by tapping the foot on the correct side of the Wii balance board.[34 44] Seven reactions were collected, and the average reaction time of the initial six was used in the analyses. The Short Physical Performance Battery was used to evaluate lower extremity performance and involved three elements: (1) balance with three different foot positions (side-by-side, semitandem and tandem), (2) two 4 m walks and (3) five sit-to-stands.[36 45] A score was calculated (range: 0–12; higher score indicates better performance) and used in the analyses. Further, the time used in the five sit-to-stands was also analysed as a measure of functional strength.[46]

Cognitive function, known as executive function, was evaluated using the trail making test (TMT) part A and part B.[47 48] Participants sequentially connected numbers (part A) or alternating numbers and letters (part B). Part A assessed visual search, motor speed skills and attention while part B evaluated working memory and task shifting.[48] The time to complete part B minus part A (ΔTMT) was used in the analyses.[49 50]

Sociopsychological outcomes included concerns about falling and health-related quality of life. The concerns about falling were evaluated using the Short Falls Efficacy Scale-International, and the score was used in the analyses (range: 7–28; a higher score indicates higher concern).[51] Moreover, the health-related quality of life was assessed using EuroQoL 5-dimensions, 5-levels (EQ-5D-5L).[52 53] The EQ-5D-5L index score (range: −1 to 1; higher index indicates better quality of life) and Visual Analogue Scale score (range: 0–100; higher score indicates better quality of life) were used in the analyses.

Sample size

The sample size was calculated based on an expected decrease in the study's primary outcome in fall rates. Therefore, the sample size calculation was based on Poisson's regression model in G*Power (V.3.1.9.4, University of Kiel, Kiel, German). An expected 50% effect size from a base fall rate of 0.85 with an 80% power and 5% significance level necessitated 70 participants in each group, assuming a 20% drop-out.

Randomisation

Immediately after pretraining assessments, participants were allocated to either the PBT or control group using a blocked randomisation module generated in STATA and uploaded in REDCap. The module was created by research staff not involved in any other trial activities. Random block sizes of 2, 4, 6 and 8 were used to conceal the allocation sequence. The nature of training interventions and practical limitations led to neither the participant nor the outcome assessor being blinded for group allocation.

Statistical methods

All statistical analyses were conducted following the preregistered statistical analysis plan in collaboration with an external biostatistician.[30] The primary statistical analyses were performed following the intention-to-treat principle. A per-protocol analysis was conducted for participants who completed at least 75% of the intervention. The analyses were conducted in STATA (V.17.0, StataCorp), and p values of <0.05 were considered statistically significant.

Demographic data are presented as a mean and SD, median and IQR, or number and percentage, where appropriate. A linear mixed-effects regression model with the Restricted Maximum Likelihood estimation procedure was used to evaluate the between-group differences in the physical, cognitive and sociopsychological measures. In the model, group and time were set as fixed and included together with the interaction term. Record ID was set as a random effect. The results will be presented as estimates of the between-group differences of the within-group changes (pretraining to post-training, pretraining to 6 months, and pretraining to 12 months). Model assumptions were checked by inspection of residual plots, and deviations will be mentioned, but will not affect the analysis. Further, missing data were appraised missing at random; thus, multiple imputations were not conducted as it does not add any benefits to the linear mixed-effects model.[54] We did not correct for multiple adjustments; thus, the results should be interpreted as explorative.[55]

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Participant flow

Of the 199 screened older adults, 140 were enrolled and randomised to either the PBT or control group between March and November 2021 (see figure 2). The baseline characteristics of both groups can be found in table 1. Loss

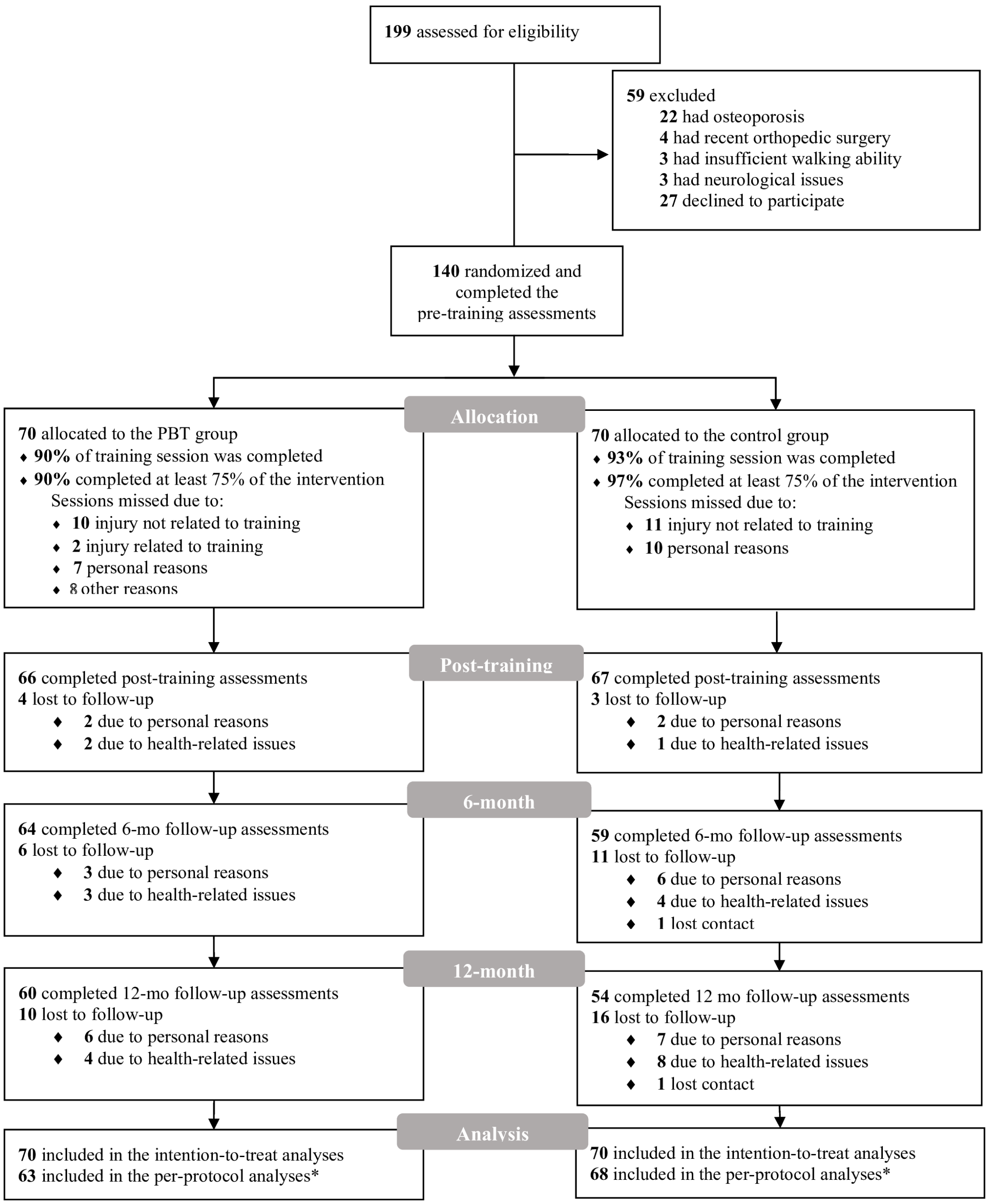

Figure 2 CONSORT flow chart of the participant flow through the present study. *Per-protocol analysis only included participants that completed at least 75% (three of four sessions) of the assigned intervention.

to follow-up was 4 (6%) and 3 (4%) at the post-training test, 6 (9%) and 11 (16%) at the 26-week follow-up, and 10 (14%) and 16 (23%) at the 52-week follow-up in the PBT and control group, respectively. At least one data point was missing for 13 (19%) in the PBT group and 18 (26%) in the control group. There were similar reasons for drop-out and demographic characteristics between groups among participants with missing data (see online supplemental material 2). The PBT group had a 90% adherence to training while the control group completed 93% of the assigned sessions. Moreover, 90% of the PBT group and 97% of the control group completed at least 75% of the intervention, which was the limit for being included in the per-protocol analyses.

Outcomes and estimation

All results from the unadjusted model regarding the physical, cognitive and sociopsychological measures are presented in online supplemental table 1. Multiple within-group differences were found; however, this section only contains the results of the between-group differences. Among the physical functions, a significant difference from the pre-training to post-training test favouring the PBT group was found in choice stepping

Table 1 Baseline characteristics of participants

	PBT group (n=70)	Control group (n=70)
Age (years), mean (SD)	72.7 (4.7)	72.0 (4.7)
Sex, no. female (%)	41 (59)	38 (54)
Frailty,* median (IQR)	2 (1–3)	2 (1–3)
Living arrangement, no. living alone (%)	23 (33)	24 (34)
Daily activity level, sitting down† (hours)	4 (6)	6 (9)
Medication, median (IQR)	2 (0–4)	3 (0–4)
Function of daily activities,‡ median (IQR)	2 (1–2)	2 (1–2)
Fall within the past 12 months, no. fall (%)	28 (40)	29 (41)
Cognition,§ median (IQR)	26 (24–28)	26 (24–28)
Physical function,¶ median (IQR)	12 (11–12)	12 (11–12)
Habitual gait speed (m/s), mean (SD)	1.3 (0.2)	1.3 (0.2)
Executive function,** median (IQR)	47.3 (26.1–63.5)	40.7 (29.1–61.8)

*Tilburg Frailty indicator (score 0–15; lower is better).
†International Physical Activity Questionnaire—time spent sitting down on average per day.
‡The Vulnerable Elderly-13 Survey (score 0–10; lower is better).
§The Short Orientation-Memory-Concentration Test (score 0–28; higher is better).
¶The Short Physical Performance Battery (0–12; higher is better).
**Trail Making Test part A subtracted from part B (lower score implied better performance).
PBT, perturbation-based balance training.

reaction time (−49 ms, 95% CI −80 to −18) and dual-task gait speed (0.05 m/s, 95% CI 0.01 to 0.09). However, none of these improvements were retained for the 6- or 12-months follow-up. There were no significant between-group differences in any of the other physical, cognitive or sociopsychological factors.

Ancillary analyses

When adjusting for age, sex and previous falls, the analyses identified significant changes from the pre-training to post-training test favouring the PBT group in single-task gait speed (0.03 m/s, 95% CI 0.00 to 0.06) and five sit-to-stands (−0.54 s, 95% CI −0.97 to −0.01). Otherwise, the analyses led to similar results as the unadjusted model. Lastly, analysing the data using a per-protocol approach did not lead to different estimates than the intention-to-treat analyses. All results of the sensitivity analyses can be found in online supplemental material 3.

DISCUSSION

This secondary analysis from a randomised, controlled trial showed that four sessions of treadmill PBT did not lead to long-term (≥6 months) improvements in the evaluated physical, cognitive or sociopsychological measures. However, there was a significant short-term improvement from the pretraining to post-training test in choice stepping reaction time and dual-task gait speed favouring the PBT group.

Short-term effects of PBT

PBT led to significantly greater improvements in the choice stepping reaction time from pretraining to post-training than regular treadmill walking (−49 ms, 95% CI −80 to −18). Choice stepping reaction time is a composite measure of fall risk that evaluates the ability to make quick and appropriate voluntary stepping responses to visual cues.[34] The improvement found in our study contrasts with,[56] which showed that three slip and trip overground walkway PBT sessions had no beneficial effects on the choice stepping reaction time.[56] This discrepancy may be due to Okubo *et al* having four stepping options in the reaction test while our test only had two.[56] This may lead to the performance being more reliant on executive functions, which this and previous PBT studies have shown limited effects on.[57] However, in line with our results, Kurz *et al* showed treadmill PBT significantly improved voluntary step execution onto one of two targets triggered by a somatosensory cue.[58] This improvement in voluntary step execution was achieved by a faster step initiation time which implies an enhanced central processing speed.[58] Furthermore, other PBT studies have also reported significant improvements in stepping reactions following either somatosensory or auditory cues.[59–61] Our study, however, is the first to show that PBT improves voluntary stepping performance to visual cues. Collectively, PBT may induce adaptations within the central nervous system that benefit gait adaptability, which is important in fall prevention.[62] Still, while there is no established minimally clinically important difference regarding choice stepping reaction time, the 7% improvement after PBT is smaller than the 13% difference previously found between fallers and non-fallers.[34]

Our results also identified significant improvements from the pretraining to post-training test favouring PBT in dual-task gait speed (0.05 m/s, 95% CI 0.01 to 0.09); yet, these improvements were below the limit of minimal clinically important difference (gait speed: 0.10 m/s).[63 64] No other physical and cognitive measures showed a between-group difference following PBT. Supporting these findings, studies applying multidirectional perturbations within 3–5 sessions showed no improvements in physical measures of strength, static balance and gait.[23 56 65] Likewise, a single session of 96 waist pull perturbations on a treadmill did not lead to changes in the executive function evaluated using the TMT.[57] However, in contrast to our results, studies including longer training intervention (≥4 weeks) in community-dwelling older adults and Parkinson's patients have been able to show improvements in various physical, cognitive and sociopsychological measures.[25 27 28] In summary, our results indicate that adaptations to PBT interventions are highly task-specific, but some research may imply that higher dosages could lead to better transfer effects.[13 14 18]

Lastly, the PBT intervention failed to show significant between-group differences in the sociopsychological measures. However, close-to-perfect concerns about falling and quality of life scores at pretraining enforced a ceiling effect leaving almost no room for improvement. Therefore, future studies should evaluate these parameters in participants exposed to substantial concerns about falling and low quality of life.

Long-term effects of PBT

A key component of PBT is the well-documented long-term retention of reactive balance adaptations following even small training dosages.[18–20] Improvements in choice stepping reaction time must also be retained throughout the detraining period to be relevant. While choice stepping reaction time in the PBT group remained significantly lower at the 6 and 12 months follow-up compared with the pretraining test, these improvements were not significantly different from the control group (see online supplemental table 1). Thus, there were no long-term effects of PBT on any physical, cognitive or sociopsychological measures. These results align with our primary findings that PBT did not lead to a significant decrease in daily life fall rate.[31] Our findings also support the current detraining literature, which points to a decline in physical performance following training cessation in older adults.[66–68]

Practical implications

While the previously published results of the primary outcome paper showed a sustained improvement in reactive balance control over 12 months in laboratory settings (−63% laboratory fall rate at the 12-month follow-up), we only identified a partial transfer of adaptations to daily life (a nonsignificant 22% decrease in fall rates).[31] Moreover, the findings reported in this paper also show that PBT may have limited effects on other important physical, cognitive and sociopsychological factors. This indicates that PBT should not be regarded as a single intervention but as part of a multicomponent training programme. Considering the task-specificity of training adaptations, it is not surprising that multicomponent training programmes have proven most effective in improving overall physical and cognitive functions.[69 70] It has recently been recommended that fall preventive training programmes should include balance challenging and functional exercises with additional tai chi and progressive strength training.[7] Adding PBT to multicomponent training programmes could potentially improve the fall preventive effect with only slightly higher training dosages.[13 18 62] However, this remains speculative until studies have shown the effectiveness of such multicomponent interventions.

Limitations

The results of this study should be interpreted considering the study's limitations. First, due to practical limitations and the nature of training interventions, the outcome assessor of these secondary outcomes and participants were not blinded for group allocation. Second, participants were convenience sampled, low-risk older adults with no specific physical, cognitive or sociopsychological problems. They were, therefore, not the targeted population for fall preventive training according to the recent world guidelines of fall prevention and management in older adults.[7] Moreover, this population may have a limited potential for improvement, possibly explaining the lack of effect. Future PBT studies should investigate a frailer population to evaluate the potential effect among those prone to fall-related injuries. Finally, we did not correct for multiple comparisons, which may have led to false positive results due to mass significance; thus, the results should be seen as explorative only.

CONCLUSION

Secondary analyses from a randomised controlled trial showed that PBT led to short-term improvements in choice stepping reaction time and dual-task walking speed. However, these improvements were not retained at the 6 or 12 months follow-up tests. Moreover, PBT did not cause clinically important improvements in the other evaluated physical, cognitive or sociopsychological measures. These findings underline that adaptations to physical exercise are task-specific. However, the healthy state of the study's population may have imposed a ceiling effect limiting the ability to show any beneficial effects. Further studies adding PBT to multicomponent training programmes and studies on more frail older adults with a greater potential for improvements are needed.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants and the study was performed following the Declaration of Helsinki. North Denmark Region Committee on Human Research Ethics (N-20200089) and the Danish Data Protection Agency (2021-014) approved the study. All participants gave written informed consent before enrolment. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. Deidentified trial results data will be available on reasonable request for non-commercial use up to 5 years after the publication of the trial findings. The available data will include (but is not limited to) deidentified individual participant data, the study protocol, the Statistical Analysis Plan (SAP), informed consent forms and analytic codes used. Requests for access will be reviewed by a designated data access committee to ensure they are for non-commercial, scientific purposes and that requesters agree to abide by data protection protocols. Data-sharing agreements will be required. Please note that the data-sharing plan outlined in the trial registration is outdated and cannot be changed.

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SUPPLEMENTARY MATERIAL 1: DETAILED DESCRIPTION OF TESTS

This supplementary material describes the tests used in the pre-training, post-training, 26-week follow-up, and 52-week follow-up tests. Moreover, the instructions given to the participants are also outlined. During the trial, all instructions were provided in Danish; however, this supplementary material is directly translated into English.

The order of the test was identical at each testing session at was as follows: 1) Trial-making-test, 2) balance, 3) choice stepping reaction time, 4) gait, 5) short physical performance battery, and 6) questionnaires.

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TRIAL MAKING TEST

Description

The executive function is evaluated using the Trial-Making-Test (TMT) Part A and B. Part A involves sequentially connecting 25 randomly arranged numbers (1- 2- 3-…-25) on paper with a pen. In Part B, 25 randomly placed numbers and letters (1- A- 2- B-…-12- L) are connected alternatingly. The time to complete Part A and Part B was recorded using a handheld stopwatch, and the number of mistakes was registered.

Instruction

"[Show the practice sheet of Part A] In this test, you must sequentially connect the numbers; from 1 to 2, from 2 to 3, and so on [point on the paper]. This is a practice sheet before we move on to the actual test. [participant performs practice sheet]. If you make a mistake, I will highlight it by making a perpendicular line, and you will return to the previous number. I will not tell you what the mistake was."

"[Show the test sheet of Part B] Now we move on to the actual test. In this test, you must connect 25 numbers in the same manner as on the practice sheet. You will begin at 1 [point at number 1] and finish at 25 [point at number 25]. You must connect the numbers as fast as possible and with as few mistakes as possible. I will count from 3, and you may start on "go". "

"[Show the practice sheet of Part B] In the next part of the test, you must alternatingly connect the numbers and letters; from 1 to A, from A to 2, from 2 to B, and so on [point on the paper]. This is a practice sheet before we move on to the actual test [participant performs practice sheet]."

"[Show the test sheet for Part B] Now we move on to the actual test. In this test, you must connect the 25 numbers or letters in the same manner as on the practice sheet. You will begin at 1 [point at number 1] and finish at "L" [point at "L"]. You must connect the numbers as fast as possible and with as few mistakes as possible. I will count from 3, and you may start on "go". "

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BALANCE TEST

Description

The balance test was conducted using a Wii balance board (WBB) and the Fysiometer software. Participants stood as still as possible for 30 seconds for three trials under single- and dual-task conditions, respectively. The dual task condition involves naming grocery items from specific supermarket sections. During the test, the participant was instructed to look at a fixed mark at eye height three meters in front of the participant. The area and speed of the centre of pressure displacement were registered in the FysioMeter software.

Instruction

"During the balance test, you must step onto the Wii balance board and place your feet so the outside of your foot is aligned with the edge of the Wii balance board [guide the foot placement of participant]. You will have to stand as still as possible for 30 seconds while looking at the mark in front of you [pointing at the mark] and holding your wrist [illustrate the arm position]. You will have to perform three trials only focusing on standing still, and then three times while simultaneous mentioning grocery items from the supermarket. Are you ready for the first 30 seconds?"

[Immediately before each 30-second trial, the following is instructed] "Look at the mark in front of you and attempt to stand as still as possible; the 30 seconds will start in 3, 2, 1, now."

"For the next three trials, you will have to stand in the same position as before [make sure foot placement is correct] as still as possible for 30 seconds while also mentioning as many grocery items as possible. Before each trial, I will tell you which supermarket section you must mention items. Are you ready for the first 30 seconds?"

[Immediately before each 30-second trial, the following is instructed] "Look at the mark in front of you, hold your wrist, and attempt to stand as still as possible, while also mentioning as many items from the [insert supermarket section (dairy, greens, or butchers department)]; the 30 seconds will start in 3, 2, 1, now.

CHOICE STEPPING REACTION TEST

Description

The choice stepping reaction test was conducted using a Wii balance board and the FysioMeter software. The participants had to react as fast as possible by tapping the correct side of the WBB with the correct foot in response to a visual cue presented on a computer screen seven times. The WBB was placed approximately five cm in front of the participants' feet, and the computer screen was one meter away. A WBB was shown on the computer screen, and the cue was a green light on either the right or left of the WBB. The timing (1-4 seconds) and side were random to maximize the unpredictability. The time from the cue was given to the correct response was performed was recorded with the FysioMeter software.

Instruction

"For the reaction test, you must stand with the feet behind each side of the Wii balance board [guide the foot placement of participant]. A Wii balance board is illustrated on the screen in front of you. When I press "start", the left or right side will turn green after one to four seconds. You must tap on the correct side, as fast as possible, with the correct foot. If it is the left side, you must use the left foot, and vice versa. Before we begin, you will have three practice trials. Remember to focus on being as fast as possible."

[Participants get three attempts]

"Now we progress to the real test, and you will have to perform seven reaction trials. Remember to be as fast as possible."

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GAIT TEST

Description

The gait test involved walking eight meters at the preferred walking speed for a total of six trials. The initial three were conducted as a single task, while the last three were under a dual-task condition. The dual task involved continuously subtracting three from a random three digits number. The middle six meters will be recorded using a handheld watch.

Instruction

"During the gait test, you must walk 8 meters from the initial line through the end line [pointing at the two lines]. You will have to walk six times, the first three trials only focusing on walking, while the last three will also involve arithmetics. During the trials, you will have to walk at your regular pace. I will say "3, 2, 1, go", and on "go", you can walk."

[Participant completes three trials as a single task]

"During the next three trials, you will have to walk at your regular pace and simultaneously perform arithmetics. Before each trial, I will tell you a number, which could, for example, be 150. You will then have to continuously subtract three from that number while walking at your regular pace. If the number is 150, it will look like this [illustrate the test by walking and subtracting three]; 147, 144, 141, 138, and so on until you are at the end of the path [pointing at the end]"'

[Participant completes three trials as a dual task with three different numbers]

THE SHORT PHYSICAL PERFORMANCE BATTERY

Description

The short physical performance battery consists of a balance, gait, and strength component. The balance component includes standing in three foot positions (side-by-side, semi-tandem, and tandem) for ten seconds. The gait component involves two four-meter walks at a preferred walking speed, and the strength component consists of five sit-to-stands as fast as possible. Each element is scored based on performance and collected in a composite score (0-12; higher scores indicate better performance).

Instruction

"First, you have to perform a balance test. You have to stand for ten seconds with three different foot positions. During the ten seconds, you are not allowed to move your feet or grab any obstacles to regain balance. The first foot position is a side-by-side position [show the foot position and correct the participant's position]. When you feel in balance, say "go," and the ten seconds will begin."

[If the participants complete progress to the next foot position, if not, the balance test is over]

"The next foot position is a semi-tandem foot position [show the foot position and correct the participant's position]. When you feel in balance, say "go," and the ten seconds will begin."

[If the participants complete progress to the next foot position, if not, the balance test is over]

"The next foot position is a tandem foot position [show the foot position and correct the participant's position]. When you feel in balance, say "go," and the ten seconds will begin."

"The next test is a 4-meter waking test; you must walk 4 meters from the initial line through the end line [point at the two lines] two times at your regular pace. I will count from 3, and on "go", you begin."

"The last part of this test battery is a strength test, where you must stand up from a chair five times as fast as possible. Please sit in the chair and cross your hands in front of your chest [illustrate the arm position]. Now stand up and sit down once. You will have to repeat those five times as fast as possible. I will count from 3, and the time begins on "go". When you stand up the fifth time, the time will stop." [count for each repetition].

QUESTIONNAIRES

Instruction

"You must fill out this questionnaire which involves a variety of questions that relates to the risk of falling and your well-being. You must read the questions thoroughly and provide a response that describes you the best. If you have any questions regarding understanding the question, you are welcome to ask me; however, I will not be able to help you answer the questions."

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SUPPLEMENTARY MATERIAL 2: MISSING DATA

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MISSING DATA

Table SM3.1 – Missing data for each outcome

Outcome	PBT group				Control group			
	Pre-training	**Post-training**	**6-month follow-up**	**12-month follow-up**	**Pre-training**	**Post-training**	**6-month follow-up**	**12-month follow-up**
Gait	0 (0)	4 (6)	6 (9%)	10 (14%)	0 (0)	3 (4%)	11 (16%)	16 (23%)
Balance	0 (0)	4 (6)	6 (9%)	10 (14%)	0 (0)	3 (4%)	11 (16%)	16 (23%)
Reaction	0 (0)	4 (6)	6 (9%)	10 (14%)	0 (0)	3 (4%)	11 (16%)	16 (23%)
SPPB	0 (0)	4 (6)	6 (9%)	10 (14%)	0 (0)	3 (4%)	11 (16%)	16 (23%)
TMT	0 (0)	4 (6)	6 (9%)	10 (14%)	0 (0)	3 (4%)	10 (14%)	16 (23%)
FES	0 (0)	4 (6)	6 (9%)	10 (14%)	0 (0)	3 (4%)	10 (14%)	16 (23%)
EQ5D	0 (0)	4 (6)	6 (9%)	10 (14%)	0 (0)	3 (4%)	10 (14%)	16 (23%)

Table SM3.2 – Summary of reasons for missing data in each group

Reason	PBT group (n =13)	Control group (n = 18)
Injury/illness	6	9
Personal reasons*	7	9

* Personal reasons include logistical issues, lack of motivation, and changes in personal relations forcing stoppage in participation

Table SM3.3 – Baseline characteristics of participants with at least one missing data point in each group

	PBT group (n = 13)	Control group (n = 18)	p-values
Age (years), Mean (SD)	73 (5.0)	72 (5)	0.66$^{\alpha}$
Sex, no. female (%)	9 (69)	9 (50)	0.46$^{\gamma}$
Frailty*, median (IQR)	3 (2-4)	2 (1-3)	0.13$^{\beta}$
Medication, median (IQR)	4 (2-7)	2 (0-4)	0.19$^{\beta}$
Function of daily activities♦, median (IQR)	2 (2-3)	2 (1-3)	0.45$^{\beta}$
Previous fallers, No. fallen (%)	6 (46)	6 (33)	0.71$^{\gamma}$
Fear of falling, Median (IQR)	7 (7-8)	8 (7-9)	0.57$^{\beta}$
Cognition♣, median (IQR)	24 (24-26)	26 (24-26)	0.32$^{\beta}$
Physical function•, Median (IQR)	11 (11-12)	12 (11-12)	0.45$^{\beta}$
Habitual gait speed (m/s), Mean (SD)	1.2 (0.1)	1.3 (0.2)	0.12$^{\alpha}$
Dual-task gait speed (m/s) Mean (SD)	1.0 (0.2)	1.2 (0.2)	**0.03**$^{\alpha}$
Single-task balance, sway speed (mm/s) Median (IQR)	13.83 (10.97-19.03)	15.60 (12.00-25.67)	0.37$^{\beta}$
Dual-task balance, sway speed (mm/s) Median (IQR)	20.30 (15.78-25.93)	23.67 (15.77-25.93)	0.19$^{\beta}$
Reaction time (ms), Mean (SD)	904 (148)	959 (128)	0.86$^{\alpha}$
Executive function© (s), median (IQR)	59.18 (51.73-63.78)	45.93 (28.83-78.88)	0.12$^{\beta}$

* Tilburg Frailty indicator; ♦ The Vulnerable Elderly-13 Survey; ♣ The Short Orientation-Memory-Concentration Test; • The Short Physical Performance Battery; © Trail Making Test Part A subtracted from Part B; bold text indicates significant group differences. $^{\alpha}$ Unpaired sample t-test; $^{\beta}$ Wilcoxon signed rank test; $^{\gamma}$ Fisher's exact test; bold text indicates significant between group differences

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Table SM3.4 – Baseline characteristics of participants with at least one missing data point compared to participants with no missing data

	With missing (n = 31)	Without missing (n = 109)	p-values
Age (years), Mean (SD)	72 (5.1)	72 (4.6)	0.52$^{\alpha}$
Sex, no. female (%)	18 (58)	61 (56)	1.0$^{\gamma}$
Frailty*, median (IQR)	2 (1-3)	1 (1-3)	0.07$^{\beta}$
Medication, median (IQR)	3 (1-5)	2 (0-4)	0.25$^{\beta}$
Function of daily activities♦, median (IQR)	2 (1-2)	2 (1-3)	0.55$^{\beta}$
Previous fallers, No. fallen (%)	12 (39)	45 (41)	0.84$^{\gamma}$
Fear of falling, Median (IQR)	8 (7-9)	7 (7-8)	0.57$^{\beta}$
Cognition♣, median (IQR)	26 (24-26)	26 (24-28)	0.12$^{\beta}$
Physical function•, Median (IQR)	12 (11-12)	12 (11-12)	0.28$^{\beta}$
Habitual gait speed (m/s), Mean (SD)	1.3 (0.2)	1.3 (0.2)	0.25$^{\alpha}$
Dual-task gait speed (m/s) Mean (SD)	1.1 (0.2)	1.1 (0.2)	0.47$^{\alpha}$
Single-task balance, sway speed (mm/s) Median (IQR)	14.3 (11.7-20.7)	14.9 (12.0-19.2)	0.89$^{\beta}$
Dual-task balance, sway speed (mm/s) Median (IQR)	21.8 (14.4-27.3)	18.0 (14.9-25.1)	0.25$^{\beta}$
Reaction time (ms), Mean (SD)	927 (140)	889 (108)	0.95$^{\alpha}$
Executive function© (s), median (IQR)	54.8 (36.3-74.2)	37.5 (25.5-58.4)	0.06$^{\beta}$

* Tilburg Frailty indicator; ♦ The Vulnerable Elderly-13 Survey; ♣ The Short Orientation-Memory-Concentration Test; • The Short Physical Performance Battery; © Trail Making Test Part A subtracted from Part B; bold text indicates significant group differences. $^{\alpha}$ Unpaired sample t-test; $^{\beta}$ Wilcoxon signed rank test; $^{\gamma}$ Fisher's exact test; bold text indicates significant between group differences

SUPPLEMENTARY MATERIAL 2: RESULTS

This supplementary includes the results of the sensitivity analyses and the stata code used for both the primary analyses and the sensitivity analyses.

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PER-PROTOCOL ANALYSES

Table SM2.2 – Results of fall-related risk factors using a per-protocol approach which only included participants who completed at least 75% of the intervention

	Between group differences		
	Pre-training to post-training (95% CI)	Pre-training to 26-week follow-up (95% CI)	Pre-training to 52-week follow-up (95% CI)
Physical measures			
Gait speed, single task, m/s Mean (SD)	0.03 (-0.00 to 0.06)	0.01 (-0.02 to 0.05)	0.01 (-0.03 to 0.05)
Gait speed, dual task, m/s Mean (SD)	**0.05♣** **(0.02 to 0.09)**	0.03 (-0.01 to 0.07)	0.03 (-0.02 to 0.08)
Sway area, single task, mm^2 Median (IQR)	-2.2 (-6.5 to 2.0)	-1.8 (-6.2 to 2.7)	3.2 (-2.9 to 9.2)
Sway area, dual task, mm^2 Median (IQR)	-10.2 (-24.2 to 3.9)	4.7 (-9.0 to 18.4)	12.9 (-18.8 to 44.5)
Sway speed, single task, mm/s Median (IQR)	0.1 (-1.0 to 1.3)	0.3 (-0.9 to 1.5)	0.1 (-1.3 to 1.5)
Sway speed, dual task, mm/s Median (IQR)	-1.6 (-3.2 to 0.1)	0.1 (-2.0 to 2.2)	1.4 (-1.3 to 4.0)
Reaction time, ms Mean (SD)	**-57♣** **(-84 to -30)**	-31 (-64 to 2)	-31 (-64 to 2)
SPPB, score• Median (IQR)	**0.2♣** **(0.0 to 0.4)**	0.2 (-0.1 to 0.4)	-0.0 (-0.2 to 0.3)
Five sit-to-standµ, s Mean (SD)	-0.48 (-0.97 to 0.01)	-0.38 (-0.92 to 0.16)	-0.35 (-0.92 to 0.21)
Cognitive measures			
TMT ΔAB, s Median (IQR)	-2.78 (-16.38 to 10.82)	4.28 (-7.90 to 16.46)	-2.77 (-15.38 to 9.85)
Sociopsychological measures			
Fear of Falling, score▪ Median (IQR)	-0 (-1 to 1)	-0 (-0 to 0)	-0 (-1 to 0)
EQ5D, index⊕ Median (IQR)	0.01 (-0.01 to 0.04)	0.02 (-0.00 to 0.04)	-0.01 (-0.03 to 0.02)
EQ5D, VAS▫ Median (IQR)	-0 (-2 to 2)	-0 (-3 to 2)	1 (-2 to 3)

* Significant difference from pre-training test; ♣ Significant difference between groups; • SPPB score ranges between 0 and 12, 12 is the best score; ▪ s-FES score ranges between 7 and 28, 28 is the best score; ⊕ EQ5D Index ranges between 0 and 1, 1 is the best score; ▫ EQ5D VAS ranges between 0 and 100, 100 is the best score; µ Collected as part of the short physical performance battery.

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SENSITIVITY ANALYSES: ADJUSTED FOR AGE, SEX, AND PERVIOUS FALLS

Table SM2.3 – Results of fall-related risk factors for each testing session as well as group differences at post-training, 26-week follow-up and 52-week follow-up for the adjusted model (age, sex, and previous falls)

	Between group differences		
	Pre-training to post-training (95% CI)	Pre-training to 26-week follow-up (95% CI)	Pre-training to 52-week follow-up (95% CI)
Physical measure			
Gait speed, single task, m/s Mean (SD)	**0.03♣ (0.00 to 0.06)**	0.02 (-0.02 to 0.05)	0.02 (-0.02 to 0.05)
Gait speed, dual task, m/s Mean (SD)	**0.06♣ (0.02 to 0.09)**	0.03 (-0.01 to 0.07)	0.04 (-0.01 to 0.08)
Sway area, single task, mm^2 Median (IQR)	-2.8 (-6.8 to 1.3)	-2.6 (-6.8 to 1.7)	2.2 (-3.6 to 7.9)
Sway area, dual task, mm^2 Median (IQR)	-11.5 (-24.9 to 1.95)	2.1 (-10.5 to 14.8)	10.1 (-19.3 to 39.4)
Sway speed, single task, mm/s Median (IQR)	0.1 (-1.0 to 1.1)	-0.0 (-1.1 to 1.1)	-0.1 (-1.5 to 1.2)
Sway speed, dual task, mm/s Median (IQR)	-1.6 (-3.3 to 0.1)	0.3 (-2.3 to 1.7)	1.1 (-1.5 to 3.6)
Reaction time, ms Mean (SD)	**-57♣ (-83 to -30)**	-27 (-58 to 5)	-27 (-59 to 6)
SPPB, score• Median (IQR)	**0.2♣ (0.0 to 0.4)**	0.2 (-0.1 to 0.4)	-0.1 (-0.2 to 0.3)
Five sit-to-standµ, s Mean (SD)	**-0.54♣ (-0.97 to -0.01)**	-0.44 (-0.98 to 0.10)	-0.40 (-0.93 to 0.14)
Cogntive measure			
TMT ΔAB, s Median (IQR)	-3.80 (-18.18 to 10.57)	3.30 (-9.47 to 16.07)	-3.79 (-17.22 to 9.64)
Sociopsychological measure			
Fear of Falling, score▪ Median (IQR)	-0 (-1 to 0)	-0 (-1 to 0)	-0 (-1 to 0)
EQ5D, index⊕ Median (IQR)	0.01 (-0.01 to 0.04)	0.02 (-0.00 to 0.04)	-0.01 (-0.03 to 0.02)
EQ5D, VAS▫ Median (IQR)	-0 (-2 to 2)	-1 (-3 to 2)	0 (-2 to 3)

♣ Significant between-group difference favouring the PBT group; • SPPB score ranges between 0 and 12, 12 is the best score; ▪ s-FES score ranges between 7 and 28, 28 is the best score; ⊕ EQ5D Index ranges between 0 and 1, 1 is the best score; ▫ EQ5D VAS ranges between 0 and 100, 100 is the best score; µ Collected as part of the short physical performance battery.

STATA CODES USED FOR ANALYSIS

All the statistical tests was conducted in STATA version 17.0. The outcomes was adjusted for the baseline values for the same outcome. This code was used for all the outcomes in this study:

mixed [insert variable] i.time##i.intervention baseline_[insert variable] || record_id:, vce(robust)

Model adjusting for age, sex, and previous falls:

mixed [insert variable] i.time##i.intervention baseline_[insert variable] age i.sex i.prev_faller || record_id:, vce(robust)

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Supplementary Table 1 – Results from the linear mixed effects model of fall-related risk factors for each testing session as well as group differences at post-training, 6-month follow-up, and 12-month follow-up

	PBT Group Δ				Control group Δ				Between-group differences Ω		
	Pre-training (n = 70)	Post-training (n = 66)	6-month follow-up (n = 64)	12-month follow-up (n = 60)	Pre-training (n = 70)	Post-training (n = 67)	6-month follow-up (n = 59)	12-month follow-up (n = 54)	Pre-training to post-training	Pre-training to 6-month follow-up	Pre-training to 12-month follow-up
Physical measures											
Gait speed, single task, m/s	1.28 [1.24;1.32]	1.29 [1.25;1.33]	1.26 [1.22;1.31]	1.24* [1.20;1.28]	1.26 [1.22;1.30]	1.24 [1.20;1.28]	1.24* [1.20;1.28]	1.22* [1.17;1.26]	0.03 [-0.00;0.06]	0.01 [-0.02;0.04]	0.01 [-0.02;0.04]
Gait speed, dual task, m/s	1.12 [1.07;1.16]	1.17* [1.12;1.21]	1.13 [1.08;1.18]	1.13 [1.08;1.18]	1.12 [1.07;1.17]	1.12 [1.07;1.17]	1.11 [1.06;1.16]	1.10 [1.05;1.15]	**0.05♣** **[0.01;0.09]**	0.02 [-0.02;0.06]	0.03 [-0.01;0.07]
Sway area, single task, mm² ∞	25.18 [19.90;30.47]	25.00 [19.66;30.35]	23.54 [18.16;28.92]	27.71 [22.26;33.15]	32.28 [27.00;37.57]	32.30 [26.96;37.63]	30.65 [25.18;36.12]	30.16 [24.60;35.72]	-0.19 [-5.69;5.30]	-0.01 [-5.67;5.65]	4.65 [-1.16;10.45]
Sway area, dual task, mm² ∞	45.75 [29.86;61.65]	39.12 [22.97;55.28]	46.97 [30.68;63.27]	59.20 [42.64;75.77]	61.43 [45.54;77.33]	59.13 [43.03;75.22]	53.31 [36.64;69.97]	57.73 [40.66;74.79]	-4.32 [-24.22;15.57]	9.34 [-11.13;29.81]	17.15 [-3.85;38.16]
Sway speed, single task, mm/s ∞	15.98 [14.09;17.87]	14.86* [12.96;16.76]	16.35 [14.44;18.25]	16.83 [14.91;18.74]	18.21 [16.32;20.10]	16.74* [14.84;18.64]	18.31 [16.39;20.23]	18.90 [16.97;20.83]	0.35 [-0.89;1.60]	0.27 [-1.01;1.56]	0.16 [-1.15;1.48]
Sway speed, dual task, mm/s ∞	21.64 [19.03;24.26]	19.11* [16.48;21.75]	21.83 [19.19;24.47]	22.99 [20.33;25.65]	22.95 [20.33;25.56]	21.62 [18.99;24.24]	23.02 [20.35;25.69]	22.87 [20.18;25.57]	-1.20 [-3.25;0.85]	0.11 [-2.00;2.22]	1.42 [-0.75;3.58]
Choice stepping reaction time, ms,	890 [863;917]	821* [793;849]	841* [813;869]	832* [803;860]	903 [876;931]	883 [856;911]	873* [844;901]	863* [834;892]	**-48.84♣** **[-79.88;-17.79]**	-18.19 [-50.06;13.67]	-18.12 [-50.92;14.68]
SPPB score • ∞	11.53 [11.34;11.72]	11.73* [11.53;11.92]	11.59 [11.39;11.79]	11.63 [11.43;11.83]	11.34 [11.15;11.54]	11.42 [11.22;11.61]	11.32 [11.12;11.53]	11.48 [11.28;11.69]	0.13 [-0.11;0.36]	0.08 [-0.16;0.32]	-0.04 [-0.29;0.21]
Five sit-to-stand, s µ	10.64 [10.09;11.19]	9.79* [9.23;10.34]	10.14* [9.58;10.70]	9.43* [8.86;10.00]	11.24 [10.69;11.79]	10.68* [10.13;11.24]	10.93 [10.37;11.50]	10.20* [9.63;10.78]	-0.30 [-0.82;0.23]	-0.20 [-0.74;0.34]	-0.17 [-0.73;0.38]
Cognitive measures											
TMT ΔAB, s ∞	57.32 [42.20;72.44]	53.84 [38.62;69.06]	56.99 [41.67;72.30]	55.69 [40.28;71.10]	59.31 [44.22;74.41]	56.21 [41.02;71.40]	50.57 [35.14;65.99]	56.72 [41.08;72.36]	-0.37 [-13.21;12.46]	8.41 [-4.80;21.63]	0.96 [-12.61;14.54]
Sociopsychological measures											
Fear of Falling, score ▪ ∞	7.79 [7.45;8.12]	7.98 [7.64;8.33]	8.13* [7.79;8.48]	7.91 [7.55;8.26]	7.90 [7.56;8.24]	8.31* [7.96;8.65]	8.23* [7.87;8.58]	8.18 [7.82;8.55]	-0.21 [-0.64;0.22]	0.02 [-0.42;0.46]	-0.16 [-0.61;0.29]
EQ5D, index ⊕ ∞	0.95 [0.93;0.97]	0.95 [0.93;0.97]	0.94 [0.93;0.96]	0.93* [0.91;0.95]	0.95 [0.93;0.96]	0.94 [0.92;0.95]	0.92* [0.90;0.94]	0.93 [0.91;0.95]	0.01 [-0.01;0.04]	0.02 [-0.00;0.04]	-0.01 [-0.03;0.02]
EQ5D, VAS ▫ ∞	86.73 [84.46;89.00]	88.40 [86.09;90.71]	87.78 [85.45;90.11]	88.53 [86.16;90.89]	87.00 [84.73;89.27]	88.75 [86.45;91.05]	88.48 [86.11;90.85]	88.11 [85.67;90.55]	-0.08 [-2.95;2.78]	-0.42 [-3.37;2.52]	0.69 [-2.34;3.71]

Δ Estimated means and 95% confidence intervals from the mixed model; * Significant within-group difference from pre-training test; ♣ Significant difference favouring the PBT group; • SPPB score ranges between 0 and 12, 12 is the best score; ▪ s-FES score ranges between 7 and 28, 7 is the best score; ⊕ EQ5D Index ranges between 0 and 1, 1 is the best score; ▫ EQ5D VAS ranges between 0 and 100, 100 is the best score; µ Collected as part of the short physical performance battery, Ω Estimation from mixed models of between-group difference in within-group differences with 95% confidence intervals; ∞ model assumptions not completely fulfilled