



# The effects of dual-task balance training on gait in older women with osteoporosis: A randomized controlled trial

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## ABSTRACT

**Background:** Although there is a growing body of literature showing promising effects of balance training on gait in older adults, little is known about the effects of dual-task training on varying domains of spatial and temporal gait parameters.

**Research question:** Does the short-term effects of dual-task balance training differ between single and dual-task gait in older women with osteoporosis with regards to different gait domains (pace, rhythm, variability, asymmetry and postural control)?

**Methods:** Elderly women with osteoporosis who experienced fear of falling and/or  $\geq 1$  fall the last 12 months were recruited. Ninety-five participants were randomized to 12 weeks of balance training or to a control group. The participants in the training group ( $n = 65$ ) received 12 weeks (3 times/week) of balance and gait exercises including dual-tasks, and the control group ( $n = 30$ ) received care as usual. Single- and dual-task gait were assessed before and after the intervention with an electronic walkway system and analyzed using non-parametric statistics and effect sizes.

**Results:** 68 participants completed the study. The training group walked faster for single- and dual-task gait following training ( $P \leq .044$ ) by increasing their cadence ( $P \leq .012$ ) and reducing step and swing time ( $P \leq .045$ ) compared with the control group. Significant between-group differences in favor of the training group were found for gait variability during dual-task gait ( $P \leq .041$ ). The improvement in speed were greater for dual-task than single-task gait (0.10 vs. 0.05 m/s) and the effect sizes revealed small to medium effects for dual-task gait, and either non-existent or small for single-task gait.

**Significance:** Greater training effects found on a variety of domains of dual-task gait compared to single-task gait support the role of cognitively demanding exercises for the maintenance of safe ambulation in older women with osteoporosis.

## 1. Introduction

The population of individuals with osteoporosis continues to increase due to the rapid aging of the population worldwide [1]. Osteoporosis reduces the density and quality of bone which in turn increase the risk of fractures [2,3]. The disease is common in the older population and in Sweden 107 000 new osteoporosis-related fractures were reported in 2010 and a majority of those affected were women [3].

It is known that alterations of spatiotemporal gait characteristics are linked to disability in older adults (e.g. falls, injuries, and mortality) [2,4] and older adults with osteoporosis make up a certain risk group [5,6]. With increased age, walking also becomes less

automatic and more under executive control, i.e. increased attention is allocated to the walking pattern itself [7]. Such a control strategy might, however, impair the ability to allocate attention to other important aspects of the environment or to other tasks. Accordingly, performing a cognitive task while walking (i.e. dual-task) has been shown to decrease speed and increase gait variability in older adults with osteoporosis [6], which in turn has been related to increased risk of falling [8,9].

In theory, dual-task interference during gait could be minimized by increasing automaticity of one of the tasks through repetitive practice (e.g. separate gait and cognitive training) [10,11]. Alternatively, cognitive-motor interference may be improved through practicing of dual-task exercises, i.e. training two tasks simultaneously (e.g. gait combined

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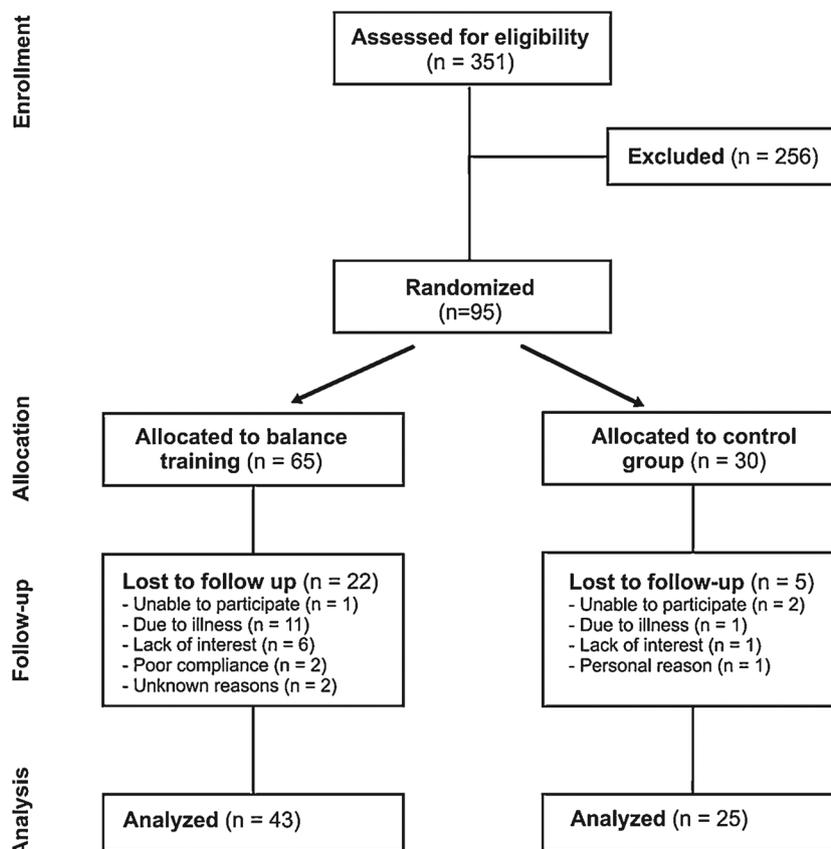


Fig. 1. CONSORT flow diagram illustrating recruitment, randomization, and tracking of the participants over the course of the study.

Table 1  
Participant characteristics<sup>a</sup>.

Variables	Training group (n = 43)	Control group (n = 25)	P-value
Age (years)	76 (6)	76 (5)	.796
Female	43 (100%)	25 (100%)	1.00
Body mass index	25 (4)	26 (4)	.126
Mini-Mental State Examination	28.3 (1.5)	28.1 (1.4)	.625
Experience ≥ 1 fall the last year	20 (47%)	13 (52%)	.802
Fear of falling	43 (100%)	25 (100%)	1.00
FES-I	28.8 (7.0)	28.3 (5.8)	.776
EQ VAS	67 (19)	69 (21)	.701
The Geriatric Depression Scale	4.0 (3.6)	3.0 (2.6)	.236
Physical activity (steps per day)	6084 (2879)	5394 (2822)	.340

Abbreviations: FES-I = Falls Efficacy Scale-International; EQ VAS = Euro Quality of Life visual analogue scale.

<sup>a</sup> Continuous data are presented as mean (standard deviation) and nominal data as number (percentage).

with a cognitive task) [7,12]. There is a growing body of literature showing promising effects of balance training including dual-tasking on gait speed in older adults [10,13,14]. However, although gait speed is a good outcome for the evaluation of performance due to its robust clinometric properties [15,16], gait is multidimensional and cannot be fully evaluated based on a single metric [17].

We have previously shown that balance training, including dual-tasking, improves walking speed and reduces fear of falling in older adults with osteoporosis [14]. Our goal with this study was to compare the short-term effects of dual-task balance training on different domains of single- and dual-task gait in older women with osteoporosis [17]. Because this training program specifically emphasized cognitively demanding dual-task exercises [18], we anticipated larger training effects on dual-task gait than single-task gait.

## 2. Methods

### 2.1. Design

This study, approved by the Regional Ethical Board in Stockholm (2009/819-32, 2012/1829-32), was a pre-planned secondary analysis of a randomized controlled study for older adults with osteoporosis (trial registration no: NCT01417598, ClinicalTrials.gov).

### 2.2. Participants

Community-dwelling older women with diagnosed osteoporosis were recruited by advertisement in local newspapers in Stockholm County and through the Swedish Osteoporosis Society and Karolinska University Hospital. Inclusion criteria were age ≥ 65 years, being independent in daily ambulation, experience of fear of falling and/or ≥ 1 fall in the last 12 months. Exclusion criteria were a history of fractures during the last year, cognitive impairment as indicated by a Mini-Mental State Examination score < 24 [19], and other medical conditions substantially influencing gait. All participants signed an informed consent form before entering the study.

### 2.3. Randomization and blinding

Participants were randomized into three groups: 1) balance training, 2) balance training with supplementary promotion of physical activity, or 3) a control group. While group 1 and 2 performed the same balance training program, participants in group 2 was instructed to perform supplemental physical activity in the form of walking with or without poles during the intervention period. The randomization was performed in blocks of 9 after baseline testing

using web-based software ([www.randomization.com](http://www.randomization.com)). For the aim of this study, the two training groups were merged into one intervention group because both groups received the same training intervention and demonstrated similar levels of physical activity across the intervention period [14]. The test leaders were blinded to group allocation at baseline; however, blinding was not possible after baseline testing because some of the test leaders were also involved in the balance training.

#### 2.4. Sample size

For the original study, the sample-size calculation, as detailed in a previous study [14], was based on a randomized controlled study investigating the effects of a similar balance training program in older adults [20]. Power was set to 80%, a two-sided test at the alpha level of 5%, and an anticipated dropout rate of 15%. Taken together, a sample size of 21 participants per group would be required to ensure adequate statistical power.

#### 2.5. Intervention

The content of the balance training program has been detailed in a previous publication [18]. Briefly, the balance training was performed in groups of 6–10 participants for 12 weeks (3 times/week, 45 min/session) at two university hospitals. Each session was supervised by 2 or 3 trainers to ensure the participants' safety and to promote training progression. All the trainers involved in this study were physiotherapists ( $n = 5$ ) educated in the framework of this training concept. Every training session started with a warm-up session for 5 min, consisting of varied walking tasks aiming to boost the cardiovascular system. The following 30 min focused on challenging balance exercise divided into blocks of 10 min. The program ended with a 5-min cool-down session with walking and stretching.

The training relied upon the continuous progression and adaptation of exercises with regards to the participants' abilities. Specifically, each session included seated, standing, and walking exercises targeting various systems for postural control, such as stability limits (e.g. leaning/reaching tasks to stimulate weight shifts in multiple directions), integration of sensory information (e.g. standing, transfers, and walking on uneven surfaces with/without visual restrictions), various aspects of gait (e.g. changing direction/speed and obstacle crossing), and balance reactions (i.e. postural adjustment occurring when balance is highly challenged).

To target cognitive-motor interference, dual-task exercises were integrated into the program by adding concurrent cognitive (e.g., counting, remembering items) and/or motor tasks (e.g. carrying and/or manipulating objects) to the balance exercises. The aim with dual-task exercises was to induce continuous cognitive-motor interference while the participants performed varying balance and gait exercises. To ensure an adequate difficulty level of the training, the dual-task exercises was aiming for a level where the participants' gait and balance performance were interfered compared to the single-task performance (e.g. interfering with speed, regularity or quality of movement). Dual-tasking was incorporated in all types of exercises throughout the program, and at least two thirds of each training session focused on exercises involving standing and walking. The tasks used for the dual-task exercises during the intervention were not the same as those used during the baseline and follow-up assessments.

The participants in the control group were encouraged to maintain their normal physical activities and were not restricted from participation in ongoing exercise regimens.

#### 2.6. Testing procedure

Data collection at baseline and at the 12-week follow-up covered three steps. First, demographic data (age, gender, body weight, and

height) and data on concerns about falling, fall history, health-related quality of life, and depression were collected using structured interviews and self-reported questionnaires. Fear of falling was assessed with the single-item question; "In general, are you afraid of falling?" [21]. Concerns about falling were assessed with the Falls Efficacy Scale-International, which includes 16 questions about daily activities graded on a 4-point scale [22]. Health-related quality of life was evaluated with the Euro Quality of Life visual analogue scale [23] and signs of depression were evaluated with the Geriatric Depression Scale [24].

Second, gait was assessed in a movement laboratory using the GAITRite® (active zone; length 7.93 m, width 0.61 m).<sup>1</sup> Acceleration and deceleration distances of 2 m was given on each side of the mat (i.e. total track of walk was 12 m) to ensure steady state walking upon the mat. The participants were instructed to walk at a comfortable pace during normal gait (i.e. single-task) and while walking and performing the cognitive task of reciting every second letter of the Swedish alphabet (i.e. dual-tasking). This recitation task, incorporating working memory, has been found to predict falls in older adults [25]. Participants were instructed to place equal focus on the walking and the cognitive task during the dual-task gait assessment. Each gait condition was performed six times. Our analysis was guided by a model of gait recently developed and validated for older adults [17] that includes five domains: pace (step velocity, step length, cadence, and swing time variability), rhythm (step time, swing time, and stance time), variability (step velocity variability, step time variability, and stance time variability), asymmetry (step time asymmetry, swing time asymmetry, and stance time asymmetry), and postural control (step width, step width variability, and step length asymmetry). The gait parameters were calculated as either the mean of the right and left steps, the square root of the mean variance of the right and left steps (i.e. the standard deviation (SD)), or as the absolute difference between the right and left steps [17]. To gain more insight into dual-task performance, the average accuracy of the recitation task (i.e. the number of correct responses/total number of letters recited) was analyzed.

Third, to provide information about the level of community ambulation, accelerometers (Actigraph, GT3X+)<sup>2</sup> were used to measure the physical activity level during free-living conditions (waking hours of the day) prior to the intervention period. The outcome; average steps per day, was based on 5–7 days of  $\geq 9$  h of valid data.

#### 2.7. Statistical analysis

Statistical analyses were carried out using IBM SPSS, version 23.0 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics, means (SD), and numbers (percentages) were used to present demographics, concerns about falling, health-related quality of life, signs of depression and level of physical activity at baseline. Gait data were analyzed using a per-protocol approach owing to the small dropout rate. Because the gait variables were overall not normally distributed, the Mann-Whitney  $U$  test was used to analyze between-group differences (i.e. the difference between the baseline and the follow-up assessments). In the case of significant between-group differences, within-group differences between baseline and the follow-up were analyzed with the Wilcoxon signed-rank test. Gait outcomes were presented as the median (inter quartile range) and the level of significance was set at  $P \leq 0.05$ . To obtain information regarding the magnitude of between-group differences, non-parametric effect sizes were calculated based on the  $z$ -values obtained from the Mann-Whitney  $U$  tests (effect size =  $z/\sqrt{n}$ ). Effect sizes

<sup>1</sup> GaitRite: CIR Systems, Inc., Franklin, NJ, USA.

<sup>2</sup> Actigraph: GT3X+, Pensacola, FL, USA.

were categorized as follows: small effect = 0.1; medium effect = 0.3; and large effect = 0.5 [26].

### 3. Results

Of the 351 participants assessed for eligibility, 95 were randomized to either the training group (n = 65) or to the control group (n = 30). Of these, 68 completed the assessments at baseline and follow-up (training group: n = 43, control group: n = 25, see Fig. 1). Baseline characteristics of those completed the study are presented in Table 1. There were no significant differences between groups regarding demographics, fall history, fear of falling, health-related quality of life, signs of depression, level of physical activity (see Table 1), or for any gait parameters at baseline.

Gait parameters during single-task and dual-task gait are presented in Tables 2 and 3. As illustrated in Fig. 2, we found overall greater effects sizes for dual-task gait than single-task gait; small (n = 6) to medium (n = 7) training effects were found for most gait parameters during dual-task gait, whereas the effects for single-task gait were either small (n = 9) or non-existent (n = 7).

For dual-task gait, we found significant between-group differences favoring the training group in the domains of pace (step velocity:  $P = .009$  and cadence:  $P = .001$ ) and rhythm (step time:  $P = .001$ , swing time:  $P < .001$  and stance time:  $P = .002$ ). Similar results were demonstrated for single-task gait. However, while significant group differences favoring the training group were observed for cadence ( $P =$

.043) and swing time ( $P = .032$ ) the results for step velocity and step time were only approaching significance ( $P \leq .065$ ). The training group increased their step velocity (single-task:  $P = .002$ , dual-task:  $P = .002$ ) and cadence (single-task:  $P = .012$ , dual-task:  $P = .001$ ) and reduced their step time (single-task:  $P = .010$ , dual-task:  $P = .001$ ) and swing time (single-task:  $P = .003$ , dual-task:  $P = .001$ ) between baseline and follow-up. These parameters remained unchanged in the control group ( $P \geq .459$ ).

While the results showed significant between-group differences in favor of the training group for swing time SD ( $P = .008$ ) and step time SD during dual-task gait ( $P = .021$ ), no group differences were found for gait variability during single-task gait ( $P \geq .463$ ). The difference in swing time SD occurred due to a trend towards decreased variability in the training group ( $P = .053$ ) and trend towards increased variability in the control group between baseline and follow-up ( $P = .053$ ). The difference in step time SD derived from a significant increase in the control group between baseline and follow-up ( $P = .046$ ). A significant between-group difference favoring the training group was found for swing time asymmetry during single-task gait ( $P = .016$ ) owing to a significant decrease in the training group ( $P < .001$ ). No significant between-group differences were found for the postural control domain ( $P \geq .097$ ).

Although no between-group difference was found for the performance of the cognitive task while walking ( $P = .580$ ), accuracy in performing the task improved in both groups between baseline and follow-up (training group: 80% vs. 83%,  $P = .033$ , control group: 82% vs. 86%,  $P = .001$ ).

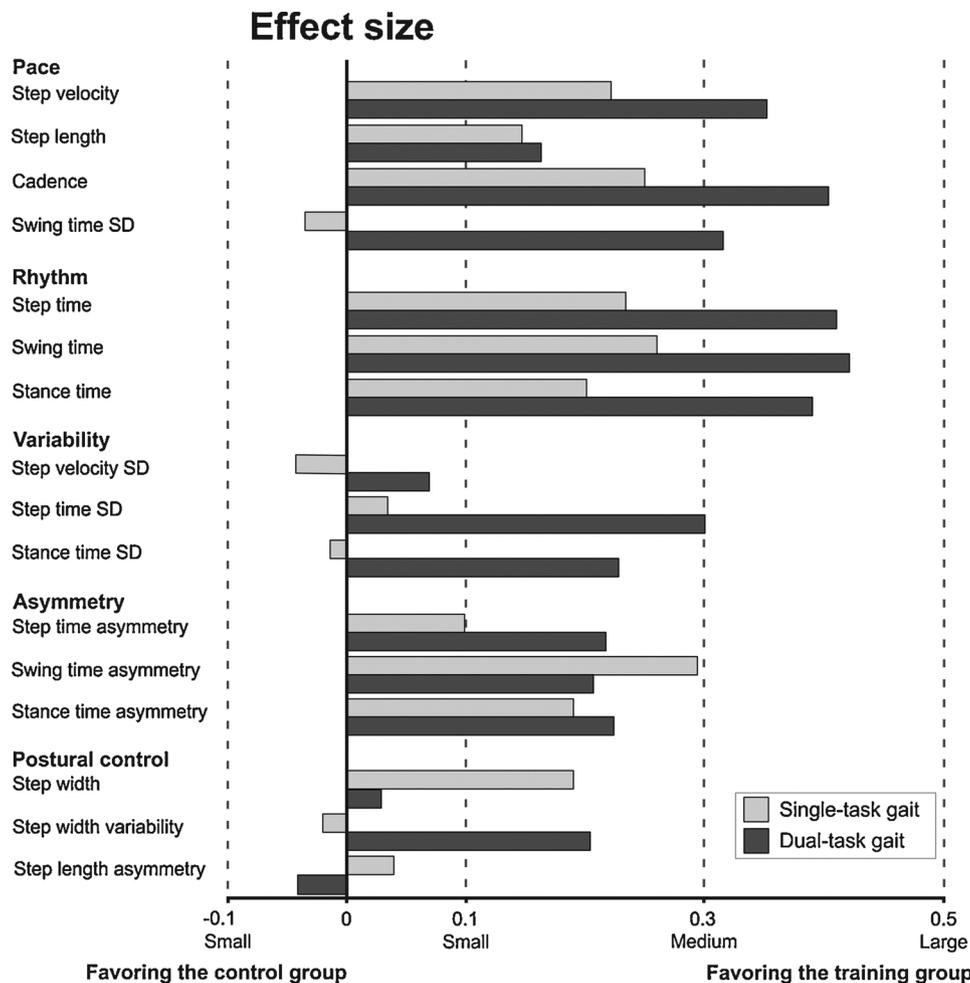


Fig. 2. Between-group effect sizes of gait parameters. The vertical dashed lines illustrate small (0.1), medium (0.3) and large (0.5) differences between the groups.

**Table 2**  
Gait parameters during normal walking at baseline and at follow-up.<sup>a</sup>

	Training group (n = 43)			Control group (n = 25)			P-value <sup>b</sup>
	Baseline	Follow-up	Difference	Baseline	Follow-up	Difference	
<b>Pace</b>							
Step velocity (m/s)	1.139 (0.300)	1.268 (0.288)	0.055 (0.160)*	1.154 (0.267)	1.172 (0.266)	−0.001 (0.170)	.065
Step length (m)	0.614 (0.087)	0.641 (0.089)	0.018 (0.038)	0.610 (0.143)	0.594 (0.125)	0.000 (0.052)	.252
Cadence (steps/min)	112 (11)	118 (10)	2 (11)*	115 (12)	112 (12)	−1 (8)	<b>.043</b>
Swing time SD (ms)	137 (31)	136 (33)	0 (30)	140 (28)	134 (32)	−6 (20)	.804
<b>Rhythm</b>							
Step time (ms)	530 (50)	510 (40)	−10 (50)*	520 (60)	535 (60)	0 (40)	.064
Swing time (ms)	410 (50)	395 (40)	−10 (40)*	400 (40)	400 (40)	0 (30)	<b>.032</b>
Stance time (ms)	660 (60)	640 (80)	−10 (90)	650 (80)	650 (80)	10 (60)	.117
<b>Variability</b>							
Step velocity SD (m/s)	0.246 (0.048)	0.258 (0.036)	0.191 (0.040)	0.247 (0.027)	0.242 (0.036)	0.184 (0.040)	.463
Step time SD (ms)	141 (35)	137 (25)	−4 (30)	138 (20)	134 (24)	−1 (20)	.779
Stance time SD (ms)	154 (37)	151 (31)	−3 (40)	157 (25)	160 (31)	−4 (40)	.919
<b>Asymmetry</b>							
Step time asymmetry (ms)	10 (20)	10 (0)	0 (20)	10 (10)	10 (20)	0 (20)	.368
Swing time asymmetry (ms)	10 (20)	10 (20)	−5 (10)*	10 (20)	10 (10)	0 (20)	<b>.016</b>
Stance time asymmetry (ms)	10 (10)	10 (10)	0 (10)	10 (20)	10 (10)	0 (20)	.167
<b>Postural control</b>							
Step width (m)	0.066 (0.035)	0.066 (0.037)	−0.001 (0.023)	0.081 (0.046)	0.086 (0.041)	0.000 (0.001)	.124
Step width SD (m)	0.015 (0.004)	0.015 (0.004)	0.000 (0.003)	0.015 (0.005)	0.014 (0.002)	0.000 (0.004)	.995
Step length asymmetry (m)	0.017 (0.024)	0.016 (0.028)	0.001 (0.015)	0.010 (0.020)	0.014 (0.023)	0.001 (0.017)	.741

Abbreviations: m/s = meters per second; m = meters; ms = milliseconds.

<sup>a</sup> Data are presented as median (inter quartile range).

<sup>b</sup> Mann–Whitney *U* test to determine between-group differences.

\* Significant difference ( $\leq .05$ ) between baseline and follow-up (Wilcoxon signed-rank test).

**Table 3**  
Gait parameters during dual-task walking at baseline and follow-up.<sup>a</sup>

	Training group (n = 43)			Control group (n = 25)			P-value <sup>b</sup>
	Baseline	Follow-up	Difference	Baseline	Follow-up	Difference	
<b>Pace</b>							
Step velocity (m/s)	1.138 (0.404)	1.230 (0.265)	0.096 (0.200) <sup>†</sup>	1.101 (0.257)	1.078 (0.367)	−0.010 (0.190)	<b>.009</b>
Step length (m)	0.634 (0.137)	0.650 (0.086)	0.018 (0.053)	0.591 (0.103)	0.599 (0.118)	0.082 (0.051)	.201
Cadence (steps/min)	106.6 (19.8)	111.4 (14.4)	6.8 (11.7)*	108.5 (9.9)	110.9 (13.8)	−1.7 (15.7)	<b>.001</b>
Swing time SD (ms)	160 (67)	149 (51)	−10 (50)	162 (69)	176 (111)	11 (60)	<b>.008</b>
<b>Rhythm</b>							
Step time (ms)	560 (100)	540 (70)	−35 (70)*	560 (50)	540 (70)	10 (80)	<b>.001</b>
Swing time (ms)	420 (70)	410 (70)	−30 (40)*	420 (60)	420 (60)	10 (50)	<b>&lt; .001</b>
Stance time (ms)	690 (150)	660 (110)	−45 (110)*	680 (70)	670 (100)	10 (120)	<b>.002</b>
<b>Variability</b>							
Step velocity SD (m/s)	0.276 (0.081)	0.278 (0.067)	0.211 (0.060)	0.280 (0.064)	0.282 (0.097)	0.220 (0.080)	.642
Step time SD (ms)	175 (73)	160 (54)	−13 (50)	172 (98)	176 (132)	9 (80)*	<b>.021</b>
Stance time SD (ms)	193 (93)	179 (59)	−11 (60)	188 (108)	200 (128)	2 (70)	.062
<b>Asymmetry</b>							
Step time asymmetry (ms)	10 (30)	10 (20)	0 (20)	10 (20)	10 (40)	0 (30)	.055
Swing time asymmetry (ms)	10 (20)	10 (20)	0 (20)	10 (20)	10 (30)	0 (20)	.103
Stance time asymmetry (ms)	10 (20)	10 (20)	0 (20)	10 (20)	20 (30)	10 (40)	.075
<b>Postural control</b>							
Step width (m)	0.064 (0.040)	0.066 (0.045)	−0.004 (0.026) <sup>†</sup>	0.104 (0.062)	0.098 (0.061)	−0.001 (0.020)	.698
Step width SD (m)	0.016 (0.005)	0.015 (0.005)	0.000 (0.003)	0.014 (0.004)	0.016 (0.006)	0.001 (0.002)	.097
Step length asymmetry (m)	0.016 (0.020)	0.018 (0.029)	0.001 (0.013)	0.012 (0.019)	0.016 (0.022)	0.000 (0.018)	.804

Abbreviations: m/s = meters per second; m = meters; ms = milliseconds.

<sup>a</sup> Data are presented as median (inter quartile range).

<sup>b</sup> Mann–Whitney *U* test to determine between-group differences.

\* Significant difference ( $\leq .05$ ) between baseline and follow-up (Wilcoxon signed-rank test).

#### 4. Discussion

This study compared the short-term effects of dual-task balance training on different domains of single- and dual-task gait in women with osteoporosis. In line with the emphasis of the training program on dual-task exercises, larger training effects were found for dual-task gait compared to single-task gait. We also found that the gait domains of pace and rhythm improved for both single-task and dual-task gait following training, whereas the results indicated improvements in

variability only for dual-task gait. Our findings support the notion of the role of cognitively demanding balance training for the maintenance of safe and efficient gait in older adults.

In line with our findings, a recent meta-analysis reported a larger treatment effect on gait speed for dual-task gait (0.11 m/s) compared to single-task gait (0.06 m/s) following varying types of physical exercise in older adults [13]. Importantly, the training effect found in our study for gait speed during dual-tasking (approximately 0.10 m/s) likely reflects a clinically relevant improvement [15,16]. Several plausible

explanations exist for this improvement. First, the positive effects of balance training on dual-task gait might be attributed to improved efficiency in integrating the primary and secondary task (i.e. gait and the cognitive task). This is a possible explanation because task integration was extensively targeted in this balance-training intervention [18]. Alternatively, improved single-task performance might indirectly improve dual-task performance through increased automaticity of gait. This could result in less attentional resources being used for gait and thereby decreasing the overlap in brain activity between gait and the cognitive task [7,27]. This view is partly supported in our study by the improvements in single-task gait following training. Although these results and previous findings [13] support the role of dual-tasking balance training for older adults, the underlying mechanisms of improvement in dual-task abilities requires further investigation.

In contrast to previous studies, which have mainly reported training effects on gait speed [13], this study provides novel findings regarding the benefits of balance training on different aspects of gait. First, our results indicate beneficial training effects on variability during dual-task gait. Because previous studies have established the association between high gait variability and the occurrence of falls in older adults [28–30], our findings could be of importance for the maintenance of safe ambulation in older adults. Nevertheless, the results for gait variability found in our study need to be interpreted cautiously because the differences between groups mainly derived from a combination of non-significant trends within the training and control groups. Second, the training group also walked faster by increasing their cadence and by reducing their swing and stance time following training. Because these gait parameters are known to be speed dependent [31,32], these findings likely reflect a natural change in the walking pattern mediated by increased walking speed following training. Finally, the training effects on gait asymmetry and postural control were scarce, which likely reflect that our sample of women with osteoporosis showed no impairment in these domains at baseline, thereby limiting the potential for improvement due to training.

#### 4.1. Study limitations

Our results can only be generalized to the population of older women with osteoporosis who reported fear of falling or previous falls with an ambulatory profile of approximately 1.1 m/s in single-task gait speed and a physical activity level of approximately 5000–6000 steps per day. One limitation to this work is that we did not assess the performance of the cognitive task as a single-task (e.g. in a seated position). Such information would have been useful in order to determine whether there were any effects of training on task prioritization strategies during dual-task gait. Therefore, to further explore the potential of dual-task exercise for rehabilitation, it is recommended that future studies examine the performance of gait and the added task (e.g. a cognitive task) separately [13]. Furthermore, changes in gait speed between baseline and the follow-up in the training group could by itself have led to changes in other gait domains (e.g. variability). Finally, we were unable to blind the test assessors to group allocation at follow-up for practical reasons, which could have influenced the assessment of gait.

#### 5. Conclusion

In line with the focus of the training program on cognitively demanding balance exercises, greater training effects were found in a variety of domains of dual-task gait compared to single-task gait. This supports the role of cognitively demanding exercises for the maintenance of efficient and safe ambulation in older women with osteoporosis. To gain more insight into the role of dual-task training for gait rehabilitation, we recommend that future studies should focus on exploring the long-term effects of dual-task exercises on task-prioritization strategies.

#### Conflict of interest

The authors declare that there are no conflicts of interest.

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