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# A novel group-based stepping exercise program to improve fall risk factors in older adults: first results of a pilot study

Eleftheria Giannouli, Tobias Morat, Jessica Coenen, Stephan Bandelow, Wiebren Zijlstra



Avoiding a trip/slip in real life requires:

- fast stepping movements
- high foot placement accuracy

Age-related changes in spatiotemporal characteristics of stepping for balance:

- slower stepping reactions (Pijnappels, Delbaere, Sturnieks, & Lord, 2010)
- too short steps or steps in a wrong direction (Chapman & Hollands, 2006b, 2007)
- collision of one leg against the other during oblique steps (Maki & McIlroy, 2006)





Effective falls prevention training regimes should:

- focus on performing precise, rapid and well-directed steps
- include a cognitive component
- have a high difficulty level (i.e. including challenging balance exercises)

Stepping training has been found to be particularly effective in reducing falls (Okubo, Schoene & Lord, 2016)

Existing stepping training programs often lack in:

- ➤ variation
- > complexity
- possibility to gradually and systematically increase loading in order to check for dose-response effects



# Aim

To develop a balance training program that incorporates the execution of **multidirectional** voluntary steps with **varying speeds** and in **dual-/multi-tasking** conditions which aims to improve **postural control**, **cognitive functioning** and balance-related **self-efficacy** and allows **dose-response** assessments



### Methods

**Intervention group**: "StepIt" Training Program for 9 weeks **Control group**: continued with their normal activities

#### <u>Equipment</u>

- ✓ Stepping Mats
- ✓ Metronome & Speakers
- ✓ Flipchart
- ✓ (Additional small items for DT and MT conditions)



90x90cm: 9 squares \* 30x30cm each Quasi-design

Session structure (2x/week)

10 Min Warm-Up 45 Min Stepping 5 Cool-down

Per group: 10 Persons & 2 Trainers



## Methods





## Methods











**Principles for increasing difficulty level** 

- Motor load
- Direction and length of steps
- > Execution pace

Cognitive load

- Number of steps for each pattern
- Additional motor/cognitive tasks

Maak	Steps	Pace (BPM)		Direction of		
week		RF/LF	BF	Feet Placement		
1	3	92-100	64-78			
2	1	100-108	78-86	Forward, Side & Back	Single Task (ST)	
3	4	108-110	86-88			
4	5	110-112	88-90	Forward, Side & Back		
5	c 110 90-92		90-92	9 Skipping middle line (SML)	Dual-Tasking (DT)	
6	0	112	94-96	& skipping middle mie (sivic)		
7	7	114	96-98			
8	0	116	98-100	Forward, Side, Back, SML & oblique steps	Multi-Tasking (MT)	
9	ð	118	102-104			
RF						

RF: Right Foot LF: Left Foot BF: Both feet



#### Inclusion criteria:

- >60 years old
- Physician's written statement of non-objection for participation
- Neither quit nor initiate regular sporting activities



#### **Exclusion criteria:**

- Cognitive impairment
- Neurological/cardiovascular/orthopedic diseases which could interfere with functional mobility
- Inability to stand up from a chair independently
- Severe sensory impairments
- Unable to commit to at least 80% of exercise sessions









# **Sample:** n=40 (IG: n=20)

	ALL	IG	CG
Women (%)	50	55	45
Retired (%)	85	85	85
Sports on a regular basis (%)	80	80	80
Self-reported balance problems (%)	53	40	65
Fallers (%)	66	69	62
Fear of Falling (%)	45	55	35
Regular medication intake (%)	75	75	75
Chronic Diseases (%)	54	61	47
Age	70 (±8.2)	70.3(±6.3)	69.8 (±9.9)
BMI	26.5 (±4.9)	26.0 (±3.8)	27.1(±5.8)
Education (years)	15.0 (±5.8)	16.4 (±4.7)	13.6 (±6.5)
IPAQ	5745.5 (±3702.7)	5766.6 (±3895.4)	5724.4 (±3600.9)

IC: Intervention Group CG: Control Group BMI: Body Mass Index IPAQ: International Physical Activity Questionnaire





## **Adherence & Participants' Feedback**

Dropouts: n=1 (in week 7)

Adherence: 85.3%

67% reported positive effects on their balance/coordination







## Significant time\*group interactions for:

#### Physical

- Four Square Step Test (Single-Task)
- Four Square Step Test (Dual-Task)
- 5xSit-to-Stand
- Maximum Step Length Test
- Multi-Target Stepping Task (Single-Task)
- Multi-Target Stepping Task (Dual-Task)
- Postural sway (jerk) (normal standing)
- Postural sway (jerk) (tandem)
- Stride Length
- Stride Velocity
- iTUG (Single-Task)
- iTUG (Dual-Task)

## Cognitive

- Digit Span
- Reaction Time

#### Psychological

- Falls Efficacy Scale
- Activities-specific Balance Confidence



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#### Conclusions

## Discussion

- High adherence
- Positive feedback

No adverse events

The training is feasible

Consistent interaction effects on dual-task performance (no effects on single task conditions)

### **Next steps**

- Improve intensity adjustment/progression
- Increase intervention duration
- Apply to a more fall-prone sample
- Find ways to check for correct execution











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# Thank you very much for your attention!



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