Home-based exergaming to enhance resistance to falls after stroke (HEROES): proof-of-principle study protocol.

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We aim to investigate whether the HEROES intervention improves reactive step quality in people with chronic stroke.

Background

- People after stroke face a substantially elevated risk of falling [1].
- Reactive stepping is crucial for preventing falls, but is impaired after stroke [2].
- Perturbation-based training effectively improves reactive steps and reduces falls [3,4].
- However, its large-scale clinical uptake is limited.
- Safe and feasible alternatives for home-use do not yet exist [5].
- Interventions based on the principle of *Action Observation with Motor simulation* provide a promising solution [6].
- The HEROES intervention examined in this proof-of-principle evaluation was co-developed with patients and capitalizes on the potential of this principle.

HEROES intervention

A single session of *real* perturbation-based training, followed by home-based reactive balance training with the HEROES exergame, capitalizing on the principle of *Action Observation with Motor simulation* of reactive stepping.

Control intervention

Home-based voluntary step training with the commercial-available Clock Yourself application. No additional training with real perturbations.

Three-arm proof-of-principle evaluation with randomized design:

HEROES Group A	HEROES Group B	Control Group
Balance assessment #1	Balance assessment #1	Balance assessment #1
Single perturbation-based training session	Single perturbation-based training session	
5-week home-based reactive balance training with the HEROES exergame	5-week waiting period	5-week home-based voluntary balance training with the Clock Yourself Game
Balance assessment #2	Balance assessment #2	Balance assessment #2
5-week waiting period	5-week home-based reactive balance training with the HEROES exergame	5-week waiting period
Balance assessment #3	Balance assessment #3	Balance assessment #3

Eligible subjects meet the following criteria:

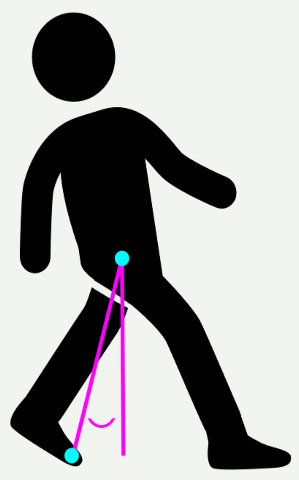
- 18 to 75 years old
- Unilateral cerebral stroke ≥6 months ago
- Completed inpatient rehab ≤2 years ago
- Residual impairments in gait and/or balance
- Ability to stand and walk independently (FAC≥4)
- Lives in the community

Exclusion criteria are:

- Medication or other conditions affecting balance
- Severe cognitive or behavioral problems
- Persistent unilateral spatial neglect.

Primary outcome measure

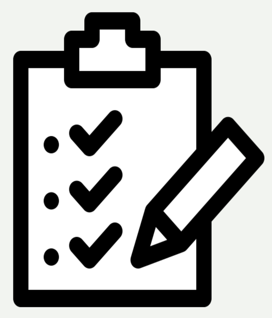
We will assess quality of the reactive step, expressed by the leg angle, in response to sudden balance perturbations at a personalized intensity, determined at baseline. Reactive step quality will be assessed on a specialized treadmill (GRAIL).



Secondary outcome measures

Standardized set of post-stroke balance and mobility assessments [7]:

- Fugl-Meyer lower extremity (FM-le)
- Trunk Impairment Scale (TIS)
- Dynamic Gait Index (DGI)
- MiniBESTest
- 10-meter walk test (10mwt)



Participant recruitment

60 participants will be recruited at the six participating Dutch rehabilitation centers.

The ultimate goals of the HEROES project are:

1. Enable safe and feasible reactive balance training at home.
2. Prevent falls and fall-related injuries after stroke.
3. Save fall-related healthcare costs.

[1] Weerdesteyn, J Rehabil Res Dev, 2008
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[5] Gerards, Geriatr Gerontol Int, 2017
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Clinical partners

MRC Aardenburg, Revant Medisch Specialistische Revalidatie, Klimmendaal revalidatiespecialisten, Sint Maartenskliniek

Academic partners

UMCG, Amsterdam UMC, University of Twente, Radboudumc

Industrial partners

8D Games, Motek a DIH brand