

# Multi-joint coordination and adaptation of ankle and hip strategy in healthy young and healthy elderly

Published: 07-01-2014

Last updated: 19-03-2025

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|------------------------------|----------------------------------------|
| <b>Ethical review</b>        | Approved WMO                           |
| <b>Status</b>                | Completed                              |
| <b>Health condition type</b> | Movement disorders (incl parkinsonism) |
| <b>Study type</b>            | Interventional                         |

## Summary

### ID

NL-OMON40406

### Source

ToetsingOnline

### Brief title

Multi-joint coordination in standing balance

### Condition

- Movement disorders (incl parkinsonism)

### Synonym

chronological age, decreased motor control

### Research involving

Human

### Sponsors and support

**Primary sponsor:** Universiteit Twente

**Source(s) of monetary or material Support:** STW;NeuroSIPE

## Intervention

**Keyword:** adaptation, ankle and hip strategy, elderly, Standing balance

## Outcome measures

### Primary outcome

Frequency Response Functions (FRF) describe the relation between the disturbances and the human responses (ankle and hip angle and corresponding joint torques) in means of amplitude and timing.

### Secondary outcome

A model is fit onto the experimentally derived FRF, to estimate parameters with a physiological meaning, for instance ankle and hip joint passive stiffness, reflexive properties and time delays.

## Study description

### Background summary

Both the ankle and the hip joint play an important role in maintaining standing balance. To compensate for external disturbances (e.g. forces acting on the body) and to prevent falling, multi-joint coordination must be provided to generate the appropriate corrective joint torques around the ankles and the hips to maintain standing balance. In order for the neuromuscular controller to adjust strategy in various conditions, variability and adaptability of multi-joint coordination are essential features of standing balance control. Elderly have altered strategies to maintain standing balance compared to young adults, which can cause impaired standing balance and possibly falls. We have developed a new device to study multi-joint coordination by the application of two continuous and random external disturbances and using closed-loop system identification techniques (CLSIT). In addition, the device makes it possible to manipulate ankle and hip strategy, by altering the dynamics of the device (how the environment is perceived by the subject) and applying extra force fields at the hip or shoulder level. Adaptation in clinical practice can be tested by letting subjects stand on a compliant surface, which manipulates the ankle strategy. These compliant surfaces are implemented using foam-mats, from which the properties are often unknown and the stiffness is uncontrollable. Our lab

offers the possibility to manipulate the stiffness of the support surface in a controllable way, using a second device. Using support surface rotations around the ankle and CLSIT, the underlying mechanisms that cause adaptation can be identified.

## **Study objective**

The aim of the study is to investigate the differences in multi-joint coordination between healthy young and healthy elderly. Secondly, we want to study adaptation of ankle and hip strategy with the application of whole-body force fields and investigate how elderly are able to adjust their multi-joint coordination in comparison to young adults. To relate adaptation more to a clinical measure of standing on a foam mat, adaptation to compliant surfaces is studied the young adults.

## **Study design**

This study is designed as a non-invasive, cross-sectional intervention study to assess multi-joint coordination and adaptation in ankle and hip strategy. There is no randomization in groups, as subjects either belong to healthy young or healthy elderly. First, The both the young and elderly subjects participate in one experimental session, in which the test conditions are randomized. The healthy young subjects are asked to participate in an additional session, to study the effect of compliant surfaces on balance control. In this experimental session the test conditions are randomized again.

## **Intervention**

To study multi-joint coordination, balance disturbances are externally applied by pushing and pulling at the hips and shoulders or by rotations of the support surface around the ankles. The disturbances contain multiple frequencies ranging from 0.05-5Hz, making the disturbance unpredictable. The disturbances are submaximal, challenging the balance control system, but not intended to make subjects step or fall. In addition, to study adaptation of the ankle and hip strategy, external whole-body force fields are applied, by altering the dynamics of the device and thereby manipulating ankle and hip strategy. To study the adaptation of the ankle strategy when standing on compliant surfaces, the stiffness of the support surface is manipulated by altering the dynamics of the device.

## **Study burden and risks**

Healthy young and healthy elderly Pparticipants are asked to visit the VR-laboratory at the University of Twente once. During a two-hour experiment (including explanation, preparation and measurements), biomechanical responses will be measured as a result from small push and pull disturbances at the hip

and shoulder level and externally applied force-fields. The healthy young are asked to participate in an additional experiment, for which they have to visit the VR-laboratory once more. During this additional two-hour experiment, biomechanical responses will be measured as a result of small perturbations at the ankle during stance on firm or compliant surfaces.

Participants can rest between trials according to their own needs. The burden and the risk for the participants are very low. In this study there is a risk for the participants to lose their balance. Therefore, participants are secured by a safety-vest at all times to prevent falls. Participants will have no direct benefit from taking part in this study. However, they contribute to gain a better understanding of the (patho)physiological mechanisms in balance control and impaired balance.

## Contacts

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## Trial sites

### Listed location countries

Netherlands

## Eligibility criteria

### Age

Adults (18-64 years)

Elderly (65 years and older)

## Inclusion criteria

- \*Healthy young subjects aged between 20-30 years
- \*Healthy elderly subjects aged 70 years or older
- \*Ability to stand independently for approximately 5 consecutive minutes
- \*Written informed consent

## Exclusion criteria

Unable to give informed consent  
Orthopaedic problems, as a recent hip or knee replacement  
Neurological disorders  
A history of cardiac conditions that interfere with physical load  
Chronic joint pain, or rheumatoid arthritis  
Use of medication with an effect on balance control  
Pregnancy

## Study design

### Design

**Study type:** Interventional

Masking: Open (masking not used)

Control: Uncontrolled

Primary purpose: Diagnostic

### Recruitment

NL

Recruitment status: Completed

Start date (anticipated): 26-03-2014

Enrollment: 30

Type: Actual

### Medical products/devices used

Generic name: Double inverted Pendulum perturbator and Bilateral Ankle Perturbator

Registration: No

## Ethics review

Approved WMO

Date: 07-01-2014

Application type: First submission

Review commission: METC Twente (Enschede)

Approved WMO

Date: 22-04-2014

Application type: Amendment

Review commission: METC Twente (Enschede)

## Study registrations

### Followed up by the following (possibly more current) registration

No registrations found.

### Other (possibly less up-to-date) registrations in this register

ID: 29151

Source: NTR

Title:

### In other registers

| Register | ID             |
|----------|----------------|
| CCMO     | NL46985.044.13 |
| Other    | NTR 15902      |
| OMON     | NL-OMON29151   |