Multisensory processing, integration and adaptation for the control of human standing balance

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Primary objective: To investigate the neuromechanical and sensorimotor principles underlying the multiaxial control of standing balance. Specific sub-objectives of this proposal are:1) To determine how multiple axes of balance control are...

Ethical review	Approved WMO
Status	Recruiting
Health condition type	Other condition
Study type	Observational non invasive

Summary

ID

NL-OMON52286

Source
ToetsingOnline

Brief title
Multisensory control of standing

Condition

- Other condition

Synonym
no symptoms and good health

Health condition

sensorimotor adaptation for standing balance in healthy participants

Research involving
Human

Sponsors and support

Primary sponsor: Erasmus MC, Universitair Medisch Centrum Rotterdam
Source(s) of monetary or material Support: NWO

Intervention

Keyword: multisensory integration, Standing balance

Outcome measures

Primary outcome

Standing balance behaviour: Magnitude and variability whole-body motion in different balance tasks.

Vestibular-evoked balance responses: Presence and amplitudes of vestibular-evoked balance responses.

Visually-evoked balance responses: Presence and amplitudes of visually-evoked balance responses.

Perceptual detections: Perceptual thresholds to detecting motion from different sensory cues.

Metabolic cost: indirect calorimetric gas exchange measurement to estimate metabolic cost of standing balance

Secondary outcome

N.A.

Study description

Background summary

Human standing balance relies upon the integration of cues from multiple sensory systems. Vestibular, visual, somatosensory and auditory inputs all contribute to the control of standing balance both during quite stance and when responding to external perturbations. A central issue with standing balance is that sensory signals that are encoded in one coordinate system (e.g., the head) must be transformed into a whole-body coordinate system to be relevant for standing balance control. These transformations need to be suitable for the current balancing conditions, where the different sources of sensory information may vary in their relevance to the task of standing. What are the mechanisms involved in transforming these sensory signals to be relevant to the ongoing balance control? Under what circumstance(s) are certain sensory inputs more relied upon than other sensory inputs? What are the capabilities and mechanisms for the balance controller to adapt to novel conditions? With the research being proposed here, we seek to understand the way in which humans integrate the multiple sources of sensory information relevant to the postural control of standing, as well as adapt standing control to novel balance tasks. Using a robotic balance simulator and advanced sensory stimulation techniques, we will investigate how the human balance system responds and adapts to standing balance tasks with altered mechanical and/or sensory conditions. We will compare human standing behaviour (whole-body movement), sensory-evoked balance responses and conscious perception of motion across baseline (i.e. normal standing) and experimental trials. This work will help in revealing the adaptive capabilities of the human balance controller, as well as disentangling the mechanical and sensory factors that contribute to upright stance.

Study objective

Primary objective: To investigate the neuromechanical and sensorimotor principles underlying the multiaxial control of standing balance.

Specific sub-objectives of this proposal are:
1) To determine how multiple axes of balance control are coordinated to maintain upright stance.
2) To identify the neural mechanisms underlying balance adaptation to novel sensory-motor relationships of standing balance and to characterize the errors driving these changes in balance control.
3) To determine how sensory and motor cues are combined for the conscious perception and control of standing balance.

Study design

Repeated-measures intervention study

Intervention

Performing novel standing balance tasks on a robotic balance simulator with (and without) sensory stimulation.

Study burden and risks

Healthy participants will visit the Erasmus MC at least once (up to 5 days) and an experiment will last for a maximum of 3 hours. The total time spent testing a subject will be limited to 9 hours regardless of experimental protocol. In this study, the safety measures are applied as described in recent human balance and sensory stimulation reviews. There are no serious risks associated with this study. The discomfort and risks associated with the experiments described in this proposal are minor but vary according to the methods used for each experiment. The risks/discomfort for the various techniques used are provided below.

Electrical vestibular stimulation
There are no known physical or psychological risks associated with the non-invasive electrical vestibular stimulation technique that may be used in this study. Some participants who are highly susceptible to car motion sickness may possibly experience mild nausea, light-headedness or mild headaches for a brief period (up to 1 hour) following the experiment (in about 5% of participants tested by the co-investigator in the past). The stimulation may cause slight flashing in the visual field due to stimulation of the nearby optic nerve.

Robotic balance simulator
Standing in the robotic balance simulator may cause vertigo and nausea for participants who are particularly subject to those complaints. When a subject indicates vertigo and/or nausea during any experiment and indicates that they wish to end the experiment, this request will be granted immediately.

Scleral lens
There are no known risks with the use of scleral lenses. Possible side effects include stinging or itchy eyes, increased sensitivity to light and excessive tears, and primarily occur when there is not sufficient fluid between the cornea and the lens. When this occurs the lens will be removed and reapplied with more liquid.

Virtual reality head-set
There are no known physical or psychological risks associated with using virtual reality environments. Some subjects who are highly susceptible to car motion sickness may possibly experience mild nausea, light-headedness or mild

headaches.

Gas exchange measurement
The gas exchange measurement is a method commonly employed in the sports field to monitor energetic consumption during exercise. There are no known physical or psychological risks associated with its use. To ensure more accurate results, participants will be asked to fast for at least 3 hours before the experiment. This precaution is taken to minimize digestive activity during the testing process.

Contacts

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)

Inclusion criteria

Healthy

Aged 18-60 years

Exclusion criteria

- History of neurological or psychiatric disorders
- Taking acute or chronic psychoactive drugs
- Alcoholism
- History of headaches or migraines
- History of neck or back pain,
- History of balance problems,
- Pregnant women or women currently breastfeeding,
- A prior neuromuscular injury (regardless of source),
- Incompetence to give informed consent.

Study design

Design

Study type:	Observational non invasive
Intervention model:	Other
Allocation:	Non-randomized controlled trial
Masking:	Open (masking not used)

Primary purpose: Other

Recruitment

NL

Recruitment status:	Recruiting
Start date (anticipated):	05-05-2021
Enrollment:	290
Type:	Actual

Ethics review

Approved WMO

Date:	04-05-2021
Application type:	First submission

Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)
Approved WMO Date:	10-11-2022
Application type:	Amendment
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)
Approved WMO Date:	25-04-2024
Application type:	Amendment
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)
Approved WMO Date:	20-11-2024
Application type:	Amendment
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

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

No registrations found.

In other registers

Register	ID
CCMO	NL76700.078.21