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The effects of computer game dancing on foot placement accuracy and gaze behavior in older adults

Submission date
18/07/2011

Recruitment status
No longer recruiting

Registration date
25/10/2011

Overall study status
Completed

Last Edited
21/09/2016

Condition category
Nervous System Diseases

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[X] Results
[ ] Individual participant data

Plain English summary of protocol

Background and study aims
The natural ageing process means that older people have an increased risk of having a fall. Avoiding a fall requires the body to perceive a threat to balance and respond with appropriate movements. Age-related problems with senses (e.g., poor vision) reduce the amount of available information to plan these responses. Computer game dancing simulations (CGDS) require the player to perform rapid eye movements to locate the arrows on the screen and then to make rapid and accurate step responses from either leg towards the correct button on the dance pad. CGDS further require cognitive (thinking) work, e.g. sensing, paying attention and making quick decisions. Therefore, CGDS seem ideally suited for the training of foot placement accuracy in older people. However, the potential of computer gaming for the improvement of motor skills in elderly people has yet to be explored. The aim of this study is to assess the effects of a physical training program supplemented by a CGDS on foot placement accuracy, walking, and eye movement in elderly residential care dwellers.

Who can participate?
Senior citizens (age over 65 years) from the hostels Breitenhof in Rüti (ZH) and Lanzeln in Stäfa (ZH), Switzerland

What does the study involve?
All participants undergo twice weekly resistance training of the core and leg muscle groups in combination with balance training for 12 weeks. Participants are randomly allocated to one of two groups. One group receives just this training while the other group in addition receives CGDS training. Both groups' foot placement accuracy is assessed with a stepping task. Eye movement is assessed using a head-mounted camera system. Gait (manner of walking) is assessed using a walking task. Fear of falling is assessed using a questionnaire. Vision is assessed with an eye test.

What are the possible benefits and risks of participating?
Not provided at time of registration

Where is the study run from?
Senior citizens hostels Breitenhof and Lanzeln (Switzerland)

When is the study starting and how long is it expected to run for?
June to October 2011.

Who is funding the study?
Swiss Federal Institute of Technology Zurich (Switzerland)

Who is the main contact?
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Contact information

Type(s)
Scientific

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Additional identifiers

Study information

Scientific Title
The effects of computer game dancing on foot placement accuracy and gaze behavior in older adults: a randomized control trial

Study objectives
Compared to usual care, fall prevention training programs - training programs which are supplemented by a computer game dancing simulation are better suited to improve general physical functions and foot placement accuracy performance in older adults. We also hypothesize that there will be changes in gaze behavior after training with a computer game dancing simulation. The improved performance in the foot placement task might be, at least in part, attributable to the changes in gaze behavior.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Canton of Zurich Ethics Committee, 17/02/2011, ref: Nr. EK: KEK-ZH-NR: 2011-0005/0

Primary study design
Interventional

Study design
Two groups pre-test post-test randomized control trial

Study type(s)
Prevention

Health condition(s) or problem(s) studied
Geriatrics related conditions

Interventions
1. Physical Exercise Program:
All participants undergo a regimen of twice weekly progressive resistance training of the core and lower extremities muscle groups in combination with progressive postural balance training for twelve weeks. This program conforms to the best currently available evidence for successful fall prevention interventions.
The muscle groups for the strength training are chosen because of their importance in functional activities, and are trained in standing position. During standing participants are secured with ropes they can hold on to (Redcord AS, NO-4920 Staubo, Norway). The ropes are fixated on the ceiling or on frames.
The aim of the training program concentrates on maintaining or re-establishing everyday life competence and mobility. The focus of exercise is on functional activities of daily living such as walking, standing up from a chair, sitting down or stair climbing. The aim for each exercise is to perform two sets of 10-15 repetitions of each exercise in a slow, controlled manner with one minute active break after each set and between the series. To maintain the intensity of the stimulus during training, the load is increased at each training session, as tolerated by the participants, with the help of weight vests or sand filled cuffs worn on the ankle or waist.
Training intensity is controlled by perceived exertion where an intensity between "somewhat hard" and "hard (heavy)" on Borg's perceived exertion scale indicates the strength training range. This corresponds to a point of instantaneous muscular fatigue at the end of a certain exercise. Borg's scale gives comprehensible and coherent references for exercise intensity including for resistance training. The criterion for reaching an appropriate load in strength exercise is stated "feels bold strain within the muscles, which would not be present during everyday movements".
Balance exercises are performed with a maximum of four individuals training at the same time. All exercises can be adjusted to the individual mobility level. The intensity is gradually increased and previously formulated recommendations are applied: participants perform 1-2 sets of 3-5 different exercises emphasizing dynamic postures with progressive difficulty as tolerated.

2. Computer Game Dancing Simulation (CGDS):
Stimuli in the dancing game are five dance songs with no lyrics (90130 beats per minute [BPM]; mean = 115 BPM). Songs are edited into 30 second segments and individualized files comprising dance steps synchronized to the music are created using the Dancing Monkeys MATLAB script [19]. Each 30 second segment is triplicated, resulting in five stimuli, each 1 minute 30 seconds in length, and each containing 3 identical repeats of a song and step-sequence pairing. Songs are then paired with visual cues instructing the participant how to dance to that track. A scrolling

display of arrows moving upwards across the screen cues each move, and the participant has to make the indicated step when the arrows reach the top of the screen. The symbolic arrow sequences are generated for all five tracks. StepMania (www.stepmania.com), a freeware program similar to the video game Dance Dance Revolution (Konami Digital Entertainment, Inc., Redwood City, CA), is used for step file modification and training. Participants perform dance training on a dance pad connected by USB to a desktop computer and with projection of the symbolic arrows on a wall with a beamer. There is a one minute break between dances. Electronic sensors in the dance pad detect position and timing information that is then used to provide participants with real-time visual feedback.
A room in the residential care facility that is easily accessible to the elderly is dedicated for the set up of the training equipment. All classes start with 5-10 minutes of warm-up activities, followed by 10-15 minutes of strength training exercises, and 10-15 minutes of balance skills training. The CGDS-group will receive additional 1.5-7.5 minutes of computer game dancing. All participants will complete the session with 5-10 minutes of cooling-down activities. Training sessions last 45-60 minutes and are separated by at least one day of rest. All exercise sessions are supervised individually by two qualified exercise trainers.

Intervention Type
Behavioural

Primary outcome(s)
1. Foot Placement Accuracy
We will apply a modified stepping task described by Chapman and Hollands in 2007. Participants will walk at a self-selected pace along a 10 m path and will encounter one of the three obstacle conditions.
The first condition requires the participants to place their right foot into Target 1. On the second condition participants are required to place their right foot into Target 1 and their left foot into Target 2. The third condition requires the participants to place the right foot into Target 1, then step over the obstacle and place the left foot into Target 2. The position of the targets and the obstacle remain the same for each trial.
The targets are rectangular, made of foam rubber and all of equal dimensions. They comprise a raised border (4cm x 4cm) containing a target area of about (20 cm x 42 cm). The height of the soft foam obstacle will be 17 cm, the horizontal width about 67 cm and the depth 1 cm. The height of the obstacle corresponds to the standard height for a step of a staircase (Verordnung über die Verhütung von Unfällen und Berufskrankheiten: Wegleitung durch die Arbeitssicherheit; www.ekas.admin.ch). The obstacle will be supported from the anterior side allowing it to fall forwards with respect to the participant should they make contact with it. Prior to the start participants will be instructed to close their eyes in order to not allow them to direct their attention to the targets prior to the start of the trial.
A session consists in performing 30 trials: 10 trials for each condition. Each combination of target positions will be randomized within each session. Within each condition, the target(s) will appear in two possible positions separated by 8 cm (medio-laterally).
On one side of the pathway a video camera for each target will be positioned to record the step accuracy of the participants. Step accuracy will be defined as antero-posterior foot placement accuracy (change of constant error) in millimeters.

2. Gaze behavior
Gaze behavior will be assessed with ASL Mobile Eye head-mounted system (Applied Science Laboratories, USA). The Mobile Eye records data from two cameras. The eye camera records the eye being tracked while the scene camera records the environment being observed by the user. The functional sample rate is 30 Hz. The ASL controller generates a video image with a

superimposed cursor representing gaze location. These data will be recorded on digital tape and used to identify the environmental features fixated and the duration of fixation during the trials. Outputs are both horizontal and vertical coordinates of the pupil center. These data will allow us to identify and calculate saccadic eye movements and fixation periods during each trial. Changes in gaze location are always achieved via saccadic eye movements. A saccade will be defined as a rapid eye movement (between two and four frames in duration) causing a shift in gaze between two locations. To analyze the recorded data, the MATLAB software (The MathWorks Company, Natick, USA) will be used.

Key secondary outcome(s)
1. Gait analysis
Subjects are tested under a single-task condition (preferred walking & fast walking) and under a dual-task condition, i.e., preferred and fast walking whilst counting backwards in sevens. The temporal-spatial parameters recorded are: velocity (cm/s), cadence (steps/min), stride time (s), step time (s), and step length (cm). Thereafter the participants are asked to perform the same walking task while counting.

2. Fear of Falling
The Falls Efficacy Scale International (FES-I) questionnaire is used as a measure of concern about falling to determine the transfer effects of training to activities of daily living. This scale assesses both easy and difficult physical activities and social activities with a scale of: 1 = not at all concerned, 2 = somewhat concerned, 3 = fairly concerned, 4 = very concerned.

3. Vision
The Physiological Profile Assessment (PPA) is a valid and reliable tool for assessing falls risk and for evaluating the effectiveness of interventions and is suitable for use in a range of physical therapy and health care settings. For this study we will use three measures of visual function: the "Melbourne Edge Test", the dual contrast visual acuity chart, and the device for measuring depth perception.

Completion date
31/10/2011

Eligibility

Key inclusion criteria
1. Residential status
2. Age > 65 years
3. Signed informed consent statement
4. Ability to walk 6m and stand upright for at least 5 minutes

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Senior

Sex

All

Key exclusion criteria
1. Severe cognitive impairment (Mini-Mental State Examination < 22 points)
2. Rapidly progressive or terminal illness, acute illness or unstable chronic illness
3. Impaired vision that prevented them to watch a wall screen projection

Date of first enrolment
01/06/2011

Date of final enrolment
31/10/2011

Locations

Countries of recruitment
Switzerland

Study participating centre
Institute of Human Movement Sciences and Sport
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Sponsor information

Organisation
Swiss Federal Institute of Technology (Switzerland)

ROR
https://ror.org/05a28rw58

Funder(s)

Funder type
Government

Funder Name
Swiss Federal Institute of Technology Zurich (Switzerland)

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not provided at time of registration

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article	results	14/12/2012		Yes	No