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Research

Video and computer-based interactive exercises are safe and improve task-specific balance in geriatric and neurological rehabilitation: a randomised trial

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KEY WORDS

Randomised controlled trial
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CrossMark

ABSTRACT

Question: Does adding video/computer-based interactive exercises to inpatient geriatric and neurological rehabilitation improve mobility outcomes? Is it feasible and safe? **Design:** Randomised trial. **Participants:** Fifty-eight rehabilitation inpatients. **Intervention:** Physiotherapist-prescribed, tailored, video/computer-based interactive exercises for 1 hour on weekdays, mainly involving stepping and weight-shifting exercises. **Outcome measures:** The primary outcome was the Short Physical Performance Battery (0 to 3) at 2 weeks. Secondary outcomes were: Maximal Balance Range (mm); Step Test (step count); Rivermead Mobility Index (0 to 15); activity levels; Activity Measure for Post Acute Care Basic Mobility (18 to 72) and Daily Activity (15 to 60); Falls Efficacy Scale (10 to 40), ED5D utility score (0 to 1); Reintegration to Normal Living Index (0 to 100); System Usability Scale (0 to 100) and Physical Activity Enjoyment Scale (0 to 126). Safety was determined from adverse events during intervention. **Results:** At 2 weeks the between-group difference in the primary outcome (0.1, 95% CI –0.2 to 0.3) was not statistically significant. The intervention group performed significantly better than usual care for Maximal Balance Range (38 mm difference after baseline adjustment, 95% CI 6 to 69). Other secondary outcomes were not statistically significant. Fifty-eight (55%) of the eligible patients agreed to participate, 25/29 (86%) completed the intervention and 10 (39%) attended > 70% of sessions, with a mean of 5.6 sessions (SD 3.3) attended and overall average duration of 4.5 hours (SD 3.1). Average scores were 62 (SD 21) for the System Usability Scale and 62 (SD 8) for the Physical Activity Enjoyment Scale. There were no adverse events. **Conclusion:** The addition of video/computer-based interactive exercises to usual rehabilitation is a safe and feasible way to increase exercise dose, but is not suitable for all. Adding the exercises to usual rehabilitation resulted in task-specific improvements in balance but not overall mobility. Registration: ACTRN12613000610730. **[van den Berg M, Sherrington C, Killington M, Smith S, Bongers B, Hassett L, Crotty M (2016) Video and computer-based interactive exercises are safe and improve task-specific balance in geriatric and neurological rehabilitation: a randomised trial. *Journal of Physiotherapy* 62: 20–28]**

Background

Mobility limitation and balance impairment are common consequences of many acute and chronic illnesses.[1] People with mobility limitations can benefit from rehabilitation programs[2,3] particularly if a high dosage of therapy is provided.[4,5] Rehabilitation is most likely to promote re-learning of mobility tasks if it is task-specific,[6] provides feedback about performance,[7] is goal-driven,[8] and is progressive in time and challenge.[9] Unfortunately, people in inpatient rehabilitation are relatively inactive for large portions of their day rather than being engaged in therapeutic activities.[10,11]

Interactive computer or video games that are driven by gross physical movements of the player are known as 'exergames'[12–14] and may increase the dosage of exercise within and outside of therapy sessions. Exergames combine real-time motion detection, and feedback about performance, with games that can help motivate people to exercise. The games incorporated in these systems can be engaging and can provide opportunities for repetitive practice of mobility tasks. For example, the Nintendo WiiFit[a] has been suggested to be suitable for training of balanced standing in stroke rehabilitation[15] and was found to be safe and comparable to usual physiotherapy in geriatric rehabilitation.[16]

A recently updated Cochrane review[17] showed that the use of virtual reality exergames may be beneficial in improving upper limb function and function with activities of daily living when used as an adjunct to usual care. However, studies included in that review focused on the use of one technology only, which limited

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generalisability. Moreover, due to small sample sizes and the low quality of the trials, there was insufficient evidence to reach conclusions about the impact on mobility outcomes. A more recently published systematic review and meta-analysis investigating the use of virtual reality in a stroke population found that substitution of some or all of standard rehabilitation with virtual reality training resulted in improved mobility.[18] However, when data were pooled from trials that used exergames as an addition to standard therapy, there was insufficient evidence of effect due to a lack of trials that evaluated walking speed, and the heterogeneity of the participants.[18] The feasibility of exergame use in rehabilitation settings remains unclear, with one study suggesting that patients prefer traditional therapy.[19] More research is therefore required to evaluate the feasibility and impact of a range of different interactive video and computer systems to address mobility limitations in rehabilitation ward settings.

This study aimed to assess the effectiveness, feasibility and safety of physiotherapist-prescribed, tailored, video/computer-based, interactive exercises as an adjunct to usual care on mobility outcomes, compared to usual care for people undergoing inpatient geriatric and neurological rehabilitation.

Therefore, the specific research questions for this randomised, controlled study were:

1. Does adding physiotherapist-prescribed, tailored, video/computer-based interactive exercises to inpatient geriatric and neurological rehabilitation improve mobility outcomes?
2. Is prescription of a range of tailored, video/computer-based interactive exercises a feasible and safe way of increasing dosage of therapy in the rehabilitation ward setting?

Methods

Design

A randomised, controlled study[20] was undertaken from June 2013 to February 2014. Participants randomised to the experimental group received usual rehabilitation-unit care plus physiotherapist-prescribed, tailored, video/computer-based interactive exercises to usual care. Participants randomised to the control group received usual rehabilitation-unit care alone. Random allocation occurred after baseline testing and blinded outcome assessments were completed in person at Week 2 and via telephone at Weeks 6 and 12. Participants were asked not to disclose their group allocation to the assessors. The participants and intervention physiotherapists could not be blinded to group allocation.

A statistician, who was external to the study, generated the randomisation sequence in random blocks of 2 to 6 using a computer and concealed the group allocations for participants in sequentially numbered, sealed, opaque envelopes. A pharmacist, who was also external to the project, centrally managed group allocation. The pharmacist received an email notification about the completion of each participant's baseline assessment, then opened the envelope to reveal the group allocation, and then notified the intervention physiotherapist by email about group allocation.

Participants, therapists and centre

Patients were recruited following admission to the rehabilitation wards of the Repatriation General Hospital, Adelaide, Australia. A research assistant screened all patients who were admitted to these wards during the study period. Patients were eligible if they had: reduced mobility (Short Physical Performance Battery score of < 12) of recent onset, with a clinician-assessed capacity for improvement in mobility; a minimum length of stay on the rehabilitation ward of 10 days; and a likely life expectancy of > 3 months. Exclusion criteria were: the inability to participate in the study intervention due to marked cognitive impairment (Mini Mental Status Examination < 21) or insufficient English language skills; inadequate vision to use the devices; a medical condition precluding exercise (such as unstable cardiac disease, uncontrolled hypertension, uncontrolled metabolic diseases, large abdominal aortic aneurysm or a weight-bearing restriction); or a lack of interest in the use of the exergames (assessed by simply asking the patient if they would be interested in participating in the study intervention). Patients were also excluded when the treating physiotherapists or medical specialist considered the intervention to be inappropriate for the patient.

The usual rehabilitation care received by participants in both groups included assessment and management by medical specialists, nurses, physiotherapists and occupational therapists, as well as by speech pathologists, social workers and nutritionists, if required. Physiotherapists who delivered usual care did not provide the experimental intervention and physiotherapists who delivered the experimental intervention did not provide usual care to participants.

Intervention

The additional intervention received by participants randomised to the experimental group involved an additional hour of video/computer-based interactive exercises per day, delivered in a circuit class format, five times per week. It was held in a purposefully designed video/computer-based interactive exercise space, and supervised by one physiotherapist and one physiotherapy assistant. Exercise prescription in rehabilitation is always tailored in type, dose and intensity to suit each individual's needs. The present study followed a similar approach; it was not expected that one device or exergame would be suitable for every participant. Therefore, a range of devices and games were used that were individually prescribed by a physiotherapist. The games or exercises on the video and computer-based interactive systems were: functionally relevant; provided feedback about task performance; enabled individualised tailoring and progression of exercise difficulty; enabled progress to be recorded towards a functionally relevant goal; and were relatively inexpensive.

A combination of commercially available off-the shelf devices and rehabilitation-specific systems was used. The commercially available devices included Nintendo Wii[a] and Xbox Kinect[b] gaming systems, utilising movement-based input for its games. The rehabilitation-specific systems were the HUMAC[c], Modular Interactive Stepping Tiles,[21,22] and the Dance Mat Step Training System.[23,24] The HUMAC balance system couples its balance software with a balance board. The software includes balance and weight-bearing tests, exercise protocols and balance games, and provides the user with continuous real-time visual biofeedback (eg, centre of pressure display). The Dance Mat Step Training System developed by one of the authors (Smith) can be used to assess and practise stepping skills.[25] Games to practise stepping skills involve stepping in response to prompts on a screen. The mat has four step-sensitive target panels. Patients stand at the centre of the mat and make left, right, forward or backward step responses to a sequence of step instructions that are presented on the screen. The Modular Interactive Stepping Tiles was developed by one of the authors (BB) and can be arranged in different permutations, as appropriate, so that standing balance and stepping skills in all directions can be practised with integrated visual feedback about weight taken through each leg and the number of steps taken. Game prescription was based on the protocol shown in Box 1.

Additionally, participants in the intervention group wore an activity monitor[d] for the 12 weeks after randomisation. The clip-on activity monitor was portable, lightweight, and the size of a USB pen drive. It provides motivation to increase activity through real-time feedback. During the exercise classes the physiotherapist provided feedback on daily activity levels, including step count, with detailed graphs and charts displayed on a portable electronic display device when syncing the activity monitor.