

Intensity of challenge to the balance system is not reported in the prescription of balance exercises in randomised trials: a systematic review

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Question: How has balance challenge intensity been reported in trials of balance exercise interventions? Are there any instruments designed to measure the intensity of balance challenge in balance training exercises? **Design:** Systematic review of randomised trials of balance training exercises. **Participants:** Older adults, ie, the majority of subjects were aged over 55 years. **Intervention:** Balance exercise intervention, or multi-dimensional intervention that included a balance exercise intervention. **Outcome measures:** The included trials were examined for descriptions and instruments used to report the intensity of the challenge to the patient's balance system provided by the balance exercise prescribed. The other included studies were examined for instruments that measure balance challenge intensity. **Results:** In most of the 148 randomised trials identified, measures of reported balance challenge 'intensity' were actually measures of some other aspect of the exercise, eg, aerobic intensity or a hierarchy of task difficulty without reference to the patient's ability. Three potential systems of measuring the balance challenge intensity were identified. Two were not described in any detail. One was defined in terms of the limits of the patient's postural stability, but this system appears not to have been validated. No adequate measures of balance challenge intensity were found among the other types of studies identified. **Conclusion:** The review highlights a serious gap in the methods used to prescribe, implement, and evaluate the effect of balance exercise programs. Comprehensive work in this area is required to develop a psychometrically sound measure of balance exercise intensity. [Farlie MK, Robins L, Keating JL, Molloy E, Haines TP (2013) Intensity of challenge to the balance system is not reported in the prescription of balance exercises in randomised trials: a systematic review. *Journal of Physiotherapy* 59: 227–235]

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Introduction

Age-related decline in balance occurs in both men and women, beginning as early as 40 years of age (Nitz and Low Choy 2008, Nolan et al 2010). Balance control is important for maintaining independence and safety. An extensive review of randomised controlled trials has reported that trials repeatedly demonstrate that exercise programs designed to challenge a person's balance can improve balance ability in older adults (Howe et al 2011). A recent systematic review of exercise interventions to prevent falls also concluded that exercise can prevent falls, balance exercises were essential, and strength training and walking were optional (Sherrington et al 2011). A limitation previously identified in this body of work is that outcomes of exercise programs that improve balance have been reported inconsistently (Howe et al 2011). These reviewers did not comment, however, on whether the description of exercise prescription and dosage parameters had been reported consistently.

Physiological adaptations to exercise are specific to the type of exercise performed, but the principle of overload dictates that exercise needs to be performed at or near the limits of an individual's capacity to induce a training effect (Thompson et al 2010). A recommended exercise prescription method is the FITT framework, which consists of the Frequency, Intensity, Type, and Time (ie, duration) of exercises prescribed (Thompson et al 2010). While

exercise frequency, type, and time are relatively easy to quantify, quantifying exercise intensity is more complex. Quantification of exercise intensity has been achieved in the domain of strength training, where intensity is routinely measured using the 1-repetition maximum (1RM) method (Thompson et al 2010). Aerobic training programs use intensity measures such as percentage of maximal oxygen uptake or percentage of heart rate maximum to determine the appropriate intensity for inducing a cardiovascular training effect (Thompson et al 2010). The Borg rating of perceived exertion scale was first developed as a measure of aerobic exercise intensity (Borg 1982) and more recently has

What is already known on this topic: Exercise programs designed to challenge a person's balance can improve balance ability in older adults. Exercises are normally prescribed by defining the frequency, intensity, type, and duration of exercise. Exercise needs to be performed near the limits of an individual's capacity to induce a training effect.

What this study adds: Although numerous trials of balance exercise interventions in older adults have been conducted, none has quantified the intensity of the challenge to the individual's balance system. No psychometrically validated tools exist to measure the intensity of the challenge to an older person's balance system.

been validated as a measure of strength training intensity (Gearhart et al 2001).

In determining the optimum level of challenge of balance exercises, recommendations commonly relate to the difficulty of the balance task, rather than to the intensity of the activity relative to the ability of the individual (Thompson et al 2010, Tiedemann et al 2011). Therefore, although it is known a person is performing one task that may be more difficult than another, it is not clear how to quantify the challenge of that task to the balance capability of that individual. Specialist practitioners in the field of falls and balance have reported being unable to identify an ideal balance exercise intensity prescription method, other than to say that the balance exercises prescribed need to be challenging (Haas et al 2012). Given that there are four factors used to prescribe exercise, if one factor is missing or measured inconsistently, optimal prescription dosage is confounded. To date, there has been no systematic investigation of whether or how the intensity of balance exercise prescription has been determined in trials of balance rehabilitation programs.

The research questions for this review were therefore:

1. How has balance exercise intensity been reported and prescribed in trials of balance exercise interventions?
2. Have any instruments been designed to measure the intensity of balance training exercises?

Method

Identification and selection of studies

A three-phase process was used to identify articles appropriate for inclusion in this review. In the first phase, the lead investigator (MF) conducted a search in December 2011 to identify all systematic reviews published between 2006 and 2011 that included balance exercise interventions. Reviews published earlier than 2006 were not included as it was reasoned that reviews published in the last five years would include most, if not all, relevant trials previously reviewed in this area. Key search terms and the databases searched are presented in Table 1. The titles and abstracts of articles identified by the search were reviewed to identify eligible systematic reviews based on eligibility criteria, as presented in Box 1. The reference lists of the eligible systematic reviews were searched for any additional relevant review articles for which title and abstract were also reviewed against the same criteria. Citation details were extracted for all randomised trials identified in all the eligible systematic reviews.

Box 1. Eligibility criteria for systematic reviews of trials reporting balance exercise interventions.

Review design

- Publication date no earlier than 2006
- Systematic reviews of RCTs investigating a balance exercise training intervention

Participants

- Majority of trial participants were adults over 55 years

Intervention

- A review of balance exercise intervention, or
- A review of multi-dimensional interventions (eg, falls prevention interventions) that included balance exercise as an intervention

In the second phase, the titles and abstracts of randomised trials identified in the first phase were reviewed independently by two investigators (MF, LR) against second phase eligibility criteria, as presented in Box 2. The reference lists of the included trials were also searched for additional potentially eligible trials. The titles and abstracts of these trials were also reviewed against the criteria in Box 2. Results were compared to reach consensus on eligible trials. Where there was disagreement between the two investigators regarding eligibility for inclusion, a third investigator was consulted (TH) and disagreements resolved through discussion. Two investigators (MF, LR) read the full text of eligible trials and performed independent data extraction. Results were then compared to merge relevant data extracted. Data extracted included demographics of trial participants and information on FITT parameters for each exercise program. Where available, information on the FITT parameters was extracted for the exercise intervention as a whole, as well as for balance-specific components. The investigators extracted the words authors used to report balance intensity, as well as any instruments used to measure balance challenge intensity. If a measure of balance intensity was described, a search for any reports of scale properties was conducted.

Box 2. Inclusion criteria for randomised controlled trials reporting balance exercise interventions.

Design

- Randomised controlled trial

Participants

- Older adults (age > 55 y)

Intervention

- Balance exercise intervention, either a balance specific exercise program, or a mixed exercise program that included balance exercises

Document properties

- Full text article
- English language

In the third phase, a literature scan was conducted independently by two investigators (MF, LR) to identify any instruments that reportedly measure balance challenge intensity. In particular, this search was intended to identify instruments that had not yet been used in any published randomised controlled trial. The search terms are presented in Table 2.

Assessment of the depth of literature identified

To test the comprehensiveness of this process in identifying relevant randomised trials, a capture-recapture analysis was performed on the field of trials identified from the 23 systematic reviews included. Capture-recapture analysis is a statistical analysis method used to estimate populations, more traditionally animal populations, where a total population estimate can be made from the number of a species captured, tagged, and recaptured in a geographical area. This review aimed to identify all systematic reviews published from 2006 onwards that contained randomised controlled trials of balance exercise interventions, assuming that each systematic review intended to be exhaustive in its search of the scientific literature. We have worked on the assumption that each systematic review in isolation is a 'capture' of trials from the total population of trials of balance exercise intervention and when a trial appeared in

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