



REVIEW ARTICLE (META-ANALYSIS)

Systematic Review: The Effectiveness of Interventions to Reduce Falls and Improve Balance in Adults With Multiple Sclerosis

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Abstract

Objectives: To evaluate the effectiveness of interventions in reducing falls and/or improving balance as a falls risk in multiple sclerosis (MS).

Data Sources: Computer-based and manual searches included the following medical subject heading keywords: “Multiple Sclerosis AND accidental falls” OR “Multiple Sclerosis AND postural balance” OR “Multiple Sclerosis AND exercise” OR “Multiple Sclerosis AND physical/physio therapy” NOT animals. All literature published to November 2014 with available full-text details were included.

Study Selection: Studies were reviewed against the PICO (participants, interventions, comparisons, outcomes) selection criteria: P, adults with MS; I, falls management/balance rehabilitation interventions; C, randomized/quasi-randomized studies comparing intervention with usual care or placebo control; O, falls outcomes and measures of balance. Fifteen articles of the original 529 search results were included.

Data Extraction: Two reviewers independently extracted data and assessed methodological quality using the Cochrane Risk of Bias tool.

Data Synthesis: Random-effects meta-analysis indicated a small decrease in falls risk (risk ratio, .74), although the 95% confidence interval (CI) crossed 1 (95% CI, .12–4.38). The pooled standardized mean difference (SMD) for balance outcomes was .55 (95% CI, .35–.74). SMD varied significantly between exercise subgroupings; gait, balance, and functional training interventions yielded the greatest pooled effect size (ES) (SMD=.82; 95% CI, 0.55–1.10). There was a moderate positive correlation between program volume (min/wk) and ES (Cohen’s *d*) ($r=.70$, $P=.009$), and a moderate negative correlation between program duration in weeks and ES ($r=-.62$, $P=.03$). Variations in interventions and outcomes and methodological limitations mean that results must be viewed with caution.

Conclusions: This review suggests that balance may improve through exercise interventions, but that the magnitude of the improvements achieved in existing programs may not be sufficient to impact falls outcomes. Supporting participants to achieve an appropriate intensity of practice of highly challenging balance activities appears to be critical to maximizing effectiveness.

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Falls are a significant issue for people with multiple sclerosis (MS). The need to develop an intervention to effectively manage falls has been highlighted by both professionals¹ and service users.² This is supported by research highlighting the high frequency of falls and incidence of injury, loss of function, and resultant impact on quality of life.³⁻⁸ While several pilot studies⁹⁻¹¹ have been undertaken, development of an evidence-based MS falls intervention has been constrained by the relatively limited

condition-specific data to adequately inform the content and format of such a program.

The few MS-focused falls interventions to date have predominantly used combinations of education and exercise, targeting mobility, balance, and falls self-efficacy outcomes.⁹⁻¹¹ Identifying the relative contributions of each aspect of multicomponent rehabilitation programs (such as falls interventions) to outcomes is particularly challenging.¹² One way of addressing this is to evaluate interventions targeted toward specific risk factors in a stepwise manner, rather than addressing multiple risk factors at the outset.

The association between balance, mobility impairments, and falls in MS is complex. Studies^{13,14} suggest that impairments in balance (as quantified by laboratory-based measures) appear to

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precede clinically observable changes in mobility. Evidence also demonstrates that balance is amenable to change,¹⁵ although it is currently unclear whether the magnitude of the changes made is sufficient to impact on falls. Programs focused on balance and stability have been shown to decrease falls in other populations,^{16,17} whereas those that target mobility alone (through general mobility interventions and walking programs) have tended to be either ineffective or to increase falls.^{17,18}

Research in older people suggests that the degree of challenge to balance and overall dosage are key factors influencing outcome.¹⁷ The evidence indicates that programs should achieve a minimum of 50 hours of highly challenging balance training over a 6-month period to optimize reduction in falls.¹⁸ This aspect has not been evaluated in MS.

This systematic review aimed to suggest the specific content that should be included in a falls program targeting balance as a falls risk factor for people with MS by (1) evaluating the effectiveness of interventions in reducing falls and/or improving balance as a falls risk in MS; and (2) identifying the key issues impacting on outcome, including intervention type, volume, duration, and dose.

Methods

The review was undertaken according to a predetermined protocol (available from the corresponding author) developed according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Study inclusion criteria

This review examined articles evaluating any aspect of falls management and/or any balance rehabilitation intervention in adults with a confirmed diagnosis of MS (as against clinically isolated syndrome). Studies eligible for this part of the review included randomized and quasi-randomized controlled trials (including crossover trials) comparing interventions against no intervention or placebo control. Primary outcomes included falls incidence and measures of balance (as an identified risk factor for falls). Falls outcomes included prospective and retrospective self-report and falls self-efficacy measures. Balance outcomes included direct measures of balance such as posturography and surrogate measures (such as Berg Balance Scale [BBS] and functional reach).

Search strategy

Mixed search methods were used including computer-based and manual searches. Electronic databases included Medline, Cochrane Database of Systematic Reviews, AMED, Embase, British Nursing Index, CINAHL Plus, and PsycINFO. Medical Subject Headings (MeSH) keywords and operators used were “Multiple Sclerosis

AND accidental falls” OR “Multiple Sclerosis AND postural balance” OR “Multiple Sclerosis AND exercise” OR “Multiple Sclerosis AND physical/physio therapy” NOT animals [MeSH heading].

Related terms “postural instability,” “balance,” and “falls” were used in those sources not using MeSH terms. Additionally, hand searches of reference lists and MS conference abstracts published over the past 5 years were performed. All literature published from their earliest date to November 2014 were included; only English-language sources (or those where a translation was available), where full-text details were available from either the original publication or the corresponding author, were included.

Data extraction and screening

Abstracts were extracted and screened to remove obviously irrelevant reports. Subsequently, the inclusion and exclusion criteria were applied to the abstract of each identified citation. The full text was obtained for all remaining articles, and each was then assessed for adherence to the review criteria by use of a simple checklist. Studies were evaluated independently by 2 reviewers (H.G., S.M.) throughout.

Risk of bias (quality) assessment

The Cochrane Risk of Bias tool¹⁹ was used to appraise all articles, with discrepancies in scoring resolved through discussion between the reviewers. In accordance with the aim to be as comprehensive as possible, a cutoff point was not set; however, the findings of the quality assessment were considered when drawing inferences from the data synthesis.

Data synthesis and analysis

After the eligibility and quality assessment stages, data extraction was undertaken. This included detailed demographic and MS classification data, intervention data, and results.

Evaluation of content

The interventions exclusively evaluated types of exercise. Because there was a wide variety of exercise types, analysis was undertaken using the subgroupings defined by the Prevention of Falls Network Europe group and used by Gillespie et al¹⁷: (1) strength training; (2) endurance training; (3) gait, balance, and functional training; and (4) general exercise programs.

An extra category was added (active console games [eg, Nintendo Wii]) to reflect a growing area of practice that is used to improve balance and manage falls in other groups^{20,21} and where a number of recent articles have been published in MS.

Within each of these exercise subgroups, evaluation of program content was undertaken. Owing to the heterogeneity of interventions in the “general exercise” group, analysis of content in this subsection is limited to a general description of programs type.

Strength and endurance training subgroups

Content analysis compared the type and intensity of training. The parameters based on the American College of Sports Medicine (ACSM)²² guidelines for exercise intensity and duration as used by Sherrington et al²³ were used as a framework.

List of abbreviations:

ACSM	American College of Sports Medicine
BBS	Berg Balance Scale
CI	confidence interval
EDSS	Expanded Disability Status Scale
MS	multiple sclerosis
RR	risk ratio
SMD	standardized mean difference

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