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ORIGINAL ARTICLE

Balance Exercise Program Reduced Falls in People With Multiple Sclerosis: A Single-Group, Pretest-Posttest Trial

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Abstract

Objective: To evaluate the effects of a balance exercise program on falls in people with mild to moderate multiple sclerosis (MS).

Design: Multicenter, single-blinded, single-group, pretest-posttest trial.

Setting: Seven rehabilitation units within 5 county councils.

Participants: Community-dwelling adults with MS (N = 32) able to walk 100m but unable to maintain 30-second tandem stance with arms alongside the body.

Intervention: Seven weeks of twice-weekly, physiotherapist-led 60-minute sessions of group-based balance exercise targeting core stability, dual tasking, and sensory strategies (CoDuSe).

Main Outcome Measures: Primary outcomes: number of prospectively reported falls and proportion of participants classified as fallers during 7 preintervention weeks, intervention period, and 7 postintervention weeks. Secondary outcomes: balance performance on the Berg Balance Scale, Four Square Step Test, sit-to-stand test, timed Up and Go test (alone and with cognitive component), and Functional Gait Assessment Scale; perceived limitations in walking on the 12-item MS Walking Scale; and balance confidence on the Activities-specific Balance Confidence Scale rated 7 weeks before intervention, directly after intervention, and 7 weeks later.

Results: Number of falls (166 to 43; $P \leq .001$) and proportion of fallers (17/32 to 10/32; $P \leq .039$) decreased significantly between the preintervention and postintervention periods. Balance performance improved significantly. No significant differences were detected for perceived limitations in walking, balance confidence, the timed Up and Go test, or sit-to-stand test.

Conclusions: The CoDuSe program reduced falls and proportion of fallers and improved balance performance in people with mild to moderate MS but did not significantly alter perceived limitations in walking and balance confidence.

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Imbalance and its association with risk for falls in people with multiple sclerosis (MS) are well recognized.[1-12] Several interacting factors are associated with fall risk in people with MS (PwMS). Dual tasking is frequently impaired,[13] and there is some evidence supporting that dual tasking, divided attention or being distracted are causative of falls.[8,14-16] Impairments in sensory qualities are common and often present at the onset of disease,[17] although there is conflicting evidence on whether this leads to an increased risk of falling.[8,18] Increased postural sway in standing has been reported to be associated with fall risk.[18] In addition, trunk control contributing to balance is often decreased in PwMS.[19]

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A systematic literature review[20] of the effects of physiotherapy interventions on balance in MS revealed a lack of intervention studies evaluating balance performance; thus, a knowledge gap exists that needs to be addressed. Studies investigating interventions aimed at reducing falls in PwMS are also sparse. In 1 pilot study,[21] 44 PwMS were randomly assigned to 2 intervention groups and a control group. The interventions consisted of 12 sessions of individual balance exercise sessions aiming to improve (1) motor and sensory strategies or (2) motor strategy only, while the control group received treatment not specifically aimed at improving balance. Fall frequency was reduced postintervention in comparison with that reported retrospectively 1 month before intervention. Both intervention groups showed significant improvements on the Berg Balance Scale, with a larger improvement in the combined exercise group compared with the motor-only group. Another randomized controlled trial (RCT)[22] investigated a 10-session circuit exercise program focusing on balance and strength for PwMS using walking aids and found that the exercise program significantly reduced the number of falls and number of fallers. However, data on falls were collected retrospectively. A single-group crossover study[23] showed that 6 weeks of twice-weekly sessions of visuo-proprioceptive exercises reduced the risk of falls, defined as the percentage of time using hand support to avoid falls in double-leg and single-leg stance in a laboratory setting.

A history of falls is associated with a poor sense of coherence as well as concerns about and fear of falling.[24-26] As many as 93% of community-dwelling PwMS aged 21 to 73 years reported a fear of falling as measured by the Falls Efficacy Scale—International, and 57% fell at least once during a 6-month follow-up.[27] Beside the risk of injury when falling,[7,28-30] concerns about falling can lead to restrictions in activities,[25,26] although no association was found between a history of falling and the level of physical activity measured as steps per day.[31] Confidence in the ability to maintain balance during activity is lower in those experiencing multiple falls compared with nonfallers.[32]

To summarize, few studies have evaluated balance exercise programs in PwMS where falls have been used as an outcome. More importantly, data on falls have only been collected retrospectively, introducing the risk of recall bias. Hence, the aim of the present study was to evaluate the effects of a 7-week, twice-weekly group exercise program (core stability, dual tasking, and sensory strategies [CoDuSe]) on prospectively reported falls, balance performance, balance confidence, and perceived limitations in walking among PwMS. The specific hypotheses were that participation would (1) decrease the number of falls and proportion of fallers from a preintervention period to a postintervention period; (2) improve performance on clinically administered balance measures and self-rated walking and balance-related measures between a preintervention test occasion and a test directly after the intervention period; and (3) show continued benefits in that the improvement would be maintained at a follow-up 7 weeks after completion of the intervention.

List of abbreviations:

ABC	**Activities-specific Balance Confidence**
MS	**multiple sclerosis**
MSWS-12	**12-item Multiple Sclerosis Walking Scale**
PwMS	**people with multiple sclerosis**
RCT	**randomized controlled trial**
TUG	**timed Up and Go**

Methods

The study sample was derived from an RCT investigating balance exercise, in which the participants were randomly assigned to either an early start or a late start of the intervention. The present study focused on falls and analyzed data for those starting the intervention late, enabling a prospective data collection on falls during 7-week periods not only during and after the intervention, but also before the intervention. Adults with MS diagnosed by a neurologist, and living within the recruitment area of the centers, were consecutively invited to participate. Eligible for inclusion were PwMS who were (1) able to walk 100m; (2) able to get up from the floor with minor support; and (3) unable to maintain tandem stance for 30 seconds with arms alongside the body. Exclusion criteria were major cognitive or linguistic difficulties, or other diseases or conditions preventing participation in the intervention or data collection, established by clinical judgment by the respective physiotherapist. Data were collected between August 2012 and June 2013. The allocation from the RCT remained concealed throughout the study, ensuring blinding of the data collectors. The study had an experimental design with repeated test occasions (fig 1). The study was approved by the regional ethics committee (2012/117) and conducted according to the Declaration of Helsinki.

Intervention development

Development of the program began with a scrutiny of the scientific literature for evidence regarding exercise interventions aimed at reducing imbalance in PwMS. Based on the findings, it was determined that the program should incorporate core stability, dual tasking, and activities involving altering sensory conditions. Next came an interactive process in which the program components were presented to physiotherapists interested in participating in the project. All physiotherapists involved had clinical experience of treating PwMS, and most had previous experience of leading balance exercise groups. In a day-long session, the exercises were tested practically and discussed in depth with the physiotherapists. The discussion included time to be spent on each component in the exercise program, safety aspects, group size, verbal and hands-on instructions, and how the exercises could be individualized and progressed. The length of each session and the intensity and duration of the exercise program were defined in congruence with previous research and clinical experience among the physiotherapists. Practical issues were also considered, such as the possibility and likelihood of an outpatient investing time and effort into participating in the exercise program, and the feasibility of delivering the program to actual patients. A preliminary program was constructed, and the physiotherapists had further opportunity to practice the exercises themselves. A second meeting was held where the physiotherapists were able to reflect and comment once more before the final version of the program was confirmed. Once consensus was reached, a manual was printed with a description of the exercises in text and illustrations including progression of the exercises. The manual was accessible at each site during the intervention period, and the primary investigators were available for discussion and advice throughout the study period. The