

Exercise Training For Enhancing Balance in Patients With Multiple Sclerosis: A Narrative Review

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Abstract:

Background: Balance impairment is one of the most frequent disabling symptoms in multiple sclerosis (MS), causing a decline in both independence and quality of life. Exercise training has gained attention as a potential intervention for MS patients.

Purpose: This review aims to examine and discuss the current evidence on the effectiveness of exercise training in enhancing balance in MS patients.

Methods: A comprehensive search of Science Direct, Google Scholar and PubMed was conducted using keywords such as multiple sclerosis, exercise training, balance. Search for literature was limited to English language studies. Conference abstracts and unpublished manuscripts were excluded.

Results: The findings suggest that exercise training has the potential to improve balance in MS patients.

Conclusion: Current literature highlights the positive effects of exercise training for improving balance in MS patients.

Keywords: Multiple sclerosis, exercise training, balance, neurorehabilitation.

Introduction:

Multiple sclerosis (MS) is a chronic, progressive, and disabling neurological condition that affects millions of individuals worldwide. MS results from the immune-mediated demyelination and neurodegeneration of the central nervous system (CNS), leading to various impairments, including motor dysfunction, balance issues, and coordination deficits (1). Among the numerous motor impairments, balance problems are prevalent and significantly impair the quality of life in MS patients (2).

Balance impairments, defined as the difficulties in maintaining the upright position during static, challenging, and reactive conditions of postural control, are common in Patients with Multiple Sclerosis. Balance dysfunction in MS is conceptualized as three interrelated problems: decreased ability to maintain position, limited and slowed movement towards limits of stability, and delayed responses to postural displacements and perturbations (3).

Exercise training is described as cumulative bouts of planned and structured physical activity that are repeatedly performed for an extended period of time with a specific external objective or goal of improved or maintained fitness. Multiple researchers have examined the effect of interventions that involve exercise training on balance in MS patients (4,5). But, the magnitude of the influence of exercise training on balance has varied considerably amongst published research. So, this review aims to examine the current evidence on the exercise training for improving balance in MS patients and to investigate how exercise training influences balance confidence in MS patients.

Balance impairment in MS patients:

Balance impairment is one of the most frequent disabling symptoms in multiple sclerosis. It leads to abnormal postural stability that increases the risk of falls and adversely affects the ability to safely perform activities of daily living. It affects about 75% of patients during the course of the disease (6).

Multiple sclerosis patients significantly worst on balance measures comparing to the healthy age-matched controls, indicating greater postural instability. Balance impairment is more significant for patients with progressive forms of MS rather than the relapsing remitting form of MS. Balance impaired in MS patients even before the onset of observable clinical disability. Standing balance commonly affected in MS patients, especially during unexpected sudden external force. MS patients are less able to maintain standing with a reduced base of support, such as on one leg or in tandem stance, compared with healthy controls (7).

In MS patients, it is common to have balance problems caused by the involvement of the brainstem and cerebellar structures because they both are functionally linked in the control of sensory inputs and corresponding motor output. Cerebellar dysfunction is commonly considered as an important cause of imbalance in several neurological diseases and it has been postulated that cerebellar lesions may lead to abnormal postural responses also in MS (8).

The somatosensory system with long fibers in the spinal cord is crucially dependent on intact myelinated nerves in the CNS for fast signal processing. The timely receipt of somatosensory inputs from the legs is considered highly important for adequate control of balance. Deficits of proprioceptive in the lower legs in MS patients may lead to excessive roll sway of the trunk during quiet stance. Both slowed afferent proprioceptive conduction along demyelinated dorsal columns of spinal cord and damage of proprioceptive neural pathways originating from right brain hemisphere have been proposed as important causes of impaired balance in MS patients (9).

Exercise training in MS patients:

Research confirms that exercise would be well tolerated by MS patients and supports the feasibility of engaging in various exercise modalities. Although a number of exercise intervention studies involving patients with MS have been described in the literature, their clinical utility and results in improving balance are varied. Balance Training exercises are used to improve steadiness to help patient perform daily activities as self-care successfully. Exercises used to improve balance should be designed to address each patient's specific underlying balance problem. Also, to promote changes in balance, the exercises need to be moderately challenging (10).

Regardless of specific approach, the aim of any exercise intervention is to reduce activity limitations, encourage participation, and facilitate independence and life satisfaction in those with the disease. Exercise training includes routine physical activity sessions that are comprised of aerobic exercise, resistance exercise, or combined approaches with both aerobic and resistance exercise that may further incorporate balance or stretching activities as part of the training regimen (11).

Some studies, combining strength and balance exercise have demonstrated benefits in balance confidence, standing static balance, step climbing, and functional mobility. Combining aerobic exercise and strengthening has also been effective in reducing falls in those with MS. Additionally, it is reported that there are revealed significant increases in functional reach as a result of progressive resistance exercise (12).

Task-oriented training is a favored approach for neuro rehabilitation by improving occupational performance for individuals with neurological conditions. It involves a variety of practices to help patients derive optimal control strategies for solving motor problems. One of primary aim of task-oriented training is to increase the levels of activity and participation and so increase the independence. It includes a wide range of interventions such as treadmill training, walking training on the ground, bicycling programs, endurance training and circuit training for improving balance (13).

Core stability training could improve trunk function, balance and mobility. It can also increase proprioceptive awareness of the body which lead to improve balance. Strengthening core muscles through core stability exercise improve neuromuscular system, reduce displacement of COG over the supporting surface, reduce fluctuation and so improve balance ability (14).

Vestibular rehabilitation is a specialized treatment approach that strengthens the vestibular sensory system by retraining the brain to recognize and process signals from the vestibular system and coordinate these with visual and proprioceptive inputs. The vestibular rehabilitation program consisted of static and dynamic tasks performed with changing bases of support, on various surfaces, with eyes open or closed, and different head movements (15).

Balance-based torso weighting involves strategically placing small weights on the trunk of an individual to decrease balance deviations observed during quiet stance, perturbed standing, walking, and transitioning. While the specific mechanism underlying the therapeutic effect of rehabilitative weighting has been discussed, various suggestions include joint compression to encourage co-contraction, enhanced conscious awareness of body segments, and biomechanical changes via shifting of the center of mass (16).

Finally, Novel rehabilitative approaches have taken advantage of advances in virtual reality to improve balance deficits in patients with MS. Technologic assistance has also been used to enhance rehabilitation of balance in MS. Exercise using the general physical activity games on the Nintendo Wii Fit provided short-term improvement in standing balance and physical activity in patients with MS (17).

Possible mechanisms of exercise training in MS patients:

The specific mechanisms of action whereby exercise training can improve balance in MS seemingly vary by physical therapy approach, but many physical therapy interventions are predicated on the principles of neuroplasticity and cortical reorganization. Exercises acts as a stimulus that facilitates neural adaptation in the central nervous system to improve function. For example, in a task-oriented approach, individuals practice multiple repetitions of a functional task. This intensive multisensory input facilitates reorganization in the central nervous system, and ultimately improves task performance (18).

The task-dependent plasticity in the sensorimotor network may mediate the performance of the motor task by improving motor control (e.g., increased synergistic muscle activity, improved alignment of limb segments), and ultimately improving balance ability. In addition, exercise training may act peripherally to reduce spasticity and improve strength, both of which aid in the reduction of balance impairment (19).

Limitation and future directions:

Despite these promising findings, several limitations should be considered when interpreting the results of this review. First, there was significant heterogeneity in study designs, intervention protocols, and outcome measures. The searched studies varied widely in terms of training intensity, duration, and frequency. This lack of standardization limits the ability to draw definitive conclusions about optimal training protocols. Second, many studies lacked long-term follow-up, making it difficult to assess the sustainability of observed improvements. Given the progressive nature of MS, continuous training may be necessary to maintain functional gains over time. Future studies should incorporate longer follow-up periods to better evaluate the durability of these interventions.

Third, there was significant heterogeneity of the MS population, which includes varying disease subtypes and disability levels. So, future trials are needed to confirm the efficacy of these interventions across diverse patient populations. Fourth, this work is a narrative review, it did not follow a fully systematic search strategy. Consequently, there is a possibility that some relevant studies may have been mistakenly missed.

Conclusion:

This review highlights the substantial potential of structured exercise interventions to improve balance function in MS patients. High-intensity, task-specific combined training, appears to offer the most comprehensive benefits.

Disclosure statement:

No author has any financial interest or received any financial benefit from this research.

Conflict of interest:

Authors state no conflict of interest.

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