

# The Effect of Strengthening Exercises on Functional Ability in Patients with MS: A Review Study

Narges Jahantigh Akbari <sup>a</sup>, Nahid Tahan <sup>b\*</sup>, Sedigheh Sadat Naimi <sup>b</sup>, Nafiseh Momenzadeh <sup>a</sup>, Saeed Mikaili <sup>a</sup>

<sup>a</sup> Student Research Committee, Department of Physical Therapy, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran; <sup>b</sup> Department of Physical Therapy, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

\*Corresponding Author: Nahid Tahan, Department of Physical Therapy, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran, E-mail: tnpt2378@gmail.com

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## Abstract

**Introduction:** Patients with multiple sclerosis (MS) usually report gait and balance disorders. Exercise therapy, especially strengthening exercise, is a safe and effective treatment approach in these patients. Therefore, the aim of this review study was to determine the effect of strengthening exercises on functional ability in patients with MS. **Methods and Materials:** A search of databases such as PubMed, science direct, Cochrane library, and Google scholar was reviewed to determine the existing articles on the effect of strengthening exercises on functional ability in patients with MS. **Results:** According to the evaluation of studies from 2000 to 2020, 8 articles met the inclusion criteria. These articles examined the effect of strengthening exercises on functional ability in patients with MS. The results showed that strengthening exercises improved balance variables, functional ability, strength, and quality of life. **Conclusion:** Various interventions including stretching, balance, strengthening exercises, and electrical stimulation have been used to treat balance disorders, decreased muscle strength, gait efficiency and quality of life in patients with MS. Among these interventions, strengthening exercises have been shown to play an effective role in improving functional ability, although more studies are needed in this area.

**Keywords:** Multiple Sclerosis, Walking, Strengthening Exercises, Performance

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## Introduction

Multiple sclerosis (MS) is a chronic inflammatory autoimmune disease of the central nervous system associated with myelin damage and axonal loss (1). People with MS often report problems with walking, balance, fatigue, visual system, weakness, pain, and sensory disturbances (2-5). Movement disorders in MS may lead to disruption of daily life activities and reduced quality of life (4). Among the symptoms reported in patients with MS, decreased mobility and fatigue are one of the most common problems (6, 7). Approximately 85% of patients with MS have difficulty walking following fatigue (6, 7). Since the course of MS is unpredictable, this disease creates high treatment costs for the individual and society (8).

There is no specific medication method for treating balance disorders, fatigue, and muscle weakness in MS patients (9). On the other hand, sedentary life in MS patients is mainly caused

by defects in the musculoskeletal system, as well as psychological factors such as lack of enjoyment of exercise or fear of recurrence (10). Although the benefits of exercise are well known, MS patients participate in a lower level of activity than healthy patients (2). On the other hand, strengthening exercises can improve muscle weakness, coordination, balance, agility, and muscle spasticity (9). Therefore, strengthening exercises can increase muscle strength and potentially change the quality of life without negative side effects (11).

It is reported that isokinetic training program in combination with other methods of strengthening rehabilitation has beneficial effects on gait parameters and performance (12). Therefore, the goal of rehabilitation in patients with MS is to increase muscle strength due to the reported defects (13). Resistance training has been introduced as an initial goal for MS rehabilitation (13). A study by Eftekhari *et al.* examined the combined effects of resistance

**Table 1.** Characteristics of the studies included in the review study.

Study	Design	Characteristics of the participants	Intervention time	Study group, control group	Dependent variables (measurement tools)	Results
Mayo et al. (2)	RCT	240 male and female MS patients, in the age range 19-65 years	1 year and with follow up 2 years	Intervention group (n=12): They performed strengthening exercises. Control group (n=12): performed routine exercises.	-capacity exercise(V02peak) -strength(Grip), functional ambulation (M-6MWT)	The exercise program tolerated by MS patients improved the measured parameters compared to the general guideline program
Eftekhari et al. (1)	RCT	24 female MS patients, age range 24-45	3 times a week for 8 weeks	Intervention group (n:12) : Resistance exercises Control group (n=12): received vibration.	Maximum voluntary contraction of knee extensor muscles (Brzycki, formula) -Gait speed (10 MWT).	The results showed a significant increase in the maximum voluntary contraction of the knee extensor muscles and a decrease in gait speed.
Moradi et al. (3)	RCT	14 male MS patients, age range 34.05	3 times a week for 8 weeks	Intervention group (n=8): progressive resistance training Control group (n=10): people with MS and did not receive any training program.	Ambulatory function including TUG, 10TW, three minutes step test	Positive effects of exercise program on improving body function, mobility, and quality of life in patients with MS were reported.
Bisht et al. (4)	RCT	20 male and female MS patients, age mean 51 years	12 months	Intervention group (n=10) A multimodal intervention received a combination of stretching, strengthening exercises, and electrical stimulation of the trunk and lower limbs. Control group (n=10): did not receive any treatment	-Walking performance (TUG and T25FW) -balance (Berg Balance Scale).	A higher walking speed during TUG was shown at 6 months compared to the initial value.
Jonsdottir et al. (5)	RCT	38 male and female MS patients, age range 18-80 years	5 times a week for 4 weeks	Control group (n=26): received treadmill exercises. Intervention group (n=12): received strengthening exercises.	-Resistance gait (2 MWT), -Static and dynamic equilibrium measurements (Berg Balance Scale, Dynamic Gait -Index)	The treadmill exercise group improved gait resistance, speed, and mobility. Balance improved on average in both groups following exercise.
Sangelaji et al. (9)	RCT	40 male MS patients, age range 18-50 years	4 times a week for 8 weeks	Intervention group (n=30): Different combinations of aerobic and resistance exercises with different repetition speeds were included. Control group: MS patients (n=10) were included and did not receive any treatment.	strength (JEXERS ® exercise machine) - Balance (Berg Balance Scale), -walking distance-(10MWT)	The measure indices in <b>intervention group were significantly higher compared to the control group..</b>
Sangelaji et al. (14)	RCT	59 male and female MS patients (39 females and 20 males), age range 18-50 years	10 weeks	Intervention group (n=39): received combination therapies including: aerobic, balance, strengthening and stretching exercises control group(n=20): It included people with MS and did not receive any treatment.	-Balance (10MWT), quality of life	Exercise caused a significant improvement of balance in patients with MS.
Heine et al. (15)	RCT	10 male and female MS patients and 10 healthy, age range 18-70 years	8 weeks and 3 times a week	Intervention Group (n=10): received resistance training followed by endurance training. Control group (n=10): included healthy individuals	Gait speed (12MWT)- Walking distance (ESES).	Resistance training significantly improved walking distance..

(MS: multiple sclerosis), (10 MWT=10-Meter Walk Test), (10 MWT: 10-meter timed walk test), (TUG=Timed Up and Go test), (2MWT=2 Minutes Walking Test), (M-6MWT=Modified 6 Minute Walk Test), (ESES=Exercise Self-Efficacy Scale), (12MWT=12 meter walking test)

training and overall body vibration on muscle strength, body posture, and balance in MS patients. The results reported a significant improvements in muscle strength and balance (1). In another study by Bisht *et al.*, they examined the combined effects of several interventions, including strengthening, stretching exercises, electrical stimulation, and nutritional regimen on gait and balance in patients with progressive MS. The finding reported a significant improvement in gait, balance, and quality of life associated with reduced fatigue (4).

Many factors such as decreased muscle strength and range of motion, abnormal muscle tone, and lack of sensory-motor coordination have led to postural control problems in MS patients (16). A meta-analysis study evaluating the risk factors associated with falling showed that disease progression and balance and walking problems increased the likelihood of falling. (14) According to previous studies and our information in search of content, so far no study has reviewed the effect of strengthening exercises separately on the ability to function in people with MS. Therefore, the aim of this review study was to evaluate the effect of strengthening exercises on functional ability in people with MS.

## Methods and Material

The search in PubMed, ScienceDirect, Cochrane library, and google scholar databases was conducted to find the existing studies on the effect of strengthening exercises in patients with MS. The combination of keywords "multiple sclerosis" AND (balance OR walking OR walking mobility) AND (strength training OR exercise OR strengthening exercises).

English-language studies were accepted for inclusion in the study, which had the following criteria: 1) the study design were randomized controlled trial (RCT), 2) participants in the study had MS, 3) strengthening exercises were studied as a therapeutic intervention (alone or in combination with other interventions), 4) compared to the intervention group, there should be a control group without exercises or other interventions, 5) studies in which the variable included one of the functional parameters. Studies that did not have these conditions, as well as studies carried on in patients other than MS were excluded. Case reports, studies for which only abstracts were available, articles whose interventions were other than strengthening exercises, and articles whose variables were not one of the performance parameters were also excluded.

## Results

A total of 525 related articles were found in the initial search in electronic databases. After reviewing in full text, about 307 articles were selected as free full text. Out of these 307 articles, most articles were excluded with the evaluation of title and abstract. Duplicates and other reasons (review articles), non-RCT articles were removed. Finally, 8 articles were selected as full text for the final evaluation. According to these articles, 2 functional ambulation studies, 5 walking efficiency studies, and 3 balance studies were reviewed (Table 1).

### Functional ambulation

Mayo *et al.* (2) discussed the role of strengthening exercises in the recovery of patients with MS and showed that exercise is known as an effective intervention with known benefits and no negative side effects. The variables in that study included: capacity exercise, functional ambulation, strength, and quality of life that the mean of all these variables was significantly improved. In Moradi *et al.* study, a significant change in functional ability, gait duration, muscle strength, and disability was reported, indicating the positive effects of strengthening exercises in MS patients (3).

### Walking performance

In a study by Eftekhari *et al.*, after 8 weeks of intervention, the exercise group showed a significant increase in maximal voluntary contraction of the knee extensor muscles and a decrease in the 10-Meter Walk Test (10 MWT), indicating the positive effects of strengthening exercises on walking performance (1). The study by Bisht *et al.* reported significant changes in walking time during the timed up and go test (TUG) after 6 months of training compared to pre-workout. Intragroup analysis showed that walking time improved after strengthening exercises (4). In a study by Jonsdottir *et al.*, the results showed that the group with treadmill exercise improved gait, gait resistance, and gait performance. Balance and executive functions improved on average in both groups (strengthening exercises and treadmill exercises) following exercise, indicating the positive effects of strengthening exercises in MS patients (5). In the studies of Moradi *et al.* and Sangelaji *et al.*, they reported the positive effects of strengthening exercises on gait performance (3, 9).

### Balance

A study by Sangelaji *et al.*, the intervention group consisted of different combinations of aerobic and resistance exercises with

different repetition rates. Scores were significantly higher compared to the control group for most variables such as strength, balance, and walking distance (9). In another study by Sangelaji *et al.*, the intervention group received combination therapy including: aerobic, strengthening, balance, and stretching exercises. The results showed that significant changes in the intervention group compared to the control group on balance and quality of life (14). Jonsdottir *et al.* study also reported significant improvements in static and dynamic balance indices following strengthening exercises (5).

## Discussion

MS causes a wide range of neurological disorders that are often associated with mobility problems. Decreased muscle strength appears to affect the lower limbs, although weakness in the upper limbs, trunk, and respiratory muscles is also problematic. Muscle strength is important because it is associated with problems in mobility (decreased walking speed and endurance), balance, and functional activity. Evidence support the use of strength training (weight machines, free weights, and resistance bands) to improve lower limb strength, thereby improving mobility, balance, and gait in patients with MS (17). Therefore, the aim of present study was to discover the effect of strengthening exercises on functional ability in patients with MS.

The results of the present review study showed that strengthening exercises can improve functional ability by improving muscle strength in the lower extremities in patients with MS. Strengthening exercises were able to delay the progression of the disease by reducing inflammation and encouraging nerve repair, and thus those are thought to have a positive effect on the functional ability of patients with MS.

Gutierrez *et al.* (18) showed that an 8-week strengthening exercises program improved kinematic gait. The study found that strength training included positive changes in gait (especially longer strides), more time spent in the swing phase, and less time spent in the stance phase and the double support phase. Mayo *et al.* study and Moradi *et al.* (2, 3) study looked at the role of exercise in improving patients with MS. These studies showed that exercise was considered as an effective intervention with known benefits, and strengthening exercises led to improvement in functional ambulation, power, quality of life and TUG. In fact, improving muscle strength was a predictor of ambulatory function, which described the success of strengthening exercises in improving mobility.

In the studies by Bisht *et al.* and Jonsdottir *et al.*, there was also a significant improvement in TUG, walking performance, and balance. It is likely that longer duration of strengthening exercises may challenge the balance during gait, which can have a greater effect (4, 5).

The study by Sangelaji *et al.* reported that intervention group had significantly higher scores for various variables including aerobic and resistance training for most variables, including balance, strength, and walking distance, for resistance training compared to the control group. One reason for the improvement may be that exercises such as stationary bike may strengthen people with MS who have not exercised regularly. Due to the nature of this type of physical activity, a number of muscles are effective in balance, such as the erector spine muscles, which may be strengthened by exercises. Therefore, this phenomenon may lead to improved balance only in the resistance training group (9).

A study by Sangelaji *et al.* reported that combination therapy including aerobic, strengthening, balance, and stretching exercises reported significant changes in the intervention group compared to the control group for the physical and mental dimensions of quality of life and walking distance, and balance. It can be concluded that strengthening exercises can help patients to reduce the disease associated with problems for at least a short period of time (14). According to these studies, it can be said that strengthening exercises have an effective role in improving the functional ability of patients with MS. Nevertheless, more studies are needed in this regard (17).

The results of this narrative study showed that strengthening exercise program alone or in combination with balance and endurance exercises compared to the general guideline, improved the variables of strength, functional ability, quality of life, and balance.

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