
# ACSM (2021) Multiple Sclerosis (MS) Guidelines & Recommendations.

## Introduction

Multiple sclerosis (MS) is a chronic, inflammatory, autoimmune disease of the CNS that currently affects an estimated 2–3 million individuals worldwide. Causal factors for MS include environmental factors (e.g., vitamin D deficiency and cigarette smoking), genetic factors, and exposure to infectious agents. The underlying pathogenesis of MS is complex and believed to be controlled by a cascade of inflammatory responses affecting the CNS, involving cells from both the adaptive and innate immune systems (e.g., B cells and T cells). The resulting effects of these immune responses include axonal or neuronal loss (neurodegeneration) and damage to the myelin sheath (demyelination). This leads to the observed clinical symptoms of MS (e.g., optic neuritis, ataxia, and bladder dysfunction), which vary depending on the location of the inflammatory demyelinating lesions within the CNS and the extent of the inflammation. Transient episodes of neurological deficits, known as relapses, characterize early MS. Diagnosis of MS is made using a combination of clinical, imaging, and laboratory findings. Most people who develop MS will experience a single episode, known as a clinically isolated syndrome, which resolves over time. A second relapse indicates onset of MS.

The onset of MS usually occurs between the ages of 20 and 50 yr. and affects women at a rate two to three times more than men. The disease course of MS is highly variable from individual to individual and within a given individual over time (**Table 1**). People with MS are described as having relapsing remitting MS if they experience at least two relapses. This is the most common type of MS. Of these, 15%–30% develop progressive disability with or without relapses (i.e., secondary progressive MS). Approximately 15% of people with MS experience progressive disability from the onset of MS, which is described as primary progressive MS. In 2013, it was recommended that MS be further subcategorized as active or nonactive, where active MS is defined as “the occurrence of clinical relapse or the presence of new T2 or gadolinium-enhancing lesions over a specified period of time, preferably at least one year”. **Table 1** is a summary of the expanded disability status scale (EDSS; range 0–10), which is commonly used to indicate the level of disability related to the progression of MS.

**Table 1.** Disease Courses of Multiple Sclerosis.

| Type | Characteristic |
|---|---|
| Relapsing-remitting | Periodic exacerbations followed by full or partial recovery of deficits |
| Primary progressive | Continuous disease progression from onset with little or no plateaus or improvements |
| Secondary progressive | Slow and steady disease progression that transitioned from the relapsing-remitting type |
| Progressive relapsing | Progression from onset with distinct relapses superimposed on the steady progression with or without full recovery |

Symptoms of MS include spasticity; fatigue; pain; mobility impairment; ataxia and tremor; bladder, bowel, and sexual dysfunction; emotional lability; cognitive impairment; and visual disturbances. These symptoms may limit ability to complete ADL and impact quality of life. Fatigue is one of the most common symptoms of MS, as well as mobility impairment, which may lead people with MS to avoid participation in PA. Fatigue can be both primary (i.e., directly related to disease pathology) and secondary to reduced physical fitness. People with MS also experience heat sensitivity and impaired temperature regulation, which can result in worsening symptoms including fatigue and physical and cognitive function during PA. Avoidance of PA because of fatigue and impaired thermoregulation may lead to reduced aerobic capacity, which is known to decrease with increasing levels of disability. This can result in a negative cycle of deconditioning, reduced participation in PA, and worsening symptoms including fatigue and mobility impairment.

**Table 2.** Summary of Kurtzke Expanded Disability Status Scale.

| Rating | Disability |
|---|---|
| 0-2.5 | None to minimal disability |
| 3-5.5 | Moderate disability but still ambulatory without assistive device |
| 6-7 | Severe disability but still ambulatory with assistive device |
| 7.5-9 | Essentially wheelchair-bound or bedbound |
| 10 | Death attributable to multiple sclerosis |

Decreased muscle performance is also commonly observed in MS. Upper and lower limb isometric muscle strength, lower limb muscle power, and lower limb rate of force development is reduced in people with MS compared to those without MS. Decreased muscle flexibility may also be apparent in people with MS, particularly among those with spasticity. Reduced muscle strength may be due to reduced muscle mass among people with MS found in some studies, although this is not consistent across all studies. Reduced maximal voluntary contraction, in the presence of no changes in cross-sectional area, suggests that impaired central activation in MS contributes to decreased muscle performance. Physical inactivity may also contribute to reductions in muscle size and muscle strength and therefore feed into a negative cycle of deconditioning and physical inactivity.

Participation in habitual PA is associated with improvements in cardiovascular risk factors (i.e., waist circumference, cholesterol levels, glucose levels), longevity, and improvements in health-related quality of life. Furthermore, reduced participation in PA may be associated with worsening of MS symptoms. There is evidence that exercise interventions, including aerobic exercise training, resistance training, and a combination of aerobic and resistance training improve health-related quality of life, walking speed and walking endurance, balance, depressive symptoms, muscle strength, and CRF in people with mild-to-moderate disability. Interventions that incorporate gait, balance, and functional training demonstrate the greatest improvement in balance, but these improvements may not carry over to reduced falls. There is low-quality evidence (according to the Grading of Recommendations, Assessment, Development and Evaluation or GRADE approach) that PA programs (including physiotherapy and structured exercise programs) improve spasticity in people with MS. Among people specifically with progressive MS and moderate disability, there is weak evidence that aerobic exercise training improves CRF, mobility, and cognitive function and that resistance training improves muscle strength.

As it is one of the most common and debilitating symptoms of MS, managing fatigue is often an important objective for people with MS. There is moderate quality evidence that exercise interventions can improve fatigue among people with MS compared to no exercise. Specifically, there is moderate quality evidence that aerobic exercise and mixed training, respectively, have a positive effect on fatigue in

comparison to no exercise. However, studies are limited to people with minimal-to-moderate disability, and there is large variability between studies in terms of type of exercise intervention used and type of comparison. Studies also assess fatigue using different outcome measures, such as the Fatigue Severity Scale and the Modified Fatigue Impact Scale, which may not measure the same construct, and therefore, results may not be comparable. Furthermore, fatigue is not typically the primary outcome of interest in studies of exercise interventions, and therefore, many studies to date did not select individuals based on their level of fatigue or calculate the sample size required to detect a difference in fatigue.

As indicated previously, most research regarding exercise for MS includes individuals with minimal-to-moderate disability. Although exercise has benefits for this group, similar exercise training approaches may not be accessible or feasible for people with severe disability. A review of exercise for individuals with an EDSS score of ≥6.0 concluded that there was unclear evidence regarding the benefits of conventional aerobic exercise programs, but that conventional progressive resistance training may improve muscular fitness, balance, fatigue, and quality of life. Although benefits of aerobic exercise were not clear, included studies reported that it was safe and feasible for people with severe disability. For those who are unable to perform conventional exercise, adapted exercise training may be particularly useful. Bodyweight support treadmill training and recumbent stepping are two such adapted exercises, which may improve disability, strength, fatigue, and quality of life for these individuals.

## Exercise Testing

Exercise testing is useful in determining the fitness level, physiological response, and the effectiveness of exercise training in individuals with MS. Prior to exercise testing, medical clearance should be sought, and it is recommended to review an individual's medical history, list of medications, and functional capacity. An expert group recommended the following core set of outcome measures for use within exercise studies in MS: quality of life assessed using the Multiple Sclerosis Impact Scale (MSIS-29) or MSQoL54, fatigue assessed using the Modified Fatigue Impact Scale or Fatigue Severity Scale, exercise tolerance assessed using the 6-min walk test, muscle function assessed using the Timed Up and Go, body composition assessed using waist-to-hip ratio or BMI. Additionally, a clinical practice guideline relating to outcome measures for adults with neurologic conditions recommended the use of the Berg Balance Scale to assess static and dynamic sitting and standing balance, the Functional Gait Assessment to assess walking balance, the 10-m walk test to assess walking speed, and the five times sit-to-stand to assess transfer ability.

## Exercise Testing Considerations

- Avoid testing during an acute exacerbation of MS symptoms.

- Closely monitor for any signs of fatigue, overheating, or general worsening of symptoms as exercise intensity increases.

- Perform exercise testing earlier in the day because fatigue generally worsens throughout the day in individuals with MS.

- Conduct exercise testing in a climate-controlled room (72° to 74° F [22.2° to 24.4° C], low humidity) and use electric fans or cold neck packs as appropriate.

- Furthermore, assess for impaired sensation prior to applying a heat pack.

- Use RPE in addition to HR to evaluate exercise intensity. Individuals with MS may experience cardiovascular dysfunction because of autonomic dysfunction. HR responses may be blunted during exercise, and therefore, HR may not be a valid indicator of exercise intensity.

- In most individuals with MS, a cycle ergometer is the recommended method of testing aerobic fitness because this modality requires less balance and coordination compared with walking on a treadmill. Individuals with balance and coordination problems may require the use of an upright or recumbent cycle leg ergometer with foot straps.

- In select individuals, a recumbent stepping ergometer or dual action stationary cycle that allows for the use of upper and lower extremities may be advantageous because it distributes work to all extremities, thus minimizing the potential influence of local muscle fatigue or weakness in one limb on maximal exercise testing.

- Individuals who are non-ambulatory with sufficient upper body function can be assessed using an arm ergometer.

- Assessment of $\dot{V}O_2peak$ is a valid measure of CRF in individuals with mild disability (EDSS score ≤4.0). However, $\dot{V}O_2peak$ in individuals with moderate disability (EDSS score >4.0) may be symptom limited and therefore indicate their functional ability rather than CRF.

- Depending on the disability and physical fitness level of the individual, the use of a continuous or discontinuous protocol of 3–5 min stages increasing work rate for each stage from 12 to 25 W for leg ergometry and 8 to 12 W for arm ergometry is recommended.

- In general, muscle strength and endurance can be determined using standard protocols in individuals with MS. Each large muscle group and all limbs should be tested because weakness may present itself in a particular muscle group or limb due to the heterogeneity of lesion location and impact in MS. Isokinetic

dynamometry can be used to reliably evaluate muscle performance. In a clinical or community setting, an 8–10-RM or functional testing (e.g., 30-s sit-to-stand test) can be used to measure muscular strength and endurance.

## Exercise Prescription

Individuals with MS who are not able to meet guidelines for PA of 150 min of moderate intensity per week should engage in regular PA according to their abilities with support from health care providers. For individuals with minimal disability (EDSS 0–2.5), the FITT principle of Ex Rx is generally consistent with those for healthy adults. As MS symptoms and level of disability increase, the following modifications outlined may be required.

**Table 3.** ACSM 2021 Recommendations for MS Clients

| | **Aerobic** | **Resistance** | **Flexibility** |
|---|---|---|---|
| **Frequency** | 2–5 d · wk−1 | 2 d · wk−1 | 5–7 d · wk−1, one to two times · d−1 |
| **Intensity** | **40%–70%** V̇O2R or HRR; RPE **12–15** | **60%–80% 1-RM** | Stretch to the point of feeling tightness or mild discomfort. |
| **Time** | Increase time initially to a minimum of 10 min before increasing intensity. Progress to **30–60** min as tolerated. | Begin with 1 and gradually work up to 2 sets of **10–15** repetitions. | Hold **30–60** s, 2–4 repetitions. |
| **Type** | Prolonged, rhythmic activities using large muscle groups (e.g., walking, cycling, swimming) | Multi-joint and single-joint exercises using machines, free weights, resistance bands, or body weight | **Static stretching** |

1-RM, one repetition maximum; HRR, heart rate reserve; RPE, rating of perceived exertion; V̇O2R, oxygen uptake reserve

**Exercise Training Considerations**

With individuals who have significant paresis, consider assessing RPE of the extremities separately using the 0–10 OMNI scale to evaluate effects of local muscle fatigue on exercise tolerance.

During an acute exacerbation of MS symptoms, decrease the FITT of the Ex-Rx to the level of tolerance. If the exacerbation is severe, focus on maintaining functional mobility and/or focus on aerobic exercise and flexibility. Recognize that in times of severe relapse, any exercise may be too difficult to perform.

When strengthening weaker muscle groups or working with easily fatigued individuals, increase rest time (e.g., 2–5 min) between sets and exercises as needed to allow for full muscle recovery. Focus on large muscle groups and minimize total number of exercises performed.

To eliminate balance concerns during flexibility exercises, slow and gentle passive ROM exercise should be performed while seated or lying down.

Muscles and joints with significant tightness or contracture may require longer duration (several minutes to several hours) and lower load positional stretching to achieve increases in joint ROM. Very low intensity, low-speed, or no-load cycling may be beneficial in those with frequent spasticity.

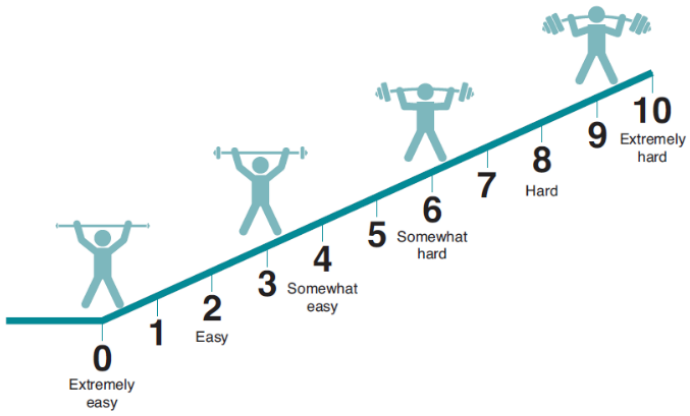


**Figure 1.** OMNI Resistance Exercise Scale of perceived exertion.

**Special Considerations**

Commonly used disease-modifying medications such as interferon β-1a and glatiramer acetate have common side effects including altered mood, flu-like symptoms, liver failure, and localized irritation at the injection site. Take medication side effects into consideration with exercise testing and scheduling.

The individual should be helped to understand the difference between more general centrally mediated MS fatigue and temporary peripheral exercise-related fatigue. Some individuals may restrict their daily fluid intake because of bladder control problems. They should be counselled to increase fluid intake with increased PA levels to prevent dehydration and hyperthermia, secondary to impaired thermoregulation. Many individuals with MS have some level of cognitive deficit that may affect their understanding of testing and training instructions. They may also have short-term memory loss that requires written instructions and frequent verbal cueing and reinforcement.

Watch for transient worsening of sensory and motor symptoms, most commonly, visual impairment, associated with exercise and elevation of body temperature. Symptoms can be minimized by using cooling strategies and adjusting exercise time and intensity.