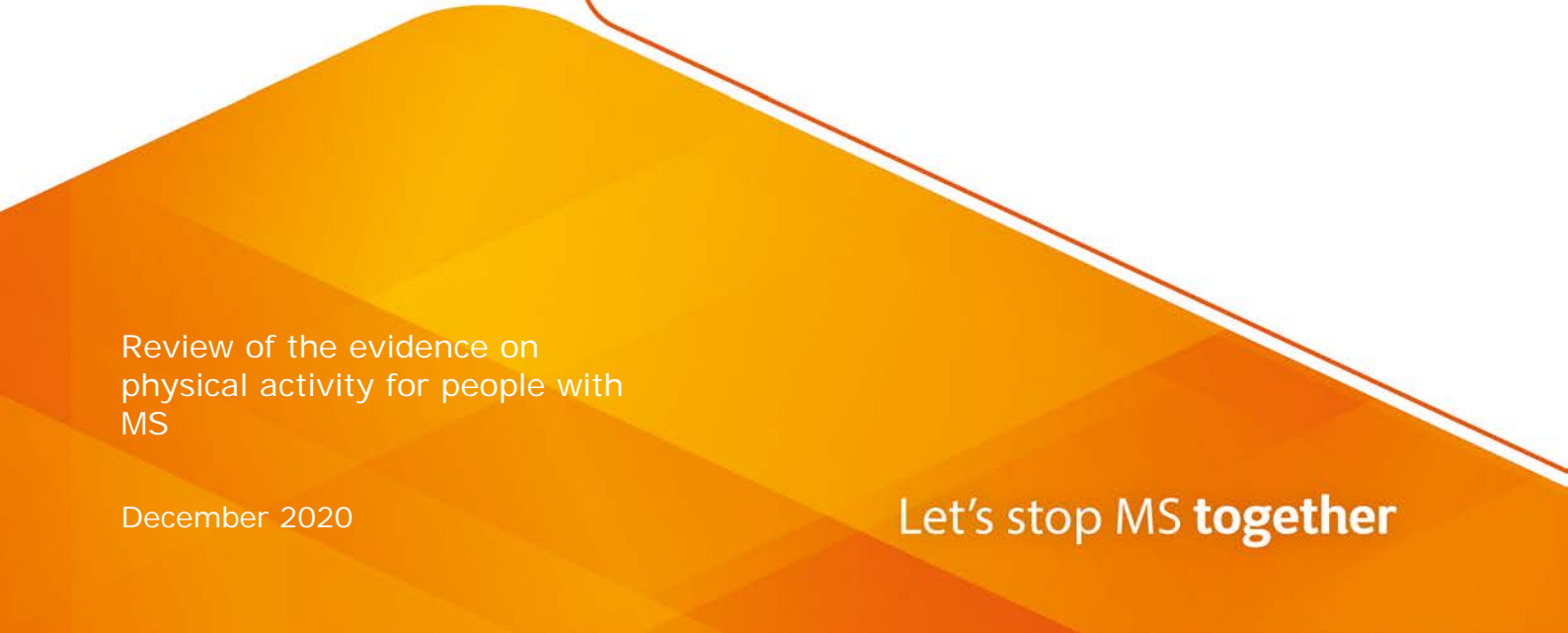


A large, stylized graphic element consisting of a central orange triangle pointing to the right, surrounded by a network of thin orange lines that form a complex, interconnected shape. The triangle has a gradient from light orange to dark orange.

**Physical activity and
managing MS**

A large, abstract graphic at the bottom of the page, composed of overlapping orange and yellow geometric shapes, creating a sense of depth and movement.

Review of the evidence on
physical activity for people with
MS

December 2020

Let's stop MS together

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1. Summary

This is a review of the evidence from various research studies. All the studies have looked at how physical activity could affect the health and wellbeing of people with multiple sclerosis (MS).

We've mainly considered previously published reviews of the research ('systematic' and 'meta' reviews) and reports from randomised control trials. We've included smaller studies if they provided results that would otherwise be unreported results or if they gave particularly useful context.

The studies included in this review show that:

- exercise is well tolerated by people with MS with few negative impacts on health and wellbeing
- in the studies we looked at, participants did on the whole keep with the programmes for the duration of the study period (usually between 6 and 12 weeks)
- when taken together the evidence shows an overall benefit for people with MS on a number of different measures including walking, balance, strength, fatigue, cognition and memory, and general wellbeing
- however, the evidence is not clear enough to identify specific guidelines for prescribing physical activity when it comes to duration, intensity or type of physical activity
- the evidence is weighted towards people with relapsing remitting MS and those with lower levels of disability
- more specific research is needed on the duration, intensity and type of physical activity in order to develop specific guidelines for clinicians and people with MS
- more specific research is needed on the benefit of and guidelines for physical activity for people with progressive forms of MS and those with more advanced disability

In recent years, clinical guidance has been to promote physical activity for people with MS. There are specific benefits to general health and wellbeing, as well as MS specific symptom management.

MS might mean people can't exercise as much as others – on average, people with MS are said to have a 'reduced tolerance for strenuous physical activity'. Many people notice their symptoms get worse if their body temperature rises with exercise. But for most people this tends to go away soon after finishing exercise.

The evidence in this review suggests that physical activity benefits people with MS. But there's not enough evidence to give clear guidance for the type of activities, length or intensity that would be most beneficial for people with MS.

The recommendations for people with MS from this review are:

- Follow the general public health guidance and try to be physically active every day
 - Some activity is better than none
 - Speak with your specialist team about doing both aerobic and strength exercise to ensure a range of benefits. This should be tailored to suit how you're affected by MS and your abilities.
-

2. Background

Definitions

Physical activity is any form of bodily movement that results in an increase in the amount of energy used.

Exercise is a type of physical activity that's planned, structured and repetitive. It also has a purpose: to improve or maintain one or more components of physical fitness.¹

The evidence so far

The evidence-base around physical activity and the health of people with MS has been growing and changing in recent years. Previously, physical exhaustion including exercise was proposed as a potential cause of faster progression of the disease and a deterioration of MS-related symptoms.² Rest and avoidance of exercise was the treatment of choice.³

But for some time now, it's been shown that people with MS can obtain many health benefits from exercise, that exercise is safe and well-tolerated^{4; 5}, and the potential worsening of symptoms after exercise only lasts for a short time and is reversible.^{6; 7} A review of 'Exercise therapy for Multiple Sclerosis' included nine randomised control trials (RCTs) and concluded that exercise leads to improved outcomes in people with MS.⁸ In addition, a systematic review found that people with MS undertaking exercise training had fewer relapses per year than those not doing exercise.⁵

Participation in physical activity, particularly exercise training, has increasingly been recommended for people with MS to manage symptoms, restore function, optimise quality of life, promote wellness, and boost participation in activities of daily living.⁹

Despite the growing evidence of these benefits, the research has also shown that people with MS generally do less 'moderate-to-vigorous' physical activity than the general population.¹⁰ It also shows that people with MS do less physical activity over time, as their MS develops.^{11 10; 12}

But in studies of structured, supervised exercise training, more than 80% of people with MS completed the programme as prescribed.⁵

Deconditioning in MS

Definitions

Deconditioning is a loss of physical fitness because there hasn't been the right amount of physical activity.

Inactivity may lead to deconditioning. For example, a person placed on bed rest for a long time might develop deconditioning of the skeletal, muscular, circulatory, and respiratory systems.

'**Exercise tolerance**' is how long and hard a person can exercise without becoming exhausted or experience negative effects

People with MS often have poor exercise tolerance and exertion fatigue which limit their daily living activities^{13; 14}

Studies have shown that even people with MS who are considered mildly disabled have weaker arms and legs and an impaired cardiorespiratory response when walking at their own pace, and that this might be related to deconditioning, cardiovascular autonomic dysfunction, and altered breathing control¹⁵.

Deconditioning may play a key role reducing how much people with MS can exercise – their exercise tolerance. To minimise fatigue, people with MS often limit their physical activity^{13; 14}. This, in turn, can lead to deconditioning and disuse that makes limb weakness and fatigue even worse¹⁶.

Researchers have looked to measure differences in components of fitness, particularly:

- aerobic capacity
- muscular strength
- balance

They've compared people with MS and the general population and, in some cases, compared people with MS of different disability levels. The evidence generally indicates that significant deconditioning in the body happens in people with MS, particularly as disability progresses¹⁷.

There's evidence that people with MS with all levels of disability can gather less oxygen when they exercise compared to the general population.^{18; 19; 20}

There's evidence that people with MS have worse musculoskeletal fitness (that's measuring how strong muscles are, and how quickly they get tired) than the general population^{6; 7; 21; 22} And there's evidence that people with MS have worse balance than the general population^{23; 24; 25}.

People with MS with more advanced disability show greater losses in aerobic capacity, muscle strength, and balance¹⁷.

Symptoms related to the disease process itself can't be reversed by exercise, but if they're caused by deconditioning, they often can be.^{26; 27}.

Health-related fitness

Health-related fitness is made up of several parts, including:

- cardiorespiratory fitness
- muscular fitness
- motor skills (using muscles to move) and balance

Cardiorespiratory fitness

Cardiorespiratory fitness is how much aerobic or endurance activity someone can do, like walking, cycling, or jogging. It's often measured by peak aerobic capacity (VO_{2peak}).

VO_{2peak} is measured by analysing the air breathed out by someone exercising until they feel they have to stop (known as 'exertional fatigue', and the 'maximal voluntary exertion').

Cardiorespiratory fitness has been shown to be important for maintaining health in the general population¹⁷.

Rampello et al. showed that cardiorespiratory training is better than neurorehabilitation for improving the walking ability and exercise tolerance in people with MS who had an Expanded Disability Status Scale (EDSS) of less than 7.¹⁵

In another study, Swank et al. (2013) showed that cardiorespiratory training can lead to an improved quality of life and emotional wellbeing for people with MS²⁸.

Cardiorespiratory training can increase aerobic fitness and reduce tiredness in people with MS that have some degree of disability²⁹. But it's not clear if people with more advanced disability have the same positive response.^{27; 30}

Muscular fitness

Muscular fitness is how much physical activity someone can do that needs muscle strength and muscle endurance.

Muscle strength is how much force a specific muscle or a muscle group can generate. Muscle endurance is how well a muscle can generate force several times, doing the same action ('across success repetitions')¹⁷. Studies have shown that strength training exercises can benefit people with MS^{26; 31}.

Motor skills – including balance

Motor skills – in particular upright balance – is how well someone can keep a good standing posture. It's often measured by 'posturography'. That tests how the whole body sways in response to changes in what someone sees ('visual cues') or with moving platforms, for example.

Generally, balance training has a small, but statistically significant effect on improving stability and reducing the risk of falls for people with MS with moderate disability^{27; 32; 33; 34}.

3. Physical activity and fatigue

The influence of exercise on fatigue was assessed in a large meta-analysis that included 17 RCTs.³⁵ The meta-analysis found that exercise training led to a moderate reduction in fatigue levels.

A major limitation of the meta-analysis is that many of the studies were very specific in the types of exercise they used and the types of people they tested. This makes it difficult to suggest that the results can be applied to everyone with MS. Most of the studies in the analysis involved people with relapsing remitting MS and the studies used different kinds of exercises, different levels of activity, and for different lengths of time.³⁶

Not all studies showed positive effects on fatigue from exercise. Smaller studies failed to demonstrate this, though the limitation in these studies was a lack of consistency in study design.³⁶

4. How often should people with MS exercise?

A systematic review published in 2018 looked at published studies in an effort to make recommendations on how much and what type of exercise could benefit people with MS.² They found three studies that had good quality data. One in Canada, one in the United States and one in the UK. Although individually they were good studies

with clear, well-evidenced recommendations, taken together their recommendations were extremely varied and didn't form a coordinated set of guidelines.

The authors of the systematic review stated that the least evaluated area in the studies they looked at was 'applicability' – how recommendations for people would work in the real world. None of the reports described what would help or hinder people trying to use their guideline. They also didn't offer ways to monitor or audit the effects if their guidelines were followed. The authors concluded that recommendations need to be applicable, clear and ready for use².

5. Evidence for people with MS with advanced disability

Most studies on the effects of physical activity have involved with people with relapsing remitting MS with minimal to moderate disability.

But one systematic review, by Edwards and Pilutti in 2017, did look at the effect of exercise training in adults with MS with severe mobility disability³⁷. They included 19 articles, from 18 studies. The studies included various types of exercise training ranging from conventional aerobic and strength training, to exercise using 'supported devices', like a body-weight support treadmill and functional electrical stimulation cycling. Edwards and Pilutti concluded that there's limited evidence on the role of exercise training in people with MS with severe mobility disability.

Exercise using supported devices may have benefits on disability, physical fitness, physical function, and symptom management. But this type of exercise is often expensive and only available in specialized settings.

One study looked at two different types of supported exercise aids:

- bodyweight supported treadmill training (BWSTT)
- total body recumbent stepper training (TBRST)

BWSTT allows someone with reduced mobility to walk on a treadmill while they're partly supported by an overhead pulley system. It needs trained staff and assistance to operate.³⁸

TBRST helps people exercise both their arms and legs by using connected arm levers and foot pedals. People can operate this themselves, without assistance.³⁸

Both of these types of exercise showed benefits for people's fatigue and quality of life, over 12 weeks of training.³⁸ But considering the limited evidence, further research is needed to determine the most effective exercise for people with MS with severe mobility disability.

6. Is one type of exercise better than others?

From the evidence, it's not clear that any one type of exercise should be recommended for a particular improvement or outcome. It appears that any exercise can result in varying levels of improvement. There are studies that have looked at specific outcomes, including walking speed, balance and cognition. But there's little consistency across the studies in terms of how often people exercised and how intense the exercise was. So it's difficult at this stage to give recommendations on a programme of exercise that would work, even based on personal situation and desired outcome.

Aerobic and resistance training (walking, running, cycling, rowing)

There is a good body of evidence showing the benefit of both aerobic and resistance exercise on walking, balance and fatigue in people with MS with moderate levels of disability.^{39; 40; 41; 42; 43}

Most studies last between 8 and 12 weeks and include people with relatively low levels of activity at the outset. Often, improvements are reported at the end of the treatment programme. It's less clear whether there are long-term benefits if people stick with an exercise routine for longer.

In a 2017 review, Miller and Soundy found that 68% of the studies on aerobic exercise showed an improvement in fatigue levels for participants.

One randomised control trial looked at the impact of aerobic exercise on people with severe fatigue. They found a reduction in fatigue at the end of a 16-week exercise programme. But when they followed up at 6 and 12 months there was no longer any difference.⁴¹

In another 12-week randomised control trial, training run by community-based health professionals improved aerobic capacity, functional mobility, memory, fatigue, and quality of life in people with MS⁴².

Studies have shown that treadmill walking (assisted and unassisted) can increase walking speed and improve mood and cognition in people with MS.^{4; 44; 45; 46}

A 2016 study looked at aerobic exercise and Pilates. Thirty-five people with MS with an EDSS of 6 or less were randomly put into two groups. One group followed an aerobic exercise course (each session lasting 40 minutes to 1 hour, 2 times per week). The other group did Pilates (each session lasting 45 min to 1 hour). Both groups did this for 8 weeks. Aerobic exercise and clinical Pilates exercises revealed moderate changes in cognition, physical performance, balance, depression, and

fatigue levels in people with MS. Pilates was shown to be more effective at improving cognition than aerobic exercise.⁴⁰

A similar study was highlighted by Motl et al in their review of the evidence. In that study, the researchers compared treadmill training with yoga. They saw improvements in walking over 10 metres in the treadmill group, but not in the yoga group. Both the treadmill and yoga group were compared to a control group who did neither exercise.³⁹

A randomised control trial assessed the impact of stationary cycling twice a week for 12 weeks. They saw a trend towards improvements in walking speed at 6 weeks. But there were no significant differences at 12 weeks.⁴

Another randomised control trial, published in 2018, looked at arm and leg cycling for 8 weeks, 3 days a week. They found that the exercise programme was well tolerated, and they saw improvements in fatigue and depression, aerobic capacity and walking.⁴⁷

One randomised control trial compared 3 different training regimes to a control group doing no exercise: cycling, arm exercises or rowing. Improvements were seen in walking (how fast people walked a certain distance) and cognition (learning and memory) for all 3 exercise groups, but not in the control group who did no exercise. They didn't see any differences between the different exercise groups.

Reviews of the evidence show improvement in walking ability or fatigue from several trials of resistance exercise training, including upper and/or lower body exercises.^{39; 48}

Mixing aerobic and resistance training

A randomised control trial with people with MS with walking difficulties used a 'multimodal approach' – the programme included different kinds of exercise (aerobic, strength and resistance). The programme was supervised and lasted 6 months. Improvements were seen in endurance walking performance and cognitive processing speed. These might have been because of improvements in cardiorespiratory capacity in people with MS who had substantial difficulty walking.⁴³

Another study used a mixture of aerobic, resistance and balance exercises. They saw significant improvements in walking ability compared to a control group who did no exercise.⁴⁹

In a 2017 review of the evidence, Miller and Soundy reported that 87% of studies with a combination exercise approach showed improvements in fatigue for people with MS.⁴⁸ But the studies included in that review weren't consistent in the type and frequency of exercise that they used. So at the moment, it's not possible to

recommend a particular combination exercise approach that would be best for people with MS.

High Intensity Interval Training (HIIT)

High Intensity Interval Training (HIIT) involves short bursts of exercise at very high intensity, with either a complete rest or 'working rest' in between bursts.

The total time for training sessions is typically around 20 minutes, made up of:

- 1 to 4 minutes of exercising at almost maximum effort (80 to 95% of maximum)
- a similar time spent at rest, or 'working recovery'
- all of this repeated 4 to 6 times⁵⁰

HIIT has been shown to have positive effects on cardiovascular fitness for people who are healthy, and people with health conditions..⁵¹

HIIT has been recommended as a possible effective intervention for people with MS. Because it's done over a shorter period of time than regular aerobic training, it can allow people to exercise at higher intensities while potentially avoiding heat stress.³⁰ A review of studies published in 2018 found that overall, the seven studies included showed positive evidence for the use of HIIT in people with MS. High intensity interval training was well tolerated (people with MS didn't show any negative effects and completed the course of training) . People with MS had positive improvements in cardiovascular fitness. All four studies included in that review that measured muscle strength reported improvements.

Further investigation of HIIT is needed with people with progressive MS and those with a moderate and severe level of disability.⁵⁰

Yoga/Pilates

In a review of the evidence in 2017, Miller and Soundy reported that 81% of studies showed yoga to have a positive effect on fatigue for people with MS.⁴⁸

Another systematic review of published studies found 4 studies that showed a positive improvement in balance for people with MS who practiced yoga between once every two weeks, and up to 5 times a week for 8, 12 or 16 weeks.⁵²

Two studies that looked at 6 months of yoga training in people with MS. They showed a positive effect on balance was in one study. In the other, walking speed, fatigue and depression improved.⁵³

A systematic review and meta-analysis carried out in 2019 found that, among the 14 studies they included, the effect of Pilates on people with MS was varied. Individually, the studies reported that Pilates resulted in positive effects on physical functioning, including balance, walking, strength, flexibility and core stability. The review authors concluded that Pilates is a feasible therapy for people with MS; it can lead to improvements in people's physical function; and it might be helpful for reducing fatigue. In one study, improvements in walking were seen after people with MS completed a 12-week Pilates and massage course, compared to those who only received massage. No differences were seen between the two groups when the researchers looked at other measures such as flexibility, endurance and muscle strength.⁵⁵

The potential benefits from Pilates are not significantly greater than benefits from other types of exercise or physiotherapy. Further high quality randomised control trials are needed to confirm the existing scientific evidence regarding the impact of Pilates on people with MS.⁵⁴

Tai Chi

A systematic review was carried out in 2017. It identified 10 relevant studies on the effect of Tai Chi for people with MS. Although the quality of across studies varied, the researchers concluded that Tai chi is effective for improving quality of life and balance in people with MS. A small number of studies also reported the positive effect of Tai chi on flexibility, leg strength, gait, and pain. The effect of Tai chi on fatigue isn't consistent across studies.⁵⁶

Aqua aerobics/ water-based exercise

Results from a randomised control trial published in 2018 showed that aqua aerobics gave women with MS with a low EDSS score (3.5 or less) significant improvements in walking speed, balance, and perceptions of fatigue. This was an 8- week course, with 3 sessions a week. The group doing aqua aerobics were compared with people who continued with their regular routine but were asked not to participate in any exercise programmes during the trial⁵⁷

A smaller study, published in 2017, looked at the effect of water-based exercise for people with different levels of disability. The researchers didn't separate the results according to levels of disability or EDSS score. But looking at everyone in the study they reported positive improvements in strength, balance and walking speed.⁵⁸

7. Conclusions

Taken together, the evidence appears to show that exercise is well tolerated by people with MS. This means that there were few negative effects for people with MS from the exercise and in general people completed the course of exercise. It's likely to show some benefit for people's wellbeing and functional abilities such as walking, balance and muscle strength.

The evidence is too varied to allow us to make clear recommendations on what type of exercise, how intense or how long it should last to get a particular result. Like the guidelines for the general public, people with MS should try to be physically active every day. Some activity is better than none. As there is no clear guideline on the type of activity that is most beneficial for people with MS, it would be a good idea to incorporate both aerobic and strength exercise into your routine if possible.

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Our community is here for you through the highs, lows and everything in between.

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Together, we are strong enough to stop MS.

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