Empowering Minds and Bodies: The Impact of Exercise on Multiple Sclerosis and Cognitive Health

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Abstract

Multiple sclerosis (MS) is a global health concern affecting around 2.6 million people. It is characterised by neural inflammation, myelin breakdown and cognitive decline. Cognitive impairment, especially reduced cognitive processing speed (CPS), which affects up to 67% of MS patients and frequently manifests before mobility concerns, is one of the disease's most serious side effects.

Effective adaptation and the application of cognitive rehabilitation treatments depend on the early diagnosis of cognitive impairment. Although pharmaceutical therapies have some drawbacks, endurance training has become a promising alternative. Intensity-controlled endurance exercise has the ability to delay the onset of MS symptoms and enhance cognitive function.

Exercise has also been shown to have neuroprotective effects in a number of neurological disorders, including MS, Parkinson's disease and stroke. This includes both aerobic and resistance training. A mix of aerobic exercise and weight training has shown promise, especially for people with mild cognitive impairment, but according to recent studies any amount of physical activity is beneficial to cognitive performance.

In conclusion, this in-depth analysis highlights the crucial part endurance exercise plays in treating MS-related cognitive impairment. It improves not only neurological health in general but also cognitive performance. Exercise can help control MS in a way that dramatically improves quality of life and well-being.

Keywords

Multiple sclerosis, exercise, cognitive function

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Around 2.6 million p osis (MS), a condition of the central nervous system. Neuronal aggravation and weakening of myelin tissue are signs of MS, prompting scarring of the focal sensory system and debilitated brain capability. This condition's progression varies due to individual pathological processes, psychological factors and environmental influences, leading to a wide variety of symptoms and lifestyle challenges. Common symptoms include fatigue, decreased mobility, pain, mood disturbances and cognitive decline, all of which profoundly impact quality of life and social participation. Thus, people with MS may engage in less physical activity and exercise than people without MS.[1]

Cognitive impairment (CI), particularly slower cognitive processing speed (CPS), is a significant consequence of MS. Up to 67% of MS patients experience CPS impairment, which often appears before progressive mobility issues. The cognitive functions most affected include information processing speed (IPS), complex attention, working memory, visuospatial skills and executive functions, with dysexecutive disorders predominating in the disease's advanced stages and an amnestic profile in relapsing-remitting MS.[2]

The presence of CI at the time of a MS diagnosis is considered a poor prognostic marker for long-term development. Early signs of MS, such as involvement in verbal memory and IPS, serve as indicators of more severe impairment in the future.[2] Early detection of CI is crucial to ensure proper social and occupational adaptation and to facilitate the implementation of specific cognitive rehabilitation techniques.[2]

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The process of detecting CI in individuals diagnosed with MS involves a thorough assessment of their performance on cognitive tests. CI may be indicated when their test performance significantly deviates, typically by 1.5 to 2 standard deviations, from the established normative mean in approximately 20–30% of the test parameters. Alternatively, CI may be identified if their performance falls notably below the expected standard, by about 1.5 to 2 standard deviations, in at least two distinct cognitive domains. Pharmaceutical therapies, including first-line disease-modifying drugs and cognitive rehabilitation, have shown limited effectiveness in treating CPS impairment. MS patients often experience poor physical and mental health, reduced driving ability and a dependency on caretakers. This underscores the importance of employing a range of strategies, including aerobic exercise training, to address CPS impairment in MS.[2]

Endurance exercise, also called aerobic exercise, it is typically carried out at an intensity below the maximum. Periods of elevated heart rate and breathing characterise endurance exercises. It has been discovered to significantly delay the onset of symptoms in people with MS.[3]

Tsai et al. discovered that serious rigorous exercise done for 30 minutes at a moderate pace, which corresponds to 65%–75% of the individual target heart rate reserve (HRR), had a good effect on individuals' mental powers such as contemplation, acknowledgement and recall.[4] It has been demonstrated that endurance training has significant impacts on a variety of tissues and organ systems in a wide range of animal species.[5]

Experimental animal models of MS substantially support exercise-induced changes in the entire brain structure and function; however, direct evidence from human studies has yet to be proven.[6] In human research, exercise appears to improve peripheral biomarkers linked to neural health and outcomes assessed by neuroimaging, implying that it may assist in sustaining the general health of the brain.[7,8]

Exercise undeniably enhances one's health and wellbeing, and it also has neuroprotective effects on the central nervous system. Human trial evidence supports the neuroprotective benefits of exercise in the prevention of MS, Parkinson's disease and stroke.[9,4] Exercise can improve the overall neurological function of the entire brain and minimise neuronal apoptosis and neurodegeneration in MS patients. It can also help stimulate neuroplasticity.[9]

According to a recent systematic review, there is no minimum threshold at which exercise can be advantageous to cognition. This indicates that any amount of physical activity is beneficial to cognitive function. Additionally, a recent meta-analysis found that individuals with mild cognitive impairment (MCI) benefit most from a combination of aerobic exercise and resistance training, while those with dementia benefit most from resistance training.[10]

However, research over the past 30 years has highlighted that exercise is essential for symptom control and illness modification. Exercise advice for persons with MS has changed over time. Since individuals with MS often need and request regular guidance on exercise training, the neurologist, working in collaboration with the multidisciplinary team, plays a pivotal role in this process. Exercise training is a risk-free intervention with no long-term negative consequences. Exercise training has a high rate of compliance and can help with a variety of MS symptoms and limitations. Exercise training should be given to MS patients on a regular and early basis.[1]

Endurance exercise is a low-cost, widely available treatment that benefits numerous organ systems. It promotes major health benefits by reducing a variety of diseases, including metabolic, cardiovascular and neurological issues, while also improving a number of physical performance indicators.[3] Activity for perseverance diminishes mind maturing, safeguards memory and insight and eases the side effects of neurodegenerative ailments. Neurogenesis, epigenetic alterations, angiogenesis, autophagy, neurotrophin and cytokine production and release, and neuronal survival and plasticity may all be enhanced by it.[3]

Significant progress has been achieved in understanding the connection between exercise and neurological well-being. According to studies in both human and animal models, regular exercise improves memory, cognition and mood and guards against a range of neurodegenerative diseases.[11] An epidemiological study found that endurance training is an effective treatment for anti-aging. It likewise exhibits an improvement in overall mental capability.[12] Neuronal survival is improved, synaptic plasticity is enhanced and disease progression is slowed by endurance exercise. Endurance training improves sleep, increases growth factor release, neurogenesis and angiogenesis, and reduces insulin resistance, neuroinflammation, stress and anxiety. As a result of these advancements, general psychological and neuropsychological health is improved. Endurance training also lowers the likelihood of ischemic injury and increases the number of mitochondria in skeletal muscle, both of which are key components of neurodegenerative disorders.[3]

According to a recent comprehensive analysis, there is no minimal barrier to the cognitive benefits of exercise, meaning that any level of activity is better than none. A recent meta-analysis also revealed that while resistance training is effective for individuals with dementia, aerobic exercise combined with resistance training is beneficial for those with MCI.[13]

The main measure of how exercise impacts an older person's brain structure is an increase in hippocampal volume. In the case of cognitive impairment, the hippocampus reveals structural and functional abnormalities. The mean annualised hippocampus shrinkage rates for AD subjects were 4.66% and 1.41%, respectively, per nine trials that included 595 AD patients.[14]

CI, specifically a slower CPS, is one of the most significant consequences of MS. People suffering from MS are in poor physical and mental health, are unable to drive and require

medical attention. Exercise can improve overall brain function while decreasing neuronal death and degeneration. According to an epidemiological study, endurance exercise is an effective anti-ageing treatment. It also demonstrates an improvement in the general brain function. Endurance exercise improves synaptic plasticity, neuronal survival and disease progression. Aerobic exercise can help people with MS in a variety of ways, including better cardiovascular health, increased energy, improved mood, increased muscular strength and neuronal protection. Regular exercise and sufficient medical treatment can enhance the general wellness and quality of life of patients with MS.

Abbreviations

MS: Multiple Sclerosis.
CI: Cognitive impairment.

Authors' Contribution

1. Ushna Zameer: Writing and draft preparation
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3. Fatima Asif: Writing
4. Ateeba Kamran: Review of the final draft

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Statement of Ethics

Not applicable.

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