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Multiple sclerosis: physical activity and well-being

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Abstract

Multiple sclerosis (MS) is a chronic disease that affects central nervous system (CNS) – coexists in brain, spinal cord and optic nerves. It can process in three different courses: remitting, progressive and progressive-relapsing. Although there is still no cure for MS, effective strategies are available to modify the disease course, reduce number of relapses, rate of progressions and development of new lesions. Nowadays, moderate physical performance is strongly recommended: besides having positive effects on the body, it can have a positive effect on the psychophysical wellbeing. Essentially there are 3 types of training protocols: aerobic (endurance training), strength training (resistance training) and combined training. The majority of the studies suggests that regular physical activity can improve fatigue, depression and quality of life in people with MS, however most of the researchers worked without any guidelines for physical activity adapted to the MS, which are still under review by the scientific community.

KEYWORDS: central nervous system, myelin loss.

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Introduction

Multiple sclerosis (MS) is a chronic disease that affects central nervous system (CNS) which coesists in brain, spinal cord and optic nerves. In particular, nerve fibers are surrounded by a fatty substance, myelin, which helps them in the conduction of electrical impulses. The disease causes loss of myelin in different areas, leaving the formation of sclerotic tissue or lesions that determine the denomination as plaques sclerosis. The nerve fibers can also be damaged or broken by stopping the ability to conduct electrical impulses to the brain, inducing symptoms that are common in MS [38]. These should cause permanent disability that many people with MS experience and should follow one of four disease courses, each of which may be mild, moderate or severe.

Relapsing-Remitting MS

People with this type of worsening of neurological function called relapses attacks, have periods followed by stages of partial or complete recovery (remissions), during which there is no progression of the disease occurs. About 85% of these people have an initial diagnosis of relapsing-remitting MS.

Primary-Progressive MS

This desease courses is characterized by a slow worsening of neurological function from the beginning, with no distinct relapses or remissions. The rate of progression may change over time, with occasional short and temporary improvements. About 10% of people are diagnosed with primary-progressive MS.

Secondary-Progressive MS

After an initial period of relapsing-remitting MS, many people have a course of secondary progressive disease in which there is a steady decline, with or without occasional flare-ups, and minor recoveries (remissions). About 50% of people with relapsing-remitting MS, developed this form of the disease within 10 years of onset, although now there are drugs that seems to disease-modifying significantly the delay of this transition.

Progressive-Relapsing MS (PRMS)

In this type of course of the disease (5%) people experience a continuously worsening, especially in neurological function. May experience some stages of recovery after these effects, but the disease continues to progress without remissions. Because no two people have the same experience of MS, the disease course may look different from person to person [4].

So far it is unknown the exact cause of MS; most researchers believe that the damage to myelin comes out from an abnormal immune system response. This abnormal response is called autoimmune response. Generally, the immune system results an ally that responds to external pathogens attacks. The situation is different when it attacks its own tissue (as occurs in MS), and autoimmune response that culminates in the destruction of myelin. It is not yet clear what triggers this process; probably a multifactorial process which plays an important role genetics, gender and environmental factors (for example, a virus or an environmental toxic substance) [12]. MS is not a contagious disease, it does not seem to be inherited even if a genetic predisposition may be involved. Anyone can develop MS, in particular:

- Most patients receive a diagnosis between 20 and 50 years.
- It appears to be a larger impact on women than men.
- Scientific research shows that there is a genetic predisposition for the disease onset.
- There are many people coming from north of europe even you can find a lot of African-Americans, Hispanics and Asians people.

Is estimated that around 2.5 million people around the world are affected by MS: about 28 people a day receive a new diagnosis. Until now there is no biological marker that can be used to diagnose the disease and need an additional tests including:

- *Patient history*, in order to detect the symptoms suggestive of a CNS damage;
- *Neurological examination*, to evaluate reflexes, coordination, balance and vision.

MS symptoms

In multiple sclerosis, damage to the myelin as well as nerve fibers produce an interference with nerve transmission between brain, spinal cord and other parts of the body. This interruption causes primary symptoms of MS depending on where the damage occurred. In the disease courses, some symptoms are reversible, while others may be more permanent. The most common symptoms are:

- *Fatigue:* is one of the most common symptoms of MS, occurring in more than 80% of people. Fatigue can significantly interfere with a person's ability to perform its functions at home and at work. It is commonly described as a sensation of "exhaustion" of the energies, with a worsening during the day that is not related to the level of effort.
- *Numbness:* it is one of the most common symptoms of MS. It is intended as the numbness of the face, body, or extremities (arms and legs) and is often the first symptom experienced by patients.
- *Walking (Gait), Balance, & Coordination Problems:* among the most common mobility limitations in MS there is the difficulty to walk and it is linked to several factors: *weakness* (muscle weakness is a major gait difficulty; it can often be compensated by performed an appropriate exercises that can help the patient); *spasticity* (is one of the most common symptoms of MS and can also interfere with the gait. It refers to feelings of stiffness and a wide range of muscle involuntary spasms (sustained muscle contractions or sudden movements). Spasticity can simply feel the muscles or can be so severe as to produce tension pain, or uncontrollable spasms of the extremities: stretching exercises and antispasmodic drugs may alleviate the reported symptoms); *loss of Balance* (balance problems usually result in gait called "drunken" known as ataxia).
- *Vision Problems:* a vision problem is the first symptom of MS for many people. The sudden onset of double vision, blurring, poor contrast or eye pain can be terrifying and the knowledge that vision may be compromised can make people with MS anxious about the future.
- *Pain:* pain syndromes are common in MS. In one study, 55% of people with MS had "clinically significant pain" at some time. Almost half were troubled by chronic pain. Pain in MS can result from damage to nerves in the CNS (neurogenic pain), or result from altered gait patterns or inappropriate use of assistive devices (orthopedic pain).
- *Cognitive Function:* cognition refers to a range of high-level brain functions, including the ability to

learn and remember information: organize, plan, and problem-solve; focus, maintain, and shift attention as necessary; understand and use language; accurately perceive the environment, and perform calculations. Cognitive changes are common in people with MS – approximately 50% of people with MS will develop problems with cognition.

- *Emotional Changes:* emotional changes are more common in MS than in other chronic illnesses – because of neurologic and immune changes caused by the disease, and as a reaction to the stresses of living with a chronic, unpredictable illness. Bouts of severe depression (which is different from the healthy grieving that needs to occur in the face of losses and changes caused by MS), mood swings, irritability, and episodes of uncontrollable laughing and crying (called pseudobulbar affect) pose significant challenges for people with MS and their family members [6, 18, 30].

MS management and physical exercise

Although there is still no cure for MS, effective strategies are available to modify the disease course, reduce number of relapses, rate of progressions and development of new lesions through the use of FDA-approved, disease-modifying drugs; to treat acute attacks, also known as relapses or exacerbations, to shorten the duration and reduce the severity; to manage symptoms; to improve function and safety; to provide emotional support, in combination, these strategies enhance the quality of life for people living with MS.

Until a few years ago, doctors believed that people with MS required all their strength to face our daily activities. Sport and movement were considered overstrain and therefore were not recommended. Today, however, the opinion has changed and it deals with the discussion in a more different way. Moderate physical performance is strongly recommended: furthermore, besides having positive effects on the body, it can have a positive effect on the psychophysical wellbeing [24]. In particular it has been demonstrated that patients with MS with EDSS <6 have reported minor muscle strain, improved ability in performing exercises, as well as in a daily routine [15, 27, 34]. It was also suggested that exercise may also have anti-inflammatory effects potentially slowing the progressive course of the disease [17, 21].

Basically, inactivity worsens the state of health of patients with MS [9]. Scientific research has shown a strong interest in this area. The results in many cases have shown the beneficial effects of appropriately structured and adapted exercise protocols on MS patients. Essentially there are 3 types of training protocols: aerobic (endurance training), strength training (resistance training) and combined training. However most of the researchers worked without any guidelines for physical activity adapted to the MS, which are still under review by the scientific community and is still suffering from a certain approximation. For this reason the results of many studies are not comparable each other because of substantial differences relating to the sample (number of patients, type of MS and EDSS level), type and duration of the protocol, timing of sessions, type and intensity of training [2, 29, 31].

Training protocol

Beyond the limits mentioned above, it has been possible to evaluate the results obtained depending on the type of workout protocol.

Endurance training (ET)

Endurance training (ET) is the most studied type of exercise. The sessions are performed by cycle ergometer or arm ergometer, treadmill, or through water exercises. Aerobic protocols are characterized by positive cardiorespiratory and neuromuscular changes; however, it would seem that ET has no effect on functional capacity (speed in going up/down stairs, walking speed etc.) [9]. Endurance training gave few results in activities that might otherwise depend on muscle strength. Also, it is not clear whether this type of training has effects on fatigue. In this regard, the studies are inconsistent and the rating scales used are not so sensitive to lack of a common standard [8]. It seems that this training is positively correlated to quality of life, mood and decrease in depressive symptoms. Recent data suggests the potential role of the innate immune system in the initiation and progression of MS, and also indicates that aerobic exercise may modulate the innate immune system by directly targeting Toll-Like Receptors signaling events [32]. There is also inconsistency between the degree of EDSS and achievements.

Resistance training (RT)

Resistance training which is focused mainly on the muscles of the lower end, being the worst hit by the disease, appears well tolerated at low-to-moderate intensity in MS patients with mild-to-moderate disability. Notable improvements (3-29%) were however found in upper extremity muscle strength (elbow extensors, elbow flexors, shoulder abductors and shoulder adductors) in studies exercising these muscle groups, indicating possible clinical meaningful strength improvements in

the upper extremity as well [37]. Muscle biopsies have shown that in all types of fibers, especially in those of type II, the Cross Sectional Area (CSA) increased [20]. Strength and muscular endurance improved in certain cases [11] either in lower or upper limbs. It can be said that the RT increases the discharge capacity of motor neurons of the pyramidal way. It seems that improvements of strength in lower limbs are obtained after about 8-12 weeks, but the results achieved are completely lost after 3 months from the suspension [11]. The available studies show that there is a correlation between progressive resistance training and decrease in fatigue and what happens sometimes significantly in the follow up (12 weeks), remaining lower than at baseline [2].

Unfortunately, the diversity of protocols (different duration and intensity mode and differences in samples) does not allow to determine whether there is evidence that the resistance training has or has not the effects on functional capacity. Even as regards balance components, some authors report significant increments but others do not. Differences also exist on the effects of progressive resistance training compared with depressive symptoms and quality of life (lack of common and/or appropriate methodologies). One certainty is an improvement in muscle strength after resistance training [1, 13, 40]. Another important aspect is newly emerged and indicates that the resistance training can slow down the progression of the disease by acting on cytokines in blood [19, 39]. This is in line with the latest scientific findings which identify the skeletal muscles as a secretory tissue able to produce and release cytokines in a contraction-dependent manner [5, 26]. Although it may think that higher intensity exercise can have an effect on inflammatory processes, so far none of these studies report problems associated with this type of training. Resistance and endurance training constitutes the two extremes of basic physical exercise. Recently it has become popular to engage in training programs that combine both resistance and endurance training (combined training) [7].

Combined training (CT)

Combined training is well tolerated by patients with MS. It is based on the assumption that there must be equal proportions between resistance and endurance training and to be administered every other day. Studies show that this protocol works on fatigue, in some cases even after 6 months of follow up. This training is a protocol that has recently been developed, and therefore there is still a sufficient number of studies that can confirm the preliminary results. Now it has been observed changes after its administration, on quality of life, depression and fatigue [14, 22, 28, 33]. It also seems that there is an increase in walking speed and endurance with this workout [9].

The appropriateness of physical activity for people with MS largely depends on patients' physiological tolerance and response to exercise. Although researches on physical exercise associated with depression and cognitive aspects are not sufficiently developed, there is a promising preliminary evidence in these fields [23], and in particular it is known that exercise affects psychological and emotional aspects of these patients by increasing self-confidence and mood [25]. Motl et al., 2009 [24] reported that physical activity was positively correlated with quality of life in indirect manner but they have not been able to find what are the key mediators involved.

In the study of Stroud and colleagues [35], patients that has been training had higher scores in all components of the SF-36 questionnaire (Form 36-item Health Survey Questionnaire) respect the others, which is indicative of a higher quality of life. These results are supported also by Stuifbergen et al. [36] that found that the role of physical activity, as measured by the physical and exercise subscale Health Promoting Lifestyle Profile II, was positively associated with quality of life.

To date, most intervention studies on the role of physical exercise have focused on patients with mild to moderate MS and although these studies were associated with benefits for people with MS [3, 10], there is little information on the influence of physical activity in people with more severe levels of disease. The results of these studies suggest that exercise can have a greater effect on quality of life in people with moderate MS. The reason for this is unknown, however it can be speculated that regular physical activity improves the ability of patients to perform physical tasks and improves the perception of patients about the impact of disability on their physical functioning. Probably, if severity and physical limitations of the disease become serious, it is possible that these limitations have too invasive impact on quality of life that can not be mitigated by exercises. A study was focused on patients with various degrees of severity and it is not limited to those with moderate or light SM [16], although this study used a small group of patients with MS, provides an overview of these correlations.

In summary, subjects who took part in regular physical activity have reported better results on the BDI (Beck's Depression Inventory), on all scales of the SF36 and up

some stairs of MFIS. This suggests that people with MS participating in regular physical activity have favorable scores in fatigue, depression and quality of life, when compared to people with MS who do not participate in regular physical activity. This study gives strength to earlier proposals that regular physical activity can improve fatigue, depression and quality of life in people with MS. In addition, it highlights the need for direct intervention studies not only to people with mild to moderate disabilities, but also to those patients with moderate to severe disabilities, in order to understand the potential improvements in physical activity to improve the quality of life of all people with MS. Therefore, further research, studying the best exercise method that can provide the maximum benefit to people with MS with varying degrees of disease severity, should be supported and encouraged.

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