MS ActiveNOW
ACTIVATING YOUR LIFE

Understanding MS and Exercise

A Fitness and Lifestyle Providers Guide

Understanding MS and Exercise: A Fitness and Lifestyle Providers Guide

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Introduction

Multiple sclerosis (MS) is an inflammatory neurological disease that can affect any myelinated structure in the central nervous system (CNS). Most researchers believe that MS is an autoimmune disease. For reasons that are still unclear, the body's immune system malfunctions and starts attacking the myelin which protects the central nervous system. There is some evidence that MS may be triggered by a common virus, and that certain people are more susceptible to developing MS because of genetic factors. There is no evidence, however, that MS is a directly inherited disease. A number of genes are probably involved in making some people more susceptible to MS. Symptoms of MS include fatigue, motor weakness, spasticity, ataxia, poor balance, visual disturbances, heat intolerance, depression, and bladder and bowel dysfunction.

Up until recently, exercise as a therapy has been under-utilized in the MS population[1,2]. This may have been due to neurological functions such as vision, motor function, and ambulation often becoming worse with exercise and therefore exercise was thought to be contributing to the disease process. It was also thought that participating in exercise would cause excessive fatigue preventing the individual from completing basic daily activities. Individuals were therefore often advised by health care professionals to refrain from participating in exercise[3]. However, the worsening of symptoms that occurs with exercise does not cause any further damage to the myelin sheath and will reverse itself upon recovery from exercise.

The most recent thinking indicates that it is safe and beneficial for individuals to participate in exercise[4,5] and it is now recognized as an important part of the care plan for persons with MS[6]. The goals of exercise in this population are to improve aerobic endurance, muscular strength and endurance, flexibility, mobility, and to prevent secondary diseases such as cardiovascular disease (CVD) or diabetes. There is evidence that exercise will also assist in maintaining the individual's independence and improve their quality of life (QoL)[7].

Multiple Sclerosis (MS)

What is it?

Multiple sclerosis (MS) is an unpredictable, often disabling disease of the central nervous system — the brain and spinal cord. The disease attacks the protective myelin covering of the central nervous system, causing inflammation and often destroying the myelin in patches. In its most common form, MS has well

[1] Romberg, A., Virtanen, A., Ruutiainen,J., Aunola, S., Karppi, S.L., Vaara, M., et al., (2004). Effects of a 6-month exercise program on patients with multiple sclerosis: a randomized study. Neurology, 63, 2034-2038.

[2] White, L.J., & Dressendorfer, R.H. (2004). Exercise and multiple sclerosis. Sports Medicine, 34, 1077-1100.

[3] Petajan, J.H., & White, A.T. (1999). Recommendations for physical activity in patients with multiple sclerosis. Sports Medicine, 27, 179-191.

[4] Petajan, J.H., Gappmaier, E., White, A.T., Spencer, M.K., Mino, L., & Hicks, R.W. (1996). Impact of aerobic training on fitness and quality of life in multiple sclerosis. Annals of Neurology, 39, 432-441.

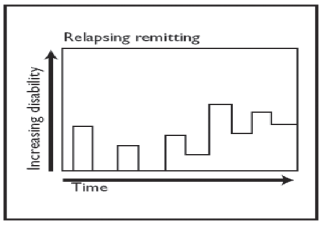
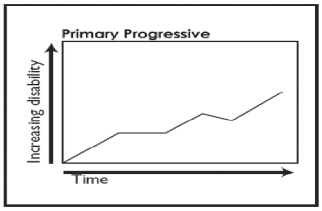
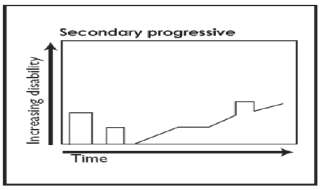
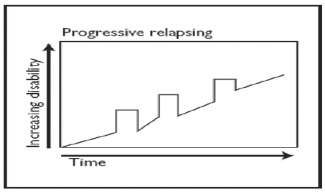
[5] Lord, S.E., Wade, D.T., & Halligan, P.W. A comparison of two physiotherapy treatment approaches to improve walking in multiple sclerosis: a pilot randomized controlled study. Clinical Rehabilitation, 12, 477-486.

[6] Rietberg, M.B., Brooks, D., Uitdehaag, B.M.J., & Kwakkel, G. Exercise therapy for multiple sclerosis (Review). Cochrane Database of Systematic Review 2004, Issue 3. Art. No.:CD003980. DOI: 10.1002/14651858.pub2.

[7] Petajan, J.H. (2000). Weakness. In Burks J.S., & Johnson K.P. (Eds.) Multiple Sclerosis: Diagnosis, medical management and rehabilitation. (1st ed. pp. 307-321). New York, NY: Demos Publications.

defined attacks followed by complete or partial recovery. The severity of MS, progression and specific symptoms cannot be predicted at the time of diagnosis.

Types of MS

TYPE		DESCRIPTION
Relapsing-remitting		Characterized by clearly defined attacks (relapses) followed by complete or partial recovery (remissions); most common form (75% at the time of diagnosis).
Primary-progressive		Less common (10 to 15% at time of diagnosis), people with this type of MS have a gradual worsening of MS from the beginning with no clear relapses or remissions.
Secondary-progressive		About half of people with relapsing-remitting MS start to worsen within 10 years of diagnosis, with possibility of increasing levels of disability.
Progressive-relapsing		Relatively rare, combines attacks with steady worsening from the onset of the disease.

MS Symptoms

Symptoms of MS are unpredictable and vary greatly from person to person and from time to time in the same person. MS attacks the protective covering — myelin — of the brain and spinal cord, causing inflammation and often damaging the myelin in patches. When this happens, the usual flow of nerve impulses along nerve fibres (axons) is interrupted or distorted. The result may be the wide variety of MS symptoms, depending upon what part or parts of the central nervous system are affected.

The damaged parts of myelin are often called “lesions” or “plaques”. There is also evidence that permanent damage to nerve fibres may occur in association with the attack on myelin.

While the following list of symptoms can seem daunting, particularly to people who are newly diagnosed, there are treatments to help manage most of these symptoms. Symptoms may include:

- Vision disturbances such as double or blurred vision
- Unusual and extreme fatigue
- Loss of balance
- Problems with coordination
- Stiffness of muscles
- speech problems
- mood or cognitive changes
- Bladder and bowel problems
- Short-term memory problems
- Partial or complete paralysis
- Spasticity
- Numbness or pain

Please keep in mind, not all people with MS will experience all symptoms and often the symptoms will improve during periods of remission.

What is MS ActiveNOW?

MS ActiveNOW is a health promotion initiative for persons with multiple sclerosis (MS) designed to:

- Increase awareness of the benefits of daily physical activity and exercise for persons with MS and providers in the health, fitness and lifestyle industry.
- Help fitness providers design exercise programs for persons with MS. So persons with MS can enjoy the benefits of exercise safely and with confidence.
- Increase access to active living and exercise opportunities in the community for persons with MS.
- Increase intention for persons with MS to be active in exercise and/or daily physical activity.

Demonstrated Benefits of Exercise

Exercise does not affect the prognosis or progression of MS but individuals can obtain the same health benefits from exercise as healthy individuals. Individuals should be encouraged to maintain or improve aerobic and muscular fitness early in their disease to offset the decrease in functional reserve that generally occurs with increasing disability and loss of function as the disease progresses[8].

Physiological

Aerobic Fitness

Individuals with MS show poor aerobic fitness even in the early stages of the disease. Aerobic fitness can,

[8] White, A.T. (2001). Exercise for patients with multiple sclerosis. International Sports Medicine Journal, 2, 1-8.

[9] Bjarnadottir, O.H., Konradsdottir, A.D., Reynisdottir, K., & Olafsson, E. (2007). Multiple sclerosis and brief moderate exercise. A randomized study. Multiple Sclerosis, 13, 776-782.

however, improve in individuals with mild to moderate MS (EDSS 1-6.5) who engage in aerobic exercise[9,10]. Aerobic power (VO2 max) and anaerobic threshold have been shown to improve when exercise is performed 3-5 days per week for 30-60 minutes at 50-60% of VO2 max[9,10] and these improvements can be seen as early as 4 weeks.

Muscular Fitness

Overall skeletal muscle function is adversely affected by MS. Reduced muscle power and/or endurance, isolated points of weakness in the range of motion (ROM) of the joint[11], and firing oscillation during sustained effort has been found[12]. Additionally, patients with MS show alterations in muscle fiber composition, interconversion of type I and type II fibers (i.e., conversion of slow twitch to fast twitch fibers), with a higher reliance on anaerobic rather than aerobic energy supply compared to healthy controls[13] These changes in fiber type are also typical in disuse atrophy, so although the disease process may contribute to some changes in muscle function, a significant proportion may be attributable to functional processes[13].

Few studies have examined the effect of strength training in MS, but those undertaken have shown positive results[14,15]. Programs consisting of functional strength training exercises (chair raises, forward lunge, step-ups, heel-toe raises, leg curls) or progressive resistance exercises (PRE) for the major muscle groups of the upper and lower body have been shown to improve leg and arm strength and endurance[14,15]. The impact of MS on physical function in day-to-day life (clumsiness, grip, balance) also appears to be reduced with PRE[15]. Lassitude, muscle fatigue, and symptom exacerbation are not negatively affected by a PRE program[15].

Pulmonary function

There is a decrease in both strength and endurance of ventilatory muscles in persons with advanced MS, and even in those with minimal to moderate MS due to motor deficits[16,17,18]. The progressive weakening of the ventilatory muscles with disease progression is similar to what is seen in the muscles of the extremities and

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[10] Mostert, S., & Kesselring, J. (2002). Effects of a short-term exercise training program on aerobic fitness, fatigue, health perception, and activity level of subjects with multiple sclerosis. Multiple Sclerosis, 8, 161-168.

[11] Armstrong, L.E., Winant, D.M., Swasey, P.R., Seidle, M.E., Cater, A.L., & Gehlsen, G.M., (1983). Using isokinetic dynamometry to test ambulatory patients with multiple sclerosis. Physical Therapy, 63, 1274-1279.

[12] Sharma, K.R., Kent-Braun, J.A., Mynhier, M., Weiner, M.W., Miller, R.G. (1995). Evidence of an abnormal intramuscular component of fatigue in multiple sclerosis. Muscle Nerve, 18,1403-1411.

[13] Kent-Braun, J.A., Ng, A.V., Castro, M., Weiner, MW, Gelinas, D., Dudley, G.A., et al. (1997). Strength, skeletal muscle composition, and enzyme activity in multiple sclersosis. Journal of Applied Physiology, 83, 1998-2004.

[14] De Bolt, L.S., & McCubbin, J.A. (2004). The effects of home-based resistance exercise on balnce, power, and mobility in adults with multiple sclerosis. Archives of Physical Medicine and Rehabilitation, 85, 290-297.

[15] Taylor, N., Dodd, K., Prasad, D., Denisenko, S. (2006). Progressive resistance exercise for people with multiple sclerosis. Disability and Rehabilitation, 28, 1119-1126.

[16] Gosselink, R., Kovacs, L., Ketelaer, P., Carton, H., & Decramer, M. (2000). Respiratory muscle weakness and respiratory muscle training in severely disabled multiple sclerosis patients. Archives of Physical Medicine and Rehabilitation, 81, 747-751.

[17] Mutluay, F.K., Gurses, H.N., & Saip, S. (2005). Effects of multiple sclerosis on respiratory functions. Clinical Rehabilitation, 19, 426-432.

[18] Savci, S., Inal-Ince, D., Arikian, H., Guclu-Gunduz, Cetisli-Korkmaz, N., Armutlu, K. et al. (2005). Six-minute walk distance as a measure of functional capacity in multiple sclerosis. Disability and Rehabilitation, 27, 1365-1371.

[19] Chiara, T., Martin, D., Davenport, P.W., & Bolser, D.C. (2006). Expiratory muscle strength training in persons with multiple sclerosis having mild to moderate disability: Effect on maximal expiratory pressure, pulmonary function, and maximal voluntary cough. Archives of Physical Medicine and Rehabilitation, 87, 468-473.

[20] Fry, D. (2007). Pulmonary function and rehabilitation in multiple sclerosis. Clinical Bulletin from the National Multiple Sclerosis Society.

is partially due to deconditioning[19,20]. Weakening of the ventilatory muscles can reduce the ability to produce a productive cough and increase the risk of respiratory complications[16,21]. Values for maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) in persons with advanced MS range from 27-74% and 18-51% of predicted values, respectively[22,23]. Persons with minimal or moderate disability from MS have been found to have MIP and MEP values ranging from 50-77% and 34-60% of predicted values, respectively[23].

Resistive ventilatory muscle training has been shown to be beneficial in persons with varying severity of MS. Significant increases in MEP and MIP have been found with both specific expiratory and inspiratory muscle training with threshold expiratory trainers[22,24].

It is recommended that pulmonary function be assessed in all persons with MS and that both expiratory and inspiratory training be included in rehabilitation programs when respiratory function is decreased.

Immune function

Exercise has the potential to positively impact the immune function of people with MS. Exercise has been shown to modulate immune function through local and systemic cytokine production[25]. Interleukin (IL)-6 produced by and released from contracting skeletal muscle during exercise has been shown to stimulate anti-inflammatory cytokines such as IL-1 receptor antagonist and IL-10 and inhibit the production pro-inflammatory tumor necrosis factor (TNF)-α[26]. There is speculation that if exercise can assist in reducing pro-inflammatory cytokines and increase anti-inflammatory cytokines that it may be beneficial to the underlying disease course in MS.

Evidence is equivocal in this area. Changes in the concentrations of certain cytokines, in particular interferon (IFN)-γ and TNF-α, have been associated with changes in disease status in MS[27]. Significant decreases in proinflammatory cytokine concentrations (IFN-γ, CRP; trend towards a reduction in TNF-α), but no change in IL-2 concentrations have been found with resistance training[28]. Other studies have not found significant changes in endocrine immune responses (cortisol, adrendocortico-releasing hormone, epinephrine, norepinephrine), neurotrophic (brain-derived neurotrophic factor, nerve growth factor) parameters or the

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[21] Smeltzer, S.C., Lavietes, M.H., & Cook, S.D. (1996). Expiratory training in multiple sclerosis. Archives of Physical Medicine and Rehabilitation, 77, 909-912.

[22] Klefbeck, B., & Nedjad, J.H. (2003). Effect of inspiratory muscle training in patients with multiple sclerosis. Archives of Physical Medicine and Rehabilitation, 84, 994-999.

[23] Buyse, B., Demedts, M., Meekers, J., Vandegaer, L., Rochette, F., & Kerkhofs, L. (1997). Respiratory dysfunction in multiple sclerosis: A prospective analysis of 60 patients. European Respiratory Journal, 10, 139-145.

[24] Fry-Welch, D., Wagner, M., Jackson, E., Chokshi, A., & Pfalzer, L. (2004). A ten week inspiratory muscle training program improves physical performance in persons with multiple sclerosis. Journal of Neurology and Physical Therapy, 28, 181-182.

[25] Heesen, C., Romberg, A., Gold, S., & Schulz, K.H. (2006). Physical exercise in multiple sclerosis: supportive care or a putative disease-modifying treatment. Expert Reviews in Neurotherapeutics, 6, 347-355.

[26] Steensberg, A., Fischer, C.P., Keller, C., Moller, K., & Pedersen, B.K. (2003). IL-6 enhances plasma IL-1ra, IL-10, and cortisol in humans. American Journal of Physiology, Endocrinology, and Metabolism, 285, E433-E437.

[27] Ozenci, V., Kouwenhoven, M., & Link, H. (2002). Cytokines in multiple sclerosis: methodological aspects and pathogenic implications. Multiple Sclerosis, 8, 396-404.

[28] White, L.J., Castellano, V., & McCoy, S.C. (2006). Cytokine responses to resistance training in people with multiple sclerosis. Journal of Sports Sciences, 24, 911-914.

inhibition of pro-inflammatory cytokines with aerobic or resistance training[29]. With few studies conducted in this area, future research needs to include larger sample sizes with greater statistical power to determine the role of exercise on immune function in MS[28,29].

Psychological

Depression

Depression is common in individuals with chronic medical conditions and has been found to occur more often in individuals with MS than with other chronic conditions[30]. More than half of all individuals with MS suffer from depression during the course of the illness[31,32] which may result from disease activity such as the onset of exacerbations, neuropathologic changes in areas of the brain, neuroendocrine changes, reaction to loss, and side effects of medication[33].

Individuals suffering from depression tend to be less physically active compared to the general population despite the fact that numerous studies have found positive support for a relationship between exercise and depression in the general population as well as those with chronic diseases. In the MS population, the few studies assessing the influence of exercise on depression in MS have demonstrated positive results[34,35]. Participation in 8-15 weeks of aerobic or physiotherapy-based exercises decreases depression and anxiety and improves mood when exercises are performed in either an outpatient or home-based setting[34,35]. Having people with MS consistently participate in aerobic exercise has the potential to positively influence one of the most debilitating symptoms of the disease.

Quality of life (QoL)

Multiple sclerosis has been found to severely affect one's QoL in a negative way[36,37,38]. An increasing rate of change in functional limitations over time appears to be associated with decreases in both exercise

[29] Schulz, K.H., Gold, S.M., Witte, J., Bartsch, K., Lang, U.E., Hellweg R et al. (2004). Impact of aerobic training on immune-endocrine parameters, neurotrophic factors, quality of life and coordinative function in multiple sclerosis. Journal of Neurological Sciences, 225, 11-18.

[30] Patten, S.B., Beck, C.A., Williams, J.V.A., et al. (2003). Major depression in MS: a population based perspective. Neurology, 61, 1524-1527.

[31] Johnson, S.K., Deluca, J., & Natelson, B.H. (1996). Depression in fatiguing illness: Comparing patients with chronic fatigue syndrome, multiple sclerosis, and depression. Journal of Affective Disorder, 39, 21-30.

[32] Sadovnick, A.D., Reick, R.A., Allen, J., Swartz, E., Yee, I.M.L., Eisen, K., et al. (1996). Depression and multiple sclerosis. Neurology, 46, 628-632.

[33] LaRocca, N.G. (2000). Cognitive and emotional disorders. In Burks J.S., & Johnson K.P. (Eds.) Multiple Sclerosis: Diagnosis, medical management and rehabilitation. (1st ed. pp. 405-423). New York, NY: Demos Publications.

[34] Patti, F., Ciancio, M.R., Reggio, E., Lopes, R., Palermo, F., Cacopardo, M. et al. (2002). The impact of outpatient rehabilitation on quality of life in multiple sclerosis. Journal of Neurology, 249, 1027-1033.

[35] Wiles, C.M., Newcombe, R.G., Fuller, K.J., Shaw, S., Furnival-Doran, J., Pickersgill, T.P., et al. (2001). Controlled randomized crossover trial of the effects of physiotherapy on mobility in chronic multiple sclerosis Journal of Neurology, Neurosurgery and Psychiatry, 70, 174-179.

[36] Koseoglu, B.F., Gokkaya, N.K.O., Ergun, U., Inan, L., & Yesiltepe, E. (2006). Cardiopulmonary and metabolic functions, aerobic capacity, fatigue and quality of life in patients with multiple sclerosis. Acta Neurologica Scandinavica, 114, 261-267.

[37] McCabe, M.P., & McKern, S. (2002). Quality of life and multiple sclerosis: Comparison between people with multiple sclerosis and from the general population. Journal of Clinical Psychology in Med Settings, 9, 287-295.

[38] Nicholl, C.R., Lincoln, N.B., Francis, V.M., & Stephan, T.F. (2001). Assessing quality of life in people with multiple sclerosis. Disability and Rehabilitation, 23, 597-603.

behaviour and QoL[39]. Exercise has been found to be associated with an improvement in QoL in persons with a variety of chronic diseases in general, and several studies have also found exercise to be associated with an improvement in QoL in individuals with MS[34,39,40]. Individuals with MS who participate in aerobic activities, such as aquatics and stationary cycling, have improvements in physical (bodily pain, mobility), social (social interaction and functioning), and mental (fatigue/thinking, vitality) components of QoL[41].

Functional

Fatigue

Fatigue is often the most common and debilitating symptom for individuals with MS[42] and has been reported by approximately 65% of individuals with MS[43,44]. People with MS who have participated in exercise programs have demonstrated an improvement in their levels of fatigue[45,46]. Much of the improvement in fatigue is thought to be related to increases in aerobic capacity and muscular endurance that occurs with aerobic exercise (i.e., offsetting a detraining effect of inactivity). Increases in aerobic capacity and muscular endurance assist in reducing the fatiguing effects of deconditioning and allows the individual to perform activities with less effort[4]. Participation in aerobic activities, like treadmill walking, may also alter and improve the motor skill thereby reducing the effort of walking and lessening the symptom of fatigue[44].

Mobility

Difficulty walking is one of the most common challenges for individuals with MS. A decrease in mobility often leads to decreased participation in exercise, increases in muscle weakness, and further impairments in mobility. Approaches to improve mobility have mostly been task- or facilitation-oriented. A task-oriented approach consists of functional exercises based on the necessary components required for walking and functional mobility. The facilitation approach aims to reduce impairments that are associated with postural control, balance responses, the ability to recruit motor activity in different parts of the range, muscle length, tonus change, and body malalignment. Both task- and facilitation-oriented approaches, whether completed in an outpatient or home-based program, have been shown to significantly improve sensation, anterior

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[39] Stuifbergen, A.K., Blozis, S.A., Harrison, T.C., & Becker, H.A. (2006). Exercise, functional limitations, and quality of life: A longitudinal study of persons with multiple sclerosis. Archives of Physical Medicine and Rehabilitation, 87,935-943.

[40] Sutherland, G., Andersen, M.B., & Stoov, M.A. (2001). Can aerobic exercise training affect health-related quality of life for people with multiple sclerosis? Journal of Sport and Exercise Psychology, 23, 122-135.

[41] Motl, R. W., & Gosney, J. L. (2007). Effect of exercise training on quality of life in multiple sclerosis: A meta-analysis. Multiple Sclerosis, 00, 1-7.

[42] Fisk, J.D., Pontefract, A., Ritvo, P.G., Archibald, C.J., & Murray, T.J. (1994). The impact of fatigue in patients with multiple sclerosis. Canadian Journal of Neurological Sciences, 21, 9-14.

[43] Freal, J.E., Kraft, G.H., & Coryell, J.K. (1984). Symptomatic fatigue in multiple sclerosis. Archives of Physical Medicine and Rehabilitation, 65, 135-138.

[44] Krupp, L.B., Alvarez, L.A., La Rocca, N.G., & Scheinberg, L.C. (1988). Fatigue in multiple sclerosis. Archives in Neurology, 45, 435-437.

[45] Newman, M.A., Dawes, H., van den Berg, M., Wade, D.T., Burridge, J., & Izadi, H. (2007). Can aerobic treadmill training reduce the effort of walking and fatigue in people with multiple sclerosis: A pilot study. Multiple Sclerosis, 13, 113-119.

[46] Oken, B.S., Kishiyama, S., Zajdel, D., Bourdette, D., Carlsen, J., Haas, M. et al. (2004). Randomized controlled trial of yoga and exercise in multiple sclerosis. Neurology, 62, 2058-2064.

balance, pendular movements, gait parameters, and Rivermead mobility index scores after 4-8 weeks of training[47].

Spasticity

Spasticity is a motor disorder characterized by an increase in muscle tone when an external imposed stretch is applied to the muscle and is a common symptom of MS[48,49]. It generally affects specific muscle groups that are responsible for maintaining upright posture which include the gastrocnemius, iliopsoas, hamstrings, and muscles of the anterior trunk[50]. Spasticity can result in joint contractures which can cause significant disability. Beneficial treatments for spasticity have included rehabilitation exercises (range of motion, stretching, and strengthening exercises) along with neuromuscular blockade, or rehabilitation exercises alone[51].

F-wave amplitudes are used to demonstrate changes of motor neuron excitability and have been shown to be increased in those with spasticity. Significant decreases in F-wave amplitude, mean F-wave/M-response ratio, and maximum F-wave/M-response ratio EMG recordings have been found in individuals using a motorized exercise-cycle indicating a reduction in motorneuron excitability[52]. In individuals with MS participating in unloaded leg cycling, and who are taking anti-spastic medications, reductions in soleus H-reflex and scores on the Modified Ashworth Scale have been found[53].

Reducing Risk of Co-morbidities

A physically inactive lifestyle has been shown to increase the risk of cardiovascular disease (CVD), diabetes, osteoporosis, and some types of cancers. Persons with MS are more sedentary than other individuals with other chronic conditions and should, therefore, be encouraged to add daily physical activity and/or exercise to obtain the same physiological benefits from physical activity as healthy individuals.

Cardiovascular Diseases (CVD)

Research has shown that physical activity may reduce the incidence of coronary heart disease (CHD) by improving other risk factors known to be associated with CHD such as decreasing blood pressure (BP) and

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[47] Armutlu, K., Karabudak, R., & Nurlu, G. (2001). Physiotherapy approaches in the treatment of ataxic multiple sclerosis: A pilot study. Neurorehabilitation and Neural Repair, 15, 203-211.

[48] Young, R. (1994). Spasticity. A review. Neurology, 44(9), S12-S20.

[49] Haselkorn, J.K., Balsdon Richer, C., Fry-Welch, D., Herndon, R.M., Johnson, B., Little, J.W., et al. (2005). Spasticity management in multiple sclerosis: Evidenced-based management strategies for spasticity treatment in multiple sclerosis. Journal of Spinal Cord Medicine, 28, 167-199.

[50] Shapiro, R.T. (2003). Managing the symptoms of multiple sclerosis. 4th ed. New York: Demos.

[51] Freeman, J.A., Langdon, D.W., Hobart, J.C., & Thompson, A.J. (1997). The impact of inpatient rehabilitation on progressive multiple sclerosis. Annals of Neurology, 42, 236-244.

[52] Rosche, J., Paulus, C., Maisch, U., Kaspar, A., Mauch, E., & Kornhuber, H.H. (1997). The effects of therapy on spasticity utilizing a motorized exercise-cycle. Spinal Cord, 35, 176-178.

[53] Molt, R.W., Snook, E.M., & Hinkle, M.L. (2007). Effect of acute unloaded leg cycling on spasticity in individuals with multiple sclerosis using anti-spastic medications. *Internal Journal of Neuroscience, 117,* 895-901.

hypercholesterolemia and increasing high-density lipoprotein[54,55]. Results of a meta-analysis by Berlin and Colditz[56], demonstrated an association between physical inactivity and an increased risk of CHD in a dose-response fashion. A more recent review by Kohl[57] also demonstrated that CVD incidence and mortality are causally related to physical activity in an inverse, dose-response manner. Studies analyzed together demonstrated a lower risk of CVD with subsequent higher levels of physical activity. Sundquist[58] et al studied the long-term effect of leisure-time physical activity on incidence of CHD among men and women. Results indicated that when leisure-time physical activity increased, incidence rates of CHD decreased.

Type II Diabetes

Physical inactivity is one of the many factors contributing to the incidence of type II diabetes. There have been several studies and reviews evaluating the relationship between physical activity and the incidence of type II diabetes[59,60,61,62]. Most studies have found physical activity to be beneficial for the prevention of diabetes, the management of impaired glucose tolerance[63] and for improving glucose control in diabetics[61]. In a meta analysis of 10 studies, Jeon and associates[59], found that individuals who engaged in regular physical activity of moderate intensity had an approximate 30% lower risk of type II diabetes compared to sedentary individuals. In individuals at higher risk for diabetes, the addition of moderate physical activity for 150 minutes a week and adhering to a healthy low calorie, low fat diet was found to be effective at preventing or delaying type II diabetes[64].

Cancer

Evidence shows that physical activity is most protective against colon and breast cancers and overall cancer risk. Data from combined studies has shown that there is a lower risk of colon cancer among men and women who are more physically active[65]. A dose response relationship has also been found between physical activity and the risk of colon cancer with higher levels of physical activity decreasing the risk of

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[54] Pate, R. R., Pratt, M., Blair S. N., et al. (1995). Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA, 273*, 402-407.

[55] Thompson, P. D., Buchner, D., Pina, I. L., et al. (2003). AHA scientific statement: Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease. *Circulation, 107*, 3109-3116.

[56] Berlin, J. A., & Colditz, G. (1990). A meta-analysis of physical activity in the prevention of coronary heart disease. *American Journal of Epidemiology, 132*, 612-628.

[57] Kohl, H. W. (2001). Physical activity and cardiovascular disease: Evidence for a dose response. *Med Sci Sports Exerc, 33,* S472-S483.

[58] Sundquist, K., Qvist, J., Johansson, S. E., & Sundquist, J. (2005). The long-term effect of physical activity on incidence of coronary heart disease: a 12-year follow-up study. *Preventive Medicine, 41*, 219-225.

[59] Jeon, C. Y., Lokken, R. P., Hu, F. B., & van Dam, R. M. (2007). Physical activity of moderate intensity and risk of type 2 diabetes: a systematic review. *Diabetes Care, 30*, 744-752.

[60] Yates, T., Khunti, K., Bull, F., Gorely, T., & Davies, M. J. (2007). The role of physical activity in the management of impaired glucose tolerance: a systematic review. *Diabetologia, 50*, 116-1126.

[61] Kelley, D. E., & Goodpaster, B. H. (2001). Effects of exercise on glucose homeostasis in type 2 diabetes mellitus. *Med Sci Sports Exer, 6*, S495-S501.

[62] Hu, G., Lakka, T. A., Kilpelainen, T. O., & Tuomilehto, J. (2007). Epidemiological studies of exercise in diabetes prevention. *Appl Physiol Nutr Metab, 32*, 583-595.

[63] Tuomilehto, J., Lindstrom, J., Eriksson, J. G., Valle, T. T., Hamalainen, H., Ilanne-Parikka, P., et al. (2001). Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *New England Journal of Medicine, 344*, 1343-1350.

[64] Knowler, W. C., Barrett-Connor, E., Fowler, S. E., Hamman, R. F., Lachin, J. M., Walker, E. A., et al. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformim. *New England Journal of Medicine, 346*, 393-403.

colon cancer. It is thought that physical activity may help decrease the transit time of fecal matter through the colon reducing the exposure of the intestine wall to carcinogens.

With regards to breast cancer, data demonstrates a lower rate of breast cancer among active women[65]. The data supports a dose-response relationship between physical activity and breast cancer. The potential biological mechanism by which physical activity may decrease breast cancer risk include the alteration of menstrual cycle patterns and exposure to sex hormones, enhancement of immune function, changes in body weight, and changes in insulin like growth factors[66].

Exercise Prescription

The primary goal of exercise prescription in this population should focus on maintenance of, and when possible, an increase in, physical function, joint flexibility, aerobic endurance, and muscular strength and endurance[67]. It is essential that exercise prescriptions for persons with MS are very individualized due to their varied symptoms. The following paragraphs will discuss the current recommended guidelines by the American College of Sports Medicine (ACSM) and Petajan and White (1999) for the prescription of endurance, strength, and flexibility training.

Endurance Training

Endurance training is associated with improvements in aerobic fitness which allows individuals to perform more work with less energy. A higher aerobic fitness is also associated with fewer chronic diseases such as CVD and diabetes.

When selecting the mode for endurance training, the individual's symptoms need to be taken into consideration as this will determine which type of exercise will be most appropriate. Individuals with severe paresis may need to start out by performing activities of daily living to maintain function with eventual progression to active leisure and recreational activities such as house and yard work, gardening, walking, or cycling. These leisure activities have been shown to provide enough of a stimulus to preserve function and independence. Individuals who have adequate functional capacities and motivation can be prescribed a structured aerobic exercise program to improve aerobic fitness.

ACSM recommends that exercises such as stationary cycling; walking; and low-impact, chair, and water aerobics be performed three times per week for at least 30 minutes. The 30 minutes can be accumulated throughout the day such as doing three 10- minute or two 15-minute sessions. This method is ideal for

[65] Lee, I. M. (2003). Physical activity and cancer prevention – data from epidemiological studies. *Med Sci Sports Exer, 35*, 1823-1827.

[66] Hoffman-Goetz, L., Apter, D., Denmark-Wahnefried, W., Goran, M. I., McTiernan, A., Reichman, M. E. (1998). Possible mechanisms mediating an association between physical activity and breast cancer. *Cancer, 83*, 621-628.

[67] Mulcare J.A., & Jackson K. (2006). Neuromuscular diseases and exercise. In Kaminsky, L.A., & Ewing Garber, C. (Eds.). American College of Sports Medicine resource manual for guidelines for exercise testing and prescription (5th ed. pp. 514-527). Philadelphia (PA): Lippincott Williams & Wilkins.

individuals who have a low level of fitness and/or are easily fatigued. This level of activity generally allows individuals to complete other activities of daily living such as self care, cooking, or ambulating around the house.

It is recommended that the exercise heart rate (HR) be maintained at about 60% to 75% of age-predicted maximum HR. More severely impaired or elderly individuals may need to exercise at a lower intensity such as 50% to 65% of maximum HR until their fitness level improves. Individuals who are symptom free should try to achieve an 11-14 rating on the Borg scale indicating a moderate intensity. It is recommended that a perceptual scale be used to monitor intensity since MS symptoms vary from day to day. Adjustments to work rates should be based on daily symptoms and energy levels.

Strength Training

Strength training is important to combat the effects that muscle weakness has on activities of daily living in persons with MS. Repetition of basic daily activities such as walking, rising from a chair, and climbing stairs results in muscle fatigue and individuals may limit activity leading to muscle atrophy and further muscle weakness.

Similar to endurance training, a strength training program should be based on the individuals' level of functioning. In the beginning, strength exercises can be performed with minimal equipment such as stretch bands, sand bags or one's own body weight with the number of repetitions completed dependent on the level of fatigue. Individuals should start with a few simple exercises that target specific areas of weakness. For individuals with little or no motor deficits, multi-joint strength training exercises may be performed for the major muscle groups. This program can include 1 to 3 sets of 10 to 15 repetitions performed on 2 or 3 nonconsecutive days per week. Individuals should perform exercises through a full ROM, reaching moderate fatigue at the end of the third set[3]. Exercises and length of sessions should be selected to accommodate MS-specific problems such as poor balance, coordination, and fatigue[3]. This type of program allows the individual to increase strength in opposing muscle groups and perform more complex movement patterns. These types of programs are generally designed by a physiotherapist or exercise physiologist.

Flexibility Training

Muscle shortening can be a result of spasticity or prolonged bed rest, both which may occur in MS. A thorough program of stretching with a focus on the commonly shortened muscles and muscles that cross two joints is necessary to counteract and minimize the effects. ACSM recommends that individuals perform stretching exercises one to two times per day depending on the persons' level of activity and degree of spasticity. Most stretches should be held for 30 to 60 seconds and repeated three to five times. Persons with severe spasticity or contracture may require stretching ranging from 20 minutes to several hours. Dynamic splints or weights with stretches may be needed to induce plastic deformation of connective tissue.

Disability-adapted fitness training

Table 1 provides further information on a stage adapted approach to fitness training where the level of exercise is adapted to the level of disability.

Table 1. Disability-adapted fitness training in MS*

DISABILITY	TRAINING
None: no fatigue, no thermosensitivity	Fully exertable, combined endurance and strengthening exercises, but in physiological dimensions, no extreme sports
Mild: fatiguability, perhaps thermosensitivity, minor balance disturbances	Controlled fitness training, perhaps pre-cooling, supervision to avoid overtraining, long-lasting efforts restricted
Moderate: restricted walking, paresis, lower limb spasticity, ataxia, balance problems	Training program adapted to the deficit, Nordic walking, home exercises, arm-leg ergometry, strengthening of indicated muscle groups, water exercises
Severe disability: loss of daily functions, walking nearly impossible	Preservation of movements, stretching, focused strengthening, oriented to daily activities, yoga, active/ passive training for limbs by motomed
In bed	Preservation of movements, predominately passive, breathing therapy

*Adapted from Heesen et al., (2006). Physical exercise in multiple sclerosis: supportive care or putative disease – modifying treatment. Expert Review in Neurotherpaeutics, 6(3).

Special Considerations for Exercise

Although exercise is beneficial for individuals with MS, there are several factors that may influence both how the individual responds to exercise and the amount of improvement one will achieve with exercise. These special considerations are grouped into environmental, physiological, cognitive, and functional considerations.

Environmental

Temperature

Both a person's core temperature and ambient room temperature are important to consider for individuals with MS who participate in activity. An increase in body temperature can cause a temporary worsening of symptoms[68]. Uhthoff's symptom is a visual sensory abnormality that has been associated with an increase in body temperature due to exercise, hot baths or showers, or the ingestion of hot food or liquid. The symptoms generally last only minutes, but may persist for hours.

Several options exist for alleviating temperature increases which can occur with exercise.

- Exercising in a cool environment such as an air-conditioned gym or in a swimming pool may help eliminate some of the symptoms that occur with an increase in body temperature[69].
- Cooling garments such as headbands or vests, wearing light weight clothing, and drinking cold drinks may also help[55].
- Surface cooling via water immersion before exercise can significantly reduce core temperature, as well as improve aerobic endurance, reduce sub-maximal exercise HR, and reduce the perceived level of exertion[54].

The reduction in core temperature that occurs immediately after cooling persists for several hours, and is associated with significantly less perceived fatigue. Pre-cooling, coupled with exercising early in the day to take advantage of the lower circadian body temperature, might pose less physiological and psychological stress on the individual.

Hydration

Many people with MS experience altered bladder function. Individuals may severely limit their daily intake of fluids when bladder urgency and/or exertional incontinence are problems. This can lead to chronic dehydration and general fatigue, both of which can be exaggerated during exercise. Dehydration also reduces circulating blood volume which may further increase fatigue. Adjustments in medication which help with bladder function, such as oxubutynin, may be needed, along with ensuring adequate fluid intake[7].

[68] White, A.T., Wilson, T.E., Davis, S.L., & Petajan, J.H. (2000). Effect of precooling on physical performance in multiple sclerosis. Multiple Sclerosis, 6, 176-180.

Physiological

Cardiac Dysautonomia

Abnormalities in HR and blood pressure (BP) are common in approximately 30% of people with MS[70,71], and the disease severity appears to correlate with the decrease in cardiovascular responses[72]. Orthostatic hypotension may occur due to an inadequate pressor response during exercise[73] and symptoms are often described as dizziness, lightheadedness, or syncope when moving from a supine to a sitting or standing position. Because of the affects of MS on the autonomic nervous system, it is important to continually monitor HR, BP, and rate of perceived exertion during exercise.

Medications

Medications that may affect exercise tolerance, or physiological responses to exercise, need to be considered when prescribing exercise to individuals with MS, therefore a complete history of medications must be taken before exercise is prescribed. The following are a few of the medications with possible side effects that may affect an individual's ability to undertake exercise. Amantadine HCl is often prescribed for fatigue and may cause dizziness, peripheral vasodilation, and orthostatic hypotension. Baclofen, used to reduce spasticity, may cause tachycardia, bladder dysfunction, muscle weakness, and fatigue when taken in high doses. Tricyclic antidepressants may cause hypotension, tachycardia, tremor, dizziness, and abnormal gait. Selective serotonin reuptake inhibitors may cause hypotension and tachycardia. Prednisone, used to reduce acute exacerbation of symptoms, may cause muscle weakness, loss of muscle mass, and hypertension. It is important to monitoring signs and symptoms during and after exercise to assess the possible side effects of medications.

Bladder Dysfunction

As mentioned earlier, due to effects on bladder function, persons with MS may need to urinate frequently during exercise especially if certain exercises place pressure on the bladder. Additionally, accidental bladder voiding may occur during exercise due to the negative affects on neurological function. Individuals should make sure that the bladder is voided before exercise and intermittently during the exercise session, particularly if they are drinking fluids to prevent dehydration and overheating[74].

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[69] National Multiple Sclerosis Society. (2006). Multiple Sclerosis Information Sourcebook – Exercise. Retrieved September 1, 2007 from http://www.nationalmssociety.org/site/PageServer?pagename=HOM_LIB_sourcebook_exercise.

[70] Drory, V.E., Nisipea, P.F., & Kroczyn, A.D. (1995). Tests of autonomic dysfunction in patients with multiple sclerosis. Acta Neurologica Scandinavica, 92, 356-360.

[71] Nordendo, A.M., Boesen, F., & Anderson, E.B. (1989). Cardiovascular autonomic function in multiple sclerosis. Journal of Autonomic Nervous System, 26, 77-84.

[72] Saari, A., Tolonen, U., Paakko, E., Suominen, K., Pyhtinen, J., Sotaniemi, K., et al. (2004). Cardiovascular autonomic dysfunction correlates with brain MRI lesion load in MS. Clinical Neurophysiology, 115, 1473-1478.

[73] Pepin, E.B., Hicks, R.W., Spencer, M.K., Tran, Z.V., & Jackson, C.G. (1996). Pressor response to isometric exercise in patients with multiple sclerosis. Medicine and Science in Sports and Exercise, 28, 656-660.

Psychological

Cognitive

Many individuals with MS will have some level of cognitive deficit which may, in turn, affect their ability to follow an exercise program. Deficits may occur with memory[75], abstract reasoning and problem solving, attention and concentration[76], and speed of information processing[77]. Individuals may require additional time for information processing as well as multiple forms of information presentation to ensure understanding of their exercise program. Written instructions of exercises may be required in addition to verbal cues[78].

Functional

MS Exacerbation

Exercise programs need to be flexible in order to accommodate MS exacerbations. Modifications to the exercise program may be required when the individual resumes their activity because of residual neurological deficits from exacerbations. Depending on the severity of the exacerbation, light activity such as gentle stretching and ROM exercises are encouraged to avoid deconditioning. Individuals may present with new MS signs and symptoms during an exacerbation which may require corticosteroid therapy. This treatment, in turn, may cause muscle weakness and decreased sweating further affecting ability to exercise.

Fatigue

Fatigue will affect the time of day that is best for individuals to exercise. In general, fatigue from MS worsens later in the day, so it may be best to schedule exercise earlier in the day. Fatigue may also affect the results of motor testing and therefore evaluation of muscle strength should be done during the best time of day for the individual. Within an exercise regimen, a balance between rest and exercise is needed to avoid becoming overly fatigued. Also, resting for 10-15 minutes several times a day can be just as restorative as prolonged periods of rest which may include sleeping.

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[74] Benyas, P. (1999). Multiple Sclerosis: Designing an exercise program. The National Centre on Physical Activity and Disability. Retrieved September 1, 2007 from http://www.ncpad.org/disability/fact_sheet.php?sheet=187&view=all.

[75] Rao, S.M., Grafman, J., DiGiulio, D. (1993). Memory dysfunction in multiple sclerosis: its relation to working memory, semantic encoding, and implicit memory. Neuropsychology, 7, 364-374.

[76] Rao, S.M., Leo, G.J., Bernardin, L., & Unverzagt, F. (1991). Cognitive dysfunction in multiple sclerosis: I. frequency, patterns, and prediction. Neurology, 41, 685-691.

[77] Litvan, I., Grafman, J., Vendrell, P., & Matinez, J.M. (1988). Slowed information processing in multiple sclerosis. Archives of Neurology, 45, 281-285.

[78] Mulcare, J.A. (2003). Multiple Sclerosis. In Durstine, J.L, & Moore, G.E. (Eds.) American College of Sports Medicine's Exercise management for persons with chronic diseases and disabilities (2nd ed. pp. 267-272). USA: Human Kinetics.

Balance and Coordination

Common symptoms of MS can lead to a loss of coordination and balance. Exercising while fatigued may also lead to poor coordination and balance, and may compromise the safety of the individual while exercising. For instance, individuals with ataxia, spasticity, sensory deficits, and foot drop may find it difficult to walk on a treadmill without handrails.

Several simple considerations may help alleviate problems that could occur during exercise. Ankle and foot orthotics may be needed to correct foot drop and prevent tripping. Mechanically synchronizing combined arm/leg ergometers help with coordination. Exercises such as stationary cycling, rowing or aquatics can be selected and supervised in individuals with these symptoms. The exercise areas should be kept free of obstacles and well lit.

Benefits of Specific Exercise Programs

Aquatics

Exercising in water provides optimal exercise conditions for persons with MS. Chest-high water enables them to stand and maintain balance for exercises with less effort than on land and allows them to achieve a greater range of motion for within their joints. The resistance that water provides can also be utilized for strengthening the muscles. Water also helps reduce body heat that is generated by exercise which helps lessen exacerbation of symptoms.

Yoga and Tai Chi

Meditative types of exercise such as yoga and Tai Chi may assist with decreasing stress, and improving relaxation, flexibility, and balance[79,80]. These types of activities involve slow, controlled movements along with breathing exercises that require attention and may help improve body awareness. The movements can be adapted to meet specific needs of each individual do not require any equipment.

Chair Exercises

When a person with MS feels that they do not have enough energy to exercise in a standing position, chair exercises can be a good alternative. Strengthening and stretching exercises can be adapted to be performed from a chair and will allow them to perform the activity while conserving some energy and preventing excess fatigue.

Group Exercise Programs

The type of exercise environment that they exercise in is also important to consider. Previous studies on exercise in individuals with chronic diseases, such as cardiovascular disease or cancer, have found that individuals who exercise in a group not only receive the physiological benefits of exercise, but also important aspects of socialization, support, and motivation. It is important to remember that adding exercise into a person's life who has MS is not always the easiest thing to do, so they may find it more motivating to exercise in a group. Groups programs also provide them with supervision if needed.

For more information about specific exercises and programs related to MS, please contact your local Chapter of the MS Society of Canada (1-800-268-7528) or email active@mssociety.ca.

Exercise Checklist

One of the hard things to do for persons with MS when deciding to become active is knowing what they should do or how to go about it. Here are some helpful pointers that you can use to help get them started and what they need to remember when exercising or being active:

Before a person with MS starts any exercise program they should:

- Always consult with a physician prior to beginning an exercise program. Their physician can then direct them to a physiotherapist in their area who can devise an exercise program specific to their needs; if the physician feels this is needed.

- A person with MS should check out local facilities for programs or activities that interest them, such as swimming or an exercise group. They can also check with their local MS Society chapter for programs and activities within their community.

- Pick an activity that they will enjoy doing - for example swimming, walking or working out at a local fitness club.

- Be encouraged to get their family and friends involved – exercising and being active is more enjoyable when it's done with a partner or group.

[79] Lan, C., Lai, J.S., Chen, S.Y., & Wong, M.K. (1998). Twelve-month Tai Chi training in the elderly: its effect on health fitness. *Medicine Science in Sports and Exercise,* 30, 345-351.

[80] Wolf, S.L., Barnhart, H.X., Ellison, G.L., Coogler, C.E., Atlanta FICSIT Group. (1997). The effect of Tai Chi Quan and computerized balance training on postural stability in older subjects. *Physical Therapy,* 77, 371-381.

To avoid fatigue and reappearance of MS symptoms a person with MS should:

- Know their own limits and do not exceed them. They should do as much as they feel they can do. Don't add to their fatigue by having them continue working to the point of exhaustion. It is okay to take breaks between activities or exercises.
- Wear light clothing and exercise in a cool environment (remember symptoms of MS can get worse with overheating).
- Avoid heat exhaustion – don't overdo it! They should and need to stay cool! When a person with MS feels fatigue, they should stop and rest or change exercises.
- When an MS relapse occurs they should take a "time-out" from exercise until symptoms have subsided. Exercise can help to contribute to a worsening of MS symptoms.
- Be encouraged to ask questions or for advice on exercise and physical activity.

Things to remember as a fitness provider:

- Don't hesitate to ask for advice. Understanding multiple sclerosis and providing exercise program can be difficult at times, there are experts in the field that can help in this regard.
- Create an environment that is welcoming, accessible and friendly by taking into considerations the symptoms of MS and the individuals needs.
- Listen to the person with MS. They know their body the best (i.e., MS symptoms, what they can and cannot do, and the impact of fatigue).

It's important for people with MS to be active NOW!! So, they too can enjoy the physical and emotional rewards of being in the best shape they can be.

Summary

Many individuals with chronic conditions, including MS, refrain from participating in exercise due to symptoms. Inactivity leads to a decrease in functional capacity and muscle weakness leading to further immobility. As this pattern progresses, it eventually affects the individual's ability to carry out the basic functions of daily living leading to a decrease in the individuals QOL.

Exercise plays a key role in preventing deconditioning in MS. Individuals should be encouraged to maintain or improve aerobic and muscular fitness early in their disease to offset the decrease in functional reserve that generally occurs with increasing disability as the disease progresses[8]. Exercise programs provide a valuable opportunity for social interaction and support which may assist in maintaining or improving the individual's QOL.

Need More Information

For more information on exercise and MS, contact your local chapter of the MS Society of Canada. This can be done by calling your local chapter or division (1-800-268-7528) or by accessing the MS ActiveNOW website (www.mssociety.ca\alberta).

Other resources available pertaining to exercise for persons with multiple sclerosis are:

DVDS:

1. Exercise and MS. (2007). MS Society of Canada Alberta Division.
2. About MS. (2007). MS Society of Canada Alberta Division.

Books:

1. *Exercises for Multiple Sclerosis.* (2006). Brad Hamler. Hatherleigh Press.
2. *Multiple Sclerosis: A Self-Care Guide to Wellness.* (2005). Nancy Holland & June Halper. New York: Demos Medical Publishing.
3. *Managing the symptoms of multiple sclerosis* (2003). R. Schapiro. 4th ed. New York: Demos.

Web Sites:

1. Multiple Sclerosis Society of Canada: www.mssociety.ca
2. National Multiple Sclerosis Society: www.nmss.org
3. Multiple Sclerosis London: http://www.lhsc.on.ca/programs/msclinic

Workout Journal

Date:			
	Exercise	**Comments**	**Fatigue Level***
1.	Ex. Cycling	10 minutes on cycle spent at level 2	3
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
General comments / observations:			

FATIGUE LEVEL*: Rate how fatigued you feel after each exercise based on a scale of 1 to 5 (i.e., 1 = no fatigue, 3 = somewhat, 5 = very).

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Multiple Sclerosis Society of Canada
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Contact the
MS Society of Canada, Alberta Division

Phone: 1-800-268-7582
Email: active@mssociety.ca
Website: www.mssociety.ca/alberta
Address: #150, 9405 - 50 Street
Edmonton, AB T6B 2T4

OUR MISSION

To be a leader in finding a cure for multiple sclerosis and enabling people affected by MS to enhance their quality of life.