Multiple Sclerosis Fitness Specialist Certification

Moving Toward A Better Quality of Life

CarolAnn, M.S., CPT
David Lyons, B.S., CPT

Multiple Sclerosis
Fitness Specialist Certification

Moving Toward a Better Quality of Life

CAROLANN, M.S. Exercise Science & Health Promotion, CPT/Educator

DAVID LYONS, B.S. Nutrition, CPT/Educator

Multiple Sclerosis: Fitness Specialist Certification

OBJECTIVE: To educate health and fitness professionals on how to effectively implement exercise training techniques and work with clients who suffer from multiple sclerosis to help develop strength, flexibility, balance, breathing, and improve their quality of life.

Learning Objective 1: During the course, participants will obtain a working knowledge of the anatomy and physiology affected by multiple sclerosis and how they are used during exercise.

Learning Objective 2: After the course, participants will be able to define the terms associated with multiple sclerosis.

Learning Objective 3: After the course, participants will be able to explain the causes, signs and symptoms of multiple sclerosis along with traditional treatment techniques and management techniques.

Learning Objective 4: During the course, participants will obtain a working knowledge of musculature anatomy and be able to select proper exercises that improve strength, flexibility, balance, breathing, and improve the overall quality of life for their clients with multiple sclerosis.

Learning Objective 5: During the course, participants will be able to explain the importance of the three planes of movement and how they apply to exercise prescription for those clients who suffer from multiple sclerosis.

Learning Objective 6: After the course, participants will be able to provide basic nutrition suggestions and advice to improve their client's quality of life.

Learning Objective 7: After the course, participants will be able to design and prescribe a proper exercise program with progression tracking for those suffering from multiple sclerosis and be able to cue proper technique and body alignment.

Learning Objective 8: After the course, participants will be able to understand the ebb and flow of Multiple Sclerosis and be able to modify their fitness programming to accommodate day-to-day symptoms and flare-ups.

Objective Outcome: These objectives will be measured by a 100-question written exam requiring the participant to achieve a passing grade of 75%.

Table of Contents

Introduction	6
What is MS	6
History of MS	7
Chapter One: MS and Epidemiology	10
Gender Differences	11
Age	11
Ethnicity	11
Economic Implications	13
Chapter Two: MS Terms	14
Chapter Three: Types of MS	20
Chapter Four: Pathophysiology of MS and Affected Anatomy	22
MS and the Brain	23
MS and the Spinal Cord	25
MS and the Optic Nerves	27
Chapter Five: MS Symptoms, Causes, Risk Factors, Diagnosis, & Treatments	30
Symptoms	30
Causes & Risk Factors	31
Diagnosis	33
Treatments	35
Chapter Six: MS Lifestyle Management	36
Chapter Seven: Mental Fitness	39
Make Lifestyle Changes for a Healthy Mind	39
Meditation	39
Yoga	41
Positive Affirmations	42
Vision Board	42
Journaling	44
The Power of Nature	45
Dealing with Burnout	46
Stress vs. Burnout	47
Chapter Eight: MS and Exercise	48
The Benefits of Exercise	48
The Best Types of Exercise	50
MS Exercise Limitations & Guidelines	50
8 Key Components of MS Exercise	52
FITT Principle and MS	62
Exercise Safety and Proper Technique	64
Chapter Nine: Scope of Practice for Health and Fitness Professionals	65
Chapter Ten: Screening and Assessments	68
Multiple Sclerosis Functional Composite (MSFC)	68
Other MS Assessments	73
Multiple Sclerosis Quality of Life Inventory (MSQLI)	76
Specific MS Condition Assessments	77
Par-Q	79
Cardiorespiratory Assessment: Six Minute Walking Test (6MWT)	79

Muscular Strength Assessment: Peripheral Muscle Strength	80
Flexibility	81
Postural Screening	82
Chapter Eleven: Goals and Program Design	85
Goal Profile	85
Concentric and Eccentric Contractions for Program Design	86
Training Methods for MS	87
The Goal of Each Exercise Designed for MSers (Concept and Theory)	90
Program Design	90
Exercise Session Format	91
Sample Weekly Workout Formats	92
Chapter Twelve: Specific Adaptations for Clients with MS	94
Progression and Regression	94
Adapting a Specific Routine for MS	97
Adapting in a Wheelchair	98
Chapter Thirteen: Nutrition and Healthy Weight Management for MS	100
10 Tips to a Healthy Plate	101
Maintaining a Healthy Weight	101
Weight Loss	101
Weight Gain	102
Mealtime Tips	103
Nutrition Mindsets for MSers	103
Inflammation	106
Short List of Foods to Enjoy/Foods to Avoid	108
Foods to Enjoy	108
Foods to Avoid	112
Meal Planning	115
Nutrient Timing	116
Eating Healthy on a Budget	118
Chapter Fourteen: Health/Fitness Professional Evaluation Checklist	121
Appendix A: Par-Q Form	123
Appendix B: 6 Minute Walk Test	124
Appendix C: 30 Second Chair Stand Test	126
Appendix D: Arm Curl (Bicep) Test	127
Appendix E: Chair Sit and Reach Test	130
Appendix F: Back Scratch Test	131
Appendix G: Planes of Movement	132
Appendix H: Exercise Library	133
Resources	165
References	166
About the Authors: CarolAnn, M.S., CPT, CN and David Lyons, B.S., CPT	170

Introduction

More than 2.3 million people are affected by MS worldwide. But because the Centers for Disease Control and Prevention (CDC) does not require U.S. physicians to report new cases, and because symptoms can be completely invisible, the prevalence of MS in the U.S. can only be estimated. People who suffer from MS are often overlooked as candidates for a solid and rewarding fitness program. For many years they have been told not to exercise to avoid exacerbations. This philosophy has led to obesity and other physical ailments in the MS community that, as fitness professionals, we know is in contrast to a lifestyle of health and wellness. Therefore, some of your clients may suffer from MS and you may be an important source for relief. Fitness professionals can effectively work with those who have MS providing them with a better quality of life through movement.

The *Multiple Sclerosis: Fitness Specialist Certification* course provides fundamental information on the anatomy and physiology affected by MS, causes of MS, signs and symptoms of MS, and traditional treatment for MS. In addition, this course provides techniques on management of MS through exercise. You will learn how to design and prescribe a proper exercise program including basic nutrition to improve the quality of life for your clients with MS. With progression tracking, your clients can experience a gradual and pleasant growth in their health and fitness status. You as their health and fitness coach can provide a positive experience to facilitate an effective path to better health and wellness.

What is Multiple Sclerosis?

Multiple sclerosis (MS) involves an immune-mediated process in which an abnormal response of the body's immune system is directed against the central nervous system (CNS). The CNS is made up of the brain, spinal cord and optic nerves. When a person has an autoimmune disease, the immune system attacks healthy tissue, just as it might attack a virus or bacteria. In the case of MS, the immune system attacks the myelin sheath that surrounds and protects the nerve fibers, causing inflammation. Myelin also helps the nerves conduct electrical signals quickly and efficiently. Multiple sclerosis means "scar tissue in multiple areas."

History of Multiple Sclerosis

Up until pre 19th century, physicians relied on superstition and hearsay to care for the sick as opposed to scientifically testing medical ideas. However, physicians of the past were very good observers and evidence from their practices and writings reveal that they were treating those with MS early in history. In fact, historical accounts of illnesses with remarkably similar symptoms can be found as far back as the middle ages. Once medical scientific testing was established, MS was one of the first diseases to be described and identified.

Jean-Martin Charcot was a French neurologist who defined and gave a name to multiple sclerosis in 1868.

The following are some of the significant milestones in the history of Multiple Sclerosis:

Year	Event
1838	Drawings from autopsies done as early as 1838 clearly show what we now recognize as MS.
1868	Jean-Martin Charcot, a professor at the University of Paris who has been called "the father of neurology,"
1873	MS was recognized in England by Dr. Walter Moxon.
1878	MS was recognized in the United States by Dr. Edward Seguin.
Late 1800s	Much of what can be learned about MS from careful observation was known—that the disease is more common in women than men, that it is not directly inherited, and that it can produce many different neurological symptoms.
Late 1800s	Scientists first learned that bacteria cause many diseases.
Early 1900s	Discovered even smaller organisms, viruses, and developed techniques for growing and studying bacteria and viruses in the laboratory. This later led to research on viral causes of MS.
1916	With the new technology of visibility of nerve cells under the microscope now available, Dr. James Dawson at the University of Edinburgh performed detailed microscopic examinations of the brains of patients who had died with MS. Dr. Dawson described the inflammation around blood vessels and the damage to the myelin with a clarity and thoroughness that has never been improved upon.
1919	MS research grew more sophisticated. Abnormalities in spinal fluid were noted for the first time.
1925	The first electrical recording of nerve transmission, by Lord Edgar Douglas Adrian, established techniques needed to study the activity of nerves and launched a series of experiments to determine just how the nervous system works. The resulting knowledge included clarification of the role of myelin in nerve conduction and a realization that demyelinated nerves cannot transmit impulses efficiently.
1928	Myelin, which had been discovered in 1878 by Dr. Louis Ranvier, was studied intensively under the microscope and the cells that make myelin (the oligodendrocytes) were discovered.
1935	Dr. Thomas Rivers at the Rockefeller Institute in New York City, demonstrated that immune cells, not viruses, produced the MS-like illness in an animal model of MS. This animal form of

	MS, called experimental allergic encephalomyelitis, or EAE, would later become an important model for studying the immunology and treatment of MS. In fact, it paved the way to modern theories of "autoimmunity"— the process by which the body generates an immunologic attack against itself.
1943	The actual composition of myelin was determined.
1946	The National Multiple Sclerosis Society was founded by Sylvia Lawry.
1947	The Society for the Advancement of Multiple Sclerosis Research was awarded to study the immunology of MS. This grant went to Dr. Elvin Kabat at Columbia University. He identified abnormal immunologic proteins in the spinal fluid of people with MS. These proteins appeared in patterns known as oligoclonal bands. Oligoclonal bands not only proved to be valuable in diagnosing MS, but also a major demonstration that MS and the immune system are connected.
1940s	The renamed National Multiple Sclerosis Society awarded grants to dozens of scientists in 17 countries in all fields of medicine, pushing forward research that ranged over every aspect of MS from description to diagnosis to causes to cures. Recipients included Dr. Jonas Salk, who studied the immunology of MS, and Dr. Rita Levi-Montalcini, who described proteins that help nerve cells grow and stay healthy.
1950	National Institute for Neurologic Disorders and Stroke (NINDS) was founded.
1951	Cortisone (a steroid) was first used to treat MS relapses (also known as exacerbations, attacks, or symptom flare-ups). Cortisone was found to reduce the severity of the relapse and to shorten its duration, but it had no long-term effects on the disease.
Post WWII	1. A strong geographical gradient was apparent, showing that the incidence and prevalence of MS increased steadily as one moved northward away from the equator. 2. It seemed that B cells produced the oligoclonal bands in MS spinal fluid. 3. Continued EAE studies.
1950s	Additional studies on nerve conduction showed how chemicals generate electricity as they flow through channels in the nerve fiber membranes. Myelin was further broken down into its components, isolating the basic protein suspected to be the target of the MS attack. Scientists studied B-cells, T-cells, genes, and myelin but without uncovering a clear unifying thread to direct MS treatment.
1960	The National MS Society funded a panel of experts, headed by Dr. George Schumacher, to draw up standard guidelines for MS diagnosis. Although they have been refined since, the basic concept of these standards is still in use today. At the same time, a rating scale for determining the level of disability and the parts of the nervous system affected by MS was developed by Dr. John Kurtzke.
1969	First study to prove that a therapy could be developed that would improve the symptoms of MS. For the first time, there was a scientific treatment for MS.
1960s	MS may combine features of both an infectious and an immune-mediated disease. The treatments that were later developed for MS all targeted either an infectious or an immune mechanism. Two Major Ideas Developed: 1. MS involves a direct immune-system attack on myelin. 2. Viruses involved in MS were now thought to alter the immune system and trigger it to damage myelin.
1978	The first CAT (Computed Axial Tomography) scans were performed on people with MS.
1970s	1. The introduction of brain wave tests called "evoked potentials" which measure nerve conduction throughout the optic nerves, brain and spinal cord and often detect hidden areas of scarring and damage.

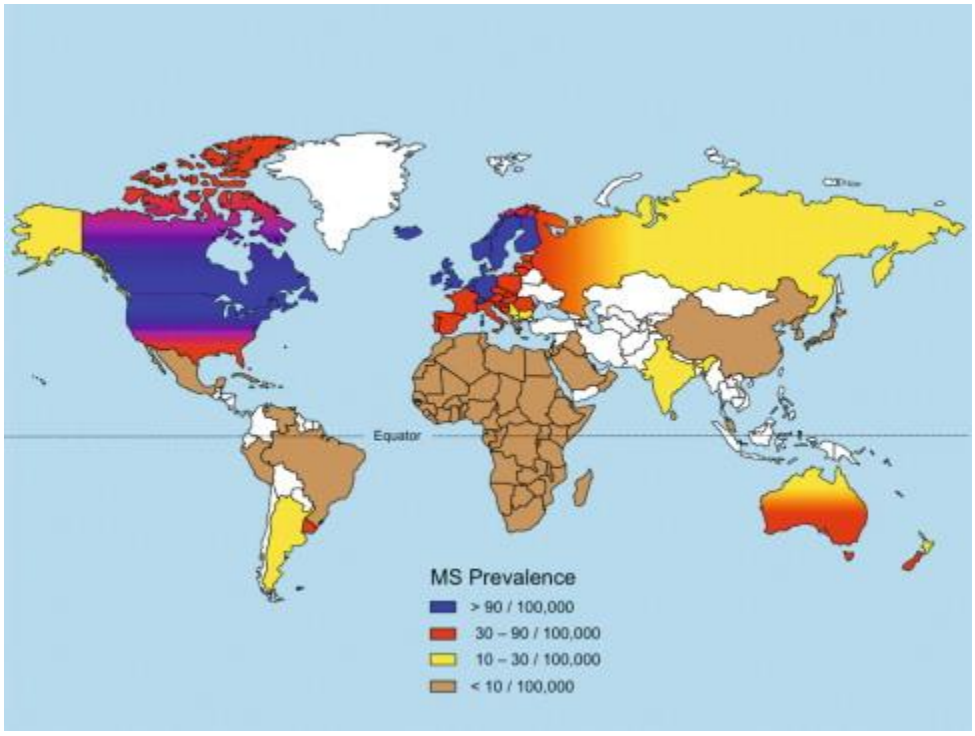
	2. Steroids to suppress immune activity were now widely used to treat MS attacks. 3. Studies involving interferon began. 4. The treatment product known as copolymer1 was developed and is today an approved disease-modifying therapy: glatiramer acetate.
1980s	1. Called the "treatment decade" in MS. There was an explosion of new treatment trials. 2. The white blood cell type that causes the actual damage to myelin in MS was identified. It is the macrophage (or "Big Eater" in Greek). 3. Identical and Fraternal twin studies.
1981-1988	1. The first MRI scans of people with MS were performed in 1981 by Dr. I R Young, in England. 2. 1984: MRI can reveal attacks on the brain by MS. 3. 1988: MRI can detect MS as an ongoing disease.
1990s	1. The Decade of the Brain 2. MRI gets more sophisticated to identify MS. 3. Through studies that involved over 80,000 people, the International MS Genetics Consortium (IMSGC) identified about 160 genetic variations related to MS, and has begun to identify the specific immune cells and proteins involved. 4. Computer technology enabled faster communication and large databases to improve research analysis and treatment. 5. Many medications are developed to treat symptoms of MS.
1993	The first injectable medication was introduced. These are also referred to as *disease-modifying therapies (DMTs)*. While these medications do not cure MS, they do work to slow disease activity as well as reduce the severity and frequency of flare-ups. Additionally, these DMTs may delay disease progression, delay disability, and increase longevity.
1996	Tizanidine was introduced for management of spasticity.
2010	Oral therapies introduced as treatments for MS relapses.
2013	Studies hint that exercise and rehabilitation can improve many functions and even help rewire the brain.
2018	FDA approved use of Gilenya in children and adolescents aged 10 years and older, making it the first drug approved by the FDA to treat MS in pediatric patients
2019	The Food and Drug Administration (FDA) has approved three applications for the first generics of the oral disease-modifying therapy Gilenya® (fingolimod) for the treatment of relapsing forms of multiple sclerosis (MS) in adults.
2019	Interest continues among both clinicians and patients alike by the prospect of treating multiple sclerosis (MS) with stem cells obtained from a patient's own bone marrow. Small studies on stem cell therapy in MS yields favorable findings.
2019	Studies suggest that individuals experiencing tremors may be helped by deep brain stimulation, or DBS. DBS has been approved by the FDA to treat conditions including epilepsy, obsessive-compulsive disorder, and Parkinson's disease. It is being investigated for several other conditions, including MS.
2019	A small, MRI-based study suggests that learning a second language may be an effective way for people with MS to stave off the decline in the brain's grey matter volume (GMV) that is a frequent hallmark of the condition.
Present	Many more drugs are being tested, and the history of MS is still being written, but more has been accomplished in the last decade than in the preceding century.

Chapter One
Multiple Sclerosis and Epidemiology

Epidemiology is the study of disease in people. It looks at the patterns, causes and effects of health and disease conditions in defined populations. Epidemiological studies have helped to identify factors that may be related to the risk of developing MS, such as latitude, migration patterns, genetics and infectious processes – read more within the section of *Causes of MS*.

Incidence and Prevalence

- The incidence of a disease is the number of new cases occurring in a given period of time (usually a year) in a given population (usually 100,000).
- The prevalence of MS is the total number of people with MS at a particular point in time, in a particular place. Most epidemiological studies in MS focus on prevalence.



According to *Atlas*, an MS resource put together jointly by the World Health Organization (WHO) and the MS International Federation in 2008, on a global level, "the median estimated prevalence of MS is 30 per 100,000," and the United States has one of the highest prevalence of MS cases. Data on the prevalence of MS per 100,000 people were estimated for 122 countries by the World Health Organization (WHO) and the Multiple Sclerosis International Federation (MSIF) (WHO and MSIF, 2008). Countries with the highest estimated prevalence included Hungary (176), Slovenia (150), Germany (149), United States (135), Canada (133), Czech Republic (130), Norway (125), Denmark (122), Poland (120), and Cyprus (110).

Although, the number may be much higher as it is likely that many people with MS remain undiagnosed in certain parts of the world. MS is not a "reportable" disease, which means that there is no requirement for healthcare providers to inform any central database when they make the diagnosis. Without this kind of centralized reporting system, there is no easy way to count people with MS.

Although MS is found in all parts of the world, its prevalence varies greatly, being highest in North America and Europe, and lowest in sub-Saharan Africa and East Asia. It is almost unheard of in certain populations such as the Inuits, New Zealand Maoris and Australian Aborigines. MS affects two to three times as many women as men, suggesting a role of hormones in the disease process.

The National MS Society is working with the Centers for Disease Control (CDC) to help with the development of a neurological disease surveillance system. The scientific community will be able to learn more about MS with such as system in place.

Gender Differences

The influence of gender on multiple sclerosis (MS) has been demonstrated in all aspects of the disease, from increased susceptibility in women to a worsened disease course and outcomes in men. Although the pathophysiology of MS is not yet clear, a number of studies have revealed gender-based patterns that point to hormonal mechanisms — and the potential for hormonal-based therapies.

Female gender is considered an independent risk factor for MS, at a commonly reported ratio of 3:1 over men, although several large cohort studies have reported a higher differential. More importantly, the gender gap is widening over time. Estrogen plays a continued role in promoting inflammation throughout the disease. Despite the increasing trends toward a gender bias for the development of MS, the role of hormones, particularly as a therapeutic option, remains controversial. More research needs to be conducted to completely understand the role of hormones in the development of MS furthering the supported theory that the cause of MS is more than just hormones.

Age

Most people are diagnosed between the ages of 20 and 40, although around three to five per cent of people with MS are diagnosed as children, and it can occur in much older adults. The average age of onset for MS is about 34 years of age. The disease typically follows a pattern, moving through different variations or types over the years. This is because as one gets older, MS symptoms are likely to change.

Ethnicity

Worldwide, approximately 2.3 million people are affected by MS. The disease is seen in all parts of the world and in all races, but rates vary widely. In general, the prevalence of MS tends to increase with latitude (e.g., lower rates in the tropics, higher rates in northern Europe), but there are many exceptions to this gradient (e.g., low rates among Chinese, Japanese, and African blacks; high rates among Sardinians, Parsis, and Palestinians).

The presence of these exceptions implies that racial and ethnic differences affect risk. In addition, a substantial increase in MS incidence has been reported from different regions, suggesting that environmental factors, as well as geographic and genetic ones, play an important role in MS.

Epidemiologic studies indicate an increase in MS prevalence in Latin America. Susceptibility to MS and clinical behavior of the disease varies genetically in Latin America; for example, MS apparently does not occur in Amerindians with Mongoloid genes.

One research project looked at information from 26,967 Caucasians, 715 Latinos, and 1,313 African Americans with multiple sclerosis. The researchers published the results in the Journal Disease & Ethnicity and reported that:

- Caucasians are one to two years older than Latinos or African Americans when they first experience symptoms and are diagnosed.
- Latinos appear to retain bladder function and mobility longer than Caucasians.
- Caucasians are less likely to report MS and depression than Latinos or African Americans, but Latinos are less likely to get mental health care.
- African Americans are less likely to get care from a neurologist specializing in MS or to go to an MS clinic.

This research found one commonality among the three groups. According to Staley Brod, MD, professor of neurology at the University of Texas at Houston, the time gap between the first symptom to getting a diagnosis is no different. It's about a six-year span between the first symptom and the diagnosis for all ethnicities.

The strongest data about differences between races or ethnicities comes from the way it progresses among African Americans and Caucasians. According to Jonathan Howard, MD, assistant professor of neurology and psychiatry at the NYU Langone Multiple Sclerosis Comprehensive Care Center in New York City, African Americans get multiple sclerosis much less, so it’s less common, but it’s much more severe. Research in this area is complicated by the fact that many African Americans in the United States have Caucasian ancestry as well.

African Americans often have poorer health outcomes for a number of chronic diseases because they might be diagnosed at a later or more advanced stage or have less access to health care. However, for an as-yet unknown reason, even when African Americans take the same medications given to Caucasians, their MS progresses more quickly to an advanced state and a loss of mobility.

Dr. Howard was part of a team that observed more severe MS lesions on MRIs of African Americans compared to Caucasians, which indicates disease progression, but not an explanation of why the disease moves more quickly.

Economic Implications

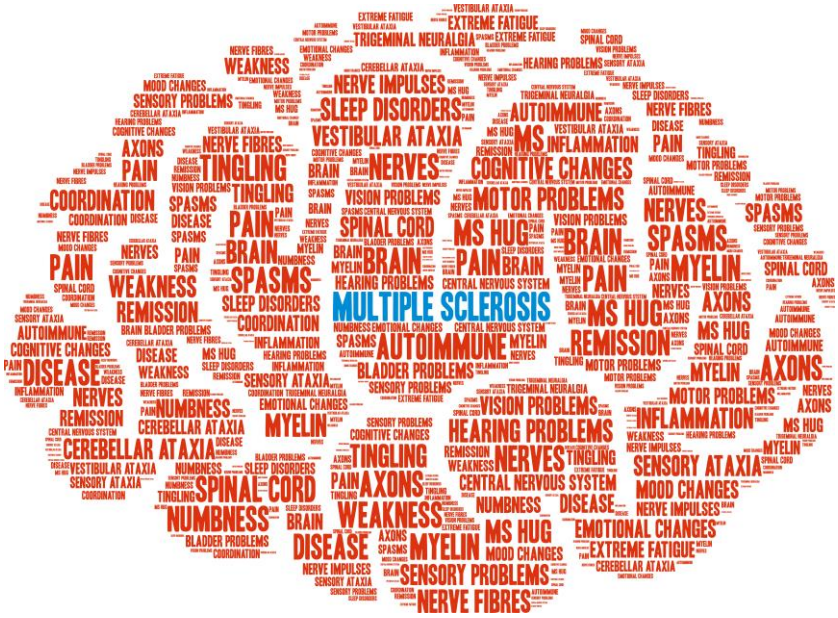
MS can substantially and adversely affect an individual's quality of life (QOL) and is associated with high costs for MS patients, their families, and society as a whole. Moreover, these burdens span a broad range of impacts, including prevalence of MS, direct costs, indirect costs, QOL, and other intangible costs (Trisolini, et al, 2010). A key issue for policy makers and advocacy organizations is the cost to society of MS. Cost of illness studies quantify the economic burden of specific diseases and can be used by policy makers to allocate research and service funding. Several cost-of-illness estimates for MS in many different countries have been published over the past 10 years, with all finding a high cost on a per person basis.

- According to the National MS Society, the average annual cost for someone with MS in the U.S., including both direct and indirect costs (i.e. lost wages), is approximately $69,000. Of this, approximately $39,000 consists of health care costs. Total cost for all people with MS in the U.S. is approximately $28 billion annually.
- Among people with MS, 5% of family incomes and 25% of individual incomes fall below the federal poverty level. (Minden et al, 2006)
- Compared to those with relapsing-remitting MS, people with primary progressive MS are more likely to be unemployed (82% vs 42%) and have lower family income. (Sonya Slfika Study, 2006)
- The costs associated with MS increase with greater disability. Costs for severely disabled individuals are more than twice those for persons with relatively mild disease. (Kobelt, et al, 2004)

Chapter Two
Multiple Sclerosis Terms

To better understand the terminology involved in Muscular Sclerosis, provided below is a glossary of terms.

Acute Attack: A sudden or severe exacerbation (also known as a relapse, attack, flare-up, or episode), in which existing symptoms worsen, or new symptoms develop. To be considered a true relapse, symptoms must be present for at least 24 to 48 hours, and not be associated with other factors that might mimic an acute attack, such as a urinary tract infection, anxiety, depression, hot weather, and extreme exercise. Relapses occur with relapsing-remitting, progressive-relapsing, and sometimes secondary-progressive forms of MS.



Advance (Medical) Directive: Written instructions that provide specific directions to doctors and family regarding a person's end-of-life choices in advance, should this person become unable to make these decisions on his or her own when needed. Typically include appointing a healthcare representative or proxy as well as creating a "living will."

Ankle-Foot Orthosis: A brace that holds and angles the foot and ankle in the best position for maximum comfort and mobility. This device can also relieve stress on the knee.

Antibody: A protein produced by the body's immune system when it detects foreign substances, called antigens. Examples of antigens include microorganisms (such as bacteria, fungi, parasites, and viruses) and chemicals. Antibodies may be produced when the immune system mistakenly targets healthy tissue, which happens with an autoimmune disorder. Each type of antibody is unique and defends the body against one specific type of antigen.

Antigen: A foreign molecule or substance that stimulates the immune system to activate a series of events to eliminate the antigen. In MS, the immune system misdirects the reactivity to antigens to damage the CNS, which is referred to as autoimmunity.

Assistive Devices: Tools, products, or types of equipment that help someone perform tasks and activities. They may help individuals to move around, see, communicate, eat, or get dressed. Some are high-tech tools, such as computers (which can be adapted to meet various disabilities such as reduced vision or dexterity/mobility problems). Others are much simpler, like a "reacher" – a tool that helps someone to grasp an object that is difficult to reach.

Assistive Technology: Any service or tool that can help a person with a disability perform activities that might otherwise be difficult or not be possible.

Ataxia: Inability to coordinate walking movements.

Atrophy (of the brain or muscles): The decrease in the volume of brain or muscle tissue often associated with MS.

Autoimmune Disease: When the body's own immune system attacks its own tissue, it is known as an autoimmune disease. MS is believed to be an autoimmune disease.

Autonomic Nervous System (ANS): The ANS helps control blood flow to and from the extremities; it also controls: heart rate; blood pressure; bowel, bladder, and sexual activity; and other automatic bodily functions.

Axon: The wire-like nerve fibers that conduct signals between neurons (nerves of the brain and spinal cord). Axons have a protective myelin covering and are found in the white matter of the brain. They are also located in peripheral nerves.

Axonal Damage: Damaged nerves that are unable to efficiently conduct impulse flow.

B-cells: Immune-system cells that produce antibodies to fight against "foreign invaders" (such as bacteria or viruses) within the body and help to regulate other immune cells. These cells have been shown to be an element of the autoimmune destruction seen in MS.

Babinski Reflex: The Babinski reflex occurs after the sole of the foot has been firmly stroked. The big toe then moves upward or toward the top surface of the foot. The other toes fan out. This reflex is normal in children up to 2-years old. It disappears as the child gets older. When the Babinski reflex is present in a child older than 2 years or in an adult, it is often a sign of a brain or nervous-system disorder. Multiple sclerosis is among the disorders that could be indicated by this reflex in people older than 2 years.

Bell's Palsy: Bell's palsy is the most common cause of facial paralysis. It usually affects just one side of the face. Symptoms appear suddenly and are at their worst about 48 hours after they start. They can range from mild to severe and include twitching, weakness, paralysis, drooping eyelid or corner of mouth, drooling, dry eye or mouth, excessive tearing in the eye, and impaired ability to taste.

Scientists think that a viral infection makes the facial nerve swell or become inflamed. Individuals are most likely to get Bell's palsy if pregnant, diabetic, or sick with a cold or flu. It can also occur with multiple sclerosis. Three out of four patients improve without treatment. With or without treatment, most people begin to get better within two weeks and recover completely within three to six months.

Blood-Brain Barrier (BBB): A protective barrier that lines the blood vessels, this layer of cells is designed to prevent damaging cells and other substances in the blood (including those that could cause disease) from entering the brain, optic nerves, and spinal cord of the CNS.

Brainstem: The back part of the brain above the base of the skull. Many nerves to the face come from this area.

Central Nervous System (CNS): Consists of the brain, optic nerves, and spinal cord and functions to send and receive nerve impulses throughout the body.

Cerebrospinal Fluid (CSF): The liquid that surrounds the brain and spinal cord.

Clinically Isolated Syndrome (CIS): Prior to a diagnosis of MS, CIS is a single attack (or the appearance of one or more symptoms characteristic of MS), with a very high risk of developing MS, when no other diseases or causes for symptoms are apparent.

Cognition: A group of mental processes that include functions such as memory, decision making, and concentration, which is the ability to focus on specific tasks and planning.

Cognitive Impairment: Some of the cognitive functions typically affected in people with MS include: information processing; perceiving; attending/responding to incoming information; information-processing speed; cognitive flexibility, such as attending to multiple stimuli at the same time ("multi-tasking"); problems with storage, manipulation, and retrieval of information; and executive function, which includes planning, working memory, attention, and problem-solving.

Corticosteroid: A steroid hormone produced in the adrenal gland. Cortisol reduces inflammation and is often used to treat unwanted inflammation in the brain that is connected to MS.

Cortisone: The name of the corticosteroid first used to treat MS relapses in 1951.

Cytokines: Small proteins that may stimulate or inhibit the function of other cells. They connect to specific receptors found on the surface of cells and send messages from one cell to another. They can stimulate or inhibit the inflammation process.

Demyelination: Damage to the protective (insulating) covering of the nerves (myelin) of the CNS, causing interruptions in the flow of nerve impulses in the CNS. This can ultimately affect a wide range of function. (Demyelination can occur outside the CNS as well, but myelin in the peripheral nervous system is chemically different than in the CNS which is why MS only affects the CNS.)

Diplopia: Double vision which can result from lesions in the brain stem, a part of the nervous system between the brain and cervical spinal cord.

Double-Blind Clinical Study: Neither the participants nor the medical staff administering or evaluating the new treatment are told who is receiving the drug and who is receiving the placebo or other drug being compared to the test drug.

Dysarthria: Speech that is abnormal as a result from problems in the brain interfering with the production of speech. There is loss of coordination and control of the speaking muscles. Speech becomes slurred or poorly articulated; it can involve a loss of volume control, unnatural emphasis on words or sentences, and a slower rate of speaking.

Dysesthesia: Type of pain that is experienced as a burning, aching, or "pins and needles" type of sensation under the skin. For some, this can be painful; for others, it is more bothersome.

Dysfunction: A medical term that describes abnormal function in a tissue or organ, usually based on disease.

Dysphagia: Swallowing dysfunction.

Dysphasia: Language disorder marked by deficiency in the generation of speech, and sometimes also in its comprehension, due to brain disease or damage.

Dysphonia: A type of Dysarthria that causes changes in the quality of speech, such as a breathless quality to the voice, or speech that sounds harsh.

Electromyography: An electrical test used to evaluate nerve and muscle problems.

Evoked Potentials: Evoked potentials measure the speed of the brain's response to visual, auditory (sound), or sensory (feeling) stimuli to the central nervous system, using electrodes (taped to the patient's head) and a computer. This system measures the time for an impulse to travel from the eye, ear, arm, or leg to the brain.

Exacerbation: An episode usually lasting days to weeks, not caused by fever or illness, where there are new or worsened neurological symptoms in patients with MS. Note that *exacerbation, attack, relapse*, and *flare* are all terms for the same thing.

Expanded Disability Status Scale: This 10-point scale (from 1 to 10 with half points) measures degrees of disability, largely in terms of mobility. Points 1 to 3 on the scale are primarily used to measure function; points 4 to 9 measure mobility. Half points are used for higher clarity.

Experimental Allergic Encephalomyelitis: An MS-like disease in animals, induced through the injection of myelin plus adjuvant (a substance that enhances the body's response), to enable investigators to see how experimental treatments affect this MS-like disorder (often in mice).

Gadolinium: A type of dye given via injection prior to magnetic resonance imaging (MRI). It serves to enhance areas of active inflammation and blood-brain barrier (BBB) breakdown.

Inflammation: A process where white blood cells as well as chemical messengers go to an area of the body to stimulate healing or to attack viruses or foreign material in the body.

Intermittent Self-Catheterization: A procedure to help bring urinary symptoms under control by inserting a catheter (a specially designed thin tube) into the urinary opening to drain urine from the bladder, for people who cannot empty their bladder normally (see neurogenic bladder).

Lesion: A localized area of abnormality. In MS, it is usually an area in the brain or spinal cord. This is not a specific term but is just a description of a finding usually seen on MRI or sometimes CT scanning.

Lhermitte's Sign: An electric shock-like sensation down the spine and legs when the neck is flexed forward; approximately 40 percent of individuals with MS experience this type of pain, although it usually does not require any treatment. It is often an indication of myelin damage in the spinal-cord area.

Lumbar puncture (LP): Also known as a spinal tap, LP is a procedure where a very thin needle is inserted at the lower back and a small amount of cerebrospinal fluid (CSF) is collected to look for induced changes or other problems.

Lymphocyte: A type of white blood cell that plays a strong role in the body's immune system, which works to defend the body against foreign bodies and disease. In MS, the lymphocytes may be misdirected to cause damage to the central nervous system. Some lymphocytes help to control the MS damage (T-regulatory cells).

Macrophage: Type of white blood cell that works to ingest and destroy foreign substances.

Magnetic Resonance Imaging: Scan of the brain and/or spine. The MRI uses a computer, radiofrequency stimulator, and a large electromagnet to provide a picture of the brain.

Monoclonal Antibody: Monoclonal antibodies are produced to defend the body and are derived from cells that are identical (cloned from a single cell and then replicated). They are produced from animal tissue, most commonly laboratory mice. Humanized monoclonal antibodies are antibodies from non-human species whose protein sequences have been modified to increase their similarity to antibodies produced naturally in humans. Monoclonal antibodies are an important type of medication, as they can be specifically targeted to perform a particular action, which is desirable when trying to impact a complex structure like the immune system. The name of all monoclonal antibodies ends with "mab." These antibodies attack and destroy specific inflammatory lymphocytes that may be damaging the CNS in MS.

Multiple Sclerosis Functional Composite: A scale that measures lower-limb function (walking), upper-limb function (arm movements), and cognition.

Myelin: Myelin is a fatty protein that serves as a protective covering and insulation to the nerves (called axons) that work like wires to carry messages to and from the CNS.

Neurogenic Bladder: Bladder problems resulting from demyelination in the nervous system pathways that control the muscles of the bladder and the sphincters of the urinary tract. The three categories of bladder problems are usually referred to as "failure to store" (small, spastic bladder), "failure to empty" (large, flaccid bladder), and "dyssynergia," which is a disconnect between the muscles of the bladder wall and the urinary sphincter.

Nocturia: The need to urinate during the night.

Nystagmus: Involuntary movements of the eyes that result from lesions in the brain stem, a part of the nervous system between the brain and cervical spinal cord. It typically is an uncontrolled side-to-side (horizontal) or up-and-down (vertical) movements of the eye. It can be asymptomatic (causing no visual problems) or severe enough to disturb vision. Objects may appear to jump or move unpredictably as the two eyes no longer coordinate well with each other. Nystagmus can be more of a nuisance than a major problem and is usually temporary. It may sometimes distort vision.

Oligoclonal Bands: Abnormal immune proteins called immunoglobulins. These are present in the CSF of roughly 90 percent of individuals with MS, however, they can occur with several other neurological disorders. Since the introduction of the MRI, CSF analysis is used less often, but it can be helpful in supporting an MS diagnosis if the MRI results are normal or inconclusive.

Oligodendrocyte: Cells that produce and maintain myelin. Over time, oligodendrocytes may be damaged or lost and fail to repair the damaged myelin.

Optic Neuritis: A condition that causes decreased or blurred vision. This is an inflammation of the optic nerve, which – unlike the nerves that innervate most of the body that are part of the peripheral nervous system – is actually part of the central nervous system and is myelinated in the same way as axons in the brain and spinal cord.

Osteoporosis: The loss of bone density.

Paresthesia: Tingling, burning, or numbing sensation.

Paroxysmal Symptom: Sudden recurrence of a symptom, spasm, or seizure.

Periventricular Region: This is the area around or near the ventricles, the spaces in the brain containing the cerebrospinal fluid.

Plaque: Areas of inflammation and damage in the brain or spinal cord in MS.

Primary-Progressive MS (PPMS): This form of MS presents a gradual but steady accumulation of neurological problems from the onset, without the presence of relapses and remissions.

Progressive-Relapsing MS (PRMS): A progressive course of MS from the onset with acute relapses occurring later in the disease course.

Pseudobulbar Affect (PBA): Characterized by uncontrolled, inappropriate, and/or exaggerated episodes of crying, laughing, or other emotional display. PBA occurs involuntarily with little or no stimulation to invoke such a response.

Pseudoexacerbation: A temporary worsening of symptoms without actual myelin inflammation or damage, brought on by other influences. These can include other illnesses or infection, over-exercise, a warm environment, depression, exhaustion, and stress. When symptoms flare, checking for a fever is important, since even a minor infection and slight increase in temperature can cause symptoms to appear.

Relapse (or exacerbation): A temporary worsening or recurrence of existing symptoms and/or the appearance of new symptoms (also called an "acute attack;" definition shown above), caused by inflammation occurring along the nerves and the myelin. This can range from a few days in duration to a few months, followed by a complete or partial recovery (remission). Acute physical symptoms and neurological signs must be present for at least 24 to 48 hours, without any signs of infection or fever, before the treating physician may consider this type of flare-up to be a true relapse. Treatments may improve recovery time.

Relapsing-Remitting MS (RRMS): A course of MS that includes temporary symptom flare-ups (also referred to as relapses, attacks, exacerbations, or bouts), which typically last for one to three months. These are followed by a complete or partial recovery.

Remission: Reduction and stability in severity of one's MS, or the disappearance of symptoms.

Remyelination: The restoration or repair of myelin (protective covering to the nerves).

Scanning Speech: Characterized by long pauses between syllables and words with loss of melody in speech production; it is a type of dysarthria.

Scotoma: Blind spot in the center of the visual field.

Secondary-Progressive MS (SPMS): This phase of MS follows relapsing-remitting MS (RRMS) and is reached when the patient experiences a progressive worsening of symptoms. SPMS may occur with or without superimposed relapses. Disease-modifying therapies for MS help to delay the conversion from RRMS to SPMS.

Spasticity: Uncontrolled involuntary continuous muscle contraction that occurs when the parts of the brain or spinal cord that controls that muscle is damaged. A tightness or stiffness of any muscle in the body but will typically occur in the legs (calf or thigh), groin, buttocks, arms, or hands.

Spinal cord: The major part of the nervous system that carries information up and down the spine from the brain to the nerves and from the nerves to the brain. It is affected in many people with MS.

T-lymphocytes or T-cells: Immune-system cells that have the ability to increase an immune response within the body, causing inflammation and damage in MS.

Trigeminal Neuralgia: A spontaneous, sharp or shooting facial pain, often brought on by a light touch or movement.

Ventricles: Are normal fluid-filled spaces in the brain. They contain the cerebrospinal fluid. Many MS lesions touch the surface of the brain where it contacts the ventricles. (A periventricular location is an 'around the ventricle' location.)

Vertigo: The sensation of "spinning or rotation," which may occur as the result of lesions in the brainstem areas that coordinate balance.

White matter lesions: Refers to localized changes in the white matter; in MS, these are plaques or lesions. There are other white matter lesions in patients with other disorders.

Chapter Three
Types of Multiple Sclerosis

Everyone with MS is different. How quickly the disease progresses and the symptoms one experiences won't necessarily be the same as someone else's with the condition. MS is a disease that starts early in life but progresses over time.

Patients usually experience a first neurologic event suggestive of MS known as Clinically Isolated Syndrome (CIS). It lasts for at least 24 hours, with symptoms and signs indicating either a single lesion or more than one lesion within the central nervous system. (Kappos, et al., 2006). CIS is a first episode of neurologic symptoms caused by inflammation and demyelination in the central nervous system. The episode, which by definition must last for at least 24 hours, is characteristic of multiple sclerosis but does not yet meet the criteria for a diagnosis of MS because people who experience a CIS may or may not go on to develop MS. When CIS is accompanied by lesions on a brain MRI (magnetic resonance imaging) that are similar to those seen in MS, the person has a high likelihood of a second episode of neurologic symptoms and diagnosis of relapsing-remitting MS. When CIS is not accompanied by MS-like lesions on a brain MRI, the person has a much lower likelihood of developing MS. Individuals with CIS who are considered at high risk for developing MS may now be treated with a disease-modifying therapy (DMT) that has been approved by the U.S. Food and Drug Administration (FDA) for that purpose. Early treatment of CIS has been shown to delay onset of MS.

Types of MS

There are 4 types of MS. They're named according to the way the disease acts on the body over time (Hooper, 2011). (See Figure 3.1)

Relapsing-Remitting MS (RRMS). This is the most common form of multiple sclerosis. About 85% of people with MS are initially diagnosed with RRMS. People with RRMS have temporary periods called relapses, flare-ups or exacerbations, when new symptoms appear.

Secondary-Progressive MS (SPMS) In SPMS, symptoms worsen more steadily over time, with or without the occurrence of relapses and remissions. Most people who are diagnosed with RRMS will transition to SPMS at some point.

Primary-Progressive MS (PPMS) This type of MS is not very common, occurring in about 10% of people with MS. PPMS is characterized by slowly worsening symptoms from the beginning, with no relapses or remissions.

Progressive-Relapsing MS (PRMS) A rare form of MS (5%), PRMS is characterized by a steadily worsening disease state from the beginning, with acute relapses but no remissions, with or without recovery.

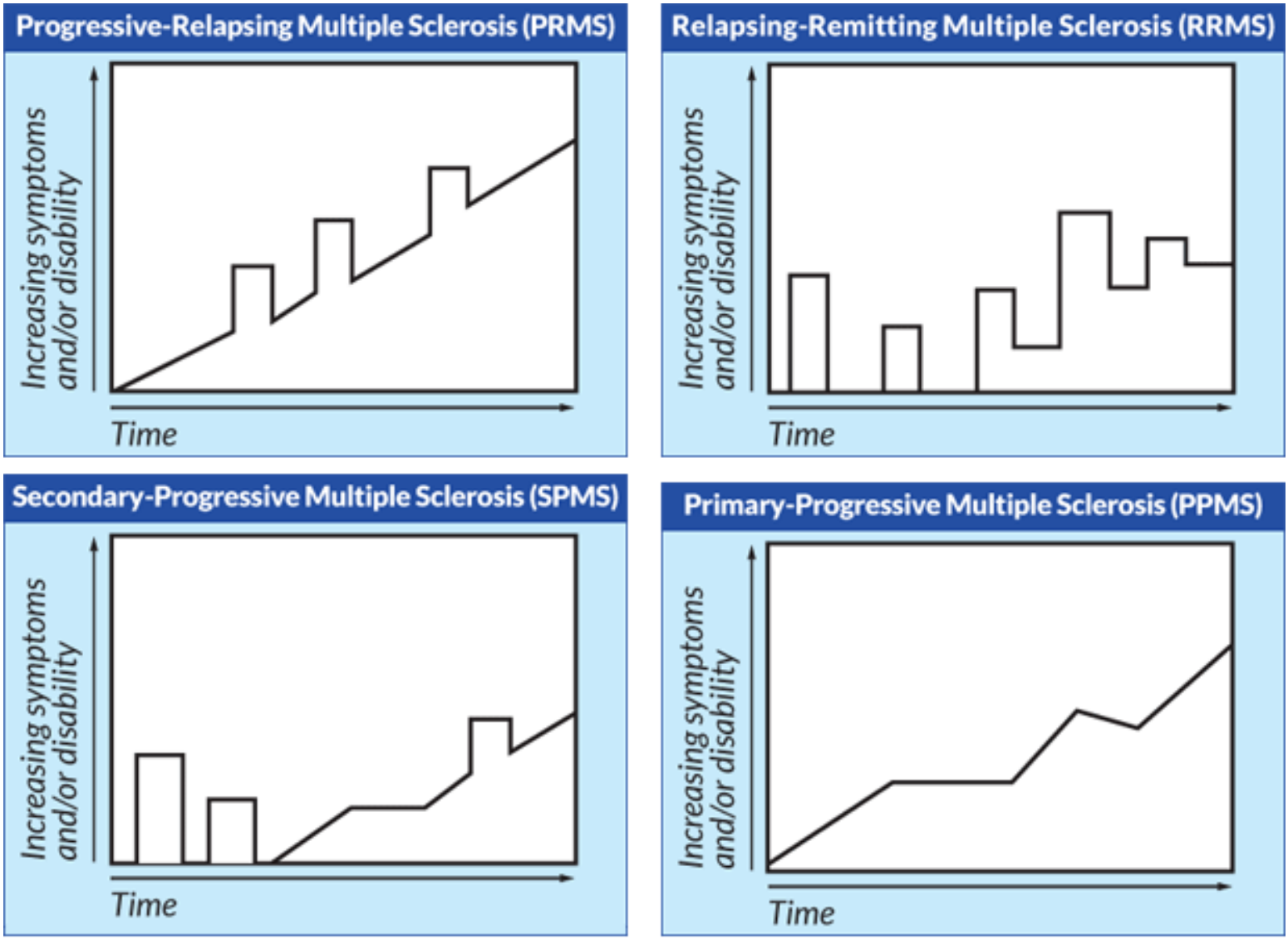


Figure 3.1

Chapter Four
Pathophysiology of Multiple Sclerosis and Affected Anatomy

Pathophysiology is a convergence of pathology with physiology. Pathology is the medical discipline that describes conditions typically observed during a disease state; whereas physiology is the biological discipline that describes processes or mechanisms operating within an organism. Referring to MS, the physiology refers to the different processes that lead to the development of the lesions and the pathology refers to the condition associated with the lesions. Nerve damage can occur anywhere in the spinal cord and/or brain, which is why MS symptoms may vary from person to person. Symptoms will occur depending on the location and severity of the white blood cell attack.

The nature of unmanaged multiple sclerosis (MS) produces recurrent attacks on the brain and spinal cord, which results in focal inflammatory lesions that can be visualized with magnetic resonance imaging (MRI). Unfortunately, 80-90% of lesions that form are silent and cannot be detected on the neurological examination, which exposes patients to a greater burden of disease and an increased risk of dysfunction. Furthermore, depending on which neurological components are affected, patients are at heightened risk for a broad suite of deficits, including weakness, spasticity, sensory loss, and cognitive issues. As the disease progresses, symptomatology may include bladder disruption, walking abnormalities, tremor, and fatigue. (See Figure 4.1)

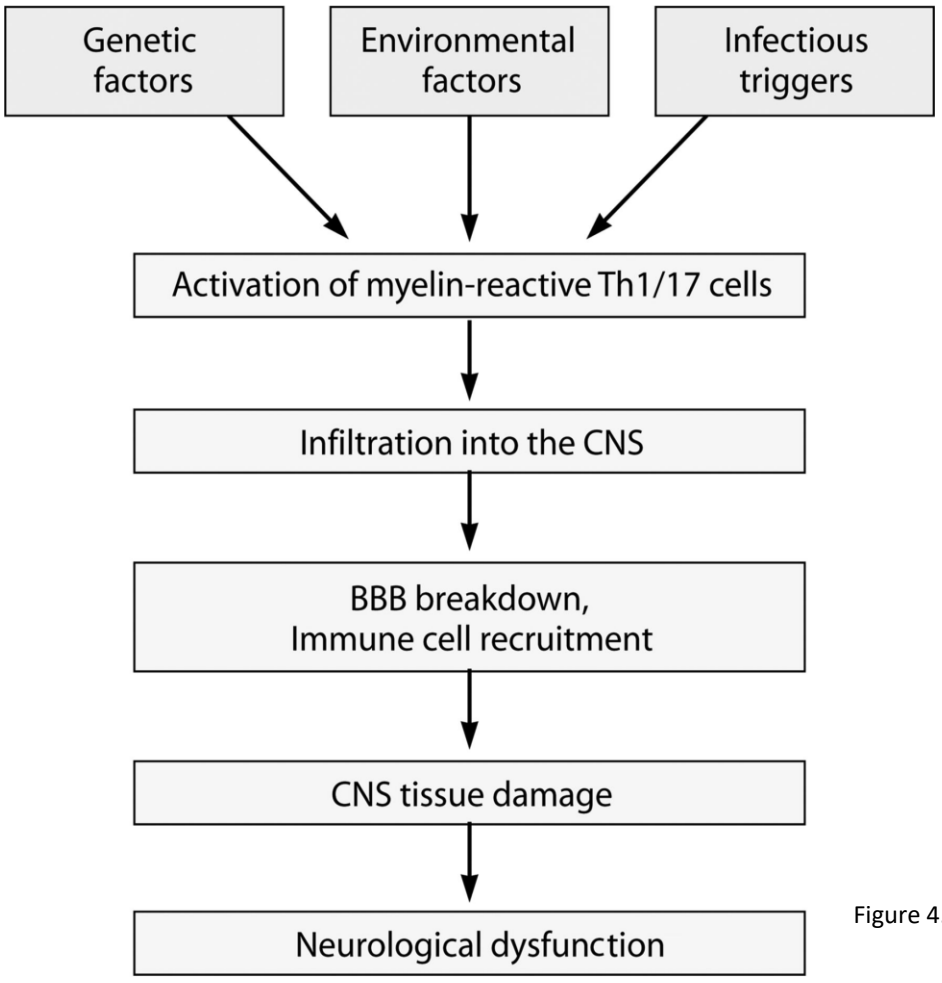
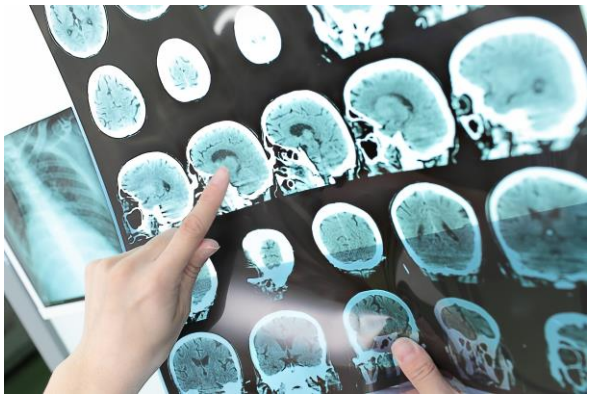


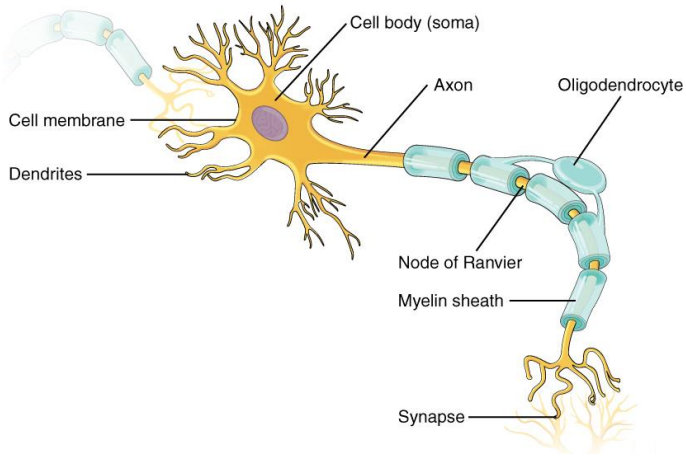
Figure 4.1

MS and the Brain



When tracking the pathology of MS, one can start at the brain. Virtually everyone with multiple sclerosis (MS) has signs of lesions in the brain, as shown by magnetic resonance imaging (MRI) scans. According to the National Multiple Sclerosis Society, about 95 percent of people with MS show brain lesions at the time of their diagnosis. The exterior portion of the brain is called the gray matter and the interior portion is called the white matter. The brain is composed of about 86 billion neurons which make up both the gray and white matter.

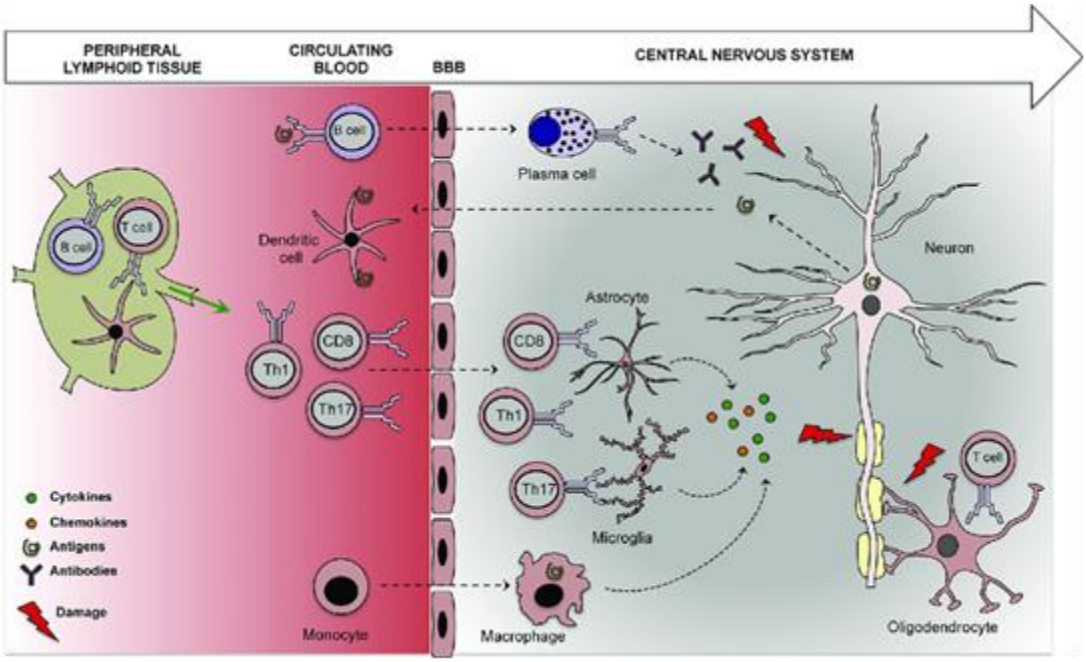
A neuron is composed of dendrites, the cell body (soma), the axon, and the axon's myelin. Also, within the neuron is the node of ranvier, oligodendrocyte, and the axon terminals. The dendrites and the cell body have a cell membrane, and that's really what gives the gray matter its color. The axon also has cell membrane, but the axon also has myelin, and it's the myelin that gives the white matter its color. Therefore, the dendrites and the cell body compose the grey matter, and the myelin that's wrapped around the axon composes the white matter. When one has MS, the lesions form throughout the white matter of the brain. This is evident because of the damage that the myelin incurs which makes up the white matter of the brain. If a person develops multiple sclerosis, one can see lesions when the immune system mistakenly recognizes the myelin as foreign and attacks it.



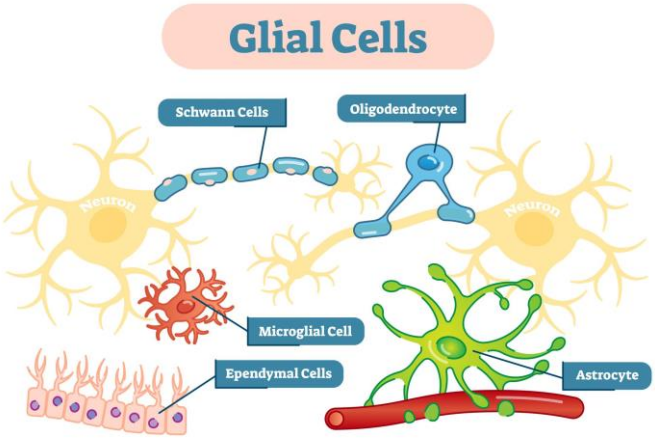
So how does the immune system actually make its way into the brain? The brain needs to receive massive nourishment from blood vessels. Ordinarily, the immune system travels through blood vessels. Coincidentally, the immune system is also traveling through the same blood vessels that the brain gets its nourishment. Outside each blood vessel are endothelial cells linked tightly together at what is called tight junctions. These linked endothelial cells outline each blood vessel by sitting on a foundation called the basement membrane. Together, the endothelial cells and the basement membrane compose what's called the blood brain barrier (BBB). The BBB is an important structure because it stops potentially harmful foreign bodies from entering the brain, i.e. viruses. The BBB also stops the immune system from entering the brain. The two main immune system cells that create damage to the myelin are the T Cells and B Cells. With a healthy BBB, these cells would not be able to enter the brain. However, if one has MS, the T Cells would be able to squeeze by the endothelial cells and break through the basement membrane. At that point, the T Cells can actually make their way into the brain which is uncharted territory or an unfamiliar environment for the T Cells.

Once the T Cell is in the brain and does not recognize a particular protein or distinct feature on the surface of the myelin, it then attacks the myelin thinking that it is a foreign object. In fact, it is the T-Cell that is the foreign entity in the brain. Once the T Cell does not recognize that part of the myelin, it'll set off an alarm and release chemicals called cytokines. Cytokines will promote the degradation of the BBB, so now the BBB becomes more permeable to more T Cells. The cytokines can also recruit

other immune cells like B Cells. Now B Cells are able to enter the BBB making antibodies for the myelin. Once B Cells make antibodies for the myelin, the myelin is targeted for further degradation. Macrophages which are a type of white blood cell of the immune system may be present as well which also physically degrade myelin. In addition, cytokines can actually be toxic to the myelin; therefore, cytokines can themselves degrade myelin leading to massive degradation of the myelin. This breaking down the BBB leads to a cluster of immune cells around a part of the brain which is called neuroinflammation.



It is thought to be inflammation that triggers the immune system to activate against the body. During a period of inflammation, attacking white blood cells can also kill glial cells. Glial cells surround nerve cells and provide support and insulation between them. They keep nerve cells healthy and produce new myelin when it's damaged. However, if glial cells are killed, they're less able to keep up with repair. Some of the new research for an MS cure is focused on transporting new glial cells to the site of myelin damage to help encourage reconstruction.



Nerve fibers also form scar tissue in areas of myelin damage. This tissue is stiff, hard, and blocks or obstructs the flow of messages between nerves and muscles. These areas of damage are typically called plaques or lesions and are a major signal of the presence of MS. In fact, the words "multiple sclerosis" mean "multiple scars."

This degradation seems pretty daunting; however, the brain actually does have a way of repairing itself. The brain also contains cells called oligodendrocytes. When myelin is degraded away, the oligodendrocyte will begin the process of remyelination. The rebuilding of the damaged myelin or the brain's natural healing process is called remyelination. However, as time goes on, that remyelination actually becomes less and less effective. The oligodendrocyte will continue to try to remyelinate the axon to the best of its abilities, but it'll ultimately just become overwhelmed by the power of the immune

system. The immune system will be persistent. The T-cells will just constantly release cytokines. The B-cells will always be around to release antibodies, and the macrophages will always be around to phagocytize or destroy the myelin. Ultimately, the remyelination process is constantly being overpowered by the immune system.

A current hypothesis states that with the progression of the disability, which marks the transition from RRMS to SPMS, occurs when ongoing irreversible tissue injury exceeds a critical threshold beyond which the nervous system can no longer compensate. It is thought that at this point that MS has primarily transitioned to a neurodegenerative condition with neurologic deterioration independent of ongoing inflammation, although superimposed inflammation can continue to cause additional injury. An important implication of this hypothesis is that the accumulation of irreversible tissue damage limits the potential for anti-inflammatory disease modifying therapies (DMTs) when used in the progressive stage of the disease. To be maximally effective, DMTs should be started early in patients with RRMS before permanent disability develops. Overall, an incomplete understanding of progressive MS pathogenesis has slowed the development of effective therapies and requires further inquiry. (Hersh and Fox, 2018)

MS and the Spinal Cord

The brain isn't the only area where lesions can develop. MS can also attack the spinal cord. Because finding these lesions involves more-elaborate imaging tests, spinal cord lesions in MS are studied less often, and many people with MS are not as aware of the role these lesions may play in the disease process.

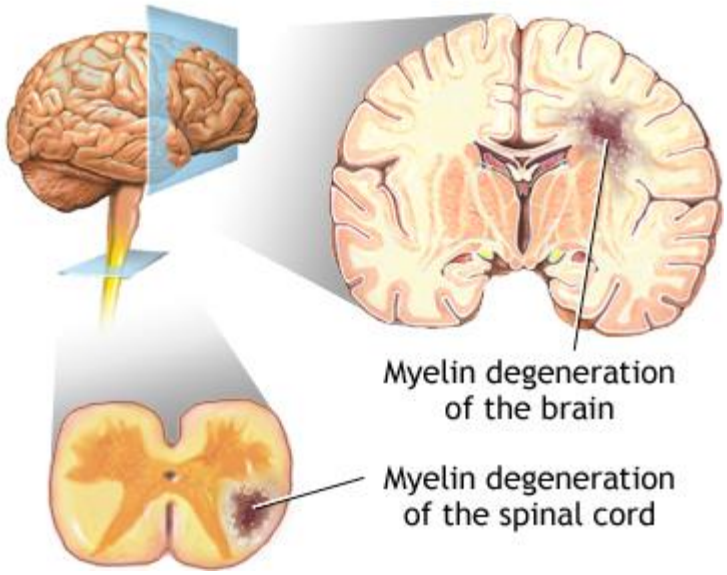
Spinal cord lesions in MS most likely form through the same mechanisms as those in the brain. White blood cells escape from the bloodstream, go through the blood–brain barrier, and get into the brain tissue. These cells cause inflammation mostly in the white matter — but also the gray matter — of the brain and spinal cord. Toxic chemicals produced by these cells strip the myelin insulation off the connections between nerves. The resulting lesions tend to be 1 to 2 centimeters in length or diameter.

Spinal MS is often associated with concomitant brain lesions; however, as many as 20% of patients with spinal lesions do not have intracranial plaques. Contrary to the white and gray matter in the brain, white and gray matter can both be affected in the spine. No strong correlation has been established between the extent of the plaques and the degree of clinical disability. Spinal cord atrophy is most relevant to progressive forms of MS (primary progressive and secondary progressive), in which it closely links to physical disability. Spinal cord lesions are more common in men, with later onset than in other forms of MS.

It's not uncommon with MS, however, to discover multiple silent brain lesions on magnetic resonance imaging (MRI) and find a person afflicted with only spinal cord problems due to the disease. Sometimes the symptomatic spinal cord lesions are more difficult to identify on scans than some clinically quiet but MRI evident brain lesions. About 90% of those with MS find that their spine is involved at some point.

As a central relay station for sensation, movement, balance and coordination for so much of the body, the spinal cord is crucial for limb function and the muscles involved in respiration.

Many with spinal cord problems and MS have numbness on one side of the body and weakness on the opposite side. They may lose standing balance or have a gait problem characterized by ataxia, such as the inability to walk a straight line. Paralysis and loss of sensation of part of the body are common. This can include total paralysis or numbness and varying degrees of movement or sensation loss.



Spinal cord lesions due to MS in the upper spine or neck (cervical region) can cause cape like sensation loss in both shoulders and in the upper arms. Quadriplegia is the great danger in cervical region MS. Anesthesia in a band like distribution around the trunk can be experienced in those with mid spinal cord inflammation and carry a chance that they could become paraplegic. All of those with MS in the spinal cord can potentially have bladder or bowel control problems. However, those with spinal cord MS of the lumbar region (the spinal cord ends at the beginning of the lumbar spine) can have symptoms dominated by retention of urine.

For those with MS, pain below the level of spinal cord involvement and sexual problems are the greatest complaints, even when there are motor difficulties in the limbs. Spinal cord induced pain is typically excruciating and often shoots down the spine (Lhermitte's Sign) or to the limb that is involved due to spinal cord damage.

Erectile dysfunction is common in men with spinal cord MS. Orgasmic and fertility problems can strike both sexes with cord lesions. Spasticity is another major problem for those with spinal cord problems of all types. The increase in muscle tone from spasticity can also be painful and movement limiting.

Medication and certain devices such as spinal cord stimulators can be valuable for many of these issues. Dyssynergia (movement incoordination) involves bladder muscle difficulties due to spinal cord MS. The incontinence and bladder emptying problems that results can be treated with medication as well.

Therapeutic research in spinal cord disorders including MS involves consideration for the transplantation of stem cells, the injection of nerve and brain derived growth factors, and medicines that can provide the energy source for spinal cord regrowth.

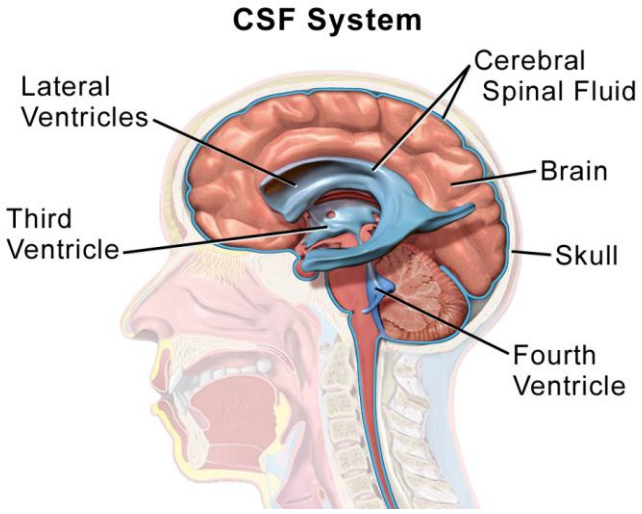
In addition, specialized conditioning and strengthening programs are critical in the rehabilitation patients with spinal cord problems.

In MS, an acute spinal cord attack is called Myelitis. Immunomodulator (medications used to help regulate or normalize the immune system) and steroid therapy is often utilized with success with a

dramatic reversal possible. If the MS patient has persistent neurological signs and symptoms from the spinal cord inflammatory attack, they are said to have a myelopathy.

Often the severity of MS is very much related to how bad the myelopathy is. Progressive MS can be characterized by spinal cord shrinkage (atrophy) over time. Reversal of this aspect of advancing MS remains a great challenge for ongoing research. Defeating the immunological process that triggers both the brain and spinal cord damage in MS is the best defense against the terrible effects of spinal cord involvement in demyelinating disease.

Cerebrospinal fluid (CSF) is a clear, colorless liquid that surrounds the brain and spinal cord. While the primary function of CSF is to cushion the brain within the skull and serve as a shock absorber for the central nervous system, CSF also circulates nutrients and chemicals filtered from the blood and removes waste products from the brain. In MS, damage to myelin causes certain types of proteins to be released into the spinal fluid. When these proteins are identified in the spinal fluid, but not in the blood, MS is thought to be one of the possible diagnoses. Spinal fluid is obtained through a lumbar puncture (also known as a spinal tap).



The CSF of people with MS usually contains:

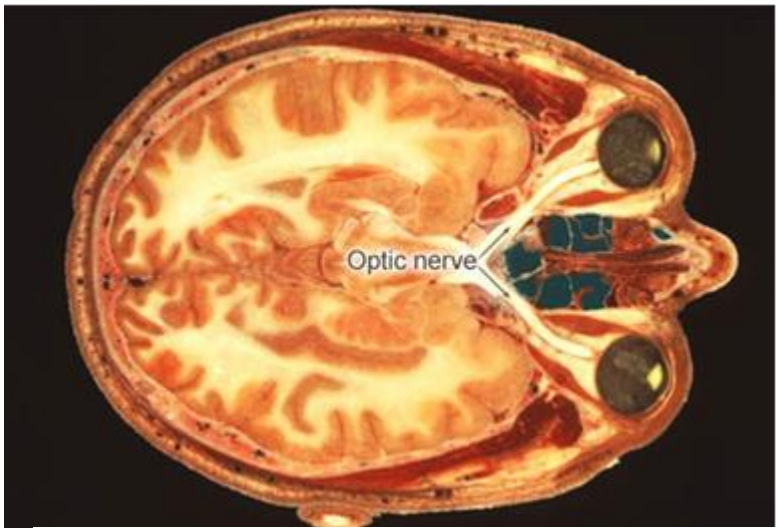
- A specific group of proteins called oligoclonal bands
- Elevation of the level of protein

These findings indicate an abnormal immune response within the central nervous system, and may be suggestive of MS. It is important to know that an abnormal immune response in the CSF is found in a number of other diseases, so the test is not specific for MS. In people with a confirmed diagnosis of MS, 5-10% do not show abnormalities in the CSF. Therefore, CSF analysis by itself cannot confirm or exclude a diagnosis of MS. The results are used in combination with the history, neurological examination, MRI and other tests to help make an accurate diagnosis.

MS and Optic Nerves

Optic neuritis (ON) is a common manifestation of multiple sclerosis (MS), and refers to an acute inflammation of the optic nerve (a bundle of nerve fibers that transmits visual information from your eye to your brain). It can be the initial demyelinating event in up to 20% of patients and occurs in almost half of patients with MS. ON associated with demyelinating disease is generally characterized by acute to subacute, painful, and monocular vision loss. Vision typically worsens over hours to days (not months), and recovery is expected to begin within 1 month of symptom onset. The pain that occurs with optic neuritis is usually ocular, retroocular, periorbital, or a frontal headache. This pain is generally exacerbated with extraocular movements and occurs in most patients with typical ON.

Furthermore, axonal damage may occur in some cases and this damage can be identified as a thinning of the retinal nerve fiber layer (RNFL) using computerized imaging technologies such as optical coherence tomography (OCT). OCT is a noninvasive imaging technique that enables high-resolution quantification of retinal structures and can detect subclinical changes in MS patients as well. RNFL and ganglion cell/inner plexiform layer (GCIP) thinning has been demonstrated in individuals with MS, not only in those with previous ON but also in those without it.



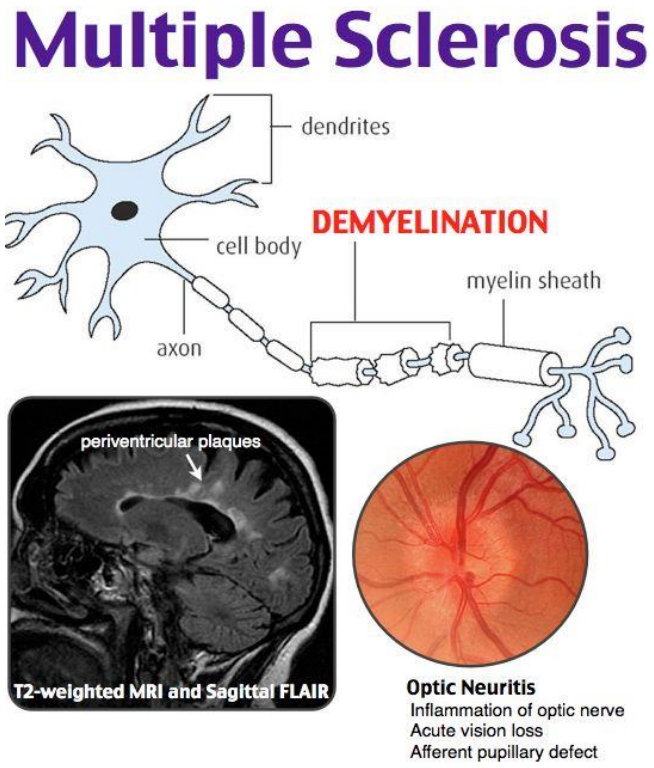
The exact cause of optic neuritis is unknown. It's believed to develop when the immune system mistakenly targets the substance covering the optic nerve (myelin), resulting in inflammation and damage to the myelin. Normally, the myelin helps electrical impulses travel quickly from the eye to the brain, where they're converted into visual information. Optic neuritis disrupts this process, affecting vision. In people with optic neuritis, the risk of developing multiple sclerosis following one episode of optic neuritis is about 50 percent over a lifetime. The risk of developing multiple sclerosis after optic neuritis increases further if an MRI scan shows lesions on the brain.

Other factors that have been linked to the development of optic neuritis include:

- Infections. Bacterial infections, including Lyme disease, cat-scratch fever and syphilis, or viruses, such as measles, mumps and herpes, can cause optic neuritis.
- Other diseases. Diseases such as sarcoidosis and lupus can cause recurrent optic neuritis.
- Drugs. Some drugs have been associated with the development of optic neuritis. They include quinine and some antibiotics.

Risk factors for developing optic neuritis include:

- Age. Optic neuritis most often affects adults ages 20 to 40.
- Sex. Women are much more likely to develop optic neuritis than men are.
- Race. In the United States, optic neuritis occurs more frequently in whites than it does in blacks.
- Genetic mutations. Certain genetic mutations might increase the risk of developing optic neuritis or multiple sclerosis.



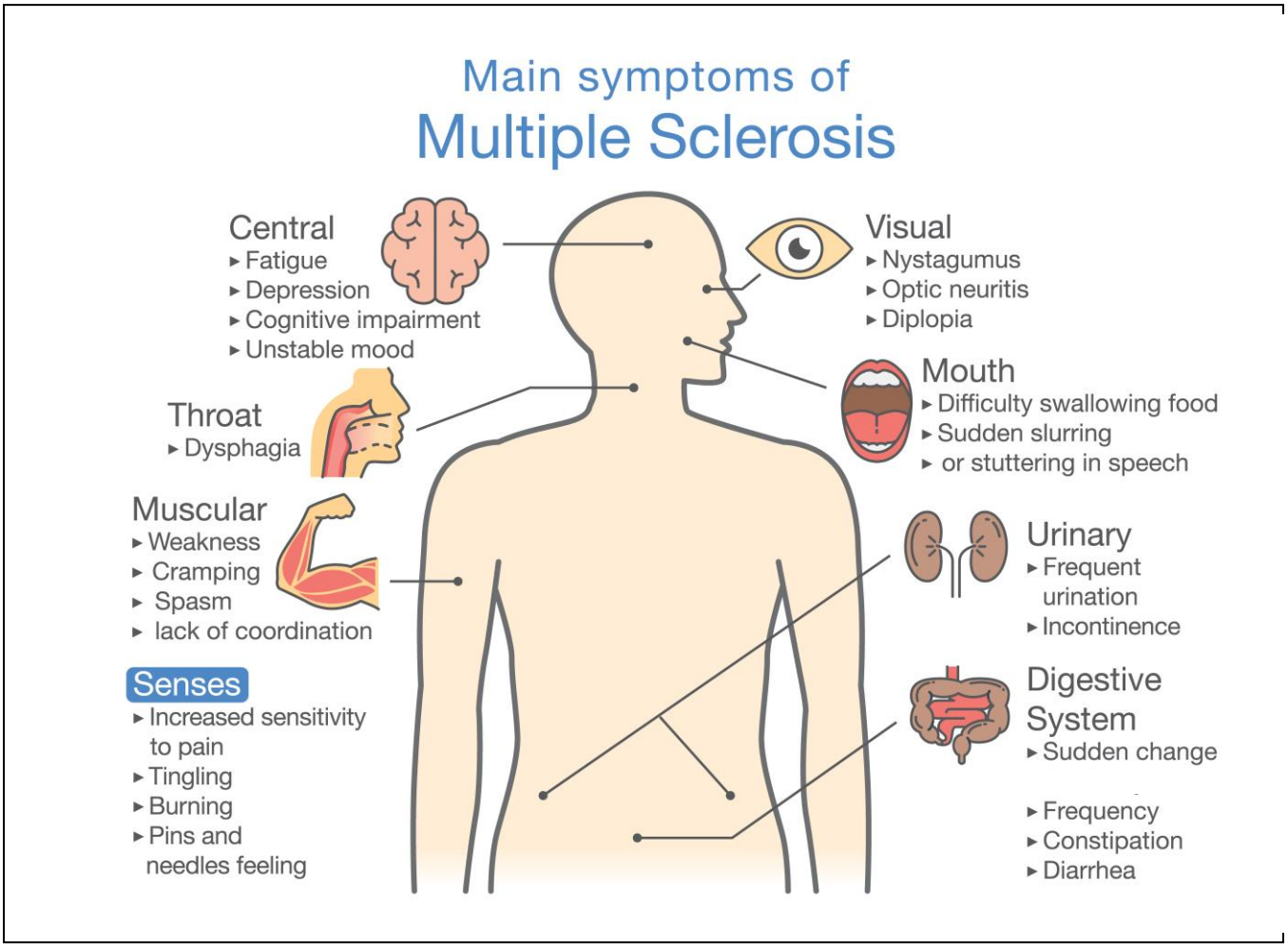
Complications arising from optic neuritis may include:

- Optic nerve damage. Most people have some permanent optic nerve damage after an episode of optic neuritis, but the damage might not cause symptoms.
- Decreased visual acuity. Most people regain normal or near normal vision within several months, but a partial loss of color discrimination might persist. For some people, vision loss persists after the optic neuritis has improved.
- Side effects of treatment. Steroid medications used to treat optic neuritis subdue the immune system, which causes the body to become more susceptible to infections. Other side effects include mood changes and weight gain.

Chapter Five
MS: Symptoms, Causes, Risk Factors, Diagnosis, and Treatments

Symptoms

Multiple sclerosis causes many different symptoms. The symptoms, severity, and duration can vary from person to person. Some people may be symptom free most of their lives, while others can have severe chronic symptoms that never go away. Signs and symptoms of MS vary widely and depend on the amount of nerve damage and which nerves are affected. Some people with severe MS may lose the ability to walk independently or at all, while others may experience long periods of remission without any new symptoms. There's no cure for multiple sclerosis. However, treatments can help speed recovery from attacks, modify the course of the disease and manage symptoms.



Symptoms of MS can be divided into two categories, Common Symptoms and Less Common Symptoms.

Common Symptoms

- Fatigue: Occurs in about 80% of people, can significantly interfere with the ability to function at home and work, and may be the most prominent symptom in a person who otherwise has minimal activity limitations.
- Walking (Gait) Difficulties: Related to several factors including weakness, spasticity, loss of balance, sensory deficit and fatigue, and can be helped by physical therapy, assistive therapy and medications.
- Numbness or Tingling: Numbness of the face, body, or extremities (arms and legs) is often the first symptom experienced by those eventually diagnosed as having MS.
- Spasticity: Refers to feelings of stiffness and a wide range of involuntary muscle spasms; can occur in any limb, but it is much more common in the legs.
- Weakness: Weakness in MS, which results from deconditioning of unused muscles or damage to nerves that stimulate muscles, can be managed with rehabilitation strategies and the use of mobility aids and other assistive devices.
- Depression: Studies have suggested that clinical depression — the severest form of depression — is among the most common symptoms of MS. It is more common among people with MS than it is in the general population or in persons with many other chronic, disabling conditions.
- Other Common Symptoms: Other common symptoms include vision problems, dizziness, vertigo, bladder problems, bowel problems, sexual problems, pain, itching, cognitive changes, and emotional changes.

Less Common Symptoms

Less common symptoms include speech problems, swallowing problems, tremors, seizures, breathing problems, respiration problems and hearing loss.

Causes and Risk Factors

The cause of MS is not known. Scientists believe MS is triggered by a combination of factors. To identify the cause, research is ongoing in areas of:

Immunology (the study of the body's immune system): In MS, an abnormal immune response causes inflammation and damage in the CNS. Many different cells are involved in the abnormal immune response. Two important types of immune cells are T cells and B cells.

- In MS, T cells become activated in the lymph system and enter the CNS through blood vessels. Once in the CNS, T cells release chemicals that cause inflammation and damage. This results in damage to myelin, nerve fibers, and the cells that make myelin. T cells are also important to help activate B cells and call on other immune system cells to participate in the immune attack.
- T regulatory cells, a type of T cell, dampen or turn off inflammation. In MS, T regulatory cells do not function correctly and do not effectively turn off inflammation.
- Cytotoxic or "killer" T cells directly attack and destroy cells bearing certain characteristics
- B cells become activated with the help of T cells. B cells produce antibodies and stimulate other proteins and in MS, these cause damage in the CNS.

Environment: Although the cause of MS is not known, more is being learned about environmental factors that contribute to the risk of developing MS. There is no single risk factor that provokes MS, but

several environmental factors are believed to contribute to the overall risk.

- Geographic: MS is known to occur more frequently in areas that are farther from the equator. Epidemiologists — scientists who study disease patterns in large groups of people— are looking at variations in geography, demographics (age, gender and ethnic background), genetics, infectious causes and migration patterns in an effort to understand why.
- Vitamin D: Growing evidence suggests that vitamin D plays an important role in MS. Low vitamin D levels in the blood have been identified as a risk factor for the development of MS. Some researchers believe that sun exposure (the natural source of Vitamin D) may help to explain the north-south distribution of MS.
- Smoking: The evidence is also growing that smoking plays an important role in MS. Studies have shown that smoking increases a person's risk of developing MS and is associated with more severe disease and more rapid disease progression. Also, cessation of smoking slows the progression of MS.
- Obesity: Several studies have shown that obesity in childhood and adolescence, particularly in girls, increased the risk of later developing MS.

Genetics (understanding the genes that may not be functioning correctly in people who develop MS): MS is not an inherited disease, meaning it is not a disease that is passed down from generation to generation. However, in MS there is genetic risk that may be inherited. Research is ongoing to better understand genetic risk and other factors that contribute to the development of MS.

- In the general population, the risk of developing MS is about 1 in 750 – 1000 (.01%)
- In identical twins, if one twin has MS the risk that the other twin will develop MS is about 1 in 4.
- The risk of developing MS is also increased when other first degree relative (parents, siblings and children) have MS, but far less than in identical twins.
- The risk for a child with one parent who has MS is approximately 2%.
- The risk for a child with two parents who have MS is approximately 12.2%
- About 200 genes have been identified that each contribute a small amount to the overall risk of developing MS.

Infectious Agents (such as viruses): Researchers are considering the possibility that bacteria and viruses may cause MS. Viruses are known to cause inflammation and a breakdown of myelin. Therefore, it's possible that a virus could trigger MS. It's also possible that the bacteria or virus that have similar components to brain cells trigger the immune system to mistakenly identify normal brain cells as foreign and destroy them. Several bacteria and viruses are being investigated to determine if they contribute to the development of MS.
These include:

- measles,
- canine distemper,
- human herpes virus-6,
- Epstein-Barr virus (EBV)

Other risk factors for MS:

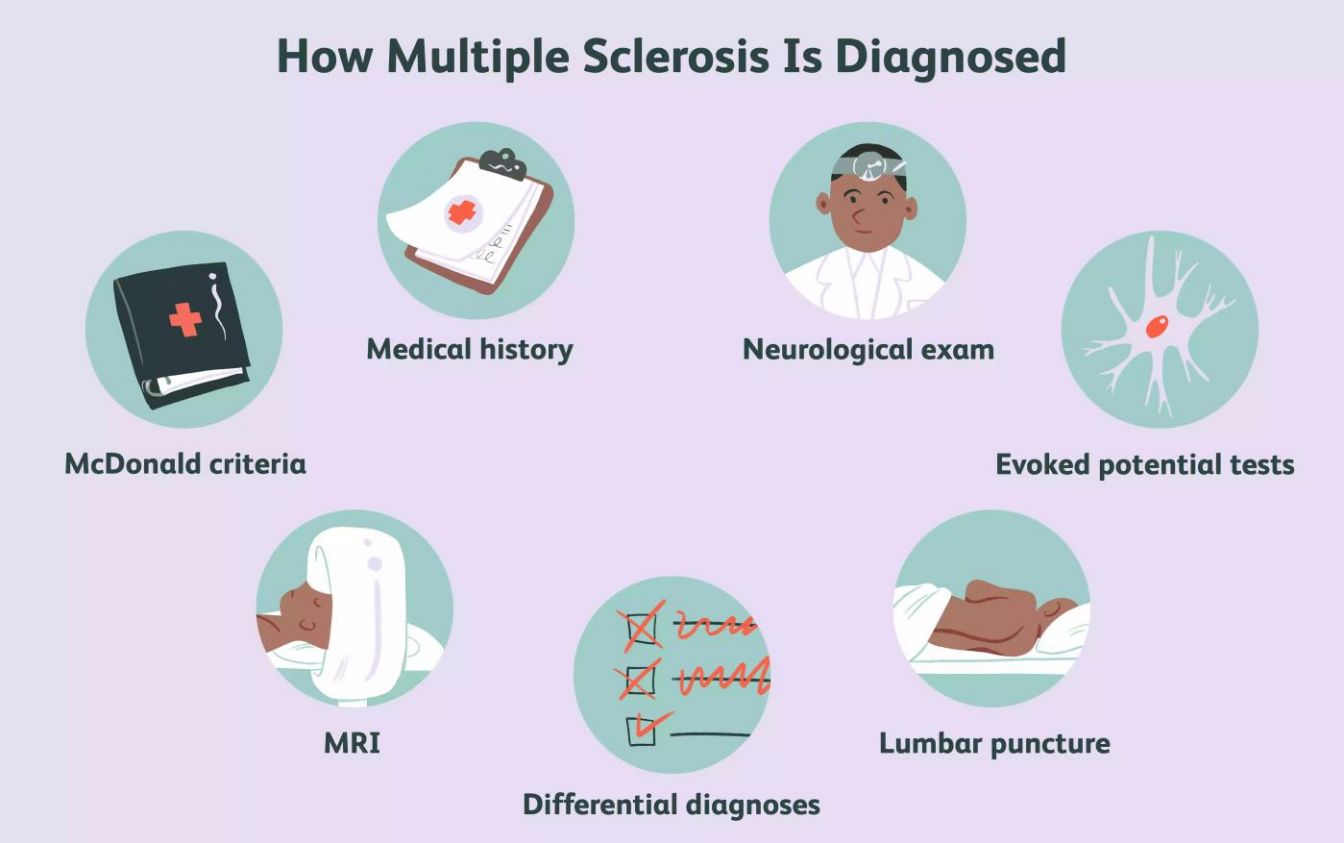
- Age: MS can occur at any age, but usually affects people somewhere between the ages of 16 and 55.
- Gender: Women are more than two to three times as likely as men are to have relapsing-remitting MS.
- Race: White people, particularly those of Northern European descent, are at highest risk of developing MS. People of Asian, African or Native American descent have the lowest risk.

- Climate: MS is far more common in countries with temperate climates, including Canada, the northern United States, New Zealand, southeastern Australia and Europe.
- Certain autoimmune diseases: You have a slightly higher risk of developing MS if you have thyroid disease, type 1 diabetes or inflammatory bowel disease.

Diagnosis

Diagnosing MS is complex and requires a complete review of one's medical history, and will include a physical exam and various tests. At this time, there are no symptoms, physical findings or laboratory tests that can, by themselves, determine if one has MS. Several strategies are used to determine if one meets the criteria for a diagnosis of MS, and to rule out other possible causes of whatever symptoms one is experiencing. These strategies include a medical history, a neurologic exam and various tests including magnetic resonance imaging (MRI), spinal fluid analysis, and blood tests to rule out other conditions. (National Multiple Sclerosis Society, 2006)

Regardless, it is imperative that the diagnosis of MS is timely and accurate since permanent neurologic damage can occur even in the earliest stages of MS. Having a quick and accurate diagnosis of MS will enable one to start the appropriate treatment(s) as early in the disease process as possible.



Criteria for a diagnosis of MS: The Revised McDonald Criteria, published in 2017 by the International Panel on the Diagnosis of Multiple Sclerosis, include specific guidelines for using MRI and cerebrospinal fluid analysis to speed the diagnostic process. MRI is used to demonstrate lesion dissemination in time (DIT) and space (DIS). The MRI can be used to look for a second area of damage in a person who has experienced only one attack (also called a relapse or an exacerbation) of MS-like symptoms — referred to as clinically-isolated syndrome (CIS). The MRI can also be used to confirm that damage has occurred at two different points in time. In some circumstances, the presence of

oligoclonal bands in a person's cerebrospinal fluid analysis can be used instead of dissemination in time to confirm the MS diagnosis. (Mantero, V., et al. 2018)

- Find evidence of damage in at least two separate areas of the central nervous system (CNS), which includes the brain, spinal cord and optic nerves AND
- Find evidence that the damage occurred at different points in time AND
- Rule out all other possible diagnoses

Medical History: A medical history, including past and present symptoms, will provide the physician with important information when diagnosing MS. A physician may also ask about past treatments and ongoing medical conditions in addition to gathering information about birthplace, family history, environmental exposures, history of other illnesses and places traveled that might provide further clues.

Physical and Neurological Examination: One's healthcare provider will perform a comprehensive neurologic exam, which includes tests of cranial nerves (vision, hearing, facial sensation, strength, swallowing), sensation, reflexes, coordination, walking and balance. A physical examination may reveal MS signs including:

- Irregular eye movement
- Changes in the way one talks
- Lack of coordination
- Sensory disturbances
- Changes in reflexes
- Weakness/spasticity in arms or legs

In many instances, medical history and neurologic exam provide enough evidence to meet the diagnostic criteria. Other tests are used to confirm the diagnosis or to identify other possible causes of the symptoms or neurological exam findings.

MRI Test: A common test in MS diagnosis is the magnetic resonance imaging test (MRI). An MRI can detect the distinctive lesions or scars in the central nervous system (brain, spine and optic nerve) that give multiple sclerosis its name. MRI is used to demonstrate lesion dissemination in time (DIT) and space (DIS). As MRI technology improves, the diagnosis of MS will be made more quickly and easily.

The 2017 diagnostic criteria for MS make it possible to diagnose MS in a person with CIS who also has specific findings on brain MRI that provide evidence of an earlier episode of damage in a different location and indicate active inflammation in a region other than the one causing the current symptoms. After reviewing one's medical history, doing a physical exam, and performing an MRI, healthcare teams sometimes have enough information to make a diagnosis of MS. In some cases, one may need additional tests to make a confirming diagnosis (spinal tap, blood tests, etc.).

Blood tests: While there is no definitive blood test for MS, blood tests can rule out other conditions that cause symptoms similar to those of MS, including lupus erythematosis, Sjogren's, vitamin and mineral deficiencies, some infections, and rare hereditary diseases.

Spinal tap (lumbar puncture): A sample of cerebrospinal fluid is removed and analyzed. The protein content of the fluid may be higher than normal. The concentration of antibodies may be high, and a specific pattern of antibodies (called oligoclonal banding) is detected in most people with multiple sclerosis.

Evoked responses: For this test, sensory stimuli, such as flashing lights, are used to activate certain areas of the brain, and the brain's electrical responses are recorded. In people with multiple sclerosis, the brain's response to stimuli may be slow because the demyelinated nerve fibers cannot conduct nerve signals normally. This test can also detect slight damage to the optic nerve.

Treatments

If one is diagnosed with MS or experiences a first-time MS event, he/she should consider talking about starting treatment as soon as possible with a healthcare team. Researchers have found that MS often causes more damage in the first year than in later years.

There are various MS treatment options available today that have been shown to decrease the frequency of relapses and to delay disease progression. There are several ways that these treatment options can be taken. Some treatments use an injection—either subcutaneous (under the skin) or intramuscular (into the muscle)—while others are given intravenously (via an infusion) or orally (by mouth).

When working with those who are taking medications for MS, it would be prudent to adjust the exercise routines in response to the side effects that one may experience. Side effects from infusions may include fatigue, nausea, headaches, and fever. Whereas one may experience tender spots from injections. Clients will usually know how they feel after treatment, but timing and programming of sessions relative to the treatment days should be taken into consideration. Communication with the client is key to providing the best exercise programming possible.

All of the medications listed below are disease modifying agents and are listed for educational purposes:

- **Beta interferons (Avonex, Betaferon, Extavia, Plegridy, Rebif)** are injectable medications used for the treatment of relapsing-remitting MS. Certain beta interferon products also may be used for a first clinical episode with MRI findings consistent with MS. Depending on the medication, injections for beta interferons can be either subcutaneous or intramuscular and dosing can vary from every other day to once a week.
- **Glatiramer acetate (Copaxone)** is given by subcutaneous injection every day for the treatment of relapsing-remitting MS. It is also used for patients who have experienced a first clinical episode and have MRI findings consistent with MS.
- **Fingolimod (Gilenya)** is a once-daily oral capsule indicated for the treatment of relapsing forms of MS to reduce the frequency of clinical exacerbations and to delay the accumulation of physical disability.
- **Teriflunomide (Aubagio)** is a once-daily oral tablet used for the treatment of patients with relapsing forms of multiple sclerosis.
- **Dimethyl fumarate** is an oral capsule taken twice a day that is used to treat people with relapsing forms of MS.
- **Mitoxantrone (Novantrone)** is a chemotherapeutic agent for the treatment of worsening relapsing-remitting MS, progressive-relapsing MS or secondary-progressive MS, and is used to reduce neurologic disability and/or the frequency of clinical exacerbations. It is administered intravenously by an infusion once every three months.
- **Natalizumab (Tysabri)** is an intravenous medication reserved for patients with rapidly progressing MS or with high disease activity despite the use of an alternate MS therapy. It is administered once every four weeks.

Chapter Six
MS Lifestyle Management

If one is living with multiple sclerosis (MS), maintaining well-being and independence may involve changing the way some things are performed and managed. One may find it helpful, or necessary, to adjust areas of the home and lifestyle in order to make daily tasks easier and less tiring. Focusing on good self-care also makes a difference. Following a well-balanced diet and getting regular physical movement may reduce the impact of the symptoms.

Reduce daily stress: Stress worsens multiple sclerosis symptoms, but MS in and of itself can also be stressful. Here are some stress management techniques that will help reduce stress:

- Prioritize to do items
- Manage time effectively
- Deep breathing exercises
- Depression and anxiety management through medication and therapy
- Ask for help with certain tasks

Create convenience: Creating convenience reduces the daily demands on your energy. Little changes can make a big difference. Here are a few simple examples that might be helpful depending on the individual circumstances:

- Keep a journal (either hand-written or digital) so that all the information about one's condition is in one place.
- Consider using voice-to-text software so one doesn't have to type on the computer.
- Place the items used most in the location that's easiest to reach.
- Consider using occupational therapy tools to help with fine motor tasks such as pulling on socks and opening jars.
- Invest in a mini fridge for the room in which one spends most time.
- Use a smartphone app to schedule reminders.
- Sometimes ask friends and family members for help like shopping or reorganizing.

Stay Comfortable: Many people who live with MS are sensitive to changes in temperature. One's symptoms may worsen when he/she feels too warm.

To help you avoid overheating, consider these options:

- Try hot weather clothing containing gel packs that stay cool.
- Purchase a firmer mattress with a cooling surface or buy cooling pads for existing mattress.
- Take cool baths.
- Stay hydrated so that the body can better regulate its temperature.
- It's also useful simply to use fans or air-conditioning in the home.

When it comes to keeping the body comfortable day or night, a few comfort tips may help:

- Sleep with a pillow under your knees to reduce the pressure on your back.
- Stretch daily to relieve muscle soreness and spasticity.
- Build your core strength to reduce back, joint, and neck pain.

Get plenty of sleep: Nearly half of those with MS also have sleep disturbances at night. Fatigue is a signature MS symptom. In addition, adults living with MS show a strong link between depression and sleep problems. Getting treatment for depression could help one sleep better. But one should also consider his/her sleep habits. One should develop a consistent bedtime and wake-up time, as well as a soothing bedtime ritual. MS symptoms such as leg pain and spasms may also be preventing restorative sleep. One should work together with his/her doctor to develop a management plan that is getting the patient the sleep needed.

Conserve energy: Fatigue is a common symptom of MS. One should keep a steady pace throughout the day and take breaks as needed.

- Work while sitting as needed, such as when folding laundry.
- Use a trolley for setting and clearing the table or putting away laundry.
- Keep cleaning supplies in every room rather than transporting them around the house.
- Use a bath bench and a removable shower head so one can sit while showering.
- When showering, avoid bar soap that can slip away, and instead choose a liquid soap dispenser.
- Purchase lightweight bedding for less restriction on movements.

Keep safe: Certain common MS symptoms, such as reduced motor control and balance issues, can potentially impact one's physical safety. One should talk to the doctor if he/she experiences symptoms that might put one at risk for a fall. Basic updates to the home and changes to one's habits:

- Buy comfortable shoes with good tread.
- Use a non-skid bath mat.
- Make sure appliances like the kettle, coffee pot, and iron have an auto shutoff.
- Point sharp utensils downward when loading a dishwasher.
- Always leave the bathroom door unlocked.
- Keep your cell phone with you at all times.
- Add extra handrails where they might help, such as on the stairs or in the bathroom.
- Share concerns about falling with family and friends. They can check in on one if time is spent alone.

Move the body: Although fatigue is a common symptom of MS, exercise can help. Exercise also enhances strength, balance, endurance, and flexibility. Physical activity also reduces the risk of certain secondary diagnoses, such as heart disease. Exercise doesn't have to be intense cardio or heavy weights to be beneficial. It can be a gentler activity such as gardening or household chores. The goal is to be active and move every day.

Eat healthy: A healthy diet is good for everyone, but when one lives with a chronic condition like MS, eating right is even more important. A balanced, nutrient-rich diet helps the entire body function better. Eat a variety of fruits, vegetables, and lean protein sources each day. One should eat a mix of healthy carbohydrates particularly whole-grain options (such as oats or whole-wheat bread) along with sources of healthy fats (such as nuts, avocados, or extra virgin olive oil). One should talk to his/her doctor about

whether any specific supplements are recommended. Some people living with MS take vitamin D and biotin, among other options.

Brain games: MS can cause cognitive impairment, which in turn may lead to greater difficulties managing day-to-day life. But early research suggests that one can take steps to train the brain and improve overall cognitive function. There are plenty of options for different types of cognitive training that one can try at home, such as working on puzzles and mind games, studying a second language, or learning a musical instrument. These activities haven't necessarily been proven to help with MS symptoms, but they will put the brain to work.

Manage overall health: Multiple sclerosis may seem like the focal point of one's life, but living with MS can be more complicated if one also has diabetes, high blood pressure, or other chronic health conditions. Physically, people who have MS do worse if they also have other conditions that can be related to lifestyle. Many of the healthy changes one makes to help multiple sclerosis, such as exercising more and eating healthfully, can also help prevent or improve other health conditions. Regular check-ups with the doctor will ensure that one is two steps ahead of managing his/her MS. Focusing on a better quality of life makes all the difference when managing a life with MS.

Chapter Seven
Mental Fitness and MS

Make Lifestyle Changes for a Healthy Mind

"You have the power to do anything you set your mind to" is a popular saying that many have heard at some point in their lives, likely starting in childhood. However, the older one gets, it may seem that the power of these words begins to fade. The trainer is one's guide and cheerleader along one's MS journey. Those with MS hold all the answers they need but the trainer must keep them focused on the positive aspects of fitness. The fitness coach's goal is to guide and support his/her clients to a new lifestyle and a new level of health while battling the disease.

The mind can be a powerful tool when beginning a new fitness routine because that which consumes the mind will steer the direction one takes in life. Marcus Aurelius once said, "You have power over your mind, not outside events. Realize this, and you will find strength." These powerful words can resonate in the personal trainer, especially as he/she helps to change the client's daily routine from his/her norm to one directed toward overcoming boundaries and challenges.

When it comes to clients' physical bodies and how they wish to use them or prefer them to look, gaining and maintaining firm control of their thoughts will allow them greater control over their bodies and the progress they seek to attain. Controlling something as powerful as the mind takes time, effort, and dedication. Can the personal trainer do it for the clients? Unfortunately, no. The power is completely inside of the client, and the beauty is, if the trainer helps the client get ready and he/she wants it, the h/she is already fueled to move ahead. Controlling something as powerful as the mind takes time, effort, and dedication.

Meditation

Though meditation has long been a therapeutic practice, it is more recently recognized from a scientific perspective for its health benefits. Studies have shown that meditation increases mental strength, focus, memory retention, and recall. It enhances cognitive skills, creative thinking, problem solving, and decision-making.

Meditation also contributes to higher information processing by enhancing the ability to ignore distractions. Moreover, it has been shown to:

- Boost the immune system and energy levels
- Improve breathing
- Improve heart rate
- Improve blood pressure
- Reduce heart issues
- Reduce brain problems
- Reduce inflammatory disorders
- Contribute to greater longevity

It can feel unfamiliar, even strange, to sit in silence and be alone with one's thoughts in this fast-paced world. There is no need to master meditation immediately, but the benefits come quickly. Meditation (even in short duration) can bring one peace, comfort, simplicity, stillness, motivation, joy, and love. It may help one focus on his/her exercise and nutritional plans, so he/she can follow through to his/her goals.

The personal trainer should suggest meditation to his/her clients. If a client cannot complete a mediation session, or that it is too hard, the personal train er can tell the client, "Then you probably need it more than ever!" Meditation is a practice. It can be intimidating or overwhelming but can help mental fitness tremendously when dealing with MS.

Here are a few simple tips to start clients meditating:

- Begin slowly. Set a timer for five minutes and increase by one minute each time they meditate. Try for thirty or more minutes a day but don't let the client get overwhelmed. Instead, they should enjoy the process.
- Keep an elevated posture. If this hurts too much, then the client should make him/herself comfortable. However, when holding an elevated posture, he/she will feel more open to his/her body's circulation.
- Recognize the breathing pattern. The pace of breathing is so important during meditation. Use the 4-7-8 breathing exercise:
    - Exhale completely through your mouth, making a whoosh sound.
    - Close your mouth and inhale quietly through your nose to a mental count of four.
    - Hold your breath for a count of seven.
    - Exhale completely through your mouth, making a whoosh sound to a count of eight.

    - This is one breath. Now inhale again and repeat the cycle three more times for a total of four breaths.
- Create an appropriate mood. Light candles, spray their favorite scent, and release from distractions.
- Have them stay with their practice. Once they begin experiencing the benefits of meditation, it is probable they will add it to their daily routine. They need to stay encouraged. It is the trainer's job to make sure they are filled with positive feedback to stay the course.
- Teach the clients to trust their feelings. They can meditate in silence, to relaxing music, or whatever they feel is best for them.

Yoga

Yoga is thought to have originated in India five thousand years ago but may be traced back even further. What yoga may have started out as, or the many forms it has taken (literally and figuratively), is a side from the training art that it has become and that we can find joy and benefit from, an art that so many before us have used in ancient practice and evolving translations. It is no wonder yoga has remained in our cultures for so long. There are many benefits to the Yoga practice. Yoga helps the body and strengthens the mind, as well. Concentration and focus are key; one must clear the mind of all distractions. Yoga incorporates breathing techniques, as well as meditation. In fact, yoga is said to have been created to help individuals meditate longer and strengthen the body to allow them to remain sitting for a longer period of time. Yoga classes are everywhere these days. One can even find free online classes. One can find a range of yoga types based on personal goals, preferred style, and fitness level. Yoga brings balance to life, which is important to mental fitness. Reducing stress through yoga is especially crucial for people with MS. It is encouraged for those with MS to take yoga classes from instructors who also know how to work with MSers. Or one can take restorative yoga classes with instructors who are familiar with MS and knows that the client will not get injured. Those with MS should avoid taking hot yoga classes.

Positive Affirmations

By adding positive affirmations to clients' routines, they have a chance to start a simple practice every day to recognize the small, important things in life while remaining focused on the positive and their goals. Saying (or thinking) affirmations to themselves daily helps them maintain a constant state of gratitude. This practice also helps them become more aware of their daily thoughts, even if this is new for them. If they are aware and open to a fresh way of thinking, possibilities that were previously closed to them will begin to open. Moreover, clients who are more difficult to work with become more open to achieving goals with positive affirmations. The first step always in changing one's fitness lifestyle is to change his/her mental fitness. It's too easy to focus on pain, defeat, obstacles, and other negative thoughts. But once the clients are able to maintain a positive, affirmative attitude, success can be ignited.

A wonderful thing about positive affirmations is that clients can create anything their mind is capable.

Start with a simple affirmation, such as:

- Today I am thankful I can exercise.
- I am going to have a great workout today.
- I am here for a reason, and I am going to conquer my goals.
- Congratulations! I did not eat that cookie!

Personal trainers should ensure their clients communicate positive things to themselves and express gratitude for who they are despite their MS challenge. Their condition, disability, or obstacle should not determine who they are and what they believe in. Once they begin this sort of self-communication, they start to believe it, they begin to live it, and they become it. The personal trainer's job will become a more positive and exciting experience. Clients should place sticky notes around the house with positive statements or inspirational quotations that they say or read every day. They can leave other sticky notes for their spouse, friends, or colleagues. MS is a disease that they have, not a disease that controls them. One should affirm every day that he/she can conquer MS, break through obstacles, and can succeed in his/her goals to create a better body in spite of what looks impossible to others. More importantly, he/she should work to become a better person in all that he/she is and to help others become better, as well. MS clients will benefit tremendously by adopting this philosophy, and the personal trainer can guide them on their way.

A couple of great resources for affirmations if one has a difficult time coming up with affirmations:

- *The Affirmation Spot*: Offers sixty-four affirmations for health, fitness, and weight loss.
- *Affirm Your Life*: An inspiration blog with a variety of affirmations on fitness.

One can also convert a personal goal to an affirmation or personal vision. For example, the affirmation "Step by step and rep by rep, I am creating my perfect body" converted to "Step by step and rep by rep, I am beating MS in the gym." Just as with anything, with practice comes habit, and with habit comes permanent change. Eventually, theses affirmations will roll right off the client's tongue, onto a sticky note, or through the mind, especially once he/she experience the benefits.

Vision Board

A vision board is a tool used to help clarify, concentrate, and maintain focus on one's life goals. It may be a physical board or a virtual one (such as a Pinterest board) on which images and words are displayed that represent whatever one wants to be, do, or has in his/her life. In this case, MS clients can collect images or items that represent a lifestyle of fitness, nutrition, and health for them—not just what someone tells them it is. Creating a vision board allows them to visualize positive affirmations more

clearly.

Vision boards are one of the most effective tools for instilling and maintaining a positive attitude, and visualization as a truly powerful exercise. *Psychology Today* reports that the brain patterns activated when a weightlifter lifts heavy weights are also similarly activated when the lifter simply imagines (visualizes) lifting weights. Many famous and accomplished athletes use vision boards as a functional tool; athletes such as Arnold Schwarzenegger, Olympic gold medalist skier Lindsey Vonn, and the most successful beach volleyball team Kerri Walsh and Misty May-Treanor. Personal trainers should consider having clients use a vision board for getting them on the right track for their fitness and nutritional program.

Vision boards are a fun, creative outlet, as well as a great brain exercise. Not only should they post pictures of things they desire, but also photos of how they wish to feel or look. Pictures can be taken from magazines or off the Internet to be posted on the board. They can even put other things on the board that represent their goals. David Lyons (an MSer), for example, fastened his competitor's number from a previous win of the 2009 Most Inspirational Bodybuilder trophy. When he looks at that button he is mentally brought back to that great day of victory as he stood on a bodybuilding stage with MS after the doctors said it was impossible. Clients can add anything that brings their mind to a place of victory, joy, and accomplishment. Those who think visually or who are motivated by results and can see or feel those results, vision boards can serve as a powerful tool. Personal trainers should encourage their clients to use the vision board tool.

Another option is an online vision board using a collage app (such as Pinterest), which they can access on their computer, phone, or tablet. They can add, erase, or edit things at any time, and it is super easy. They might use their vision board as a screensaver, so they are sure to look at it every day.

Clients should place their vision boards where they will see it every day, engage with it, and absorb it. They should feel the varying emotions their vision board stirs in them. When David looks at his board with that number hanging on it, he feels like Rocky getting into the ring to fight Apollo Creed for the second time: He is pumped! That emotion helped him get his body to a level where it had not been since his twenties. He became leaner and more muscular than anyone thought he could at fifty-six years old with MS. He even shocked himself when he looked at the pictures of him standing next to Arnold Schwarzenegger as he accepted the Health Advocate Lifetime Achievement Award in 2015, a true honor and blessing for him in his quest to serve others. To him, it was a reaffirmation of moving along the right path to help more people to improve their mental and physical wellbeing despite the effects of MS. Never underestimate the power of a vision board.

Journaling

Though it may feel time consuming, or even silly, journaling is another valuable practice. Clients should create time, as they would with any of these practices, even just five to ten minutes, four days a week (or a little more, or a little less), and write in a journal. Clients should choose a journal that fits their personality and writing style. When journaling, clients should sit in an area where they feel comfortable.

- Take one sheet of paper and divide it into three sections horizontally. In the top section, he/she should write down anything he/she wants or feels. It can be goals, questions, positive affirmations— anything at all. They might be surprised by what comes out, not only on the paper but also from within themselves. This section is their lead-in area, serving as a warm-up to their fitness and health goals section.

- Next is tracking diet and nutrition. It should include notes on the clients' diet, the foods they eat and at what time of day they are eating (and the foods they "cheat" with). Everyone has slipups! Clients need to write honestly about their eating habits so they can look back, when needed, and see when they were on point and when they went off track. Journaling is also a way to know which foods work and don't work for clients. Even clients who stay consistent with what they eat every day and at every meal will still have times when they add or remove a food, and journaling is a great way to remember how they felt when they altered their routine. A good journal of eating habits and foods in a client's diet can offer answers to a personal trainer's questions.

- The last section of journaling should be their workout routines and the weights and reps used. By journaling these facts, they (and the trainer) can see how they progress in strength and personal

goals. It's great for the client to look months back into a workout journal and see how he/she started with 25 lb. (11 kg) on an exercise and progressed to 35 lb. (16 kg) or increased reps with the same weight. It helps keep them motivated and excited to get to the next workout.

Journaling is a peaceful release, a way to clear the mind, and a strategy for releasing pent-up emotion as the client progresses toward his/her goals. A journal is a very important tool for the trainer to stay on top of the client's progression, to understand when and how to make adjustments, and to keep connected to the client even when the trainer is not with them. Incorporating this practice will separate great trainers from most other trainers who lose that much important connection with their client once the workout is over.

The Power of Nature

A simple and easy way for clients to reach their best mental state is to spend time in nature. Life gets busy, and sometimes one forgets that nature can soothe and bring one back to earth. Nature also encourages people to be active and will empower the client's workouts and encourage his/her nutritional plan. The solace of nature helps to quiet the mind. Nature is a wonderful setting in which to journal. Nature helps people socially. When people become too connected to the phone or the Internet, being in nature can help one reset. This is an extremely important issue with MS. This disease is a constant drain on the mind and body and can hinder fitness progress. Being a part of nature can help people with MS to de-stress, regain some energy back from the MS fatigue and set them back on track to reach their fitness goals. A client should begin with being outdoors twenty minutes per day, maybe two or three times a week (weather permitting of course). Then evolve that time outdoors from a nature walk or stroll in the park, to a camping or other nature enjoying, relaxing adventure. One should discover the peace and balance that being outdoors can bring. This "balanced life" feeling will fuel the client's quest to make the most progress. Now that the importance of a lifestyle of fitness, nutrition, health, and well-being have been addressed, one can begin to see the importance of mental fitness within the MS clients' total fitness. There are many interconnecting parts to living this life that allow them to overcome their obstacles, and mental fitness is key.

Dealing with Burnout

There is a close link to obtaining the fitness, health, and nutritional results one desires and experiencing burnout along the way. One does not have to be a competitive athlete to experience this phenomenon. Burnout can occur when one is overworked, over fatigued, or overstressed—mentally or physically. Learning to live with extreme fatigue on a daily basis as a regular symptom of this disease is part of overcoming the effects of MS. There is also a blurred line between physical and mental fatigue when dealing with MS as an athlete. MS athletes learn to become experts in exhaustion.

The key to helping an MS client overcome and deal with mental exhaustion is to first look at the physical demands they put on his/her body, which includes the workout routine prescribed by their trainer. When their body is over fatigued, their mind is quick to follow, and vice versa. In many cases, when dealing specifically with an MS athlete, he/she will seldom take workout breaks and instead tend to over train their bodies.

It's difficult sometimes for one with MS to take even one day off from the gym. He/she may feel lost or that the routine is broken. But that day off, and even a short daily break, can make a huge difference in one's level of stress and exhaustion. This easing off the constant body drain helps with the mental drain. The trainer, as one's fitness expert and guide, needs to place boundaries on his/her clients push to get in shape and become and remain fit. Those with MS have a tendency to go overboard and push beyond their limits. Once those with MS set their minds to entering into a fitness regimen, they are prone to over doing it and pushing their bodies, which are not used to this physical stress, beyond the healthy point. It is their desire to beat MS that drives them, and that should be commended, but the trainer must implement healthy limits to keep them from burning out quickly.

Burnout comes from persistent stress, whether emotional or physical. Stress itself is not burnout. But when one endures extreme stress day after day, burnout is inevitable. The mind–body connection is impossible to disconnect unless one consciously puts an effort into doing so. The key is to keep the clients with a positive mind-set for as long as possible. To do that, the client should use the tools previously discussed: create a vision board, post affirmations in their home, office, car, and wherever they are consistently visible, make sure they set time aside for meditation, or practice relaxing yoga

sessions. Any time spent destressing and embracing a peaceful environment, both mentally and physically, will help them deal with mental exhaustion and the stress of MS.

This may all sound like an easy answer to avoiding burnout but finding the time and actually following through with any of this is a challenge in our fast-paced lives. When dealing with MS, it is important to take charge of emotions to avoid burnout. These recommendations can become routine, not a choice, when done habitually and with purpose. The trainer should help his/her client to find the hour, or even the fifteen minutes, every day to settle down, unwind, and keep burnout at bay. Mental fitness, like physical fitness, is a lifestyle and not a thirty-day program to success or a quick fix for results. One's clients should adopt the same philosophy to reach their goals—and never quit!

Stress vs. Burnout

Know the differences between stress and burnout.

Stress
Characterized by over engagement
Emotions are over reactive
Produces urgency and hyperactivity
Loss of energy
Primary damage is physical

Burnout
Characterized by disengagement
Emotions are blunted
Produces helplessness and hopelessness
Leads to detachment and depression
Primary damage is emotional

Chapter Eight
MS and Exercise

If you are a health and fitness professional, some of your clients may be suffering from multiple sclerosis and you may be an important source for relief. Moderate exercise is known to improve use of oxygen, energy levels, anxiety, stress and depression, sleep, self-esteem, cardiovascular fitness, muscle strength, and shortness of breath. While the pain and fatigue associated with multiple sclerosis may make exercise and daily activities difficult, it is crucial to be physically active.

Benefits of Exercise

Thirty years ago, people with MS were advised not to exercise to preserve any energy and muscle strength for daily activities. Current research and anecdotal evidence suggest the contrary that exercise positively impacts the lives of those with MS. "Exercise has beneficial effects even if you have some physical limitations from your MS", says Fred Lublin, MD, a neurologist and director of the Corinne Goldsmith Dickinson Center for Multiple Sclerosis at Mount Sinai Medical Center in New York City.

According to the National Center on Physical Activity and Disability, "In addition to improving overall health, cardiovascular fitness, range of motion, and flexibility, exercise can help one increase energy, improve balance, manage spasticity, decrease muscle atrophy, and better perform activities of daily living." Studies have also come out in recent years that show exercise is critical in preventing cognitive decline in those with MS. Exercise is central in lifting depression and overall mood and may even delay the progression of the disease.

Less Fatigue

Fatigue is a common complaint among people with MS, but a variety of types of exercise can help combat this. Exercises that include some form of meditation and mind-body connection, such as tai chi and yoga have been shown to be helpful for MS fatigue. If the personal trainer for the MSer is not a yoga or tai chi instructor, the personal trainer can either suggest a class outside of the workout program or work in one's own form of relaxation/meditation session within the client's plan.

Improved Bone Density
Weight-bearing exercise — such as walking, jogging, or using an elliptical machine — strengthens bones and protects against osteoporosis, a bone-thinning disease that raises the risk of fracturing bones.

Many people with MS are at risk of developing osteoporosis due to a combination of factors:

- Low blood levels of vitamin D, the nutrient that works with calcium to protect bone health
- A history of taking corticosteroids, drugs used to treat MS flares that can lead to low calcium levels in the blood
- Mobility problems, which may make a person less likely to engage in weight-bearing forms of exercise
- Low body weight

At the same time, people with MS sometimes have balance problems that make them more prone to falling — a major cause of broken bones. Finding a way to engage in exercises that strengthen the bones is therefore important for maintaining bone density and helping to prevent fractures. According to the American Academy of Orthopedic Surgeons, some bone-strengthening options for people who cannot walk easily include strength-training exercises such as lifting light weights or using resistance from exercise bands.

Better Mood
Moderate-intensity exercise — such as resistance training and aerobic exercise — has been shown in many studies to improve mood in people who are depressed. A research review published in 2015 in Archives of Medicine and Physical Rehabilitation finds that this benefit also applies to adults with neurological disorders, including Multiple Sclerosis, particularly when physical activity guidelines are met. The Centers for Disease Control and Prevention currently recommends that adults get at least 150 minutes (2 hours and 30 minutes) of moderate-intensity aerobic exercise per week, as well as at least two workouts involving muscle strengthening exercises.

- **Boost Endorphins**
  Studies show that exercise can help restore the body's neurochemical balance, and it triggers a positive emotional state. Not only does regular exercise slow down the heart-racing adrenaline associated with stress, but it also boosts levels of natural endorphins -- pain-fighting molecules that may be responsible for the well-known "runner's high." Endorphins help to reduce anxiety, stress, and depression which are symptoms of MS.

- **Boosts Serotonin**
  Serotonin is a neurotransmitter in the brain that scientists have found to be related to multiple sclerosis (Malinova, et al. 2018 and Dorszewska, et al. 2017). Neurotransmitters are brain chemicals that send specific messages from one brain cell to another. While only a small percentage of all serotonin (1% to 2%) is located in the brain, this neurotransmitter is believed to play a vital role in mediating moods.

  Studies have found that too much stress can lead to permanently low levels of serotonin. That, in turn, can create aggression. An increased level of serotonin in the brain is associated with a calming, anxiety-reducing effect. In some cases, it's also associated with drowsiness. A stable serotonin level in the brain is associated with a positive mood state or feeling good over a period of time. Lack of exercise and inactivity can aggravate low serotonin levels.

Improved Bladder and Bowel Function

Bladder issues are very common with MS and exercise has been shown to help this problem. One of the pioneering studies on the benefits of exercise in people with MS was done in 1996 by Jack Petajan, MD, a neurologist who has MS himself. Dr. Petajan found that 15 weeks of aerobic training helped to improve bowel and bladder function in people with MS. This is where cardio exercises such as riding a stationary bike or using a rowing machine has benefits beyond heart health for MS. Even a fast-paced resistance program that elevates the heart rate will serve as the aerobic part of the MS fitness routine.

Other Positive Effects of Exercise

- Burning calories and making weight control easier
- Giving range-of-motion to painful muscles and joints
- Increasing aerobic capacity
- Improving cardiovascular health
- Strengthening bones
- Strengthening muscles
- Improving one's sense of well-being
- Increasing energy
- Relieving stress associated with a chronic disease
- Improving a person's outlook on life
- Improving quality of sleep

Best Types of Exercises for MS

Exercises such as walking, strength training, and stretching activities are effective at improving physical, emotional, and social function. They also are effective in addressing key symptoms in those with multiple sclerosis who are also being treated with medication. Some studies point to long-term aquatic exercise programs such as water aerobics as being effective in reducing symptoms and improving the health-related quality of life of those with MS. Specific exercises will be described in detail later in this course.

- Exercise consistently (aim for daily) for 15 minutes.
- As little as 5 minutes a day can reduce your pain.
- Aim to feel “good tired” after a workout but better the next day.
- If exercising increases your pain, go easier and exercise for less time.
- Don’t try to ramp up in time or intensity unless you notice an increase in energy.

.

MS Exercise Limitations and Guidelines

Usually, there are no specific exercises to avoid if one has multiple sclerosis. In general, one with MS can follow the same exercise guidelines as a healthy individual. It is generally reported by those who have MS that moving is challenging at the beginning of the exercise session. But after about 15 minutes of moving, they feel better and are able to perform the exercises with greater ease. It is also reported that not all days are good days and that those with MS need to be realistic and determine their exercise choice for that day based on how they feel. An exercise program should fit an individual’s specific abilities and interests, so he/she is safe. It may need to be adjusted overtime. Whatever the exercise program, it needs to be consistent and added to a daily check list just like any other daily task in one’s

life. Effective exercise programs include yoga, tai chi, and water exercise. Standard fitness equipment can be utilized as well as adaptive equipment which is becoming a broadening field. Exercise doesn't have to be a rigorous cardiovascular workout to provide benefits. Physical activity includes but is not limited to gardening, household chores, cooking, walking the dog, and taking the stairs instead of the elevator.

Working with people who have MS is not like working with other chronic condition clients. Due to the nature of this disease there are changes in symptoms and the ability to perform movements that can occur without notice and can be as often as daily. Although many chronic conditions have changing needs in a fitness program due to pain, fatigue and other factors, MS takes this to a higher level of modification as a result of the multiple symptoms that occur consistently with inconsistent outcomes. A personal trainer must understand this process and learn to adapt quite frequently to an MS clients' needs and capabilities during each workout. MS patients suffer many similar symptoms, yet those symptoms are so individualized and vary in severity, disability, and effect on the body. Although a client claims that that he/she has numbness in the hand, that numbness can be slight or so intense he/she cannot feel a dumbbell held in that hand. Training an MS client takes patience, understanding, and adaptability. Plans to start a client's next workout the same way the last one started can quickly change according to the client's symptoms that day. The first call to action is an assessment each and every time the client meets the trainer. The question of, "how do you feel today" will determine the plan of action. This can be as easy as no changes at all to major shifts in exercises or how the client performs the same movements based on his/her ability for that workout. But no matter what routine the client is given, it must be a well-rounded program that includes the necessary components to address the many issues people with MS face.

There are multiple aspects to a complete MS workout:

- Mental fitness (previously mentioned)
- Cardio training
- Stretching
- Balance exercises
- Core exercises
- Resistance/strength training exercises
- Coordination movements

Quick Tips

- Stay hydrated-cold water will help keep the body temperature low
- Exercise in a cool room and if outside, exercise at cooler times during the day
- No pain no gain should not be the mantra
- Always listen to your body and only exercise when you have the energy to do so, never doing more than your body wants you to do.
- Take several breaks in-between exercises to recover. You can also split the workouts into 5- to 10-minute sections that can be done throughout the day.
- Stretch daily to help with posture and increase mobility. This will lead to less pain when you're active.
- Stick with low-impact movements and move slowly to prevent excess soreness.
- Avoid going into high-intensity mode while recovering (no more than 60 percent of your maximum heart rate). Staying below this zone will help prevent fatigue.
- Keep all your movements fluid and limit the range of motion in a particular exercise whenever it causes pain.
- Keep records of how a particular exercise routine or activity makes you feel for up to two to three days afterward to see if the routine is sustainable and healthy for your current pain level.
- One should discuss his/her plan with a doctor before getting started.

The 8 Key Components of MS Exercise

Every exercise routine should address eight components to achieve a well-rounded and comprehensive program that focuses on the improvement of breathing, cardiorespiratory endurance, muscular strength, core stability, flexibility, balance, coordination, and posture (Dalgas, et al., 2009).

KEY 1: Breathing and Multiple Sclerosis

Proper Breathing Technique: One should breathe slowly during exercise. Inhale through the nose with the mouth closed. The inhalation warms and filters the air. Exhale through the mouth for twice as long as the inhale. Don't pant. That keeps the lungs from getting all the air out. When exercising avoid the Valsalva Maneuver. The Valsalva maneuver is performed by imagining that the chest and stomach muscles are very tight and bearing down as though straining to initiate a bowel movement.

The Valsalva maneuver can be dangerous due to the sudden and abrupt changes in blood pressure. These dramatic changes in heart rate, blood pressure, and carbon dioxide may produce symptoms including dizziness, light headedness, and syncope.

Diaphragm Exercises: This move strengthens a key breathing muscle, the diaphragm. One lies down with the knees bent or sits in an easy chair -- one hand on the chest, one below the rib cage. Slowly inhale through the nose so that the stomach raises one hand. Exhale with pursed lips and tighten the stomach. The hand on the chest should not move. Do this for 5 to 10 minutes, three or four times a day. Breathing this way will become easy and automatic.

Pursed Lip Breathing: This exercise reduces the number of breaths one takes and keeps the airways open longer. More air is able to flow in and out of the lungs, so that one can be more physically active. To practice it, simply breathe in through the nose and breathe out at least twice as long through your mouth, with pursed lips. Gently puff out the cheeks to create pressure. Creating pressure opens up the airways and it also slows down the breath.

Yoga Breathing: Yogic breathing exercises helps to reduce stress and anxiety.

Bhastrika (also known as Bellows Breath): 5 min

- Sit up tall, relax your shoulders, and take a few deep, breaths in and out from the nose. With each inhale, expand the belly fully as you breathe.
- Begin bellows breathing by exhaling forcefully through your nose. Follow by inhaling forcefully at the rate of one second per cycle.
- Make sure the breath is coming from your diaphragm; keep your head, neck, shoulders, and chest still while your belly moves in and out.
- For your first cycle, move through a round of 10 *Bhastrika* breaths, then take a break and breathe naturally, observing the sensations in your mind and body. After a 15- to 30-second break, begin the next round with 20 breaths. Finally, after pausing for another 30 seconds, complete a third round of 30 bellows breaths.
- Make sure to listen to your body during the practice. Bellows breathing is a safe practice, but if you feel light-headed in any way, take a pause for a few minutes while breathing naturally. When the discomfort passes, try another round of bellows breathing, slower and with less intensity.
- Practice bellows breath on an empty stomach. Wait at least two hours after eating.

Anulom vilom: 15 min Also known as the alternate breathing technique, it facilitates proper functioning of the lungs, mitigates stress, and lifts up one's mood.

- Sit with the legs crisscrossed and the hands resting sideways on the knees. If this position is challenging, place a block or blanket under your sitz bones or sit in a chair.
- Close the right nostril with your right thumb and inhale slowly through the left nostril to fill up your lungs.
- Now, release the right nostril and close the left nostril with the ring finger and exhale slowly through the right nostril. Inhale through the right nostril
- Now, release the left nostril and close the right nostril with the right thumb and exhale through the left nostril.
- It is essential to focus on your breath and practice the technique slowly.
- Repeat 60 times or for 5 minutes. One can do this any time of the day.
- Ensure that the back is straight, and shoulders relaxed while the breathing is performed.

Kapalbhati: 10 min Also known as forehead shining breathing technique or breath of fire, Kapalbhati flushes out toxic air from the body, cleansing it in the process. With cleansing come various mental and physical benefits.

- With the legs in crisscrossed position, sit up tall, lengthening the space between your navel and the heart. Place the hands on the knees. Ensure they are facing upwards. Direct the focus and awareness to the belly region. If this position is challenging, place a block or blanket under your sitz bones or sit in a chair.
- Breathe in and out through the nose and start to pull your abdomen in during the exhale and press it out during the inhale. Imagine your belly fills up with air during the inhale and use your abdominal muscles to push the air out during the exhale.
- Start to shorten each breath and pick up the pace. The breathing should be loud and quick.
- Try to equalize the inhale and the exhale in both strength and length.

KEY 2: Cardiorespiratory Fitness and Multiple Sclerosis

Endurance cardiorespiratory exercise is good for the heart and lungs and allows one to use oxygen more efficiently. Cardiorespiratory fitness is a measure of the heart's ability to pump oxygen-rich blood to the muscles. Walking, biking, and swimming are great examples of aerobic exercise.
The guidelines are the same as generally healthy individuals. One should attempt to train the cardiorespiratory system 3-5 days a week for 20-60 minutes per session. If one cannot exercise for 30 minutes continuously, he/she should exercise as long as he/she can. One should pace him/herself and take breaks. As one progresses, the goal is to exercise at an intensity level of 6-7 on the Rating of Perceived Exertion Scale (Scale Rating from 0 Nothing at All-10 Very, Very, Heavy).

- **Walking:** Just about everyone with multiple sclerosis can exercise. Walking is a great choice, especially if one is just getting started. Do it anywhere – outside, in a mall, on a treadmill. If it seems daunting, add 30 seconds or 10 yards each day. Even a slow pace is beneficial.
- **Cycling:** A stationary bike can work well for people with MS. One can cycle in his/her home, a gym, or rehab setting. It is recommended that before joining a cycle class, one should consult with the cycle instructor about the intensity level of the class. However, because stationary cycling is very much a "go-at-you-own-pace" type of a class, those with MS are encouraged to do what they can in a class setting. One can find supervision and meet people. As one improves, he/she can try to cycle outside on a traditional bike and soak up the scenery.
- **Tai Chi:** This form of exercise is an ancient Chinese practice of gentle, flowing movements. This is an excellent form of exercise for people with MS. It's a mild workout for the heart and lungs and helps tone the muscles. It also eases stress and helps one relax, if he/she is experiencing anxiety. One can participate in a group class or follow a DVD.

- **Water Aerobics:** Participating in a water-based fitness class or even simply performing self-guided water-based exercises increases aerobic capacity, increases muscular strength and endurance, increases the respiratory muscle strength, increases core stability, and improves poster

and flexibility.

Interval cardiorespiratory exercise may be an alternative to standard endurance training for individuals with MS who have difficulty in achieving their target intensity or duration of continuous exercise because of fatigue or other symptoms. Interval training is a modification of endurance training in which high-intensity exercise usually lasting less than one minute is regularly interspersed with periods of rest or lower intensity exercise. This method of physical training elicits a metabolic machine. Health and fitness professionals should teach their clients to perform all daily activities (e.g., stair climbing, uphill walking) at an interval mode consisting of short bouts of activity lasting 15-20 sec and rest periods of 1 minute. One should perform traditional interval training sessions 2-3 days a week mixed in with regular endurance type of workouts. For a more detailed format, view the FIIT Principle section for Interval Exercise. Interval training should only be incorporated after months of developing a conditioned foundation to avoid flare-ups.

Before starting the cardio portion of the workout, one should warm up the entire body for 10 minutes to avoid injuries. A warm-up can be as simple as ten minutes on a treadmill, elliptical, or rower. One should start at a comfortable pace and gradually increase to slightly more than comfortable. One should not go at high intensity. This time should be spent just as a warm-up, not part of the workout. The warm-up becomes even more important with age, or if your clients are dealing with some sort of physical limitation (in this case, MS) that might make it easier to be injured.

KEY 3: Muscular Strength and Multiple Sclerosis

When referring to muscles there are two different components to measure, *Muscular Strength* and *Muscular Endurance*. *Muscular Strength* is the ability of a muscle to generate the maximum amount of force in one single effort. *Muscular Endurance* is the ability of a muscle group to perform repetitive contractions over an adequate period of time to cause muscular fatigue. For the purpose of this course, *Muscular Strength Training* will be the term utilized to describe resistance exercise. Strength training improves fitness and functional levels, relieves physical and emotional stress, and boosts one's confidence and self-esteem. Recent research has demonstrated that strength training exercise, when done appropriately, can be safe and beneficial for individuals with MS (de Souza-Teixeira, et al., 2009 and Halabchi, et al, 2017).

Strength training exercises increase muscle strength and can make daily activities, such as climbing stairs and carrying laundry, easier. Stronger muscles use less effort to do work than weaker muscles. Some think that by using less effort, the muscles do not get as fatigued. For many years, when MS was thought to be a disorder of the muscles, people believed that one might damage the muscle if he/she exercised it too hard. Therefore, people with MS were discouraged from doing strength training type exercise. Today, research demonstrates the safety and benefit of resistance type of exercise for the person with MS (Andreasen, et al, 2011; Molt, et al, 2005; and White, et al, 2006).

Resistance training usually involves weights or resistance bands, but using one's own body weight works just as well depending on the severity of the symptoms. Strengthening exercises build individual muscles and muscle groups and can help patients with MS to be more functional. Resistance training should be performed 2-3 days a week working all major muscle groups.

- It is recommended to perform exercises that work several muscle groups at once.
- If one is going to exercise individual muscles or a small number of muscle groups, it is imperative that he/she works upper, lower, and core muscles to ensure a balanced workout optimizing function.
- Depending on the severity of one's MS condition and symptoms will determine if (s)he can lift heavy weights or not. If one has joint issues or is suffering from symptoms, light weights and more repetitions are better than heavy weights and fewer repetitions. This type of resistance training also improves muscular endurance important for those with MS.
- One should pace him/herself and allot for several breaks when needed.

KEY 4: Core Stability and Multiple Sclerosis

The word *core* itself implies deep and central. The anatomical structure that is the deepest and most central is the spine. The core is directly related to the spine specifically and generally to the torso. The spine is primarily what one wants to stabilize with the core muscles. There is also a dynamic component to the core. This aspect of core is all about movement and the specific control of movement from the deep intrinsic muscles that move the body. The major muscles that move, support, and stabilize the spine are called the muscles of the core or trunk.

Strength and Stability- Currently, the strength that comes from the core is what is gaining the most attention. It is important, however, that equal emphasis is placed on both strength and flexibility regarding the core. In other words, there should be a balanced relationship between the two components of strength and flexibility within the core muscles. The balance between strength and flexibility begets stability. Being balanced in the core makes an individual more adaptable in real life situations. For instance, the core is used every time one walks on uneven surfaces. Also, if one trips, starts to fall and then catches him/herself, it's the adaptability of the core muscles that is catching the individual.

Movement- Movement from the core is how the center of gravity is controlled. Controlling the center of gravity comes from the rectus abdominis, transverse abdominis, internal abdominal oblique, and external abdominal oblique muscles. In addition, controlling the center of gravity also comes from the multifidus, quadratus lumborum, and the erector spinae muscles. The center of gravity is located at a spot close to the top and just forward of the sacrum. When one's center of gravity is in line with gravity itself relative to one's body parts, he/she is in balance and in control. When one moves from his/her center, the movements are not only controlled, but also expansive and light. Control is a synergy of strength, stability, lightness, and ease during movement. Because one establishes a relationship with the core muscles, movement from the core then becomes intentional. (See Figure 8.1 and 8.2)

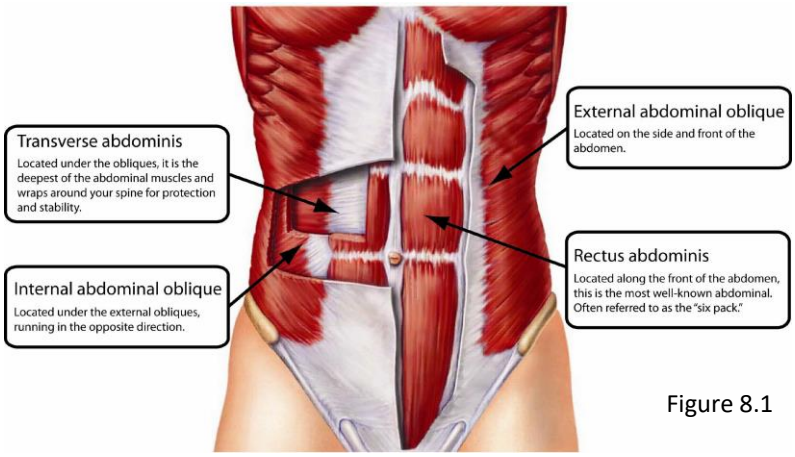


Figure 8.1

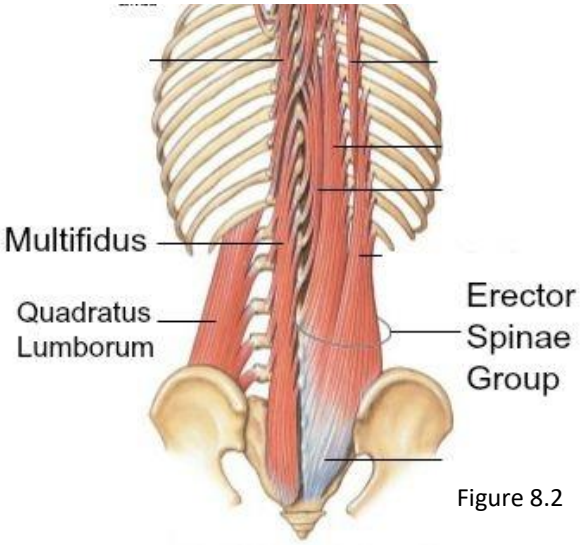


Figure 8.2

Key 5: Flexibility and Multiple Sclerosis

Flexibility is the ability to move a muscle or joint through its full range of motion without discomfort or pain. Flexibility is determined by the range of motion of a given joint or group of joints or the level of tissue extensibility that a muscle group possesses. In other words, each joint and each group of muscles in the body might have a different range of motion (ROM) or a different level of flexibility. Some areas of the body may be very tight, meaning that the muscles feel short and restricted. Some other areas of the body may feel very loose and may be able to lengthen and move freely. For example, one might be very flexible in the hamstrings, allowing him/her to bend over and touch his/her toes. But the thigh (quadriceps) muscles might be tight (inflexible) so it may be harder for one to stand up straight or bend backward. Many people who work in an office all day develop inflexible hips as a result of sitting all day. This is one of the reasons that health experts recommend standing and moving for a few minutes every hour.

According to the results of a 2014 Australian study in Disability and Rehabilitation, 56 percent of the 156 MS patients studied had reduced range of motion, or joint contractures, in at least one major joint. When joint contractures happen early in the disease, it can negatively affect the way MS progresses. Stretching is one way to improve range of motion. (Hoang, et al., 2014).

Flexibility Training

Stretching improves flexibility, but it is not absolutely necessary to do hours of stretching to enjoy the benefits of flexibility training. One can take a stretching class or follow an online video that focuses just on stretching exercises to improve range of motion throughout the body. Flexibility training must begin with a gentle warm up to increase the body's core temperature. Then, flexibility training progresses through a series of stretching exercises to lengthen the muscles in the feet, legs, hips, torso, and finally up through the head and neck.

Types of Stretching

- **Static Stretching** is a stretch that is held in a challenging but comfortable position for a period of time, usually somewhere between 10 to 30 seconds. Static stretching is the most common form of stretching found in general fitness and is considered safe and effective for improving overall flexibility. However, many experts consider static stretching much less beneficial than dynamic stretching for improving range of motion for functional movement, including sports and activities for daily living.
- **Dynamic Stretching** is a stretch that is performed by moving through a challenging but comfortable range of motion repeatedly, usually 10 to 12 times. Although dynamic stretching requires more thoughtful coordination than static stretching (because of the movement involved), it is favorable in improving functional range of motion and mobility in sports and activities for daily living. Dynamic stretching should not be confused with ballistic stretching which is bouncy in nature. Dynamic stretching is controlled, smooth, and deliberate, whereas ballistic stretching is uncontrolled, erratic, and jerky. Although there are unique benefits to ballistic stretches, they should be done only under the supervision of a professional because, for most people, the risks of

ballistic stretching far outweigh the benefits.

- **Active stretching** is stretching a muscle by actively contracting the muscle in opposition to the one being stretched. There is no use of body weight, strap, leverage, gravity, another person, or a stretching device. With active stretching, one relaxes the muscle being stretched and relies on the opposing muscle to initiate the stretch. Active stretching can be challenging because of the muscular force required to generate the stretch but is generally considered lower risk because one is controlling the stretch force with his/her own strength rather than an external force. Active Isolated Stretching (AIS) is another widely used term.
- **Passive stretching** is using some sort of outside assistance to help achieve a stretch. This assistance could be from body weight, a strap, leverage, gravity, another person, or a stretching device. With passive stretching, one relaxes the muscle that is being stretched and relies on the external force to stabilize the body in place. Very little effort is involved in passive stretching; however, there is a risk that the external force is stronger than the individual's flexibility which could cause injury.
- **Proprioceptive Neuromuscular Facilitation (PNF)** is a form of passive stretching. PNF stretching requires stretching a muscle and then forcefully contracting that muscle before stretching it again. As one moves into the stretch after the contraction, one will be able to stretch further than he/she did before. This allows one to create more length in the muscle and receive a greater flexibility benefit from the stretch.

In addition, one doesn't have to take a dedicated class to do flexibility training. Many exercisers simply add a few minutes of stretching to the end of their daily workout to relax muscles and improve range of motion. One could also take 5 to 10 minutes to stretch in the morning after getting out of bed. Just a few minutes of flexibility training each day can provide benefits. When stretching, one should practice slow and controlled breathing. Not only does proper breathing help to deepen the stretch, but it also helps one to increase lung capacity. One should gently stretch all major muscles to the point of mild discomfort while holding the stretch for 15 to 30 seconds, slowly breathing in and out. Repeat each stretch 2-3 times. Stretching is an effective method to warming up and cooling down before and after workout sessions.

Stretching exercises can help to decrease stress and improve the way the body moves and feels throughout the day. Improved flexibility can even lead to better posture. These benefits help one to move more often throughout the day, burn more calories, and lead a more functional life.

Stretching for Pain and Stiffness

The human body compensates for joint instability by tightening the more stable muscle to protect the instable muscle. By only focusing on the stretch and not on the "activation" of the weak muscle, you may only create more pain and tightness.

The four areas most involved in pain are:
1. Shoulder/neck
2. Low back
3. Hips
4. Knee

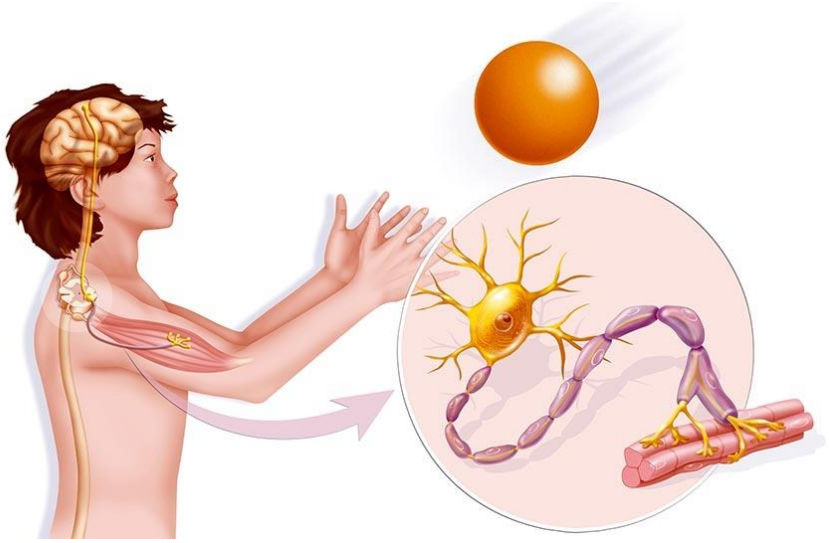
Tightness creates pain over time and represents muscle/joint instability at extreme ranges. Activate the weak muscle, which is causing joint instability, and tightness decreases while pain dissipates. (See Appendix H for Stretching Exercises)

KEY 6: Balance and Multiple Sclerosis

Balance is another issue that plagues MS sufferers. In standing movements, such as squats or lunges, one can use the Smith machine, which balances the exercise for the client. The trainer needs to know the client's limits every time he/she walks into a gym. The trainer should find ways to steady the client and secure him/her while working out. The client should not be afraid or embarrassed to hold onto the wall, equipment, or the trainer while moving from machine to machine. The client needs to be reinforced and empowered with the knowledge that he/she is a champion and should be proud of his/her accomplishment of being in the gym while many are sitting on couches doing nothing to stay fit. The trainer should encourage the client in all achievements, small and large. MS clients should be encouraged to perform balance exercises in addition to the workout routine that is developed for them in the gym.

Key 7: Coordination and Multiple Sclerosis

Coordination basically means firing the right muscle fibers at the right time for a given physical task. Thus, stability, mobility and balance are just different aspects of coordination. Furthermore, strength, flexibility, power and even endurance cannot be expressed to their full potential without coordination. Therefore, optimizing coordination should be one of your primary goals in regard to improving physical function for your MS clients. In addition to large muscle motor control and coordination, it is important to focus on movements that will give your clients more coordination specifically in the hands and fingers.



Multiple sclerosis can impact hand dexterity, coordination, and strength because of the effect it has on the brain and spinal cord, the two interconnected regions that together are called the central nervous system (CNS). The function of the central nervous system is to receive sensory information, such as smells, tastes, sounds, sights and tactile information, through special receptors and then to respond to this information with a thought or an action, or both.

All movements and actions require different forms of sensory input or feedback to accomplish the action well. This is particularly true of movements in the hands and fingers that require a high level of dexterity and complexity. If the messages sent to or from your brain (central nervous system) are impaired, there will be a loss of sensation, strength, dexterity or a combination of these problems. An example of this impairment for someone with MS might be developing a tremor when trying to touch their nose with a finger. In MS, this tremor can be dramatic, and the person's arm will go up and down significantly as they attempt to touch their nose. Hand and finger exercises can help combat the effects of the impairment caused by MS.

The exercises below can help improve fine motor skills that have deteriorated. Please note that some activities may be too easy or too hard depending on the extent of impairment.

- Stack pennies
- Turn cards over
- Pinch clothespins
- Assemble nuts and bolts
- String beads
- Pick up small objects like buttons, coins, etc.
- Crumple a sheet of paper into a ball. Try to spread it back out into a flat piece of paper using only the affected hand
- Roll a pencil between the thumb and fingers
- Place your hand on the table, and try to lift each finger one at a time off of the table
- Practice buttoning
- Pick up toothpicks with tweezers
- Fill a bowl with rice and place objects in the rice. Try to find the objects with your hand without looking

KEY 8: Posture and Multiple Sclerosis

Patients with MS tend to sink in their posture and may even attain forward shoulder posture (kyphosis) due to overall pain. Treating postural disorders could ease muscular and articular rigidity of the spine, which would limit pain and improve one's ability for daily and work activities. Postural alignment of the anterior tilt of the right and left pelvis and thoracic kyphosis is different between those with MS and healthy individuals. (See Figure 8.3)

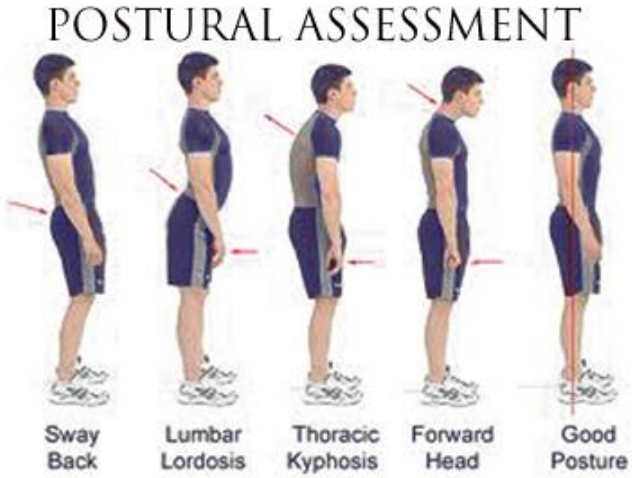


Figure 8.3

Common postural impairments include thoracic kyphosis, increased chest anterior–posterior diameter, shoulder elevation and protraction, and trunk flexion. To improve posture, strengthening and flexibility exercises are recommended for both upper and lower body (including stretching of major muscle groups such as the calves, hamstrings, quadriceps, and biceps, as well as range of motion exercises for the neck, shoulders, and trunk). Correcting kyphosis, in particular, leads to straightening of the spine leading to relieving the pressure on the spinal cord that sends pain signals to the brain exacerbating the symptoms of MS. The ability to be balanced in a good posture allows for optimal metabolic rate and contributes to how fast cells exchange. Returning the body to a proper posture can help symptoms disappear.

FITT Principle and MS

When prescribing exercise for one with MS, the fitness professional should implement the FITT Principle which is an acronym for *Frequency, Intensity, Time, and Type*. When applying the FITT principle in prescribing exercise for those with MS, the American College of Sports and Medicine Exercise Guidelines (ACSM, 2011) should be implemented.

Frequency: How often or how many times one exercises during the week.

- Endurance/Aerobic Capacity: 3-5 Days Per Week
- Interval Training: 3-5 Days Per Week
- Resistance Training: 2-3 Days Per Week
- Flexibility: 2-3 Days Per Week or After Each Workout

Intensity: How hard one exercises or the level at which heart rate, ventilation, and blood pressure increases to elicit a training response in the body.

- Endurance/Aerobic Capacity:
  - >60% of MHR (Maximum Heart Rate of 220-Age)
  - Borg Dyspnea or Fatigue Score of 4 to 6 (moderate to very severe) (See Chart 8.1)
  - Rating of Perceived Exertion of 12 to 14 (somewhat hard) (See Chart 8.2)
  - Talk Test: Should be able to say a short sentence while breathing heavy and 2-3 stops for a breath
- Interval Training: During the Work Phase <60 Seconds
  - 85-90% of MHR (Maximum Heart Rate of 220-Age)
  - Borg Dyspnea or Fatigue Score of 7-9 (very severe to very, very severe)
  - Rating of Perceived Exertion of 15 to 17 (hard)
  - Talk Test: Able to say one or two words

Shortness of Breath Modified Borg Dyspnea Scale	
0	Nothing at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight
3	Moderate
4	Somewhat Severe
5	Severe
6	
7	Very Severe
8	
9	Very, very severe (almost maximal)
10	Maximal

Chart 8.1

Rating of Perceived Exertion Borg RPE Scale		
6		How you feel when lying in bed
7	Very, very light	or sitting in a chair relaxed.
8		Little or no effort.
9	Very light	Target area when doing
10		general physical activities
11	Fairly light	
12		Target area when doing
13	Somewhat hard	exercise
14		
15	Hard	
16		
17	Very hard	How you felt with the hardest
18		work you have ever done
19	Very, very hard	
20	Maximum exertion	Don't work this hard!

Chart 8.2

- Resistance Training:
    - Initial loads equivalent to either 60 to 70% of the one repetition maximum (i.e., the maximal load that can be moved only once over the full range of motion without compensatory movements
    - A load that evokes fatigue 8 to 12 repetitions
    - Progressive Overload: The exercise dosage must increase over time to facilitate improvements in muscular strength and endurance. This increase occurs when an individual can perform the current workload for 1 or 2 repetitions over the desired number of 8 to 12, on 2 consecutive training sessions. Overload can be achieved by modulating several prescriptive variables: increasing the resistance or weight, increasing the repetitions per set, increasing the number of sets per exercise, and/or decreasing the rest period between sets or exercises.
- Flexibility: Stretch a specific muscle the point of mild discomfort. No bouncing.

Time: The duration period that one spends during one exercise session.

- Endurance/Aerobic Capacity: 20-60 Minutes
- Interval Training: 20-35 Minutes
- Resistance Training: 1-3 Sets
- Flexibility: Hold each stretch for 15-30 Seconds and Repeat 2-3 Times

Type: The preferred exercise to achieve the specific results for or improvements of Cardiorespiratory Fitness, Muscular Strength and Endurance, and Flexibility. Refer to the section on *Beneficial Types of Exercise.*

Exercise Safety and Proper Exercise Technique

Pre-Exercise: Before starting any form of exercise, one with MS should speak to his/her doctor, nurse or another health care professional to ensure it is safe to exercise. For most people with MS, the best way to learn how to exercise at the right level for him/her is to work with a fitness professional or program referred by his/her doctor.

Proper Pace: One with MS should try doing a variety of exercises to prevent tiring out one set of muscles too quickly or getting overworked. One should work at a pace that allows one to exercise for longer. For example, one could do some exercises in the morning and some later in the day.

Breathing: When exercising, it is important to remember to inhale in preparation of the movement and exhale on the exertion phase of the movement. An individual should take slow deep breaths and pace him/herself. It is recommended to purse the lips while exhaling. It is not dangerous to feel out of breath when exercising. This is a normal response to exercise and one will recover. Use the talk test to monitor intensity and level of breathlessness or fatigue. (See the talk test in the intensity section.) Breathing techniques can help one control breathing.

Medication Use: If an individual uses medication for the treatment of MS, he/she should continue to take the medication based on his/her doctor's advice. His/her doctor may adjust the dosage according to the physical activity demands.

Exercise Avoidance: One should take a day off if the MS symptoms are flaring up.

Heat Sensitivity: Heat, while it won't trigger an attack, can exacerbate the clients' MS symptoms, which range from annoying to debilitating. Remember that symptoms can vary tremendously from one MS client to another. Some may experience an "itching" sensation throughout the body after the body temperature rises during workouts. It's quite irritating but not enough to slow down one's training. Some may also deal with severe shaking of different body parts when body heat rises which may completely stop one's training for the day. It is necessary as a trainer to be cognizant of these MS effects on the client during and post-workout.

MS clients should be trained at the gym when it's cool and air conditioned. Mornings are best before the heat of the day. Gear like cooling vests and cold packs are beneficial to have on hand. It is also beneficial to keep a small, wet towel in a cooler so it gets very cold; during more intense training sessions the client may use this cold towel wrapped around his/her neck to keep cool and thwart of these symptoms during the workout. MS clients must stay hydrated and may sip icy drinks before and during the workout to keep their core temperature from rising too much. It is imperative that MS clients avoid getting overheated which may cause discontinuation of the workout. Having to stop workouts due to lack of preparation in preventing one's clients from overheating is NOT acceptable.

Chapter Nine
Scope of Practice for the Health and Fitness Professional

The health and fitness professional can play a vital role in the overall health and well-being of one who has Multiple Sclerosis. As a health and fitness professional, one should understand the extent of his/her scope of practice and be able to identify when a referral to a healthcare provider would be appropriate to avoid legal implications and potential injuries to his/her clients (Kompf, J., Tumminello, N., and Nadolsky, S., 2014).

The American College of Sports Medicine (ACSM) and the National Strength and Conditioning Association (NSCA) have delineated the specific job description of a personal trainer or health and fitness professional.

According to the ACSM: The ACSM Certified Personal Trainer (CPT) works with apparently healthy individuals and those with health challenges who are able to exercise independently to enhance quality of life, improve health-related physical fitness, performance, manage health risk, and promote lasting health behavior change. The CPT conducts basic pre-participation health screening assessments, submaximal aerobic exercise tests, and muscular strength/endurance, flexibility, and body composition tests. The CPT facilitates motivation and adherence as well as develops and administers programs designed to enhance muscular strength/endurance, flexibility, cardiorespiratory fitness, body composition, and/or any of the motor skill related components of physical fitness (i.e., balance, coordination, power, agility, speed, and reaction time).

According to the NSCA: Personal trainers are health/fitness professionals who, using an individualized approach, assess, motivate, educate, and train clients regarding their health and fitness needs. They design safe and effective exercise programs, provide the guidance to help clients achieve their personal health/fitness goals and respond appropriately in emergency situations. Recognizing their own area of expertise, personal trainers refer clients to other healthcare professionals when appropriate. Personal trainers should fulfill a specific role within the healthcare system and as a healthcare provider. Trainers should have a strong knowledge base in kinesiology, psychology, injury prevention, nutrition, and knowledge of simple medical screening tests. Because of this, they may share certain roles with other healthcare providers such as dietitians, physical therapists, doctors, and psychologists.

It is necessary for health and fitness professionals to identify two major components of their profession; research and practical application of that research. In other words, evidence base training must be applied. In addition, the health and fitness professional must take into consideration the population he/she is training and apply proper methodology or intervention.

When working with clients who have MS, health and fitness professionals should focus specifically on exercise screening and prescription. The health and fitness professional can also have general training in injury management, psychology, and nutrition. Given the appropriate educational background, health and fitness professionals may play a role in working with populations with specific medical impairments such as MS.

Injured Clients
Physical therapists and orthopedic specialists work specifically to fix what is broken or severely injured, whereas health and fitness professionals work to enhance what is not broken. Training clients consists of assessing for weaknesses and improving upon those weaknesses while working around what is severely injured or broken. Diagnosis and using corrective exercises for injuries is in the scope of the physical therapist and/or orthopedic specialist. The health and fitness professional should follow two criteria when prescribing exercise: 1. Comfort: Movement is pain-free, feels natural, and works within the client's current physiology 2. Control: The client can demonstrate the movement technique and body positioning as provided in each exercise description. To allow for comfort and control, the health and fitness professional may have to modify the range of motion or adjust body alignment to best fit the client's current ability and anatomy.

Psychology and Nutrition Counseling
The personal training profession has a solid base not just in exercise, but in nutrition as well. However, a personal trainer is not qualified like a Registered Dietitian (RD), who can write meal plans for clients. Nutrition is related to psychology in that most clients have a fair and very general understanding of what they need to do to improve their eating habits. The real question is why do they not take the steps to become healthy? Health and fitness professionals should be able to disseminate information on nutrition, serve as counselors to behavior change, and act as a motivator for health change. This can all be done without writing a specific meal plan for a client. Health and fitness professionals can implement an effective change protocol to be used to hasten behavior change.

Medical Care and Special Populations
Practicing medicine is not within the scope of practice for the health and fitness professional. However, there are certain conditions that could be easily screened by a health and fitness professional especially if a client does not spend much time with their physician or even go to their physician regularly. Health and fitness professionals encourage a healthy all-around lifestyle, which includes diet, exercise, and even sleep. As the obesity epidemic continues, so do the comorbid conditions that accompany it, including osteoarthritis, diabetes, hypertension, and obstructive sleep apnea (OSA). Health and fitness professionals could ask questions from validated questionnaires to know when to refer to a doctor. See the section on "Screening and Assessments".

Table 9.1 provides an overview of what a personal trainer does and does not do. It is important for all health and fitness professionals to be familiar with local bylaws on scope of practice, as they may be different depending on where the health/fitness professional lives (IDEA Health & Fitness Association, 2001).

Personal Fitness Trainers DO NOT:	Personal Fitness Trainers DO:
Diagnose	• Receive exercise, health, or nutrition guidelines from a physician, physical therapist, registered dietitian, etc. • Follow national consensus guidelines for exercise programming for medical disorders • Screen for exercise limitations • Identify potential risk factors through screening • Refer clients to an appropriate allied health professional or medical practitioner
Prescribe	• Design exercise programs • Refer clients to an appropriate allied health professional or medical practitioner for an exercise prescription
Prescribe diets or recommend specific supplements	• Provide general information on healthy eating according to the MyPlate Food Guidance System • Refer clients to a dietitian or nutritionist for a specific diet plan.
Treat injury or disease	• Refer clients to an appropriate allied health professional or medical practitioner for treatment • Use exercise to help improve overall health • Help clients follow physician or therapist advice
Monitor progress for medically referred clients	• Document progress • Report progress to an appropriate allied health professional or medical practitioner • Follow physician, therapist, or dietitian recommendations
Rehabilitate	• Design an exercise program once a client has been released from rehabilitation
Counsel	• Coach • Provide general information • Refer clients to a qualified counselor or therapist
Work with patients	• Work with clients

Table 9.1

Chapter Ten
Screening and Assessments

Multiple Sclerosis (MS) is a polysymptomatic disease that differs among individuals. People with MS show a reduced functional capacity compared to age-matched healthy peers, and similar to healthy older adults. Before starting an exercise training program, it is imperative that one receives a baseline evaluation. A thorough neuromusculoskeletal evaluation by one's physician provides baseline information about the person's physical status and present level of function. The initial evaluation should include assessment of all symptoms currently affecting the individual's performance. Once an initial evaluation is conducted, the below interventions focus on the following areas:

- *Early* Intervention
- Modification/Compensation Over Restoration-While some restoration is present during the remission phase of MS, one should focus on the necessary adaptations to his/her environment and behavior modification that will allow the person to remain functionally independent and productive.
- Education, Support, and Motivation-Having a comprehensive, supportive system for one who is newly diagnosed with MS is key to optimizing his/her function and mobility.
- Self-management via skills training and the use of adaptive equipment.

Once baseline function is established then an exercise assessment is needed to individualize one's exercise prescription. Even though an Occupational or Physical Therapist will more than likely assess for more specific MS functionality, the health and fitness professional will still measure the traditional core components of fitness such as cardiorespiratory fitness, muscular strength and endurance, flexibility, and body composition.

Multiple Sclerosis Functional Composite (MSFC)

As a result of a meeting addressing outcome measures in MS clinical trials, the National Multiple Sclerosis Society's Advisory Committee on Clinical Trials of New Agents in Multiple Sclerosis appointed a Task Force on Clinical Outcomes Assessment in 1994. The Task Force was charged with reviewing existing clinical outcome measures and recommending an optimal approach to clinical outcome assessment in future MS trials. The Task Force recommended that an optimal MS clinical outcome measure should be multidimensional in order to reflect the principal ways MS affects an individual —leg function and ambulation; arm and hand function; cognitive function; visual function; sensory function; and bowel, bladder, and sexual function. Additional characteristics of an optimal clinical outcome measure included applicability across the range of disease severity; strong psychometric properties; sensitivity to, and ability to predict clinical change due to MS; ability to detect treatment effects in clinical trials; practicality of administration; and acceptability to patients.

From this review came a three-part composite clinical measure, the Multiple Sclerosis Functional Composite (MSFC). The outcome measures include the Timed 25-Foot Walk (T-25FW), 9-Hole Peg Test (9-HPT), and the Paced Auditory Serial Addition Test (PASAT).

Those who administer the MSFC are not required to have extensive experience with MS patients or with standardized testing procedures. Therefore, the National MS Society's Clinical Outcomes Assessment Task Force, provides a MSFC manual with instructions to ensure that the MSFC is administered in a standardized manner, regardless of the examiner's prior experience. It would be within the scope of practice if an MS Fitness Specialist desires to administer the MSFC.
https://www.nationalmssociety.org/nationalmssociety/media/msnationalfiles/brochures/10-2-3-31-msfc_manual_and_forms.pdf

Standardizing MSFC Administration: The MSFC has three MSFC components should be administered in the following order:

1. Trial 1, Timed 25-Foot Walk
2. Trial 2, Timed 25-Foot Walk
3. Trial 1, Dominant Hand, 9-HPT
4. Trial 2, Dominant Hand, 9-HPT
5. Trial 1, Non-Dominant Hand, 9-HPT
6. Trial 2, Non-Dominant Hand, 9-HPT
7. PASAT-3''

Timed 25-Foot Walk (T25-FW)

- Description: The Timed 25-Foot Walk is a quantitative measure of lower extremity function. It is the first component of the MSFC administered. The patient is directed to one end of a clearly marked 25-foot course and is instructed to walk 25 feet as quickly as possible, but safely. The task is immediately administered again by having the patient walk back the same distance. Patients may use assistive devices when doing this task.

- Materials Needed
  Stopwatch, clipboard, Timed 25-Foot Walk Record Form, marked 25-foot distance in an unobstructed hallway, assistive device (if needed)

- Time Limit per Trial: 3 minutes (180 seconds) per trial.

- Discontinue Rules
  - If the patient cannot complete Trial 2 of the Timed Walk after a 5-minute rest period.
  - If the patient cannot complete a trial in 3 minutes.

- Administration
  Trial 1: Make sure that the stopwatch is set to 0:00. For the Timed 25-Foot Walk, the subject should be directed to one end of a clearly marked 25-foot course (clearly defined on the floor or on the wall) and instructed to stand just behind the starting line. Point out where the 25-foot course ends, then instruct the patient as follows: "I'd like you to walk 25 feet as quickly as possible, but safely. Do not slow down until after you've passed the finish line. Ready? Go." Begin timing when the lead foot is lifted and crosses the starting line. The examiner should walk along with the patient as he/she completes the task. Stop timing when the lead foot crosses the finish line. The examiner should then record the subject's walk time to within 0.1 second, rounding as needed.

- Trial 2
  After completing the first timed walk, position the patient just behind the line where s/he is now standing, repeat the same instructions, and have the patient complete the walk again.

- Record Score: The score for the T25-FWis the average of the two completed trials. This score can be used individually or used as part of the MSFC composite score.

9-Hole Peg Test (9-HPT)

- Description: The 9-HPT is a quantitative measure of upper extremity (arm and hand) function. Its use with MS patients was first reported by Goodkin, Hertsgaard, & Seminary in 1988, and it has seen increasing use in MS clinical trials and clinical practice during the last decade. The 9-HPT is the second component of the MSFC to be administered. Both the dominant and non-dominant hands are tested twice (two consecutive trials of the dominant hand, followed immediately by two consecutive trials of the non-dominant hand).
  It is important that the 9-HPT be administered on a solid table and that the 9-HPT apparatus be anchored.

- Materials Needed
  9-HPT Apparatus, Dycem, stopwatch, clipboard, 9-HPT Record Form

- Time Limit Per Trial: 5 minutes (300 seconds)

- Discontinue Rules
  - If the patient cannot complete one trial of the 9-HPT in 5 minutes.
  - If the patient cannot complete a trial with his or her dominant hand within 5 minutes, move on to the trials with the non-dominant hand.
  - If the patient cannot complete a trial with his or her non-dominant hand, move on to the PASAT.

- Administration
  Dominant Hand—Trial 1
  Make sure that the stopwatch is set to "0:00." Introduce this section by saying, "Now, we're going to be measuring your arm and hand function." If this is the first visit, ask, "Are you right- or left-handed?" Make a note of the dominant hand for subsequent instructions. Place the 9-HPT apparatus on the table directly in front of the patient. Arrange the apparatus so that the side with the pegs is in front of the hand being tested and the side with the empty pegboard is in front of the hand not being tested. Secure with a non-slip mat. Read the following instructions to the patient: "On this test, I want you to pick up the pegs one at a time, using one hand only, and put them into the holes as quickly as you can in any order until all the holes are filled. Then, without pausing, remove the pegs one at a time and return them to the container as quickly as you can. We'll have you do this two (2) times with each hand. We'll start with your [DOMINANT] hand. You can hold the peg board steady with your [NON-DOMINANT] hand. If a peg falls onto the table, please retrieve it and continue with the task. If a peg falls on the floor, keep working on the task and I will retrieve it for you. See how fast you can put all of the pegs in and take them out again. Are you ready? Begin."

  Start timing as soon as the patient touches the first peg, and stop timing when the last peg hits the container. If a peg drops on the floor, the examiner may retrieve it and put it back in the peg box. However, if a peg drops onto the table, allow the patient to retrieve it. Record the patient's time under "Dominant hand—Trial 1." If the subject stops after having put all the pegs into the holes, prompt the subject to remove them as well by saying, "And now remove them all." If the subject begins to remove more than one peg at a time, correct him/her by saying, "Pick up one peg at a time."

  Dominant Hand—Trial 2
  After the first trial with the dominant hand, say, "Good. Now, I'd like you to do the same thing

again, once again using your [DOMINANT] hand. See how fast you can put all of the pegs in and take them out again. Ready? Begin." Again, start timing as soon as the patient touches the first peg, and stop timing when the last peg hits the container. Record the patient's time under "Dominant hand—Trial 2."

Non-Dominant Hand—Trials 1 and 2
After the second trial with the dominant hand, rotate the apparatus 180 degrees such that the side with the pegs is now in front of the non-dominant hand and the empty pegboard is in front of the dominant hand. Then say, "OK. Now I'd like you to switch and use your [NON-DOMINANT] hand. This time, you can use your [DOMINANT] hand to stabilize the peg board. Ready? Begin." Administer, time, and record the two nondominant hand trials following the procedures described above for dominant hand trials.

- Record Score: The score for the 9-HPT is an average of the four trials. The two trials for each hand are averaged, converted to the reciprocals of the mean times for each hand and then the two reciprocals are averaged. This score can be used individually or used as part of the MSFC composite score.

The Paced Auditory Serial Addition Test (PASAT)

- Description: The Paced Auditory Serial Addition Test (PASAT) is a measure of cognitive function that specifically assesses auditory information processing speed and flexibility, as well as calculation ability. It was initially developed by Gronwall in 1977 to monitor the recovery of patients who had sustained mild head injuries. Stimulus presentation rates were adapted for use with MS patients by Rao and colleagues in 1989, and the measure has been widely used in MS studies during the last decade. The PASAT is presented on audiocassette tape or compact disc (CD) to control the rate of stimulus presentation. Single digits are presented either every 3'' (or every 2" for the optional 2" PASAT) and the patient must add each new digit to the one immediately prior to it. The test score is the number of correct sums given (out of 60 possible) in each trial. To minimize familiarity with stimulus items in clinical trials and other serial studies, two alternate forms have been developed; the order of these should be counterbalanced across testing sessions. The PASAT is the last measure of the MSFC that is administered.

- Materials Needed
  An audiocassette tape or CD player, audiocassette tape or CD with PASAT stimuli, clipboard and PASAT Record Forms to administer the test. Note: audiocassette tapes stretch after 50-75 presentations and should be replaced with new tapes.

- Discontinued Rules
  - If the patient does not get at least two answers correct (consecutive or not) on any one of the three 3'' practice sequences.
  - If the patient does not get at least one answer correct on PASAT-3'' test, do not administer the 2'' test. This patient is considered unable to perform the test.

- Administration
  Verify that you have the correct Record Form and audiocassette/CD before you start reading the instructions for the 3'' Practice Trial to the patient.

  PASAT-3" Practice Trials
  For PASAT-3" (stimuli every 3'') say, "On this tape (or CD) you are going to hear a series of single digit numbers that will be presented at the rate of one every 3 seconds. Listen for the first two numbers, add them up, and tell me your answer. When you hear the next number, add it to the one you heard on the tape right before it. Continue to add the next number to each preceding one. Remember, you are not being asked to give me a running total, but rather the sum of the last two numbers that were spoken on the tape (or CD)."

  Write the numbers 5, 7, 3, and 2 from left to right on a sheet of paper. Then give the following instruction: "For example, if the first two numbers are '5' and '7,' you would say '12.' If the next number is '3' you would say " (pause for an answer from patient). If the patient gives a running total (i.e., "15") or a number other than "10," provide the correct number and explain the task again before going on. "Then if the next number is '2' you would say " (pause for an answer from patient). If the patient fails to say "5," provide the answer and proceed to the practice items. Then say, "This is a challenging task. If you lose your place, just jump right back in — listen for two numbers in a row and add them up and keep going. There are some practice items at the beginning of the tape (or CD). Let's try these first." Play the sample items, stopping the tape after the last practice item. After three consecutive "no responses," prompt him/her to resume by saying, "Jump back in with the next two numbers you hear." You should always administer at least one practice trial before administering the actual test. Proceed to the PASAT-3" test if the patient gets two or more answers correct (consecutive or not). Repeat the practice items, if necessary, until the subject gets two or more answers correct. Administer the practice sequence a maximum of three times. Record answers in the space provided on the PASAT Practice Form. If the patient gets at least 2 answers correct (consecutive or not) on any of the practice sequences proceed to administer the 3" PASAT test.

  PASAT-3"
  Once it is clear that the patient possesses sufficient understanding of the task, begin PASAT 3" test. Before starting PASAT 3", remind him/her: "Remember, if you get lost, just jump back in because I can't stop the test once it has begun." Discourage talking and oral calculations during the test; only the patient's answers should be spoken out loud. The patient may need prompting to continue the test if she/he gets lost. After five consecutive 'no responses,' redirect the patient quickly by saying, "Jump back in," but do not stop the tape.

  Note: Some neuropsychologists also recommend completing the PASAT 2" to provide additional information about cognitive function. This test is identical to the PASAT 3", except that the numbers will come a little faster, one every 2 seconds. This can be added as an option after the PASAT 3". Although only the PASAT 3" is currently recommended for inclusion in the MSFC.

- Completing the PASAT Record Form and Record Score: Circle all correct answers. Write in any incorrect responses in the space provided. Place a dash when no response is given. If the patient corrects him/herself after giving a response, count the amended answer as the response. The amended response is the one that will be used in determining total correct, regardless of whether it was the correct or incorrect response. Slash through the old response and write in 'SC' with a circle around it to indicate that the patient self-corrected.

Each section of the PASAT has a maximum of 60 correct answers (i.e. 61 digits are presented for each part). Count the total number correct (number of circled answers) for PASAT-3'' and record on the PASAT Record Form. Repeat the same scoring procedure for PASAT-2'' Finally, record any circumstances that you believe may have affected the patient's performance. These are factors that may have affected the trial but were not severe enough to necessitate repetition of the trial. The score for the PASAT is the total number correct out of 60 possible answers. This score can be used individually or used as part of the MSFC composite score.

The MS Functional Composite (MSFC) was developed by the National MS Society's Clinical Outcomes Assessment Task Force, chaired by Richard Rudick, MD. 2001

Other MS Assessments

A wide variety of measures have been used in clinical studies of MS. Provided here is a brief list and summary of the measures. This list is for educational purposes only.

- Ambulation Index: The AI is a rating scale developed by Hauser et al (1983) to assess mobility by evaluating the time and degree of assistance required to walk 25 feet. Scores range from 0 (asymptomatic and fully active) to 10 (bedridden). The patient is asked to walk a marked 25-foot course as quickly and safely as possible. The examiner records the time and type of assistance (e.g., cane, walker, crutches) needed.

- Bladder Control Scale: The BLCS is based on items from the Bowel-Bladder Function Scale and the Sickness Impact Profile. This four-item instrument provides a brief assessment of bladder control and the extent to which bladder problems have an impact on everyday activities. The total score for the BLCS is the sum of the scores for the 4 items. The BLCS is one of the components of the MSQLI.

- Bowel Control Scale (BWCS): The BWCS is based on items from the Bowel-Bladder Function Scale and the Sickness Impact Profile. This five-item instrument provides a brief assessment of bowel control and the extent to which bowel problems have an impact on everyday activities. The total score for the BLCS is the sum of the scores for the 5 items. The BWCS is one of the components of the MSQLI.

- Disease Steps (DS) The DS is an ordinal clinical rating scale developed by Hohol et al (1995) to provide a straightforward assessment of functional disability in MS primarily based on ambulation. It was designed to aid in determining when to implement therapy and as a way to monitor treatment response. Scores range from 0 (normal) to 6 (essentially confined to wheelchair). There is a separate category for patients who are not classifiable. The rating itself is simple and brief. However, the information needed to arrive at a rating generally requires a medical history and both general physical and neurological examinations, including having the patient walk 25 feet. Based on information gleaned from a patient's history and neurological examination, the patient is rated on an ordinal scale ranging from 0 (normal) to 6 (essentially confined to a wheelchair). There is an additional category, "U" for patients who cannot be classified into one of the 0-6 ranks.

- Functional Systems Scores (FSS) and Expanded Disability Status Scale (EDSS): The FSS and EDSS constitute one of the oldest and probably the most widely utilized assessment instruments in MS (Kurtzke, 1983). Based on a standard neurological examination, the 7 functional systems (plus

"other") are rated. These ratings are then used in conjunction with observations and information concerning gait and use of assistive devices to rate the EDSS. Each of the FSS is an ordinal clinical rating scale ranging from 0 to 5 or 6. The EDSS is an ordinal clinical rating scale ranging from 0 (normal neurologic examination) to 10 (death due to MS) in half-point increments. The FSS and EDSS have been used in virtually every major clinical trial that has been conducted in MS during the last four decades and in numerous other clinical studies. The FSS and EDSS are ordinal clinical rating scales that are rated on the basis of the judgment of the examiner. Each of the FSS and the EDSS are single-item scales and there is no composite or summed score. The FSS include pyramidal, cerebellar, brainstem, sensory, bowel and bladder, visual, cerebral (or mental), and other.

- Health Status Questionnaire (SF-36): The Short Form-36 was derived from the General Health Survey of the Medical Outcomes Study by Stewart and colleagues (1988). It is one of the most widely used generic measures of health-related quality of life and has been shown to discriminate between subjects with different chronic conditions and between subjects with different severity levels of the same disease. The SF-36 has also demonstrated sensitivity to significant treatment effects in a variety of patient populations. Population-based normative data on the SF-36 is available for the United States and some other countries as well.

  This instrument addresses health concepts that are relevant to MS patients from the patient's perspective. There is no single overall score for the SF-36, instead, it generates 8 subscales and two summary scores. The 8 subscales are: physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role-limitations due to emotional problems, and mental health. The two summary scores are the physical component summary and the mental component summary.

  The SF-36 is one of the components of the MSQLI as well as the MSQOL-54 and was included in these instruments to serve as a generic health-related quality of life measure that could provide a basis for comparison between the MS patients and other populations.

  The scoring system for the SF-36 is relatively complex and generates subscale scores for physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role-limitations due to emotional problems, and mental health. Two summary scores can also be derived from the SF-36: the physical component summary and the mental component summary.

- Impact of Visual Impairment Scale (IVIS): The IVIS was based on items derived from the Functional Capacities Assessment developed by the Michigan Commission for the Blind. This five-item instrument provides an assessment of difficulties with simple visual tasks such as reading and watching television. The IVIS is one of the components of the MSQLI. The total score for the IVIS is the sum of the scores for the 5 items.

- Mental Health Inventory (MHI): The MHI was developed as part of the National Health Insurance Study (Veit and Ware, 1983) and has been studied extensively in a variety of populations. This instrument provides an assessment of several domains of mental health including anxiety, depression, behavioral control, positive affect, and general distress. The full-length MHI consists of 18 items while the abbreviated version has 5 items. The abbreviated version can be used if time is limited but the full-length version has the advantage of generating subscales. The MHI is one of the components of the MSQLI. The scoring system for the MHI is relatively complex and generates a total score as well as subscale scores for anxiety, depression, behavior control, and positive affect.

- Modified Fatigue Impact Scale (MFIS): The MFIS is a modified form of the Fatigue Impact Scale (Fisk et al, 1994b) based on items derived from interviews with MS patients concerning how fatigue impacts their lives. This instrument provides an assessment of the effects of fatigue in terms of physical, cognitive, and psychosocial functioning. The full-length MFIS consists of 21 items while the abbreviated version has 5 items. The abbreviated version can be used if time is limited but the full-length version has the advantage of generating subscales. The MFIS is one of the components of the MSQLI. The total score for the MFIS is the sum of the scores for the 21 items. Individual subscale scores for physical, cognitive, and psychosocial functioning can also be generated by calculating the sum of specific sets of items

- MOS Modified Social Support Survey (MSSS): The MSSS is a slightly modified version of the Social Support Survey developed as part of the Medical Outcomes Study in order to assess perceived social support. (Sherbourne and Stewart, 1991) This instrument provides an assessment of several domains of social support including tangible support, emotional support, affective support, and positive support. The full-length MSSS consists of 18 items while the abbreviated version has 5 items. The abbreviated version can be used if time is limited but the full-length version has the advantage of generating subscales. The MSSS is one of the components of the MSQLI and was modified slightly for use with MS patients following field-testing and psychometric analysis. The scoring system for the MSSS is relatively complex and generates a total score as well as subscale scores for tangible support, emotional/informational support, affectionate support, and positive social interaction.

- MOS Pain Effects Scale (PES): The PES is a modified form of the pain scale contained in the Medical Outcomes Study Functioning and Well-Being Profile. This instrument provides an assessment of the ways in which pain and unpleasant sensations interfere with mood, ability to walk or move, sleep, work, recreation, and enjoyment of life. The PES consists of 6 items and is one of the components of the MSQLI. The total score for the PES is the sum of the scores for the 6 items.

- Multiple Sclerosis Quality of Life-54 (MSQOL-54): The MSQOL-54 is a multidimensional health-related quality of life measure that combines both generic and MS-specific items into a single instrument. (Vickrey et al, 1995) (Vickrey et al, 1997) The developers utilized the SF-36 as the generic component to which 18 items were added to tap MS-specific issues such as fatigue, cognitive function, etc. This 54-item instrument generates 12 subscales along with two summary scores, and two additional single-item measures. The subscales are: physical function, role limitations-physical, role limitations-emotional, pain, emotional well-being, energy, health perceptions, social function, cognitive function, health distress, overall quality of life, and sexual function. The summary scores are the physical health composite summary and the mental health composite summary. The single item measures are satisfaction with sexual function and change in health. There is no single overall score for the MSQOL-54. See the original article describing the development and testing of the MSQOL-54 (Vickrey et al, 1995) for details. Administration forms and scoring instructions can be downloaded.

- Perceived Deficits Questionnaire (PDQ): The PDQ was developed by Sullivan et al, 1990 specifically for MS in order to provide a self-report measure of cognitive dysfunction. This instrument provides an assessment of several domains of cognitive functioning that are frequently affected in MS: attention, retrospective memory, prospective memory, and planning and organization. The full-length PDQ consists of 20 items while the abbreviated version has 5 items. The abbreviated version can be used if time is limited but the full-length version has the advantage of generating subscales. The PDQ is one of the components of the MSQLI. The total score for the PDQ is the sum of the scores for the 20 items. Individual subscale scores for attention/concentration, retrospective memory, prospective memory, and planning/organization can also be generated by calculating the sum of specific sets of items.

- Sexual Satisfaction Scale (SSS): The SSS is based on the Sexual History Form. (Nowinski and LoPiccolo, 1979) Four items from the Sexual History Form were selected to provide an indicator of overall sexual adjustment. These items address the degree of satisfaction with physically expressing affection; the variety of sexual activities engaged in; and with the sexual relationship in general. The fourth item addresses the perceived level of satisfaction experienced by the partner within the relationship. This four-item scale is one of the components of the MSQLI. The total score for the SSS is the sum of the scores for the 4 items.

Multiple Sclerosis Quality of Life Inventory (MSQLI)

The MSQLI is a battery consisting of 10 individual scales providing a quality of life measure that is both generic and MS-specific (Fischer et al, 1999). The MSQLI consists of the following individual scales that have previously been listed and described. Five of the scales have both a standard and a short form. This is mentioned here for educational purposes.

- MSQLI components:
  - Health Status Questionnaire (SF-36)
  - Modified Fatigue Impact Scale (MFIS)
  - MOS Pain Effects Scale (PES)
  - Sexual Satisfaction Scale (SSS)
  - Bladder Control Scale (BLCS)
  - Bowel Control Scale (BWCS)
  - Impact of Visual Impairment Scale (IVIS)
  - Perceived Deficits Questionnaire (PDQ)
  - Mental Health Inventory (MHI)
  - MOS Modified Social Support Survey (MSSS)

- Administration Time: If the standard, longer forms are used, the MSQLI takes approximately 45 minutes to administer. Using all 5 of the short forms, the time can be reduced to approximately 30 minutes. In addition, individual scales can be omitted to save additional time.

- Administration Method: The MSQLI consists of a set of 10 self-report questionnaires that the patient can generally complete with little or no intervention from an interviewer. However, patients with visual or upper extremity impairments may need to have the MSQLI administered as an interview. Interviewers should be trained in basic interviewing skills and in the use of this instrument.

- Scoring: Each of the individual scales generates a separate score. In addition, some of the scales generate subscales, e.g., the SF-36, the MFIS, the PDQ, and the MSSS. There is no global composite combining all the scales into a single score.

- Copy of the Manual: https://www.nationalmssociety.org/NationalMSSociety/media/MSNationalFiles/Brochures/MSQLI_-A-User-s-Manual.pdf

Specific MS Condition Assessments

There are many evaluation tools to assess MS symptoms. Listed below are for educational purposes.

- Fatigue
  - Modified Fatigue Impact Scale
  - 25-foot walk
  - Manual Muscle Test before and after 6-minute walk
  - Aerobic fitness assessment (before prescribing aerobic program)
  - Equipment assessment
  - Activity diary
  - Sleep Questionnaire
  - Evaluation of medications for impact on fatigue level
  - Depression instrument
- Walking Difficulties
  - Manual Muscle Test
  - 25-foot walk
  - 6-minute walk
  - Gait analysis
  - Tinetti Assessment Tool
  - Timed-Up and Go
  - Dynamic Gait Assessment
  - Functional Gait Assessment
  - Analysis of environment and tasks
  - Vestibular and sensory/proprioceptive assessments
  - Safety evaluations
- Weakness
  - Manual Muscle Test
  - Dynamometer; Pinch Meter
  - Five Times Sit to Stand
  - Gait analysis
  - Analysis of environment and tasks
  - Assessment of transitional movements
- Poor Balance/Risk for Fall
  - Vestibular, visual, proprioceptive, sensory, spasticity/range of motion, gait analyses
  - Manual Muscle Test
  - Berg Balance Scale
  - 6-minute walk
  - 25-foot walk
  - Timed Up and Go
  - Dynamic Gait Index
  - Functional Gait Assessment
  - Dizziness Handicap Inventory

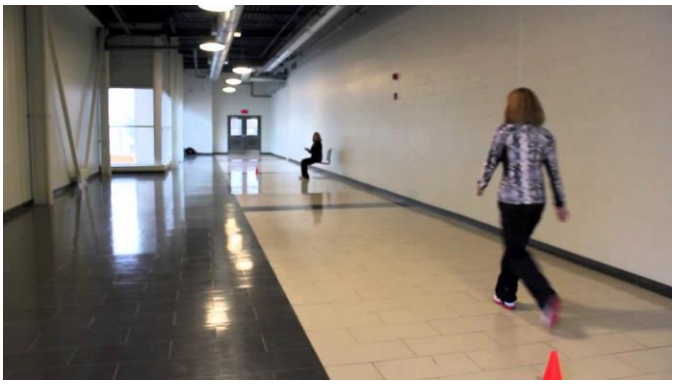
    - Tinetti Assessment Tool
- Stiffness, Spasms, Spasticity
    - Range of motion
    - Modified Ashworth
    - Consistent communication with neurologist regarding medical management (e.g., medications; intrathecal baclofen pump if severe)
- Cognitive Changes
    - Referral to a neuropsychologist
    - Modified Fatigue Impact Scale
    - Perceived Deficits Questionnaire
    - PASAT and possibly other neuropsychological screens
- Reduced Manual Dexterity
    - 9-Hole Peg Test
    - Box and Block
    - Dynamometer
    - Pinch Meter
    - Semmes-Weinstein Sensory Test
    - Spasticity
    - Coordination
- Pain
    - Trigger point assessment
    - Pain scales
    - Posture assessment
    - Equipment/seating assessment
    - Central vs. peripheral symptoms
- Tremor/Ataxia
    - 9-Hole Peg Test
    - ADL assessment
    - 25-foot walk
    - Manual Muscle Test
    - Safety evaluation
    - Canadian Occupational Performance Measure (COPM)
    - Functional Independence Measure (FIM), or other ADL assessment
- Sensory changes (including proprioception)
    - Proprioception
    - Semmes-Weinstein Sensory Test
    - Hot/cold discrimination
- Poor Vision
    - Visual acuity
    - Tracking
    - Peripheral vision
    - Visual-perceptual assessment
- Decreased Functional Independence
    - Functional Independence Measure (FIM), or other ADL assessment
    - Seating and Mobility Assessment

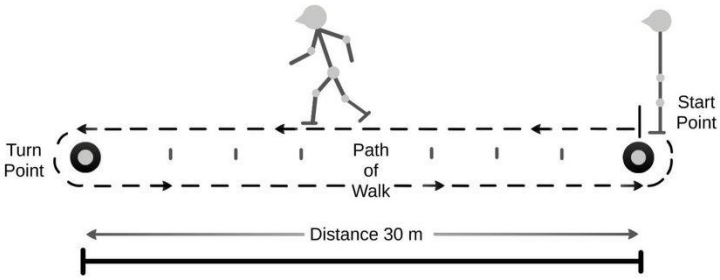
PAR-Q Form

The health and fitness professional should have an established screening protocol including a physical activity readiness questionnaire (PAR-Q) which should be conducted before any cardiorespiratory or strength training. The PAR-Q is a screening test designed to determine an individual's risks in participating in physical activity. The PAR-Q allows the health and fitness professional to identify clients with cardiovascular disease or risk factors for disease. If a client is identified as "at risk" they should be referred to a medical professional who will provide a medical evaluation before beginning an exercise program. (See Appendix A)

Cardiorespiratory Assessment: Six-minute walking test (6MWT)

The 6-min walk test (6 MWT) is a submaximal exercise test that entails measurement of distance walked over a span of 6 minutes. The 6-minute walk test (6 MWT) provides a measure for integrated global response of multiple cardiopulmonary and musculoskeletal systems involved in exercise. Main strengths of the 6 MWT stem from its simplicity in concept and performance, low cost, ease of standardization, and acceptance by test subjects, including those who are deconditioned, elderly, or frail.





In 2002, the American Thoracic Society (ATS) published guidelines on how to perform the 6 MWT. This guideline stressed the need for a standardized protocol to perform the 6 MWT to minimize variation in results. (See Appendix B)

Muscular Strength: Peripheral muscle strength

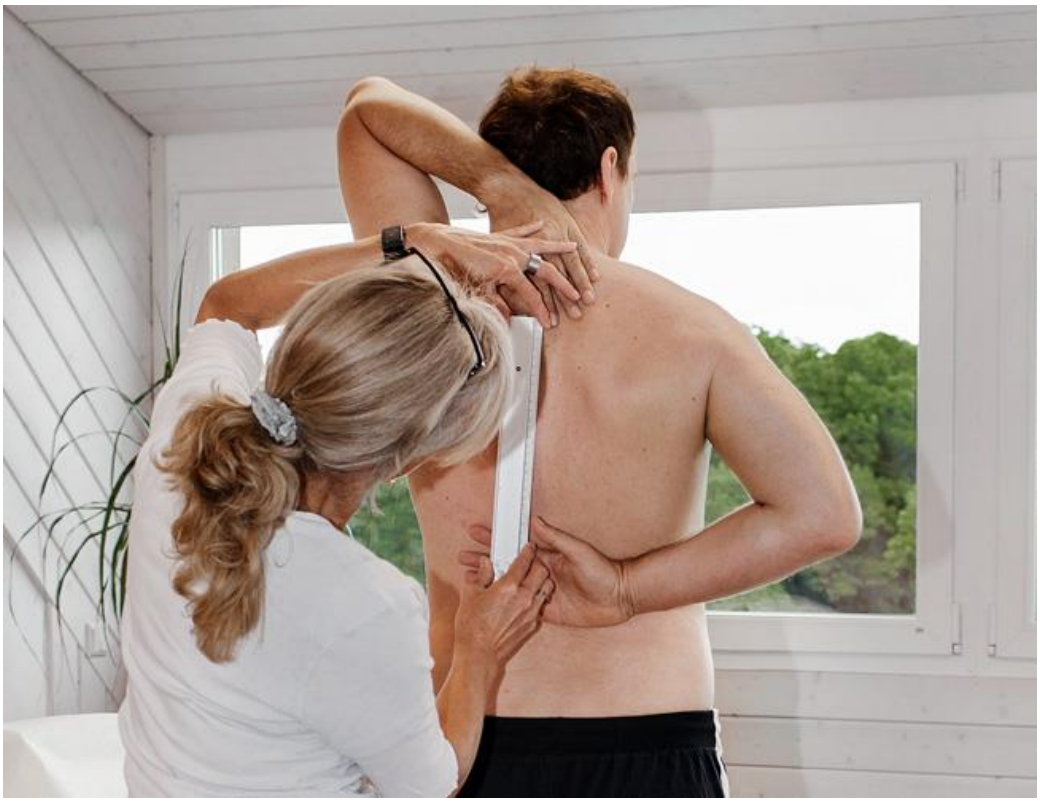
- Lower Body Strength
    - 30 Second Sit to Stand Test (30CST): The 30CST is a measurement that assesses functional lower extremity strength in older adults, but is also used in assessing functional strength in those with MS. It is part of the Fullerton Functional Fitness Test Battery. This test assesses balance, functional mobility, as well as lower body strength. (See Appendix C)

- Upper Body Strength
    - Dynamometer: A dynamometer is a machine that measures hand grip strength (HGS). Both muscle endurance and muscle strength are indicators of muscular fitness, and reduced muscle strength – measured by HGS with a dynamometer – has been associated with a higher risk of mortality.
    - Arm Curl Test: This test measures upper body strength and endurance through lifting a weight for 30 seconds. Typically, women will lift 4-5 lbs. and men will lift 8 lbs. (See Appendix D)

Flexibility

- Lower Body Chair Sit and Reach Test: This test measures flexibility in the lower body. The client, while seated with one leg extended, slowly bends forward sliding the hands down the extended leg in an attempt to touch (or pass) the toes. The number of centimeters short of reaching the toe (minus score) or reaching beyond it (plus score). (See Appendix E)

- Upper Body Back Scratch Test: This test measures flexibility of the upper body more specifically a measure of overall shoulder range of motion. This test involves measuring the distance between (or overlap of) the middle fingers behind the back with a ruler. Participants can perform this test twice, alternating hands taking the best value of each hand. The average of both hands can be used. (See Appendix F)



Postural Screening

There are many methods used to measure or screen posture. One method called photogrammetry is the science of making measurements from photographs. The input to photogrammetry is photographs, and the output is typically a map, a drawing, a measurement, or a 3D model of one's body alignment. Photogrammetry is a widely used non-invasive technique for postural evaluation. It is a viable option for healthcare professionals and researchers in the field of posture, possibly because it allows a succinct and accurate quantitative evaluation by recording subtle changes in posture in general.

From the point of view of spinal evaluation, it is capable of providing information in the frontal and sagittal planes. In this method, photographs of the subjects are taken in frontal or sagittal plane with a camera which is mounted on a leveled tripod stand, which is placed at some distance from the subjects. This distance varies amongst various researches. The photographs which are thus obtained are transferred to a computer system. They are used to calculate postural angles with the help of some software which has been installed in the computer system.

The type of software too varies from research to research. Angles are then drawn between the markers by drawing horizontal and/or vertical lines. With the use of this method, quantifiable and reliable data can be obtained. Its use in measuring head posture, shoulder posture, cervical lordosis, thoracic kyphosis, lumbar lordosis, lower limb posture and pelvic tilt has been reported in the literature (Furlanetto, T. S., 2016). (See Figure 10.1)

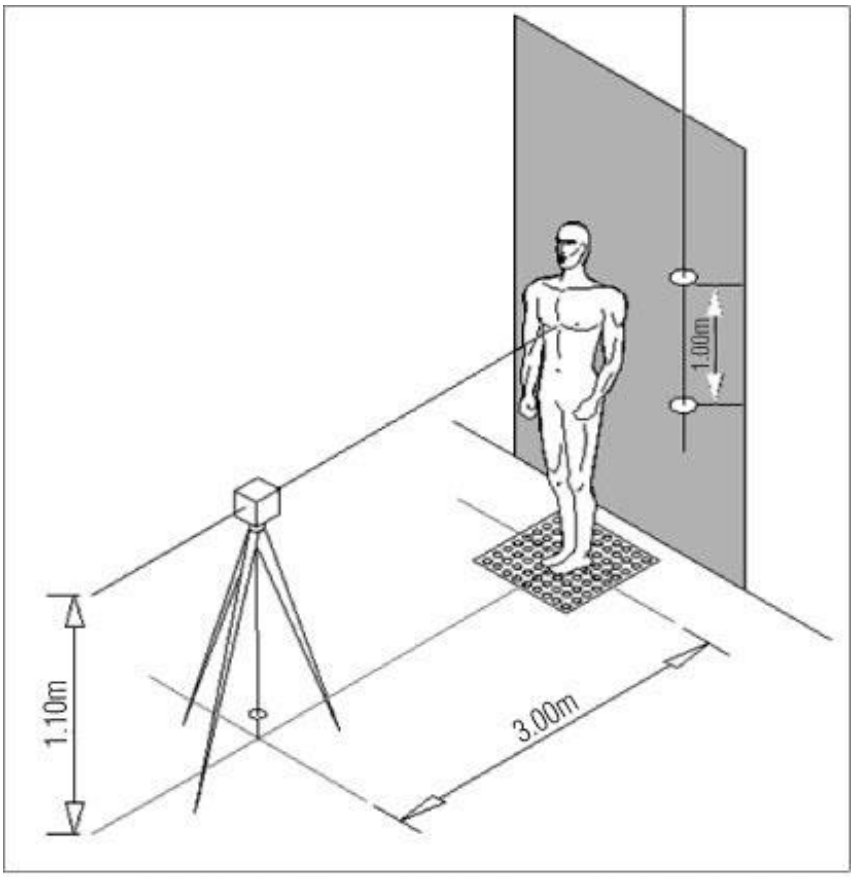


Figure 10.1

Another posture assessment used is the plumb line method. A plumb line is a string suspended overhead with a small weight, or plumb bob, attached at the end near the floor. Position the patient behind the line so you can see the body bisected by the plumb line. The assessor observes the individual from the anterior view, the lateral view, and the posterior view. The assessor then uses a checklist to record any deviations from normal. (See Figure 10.2)

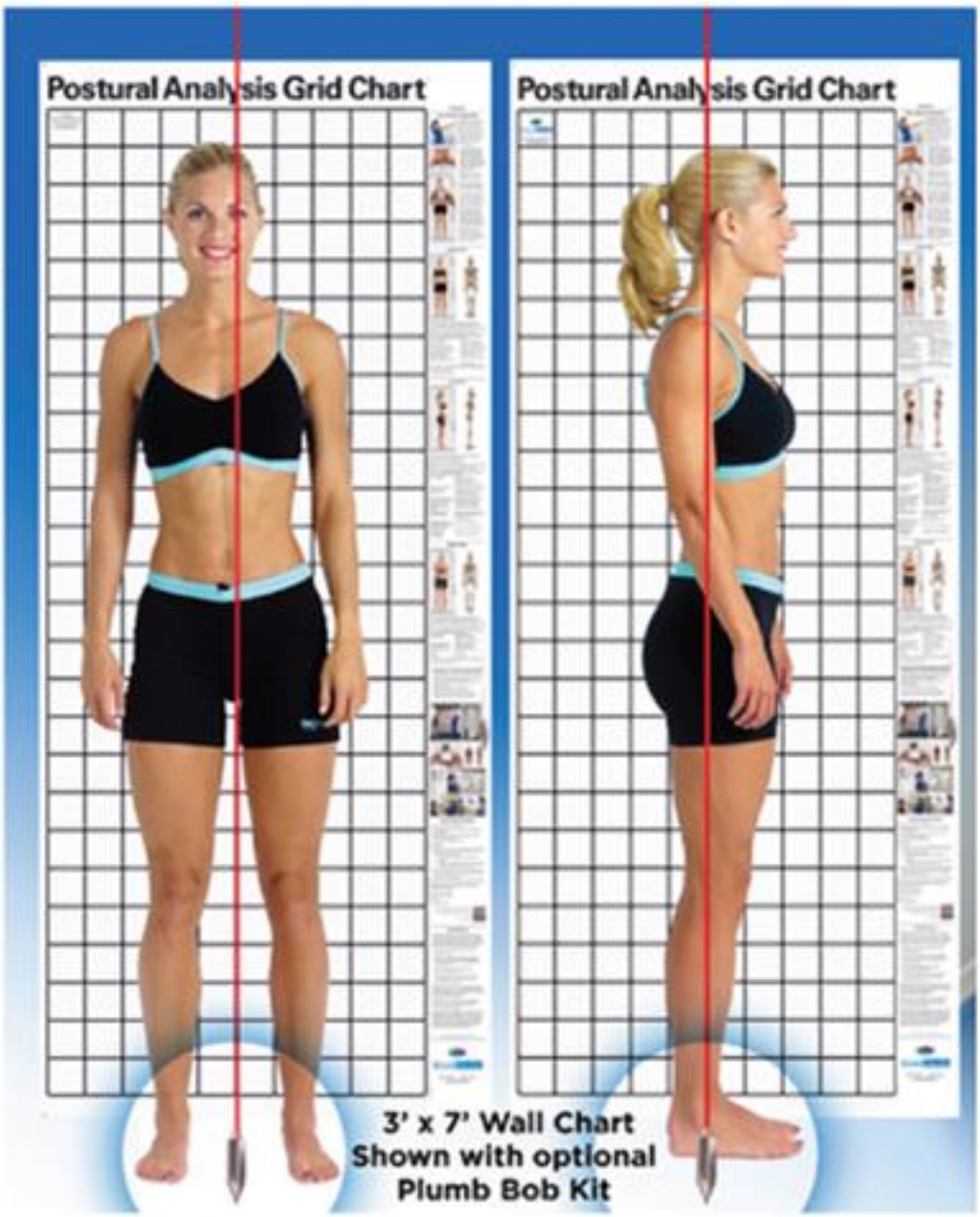


Figure 10.2

Summary

The assessment of clients and program outcomes is a crucial element of an exercise program. Before one should participate in an organized exercise program, a health and fitness professional should measure the condition of clients, including symptoms, endurance, strength, and health-related quality of life. As well as during and after a certain time of training, the health and fitness professional should reassess client performance and program effectiveness. If working with a health and fitness professional, the client should foster an open line of communication between the health and fitness professional and his/her doctor.

Chapter Eleven
Goals and Program Design

Goal Profile

Once the health and fitness professional has screened and assessed the client, it is imperative to set clear and concise goals to track one's health and fitness progress. It is helpful for the client to think about the different aspects of his/her life and where he/she would like to make changes. Goals can and should include the support of a partner or a family member.

Some common goals for many people with MS include:
To exercise on a regular basis and feel good doing it.
To be less short of breath.
To learn how to select and prepare healthy meals.
To lose or gain weight.

The goals must be S.M.A.R.T.
Specific
Measurable
Attainable
Realistic
Time-Bound

The main focus for clients with MS achieving their goals is *time*. It does not matter how long they spend in each phase of the program. They may spend as much time as they need in any phase, or they may never progress to the next phase. Their goals and abilities determine how they move through the different phases the trainer develops for them. Make sure the goals that are set for them and they set for themselves are reasonable and attainable. A person living with MS should not approach the training with the intention of becoming the next Mr. or Mrs. Universe, instead they should look at the workout routine as a way to regain strength, health, and independence, or as a supplement to physical therapy.

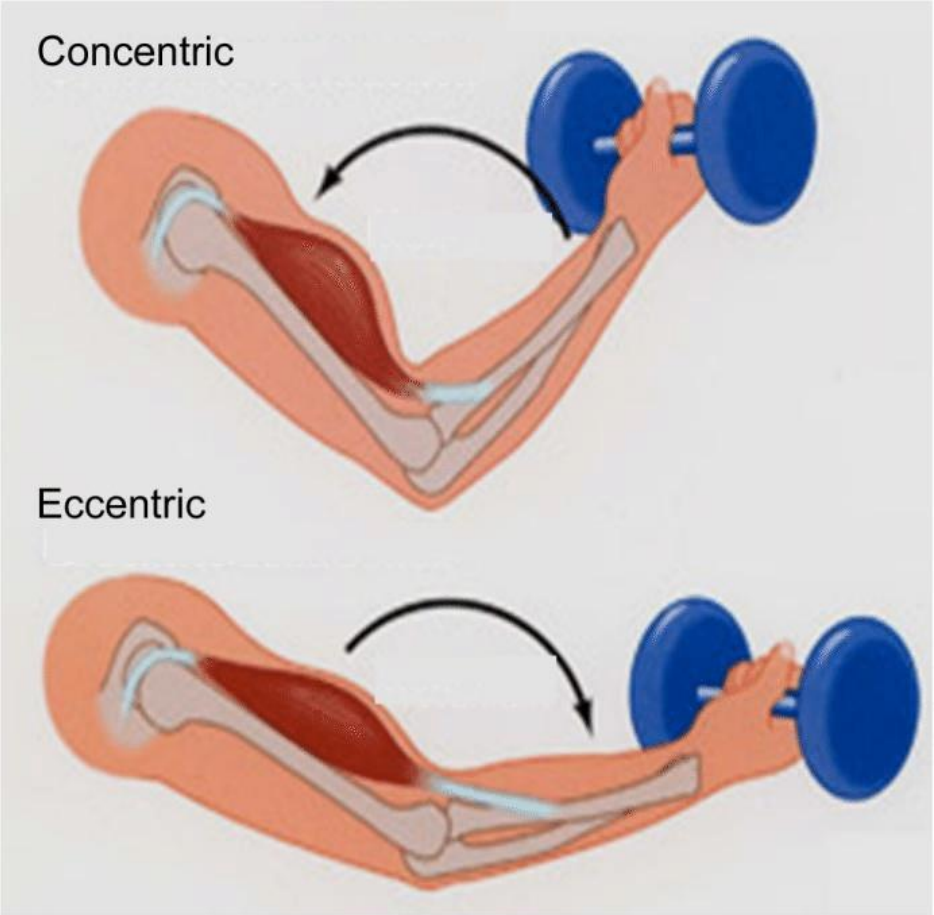
Each day of the program is adaptable, as well. If day one is too intense as it is written, simply cut back on the volume of training. They can cut back on the number of exercises or the number of sets performed for each exercise. If the program calls for 3 chest exercises, but they can only do 1, then they should start there and add a second one when they get a little stronger. This is a lifelong journey of health and fitness, not a mad dash to an unrealistic (or unsafe) finish line. Clients should challenge themselves but work at their own pace and keep safety as the number one priority.

While a health and fitness program will not cure MS, one can take control of his/her chronic condition, manage it, and increase the quality of life. He/she should work with his/her healthcare team including the health/fitness professional and focus on reaching the goals he/she sets at the beginning of the program.

Concentric and Eccentric Muscle Contractions for MS Programming

Concentric (Positive) Contractions: This contraction **shortens** the muscle as it acts against resistive force (like a weight). For example, during a biceps curl, the biceps contract concentrically during the lifting phase of the exercise.

Eccentric (Negative) Contractions: The muscles **lengthen** while producing force—usually by returning from a shortened (concentric) position to a resting position. Using the same example above, the lowering the weight back down during a biceps curl is an eccentric contraction for the biceps. One is slowing the descent of the weight back down instead of allowing the weight (and gravity) to just pull the arm back down passively.



So Why Do the Different Types of Contractions Matter?
It's essential to include both concentric and eccentric contractions in one's strength-training program. Most traditional exercises include these movements—a lifting phase (using the shortening or concentric phase) and a lowering phase to return to the start position. However, how much time is spent in each phase can affect the results. Here are some facts about the difference between concentric and eccentric movements:

- The muscles can generate more force during the eccentric phase of an exercise. For example, one may only be able to lift a 10-pound dumbbell for a biceps curl. But likely, one could hold and *lower* (the eccentric phase) a 15- or 20-pound weight.

- By slowing down the negative (eccentric) phase of the exercise, the muscle can build greater strength. This is why, typically, people are advised to lower weights or return them to the start position slowly.

Training Methods for MS

In the world of fitness for strength and conditioning, there are a multitude of training styles, methods and programs you can follow. With the various adaptations of every method whether it's an adjustment to the reps, sets, speed, rest, etc., the possibilities are endless. Each one has its merits and if one trains properly, they all will yield results in some way shape or form. Having MS does not change the fact that one has to keep the muscles from getting "bored" of the exercise routine. The best way to to keep the routine fresh and to continue to progress is to challenge the body with different training methods. The following are some of the most common methods along with why and how they can help one develop more strength and conditioning in one's battle to conquer MS through fitness.

• Time Under Tension Training

There is much being written on both sides about the training method time under tension (TUT) being a positive way to work out or a complete waste of time. The style of training for MSers involves "challenging" the MS body to perform and move in ways the nerves are saying it cannot. If one builds muscles and strengthens them through resistance training those muscles will be strong enough to push, pull and move where they want. What really counts when it comes to building and strengthening muscle is progressive overload. Muscle will grow in direct proportion to the amount of work it's required to do. By focusing on timed sets rather than going for a specific number of reps, you can directly influence the intensity of the set and stimulate results.

What is 'time under tension' training (TUT)?

TUT essentially refers to how long a muscle is under strain during a set. A typical set of 10 reps for an average person will take anywhere from 15-25 seconds depending on lifting speed. By putting a muscle under longer time of strain such as 120 seconds, you can cause extensive muscle growth. But there is a debate on how long that time of strain needs to be to turn a regular set into a TUT set. Trying to figure out the optimal TUT per set in order to accelerate muscle growth is an overly simplistic view on hypertrophy training without substantial scientific support. Based off of scientific research, this program of fitness for MSers recommends TUT of a 6 count up and 6 count down repetition pace.

Muscle Fiber Types and TUT

People have two general types of skeletal muscle fibers: slow-twitch (type I) and fast-twitch (type II). Slow-twitch muscle fibers help enable long-endurance feats such as distance running, while fast-twitch muscle fibers fatigue faster and are used in powerful bursts of movements like sprinting. To make the argument that TUT is an important type of training we have to answer the question, "Does TUT make a difference in the strengthening of any muscle fibers?" Research shows that is possible that high TUT may promote greater hypertrophy in slow-twitch muscle fibers, which are more fatigue-resistant than fast-twitch muscle fibers and therefore can't be adequately stimulated with short TUT and heavy loads (Schoenfeld, 2013, Netreba, et al., 2007; Netreba, et al., 2009; and Popov, et al., 2006). In order to be fully developed, slow-twitch fibers require to be put under tension for extended periods of time.

Different training methods must be used when trying to fully develop strength and muscle development in addition to fighting off muscle wasting in people with multiple sclerosis. TUT is not the only method of training but should absolutely be incorporated into any MS fitness program at some point. Walking

with MS or doing any movement/activity that takes a considerable amount of time is taxing on the slow-twitch muscle fibers. MS is a disease of fatigue so even cleaning out a cabinet where you are using your arms for an extended time frame to accomplish that chore is demanding on slow-twitch fibers as opposed to fast-twitch ones. Proper TUT training will help combat the fatigue associated with these types of activities for MSers.

• Rest/Pause Training

What is it?

Rest/Pause Training requires one to take as little as 10-15 second breaks between each set unlike standard training where you take as much as 3-4 minute rest periods between sets. But there are many variations of the rest/pause method which alter the amount of repetitions each set from as little as 3 to as many as 20 and where the rest is increased to 25-30 seconds. The most widely used variation of rest/pause requires you to perform a set to "failure", rest 25-30 seconds, perform another set to failure, rest 25-30 seconds, and perform a final set to failure. "Failure" is when the set ends when technique starts to falter.

Why use it?

Rest/Pause training is s a great way to increase both training intensity and efficiency by utilizing shorter rest periods between sets. There's no wasted time in rest/pause training and one can't diminish the results by resting too long between the sets. This training allows one to get stronger and create more muscle density by challenging the muscles to keep up with the non-stop pace. This training also ensures proper technique throughout an exercise.

Who should use it?

Rest/Pause is a method that helps increase muscle and strength. High Rep Training seems to be a more common method of training with beginners; however, rest/pause is an effective way to make sure a beginner uses proper technique in the workout. Therefore, whether an exercise beginner or a seasoned fitness enthusiast, one will see results using the rest/pause training.

• Supersets

A superset is a form of strength training in which one moves quickly from one exercise to a separate exercise without taking a break in between the two exercises. Typically, one will take a brief break to catch his/her breath or grab a drink of water between sets of an exercise. This also gives time for the muscles to recover. But when doing supersets, one moves from one set to another without a break. There are two main methods in which supersets can be performed. These two methods are quite different, and thus, the results derived from them vary greatly. The two main methods of supersets are **opposing muscle group supersets** and **same muscle group supersets**.

Advantages of Superset Workouts

Supersets can be used as a way to do more exercises in a given length of time. While the muscles are recovering from one set, he/she is performing another exercise rather than taking a break. One can switch back to the first exercise to perform another set and continue with that pattern until he/she needs a break for a drink or recovery. Supersets place an emphasis on stamina and ability, as the lack of a break between sets can be extremely challenging.

Opposing Muscle Group Supersets

One very common form of a superset workout includes working two opposing muscle groups back to back and then repeating the circuit. For example, a common superset includes performing one upper

body exercise (such as the bench press) and then immediately moving to a lower body exercise (such as the leg press).

Another easy method to plan supersets is to alternate with opposing muscle groups. One can alternate the bench, which works the chest, with the seated row, which engages the back. These supersets are very similar to a circuit training routine. Although supersets tend to focus on two exercises at a time, and circuit training routines often have up to 10 stations. Both the circuit and the superset workouts require little rest between exercises.

Same Muscle Group Supersets
The second way to perform a superset workout is to choose two different exercises that work out the same muscle group and then perform them back to back without a rest. Performing quadriceps extensions immediately after squats is an example of this type of superset. This type of superset works one individual area especially hard. It is a great way to focus on a particular area of the body.

- ## Negative Training

Negative training is a type of strength training designed for greater strength gains. It involves using heavier weights than one could typically lift concentrically and focuses on just the eccentric phase of the exercise. This does pose a higher risk for injury and should not be practiced by beginners.

One can also use negative training to his/her advantage as a way to progress to exercises that are currently too difficult. For example, maybe one has a goal to perform real pull-ups, but he/she doesn't have the strength yet to lift all the way up (concentric phase). He/she could work up to that movement by focusing on the lowering phase. Stand on a box or step to come up to the "up" position and then work on slowly lowering back down. After each lowering, step back up onto the box and repeat the lowering phase again. One will be working the same muscles and still benefit from the exercise this way.

If one ever hits a plateau in a strength-training program, he/she should focus a little more on the negative part of the training. This could be just what is needed to take one's fitness or strength to the next level.

The Goal of Each Exercise Designed for MSers (Concept and Theory)

1. To retrain the nervous system to perform basic tasks in movements with less energy.
2. To place muscle in proper position to induce movement with the least amount of force necessary. Thus, allowing participant to feel the muscle working again and establishing mind muscle contact.
3. To promote and retain muscle mass in order to protect bones, build bone density and protect joints and connective tissue.
4. To add enough resistance to force nervous system to adapt and become better, allow for better movement and balance.
5. To engage simultaneously, fine motor units, to improve better focus, attention and tension in each muscle and movement, allowing for better control, strength and muscle development.
6. To vary loads and tempo with dynamic movement to elicit a superior nervous system response, creating better efficiency of thought and control of each muscle and movement.
7. To build cardiovascular output through anaerobic conditioning, thus sparing more muscle, while burning fat through better body composition and for longer duration; improving sugar and lipid profiles.
8. To increase speed of movement and mind muscle connection.
9. To outsmart the effects of MS, allowing the body and mind to gain an advantage.

Why Specific Adaptive MS Exercises Work

1. Focuses on load, instead of repetition, to trigger nervous system adaptation.
2. Emphasizes tempo change to fire muscles quickly to improve mind/muscle connection while forcing a superior nervous system adaptation.
3. Uses bilateral, unilateral and simultaneous movements to trigger varying neuronal forces, which should lead to more power, strength and control of each muscle.
4. Forces the body's internal wisdom to react, instead of a conditioned mind, thus improving confidence and awareness of true capabilities. Silences fear.
5. Harnesses speed, volume and load to help build and strengthen the body through adaptation and cardiovascular endurance, thus improving oxygenation, muscular balance, dexterity and activation.

(See Appendix H for Exercise Library)

Program Design

A comprehensive health and fitness program for those with MS should include cardiorespiratory exercise, strength training, core conditioning, flexibility training, breathing exercises, proper nutrition, and education. The overall exercise program should include milestones of progression. In other words, as one improves his/her cardiorespiratory fitness and strength, the program should be adjusted to become more challenging to continue improvements. Periodic testing every 3 months will provide data for the health and fitness professional to make concessions for adaptations that have occurred in one's fitness level. The health and fitness professional can use the FITT principle to adjust specific components of the exercises to elicit a continued positive response to exercise.

Exercise Session Format

Each exercise program should include 5 components: Warm-up, cardiorespiratory exercise, strength exercise, core exercise, and cool-down/stretching. Depending on one's personal schedule and time, he/she can follow different programs to ensure all five components to an exercise program are accomplished during the week. Each session must include a warm-up at the beginning and flexibility at the end of each session.

Warm-Up and Cool-down: Warm up and cool-down are usually 5 to 10 minutes and may involve gentle stretching or exercise at a lower intensity or workload. It prepares the heart, lungs and muscles for the work to be done during exercise and cools them after a workout to prevent muscle soreness or injury.

Cardiorespiratory Exercise: Cardiorespiratory exercises like cycling, walking, and swimming should be performed 20-60 minutes per session at an RPE of 12-14 (somewhat hard) 3-5 days per week. If one is incorporating interval training, no more than 3 days a week of intervals should be performed

Strength Training: Resistance exercises should include all major muscles performing exercises at a load that can only elicit 8-12 repetitions for 2-3 sets for 2-3 days per week.

Core Conditioning: The core section of the workout should include exercises that focus on the rectus abdominis, obliques, transverse abdominis, and lower back. Each workout should include a section on core.

Flexibility: Every workout should finish with a series of stretches that focus on the entire body, especially the muscle that were trained. Hold each stretch for approximately 20-30 seconds each for 3 sets.

Sample Weekly Workout Formats

When first beginning an exercise program, one should introduce exercise at the low end of the recommendations. For example, one should only exercise 3 days a week incorporating cardio every time and one strength element at a time (i.e., only upper body on one day, only lower body on one day, and only core on one day). This method establishes a routine so not to start off too much too soon and get burned out.

Sample #1	**Total Body**	**3 Day/Week**				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Warm-up		Warm-up		Warm-up		
Cardio 30 min		Cardio 30 min		Cardio 30 min		
Chest		Leg Press		Ball Ab Crunches		
Upper Back		Leg Extension		Forearm Plank		
Shoulders		Leg Curl		Bosu® Obliques		
Biceps		Stretch		Bridge		
Triceps				Stretch		
Stretch						

Sample #2	**Split Body**	**4 Day/Week**				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Intervals Upper Body Core		**Cardio Lower Body**		**Intervals Upper Body Core**		**Cardio Lower Body**
Warm-Up		Warm-Up		Warm-Up		Warm-Up
Cardio Intervals 20 min		Cardio 45 min		Cardio Intervals 20 min		Cardio 45 min
Chest		Leg Press		Chest		Leg Press
Upper Back		Leg Extension		Upper Back		Leg Extension
Shoulders		Leg Curl		Shoulders		Leg Curl
Biceps		Stretch		Biceps		Stretch
Triceps				Triceps		
Ball Ab Crunches				Ball Ab Crunches		
Forearm Plank				Forearm Plank		
Bosu® Obliques				Bosu® Obliques		
Bridge				Bridge		
Stretch				Stretch		

Sample #3	Split Body	5 Day/Week				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Intervals Upper Body	**Cardio Lower Body**	**Cardio Core Balance**	**Intervals Upper Body**	**Cardio Lower Body**		
Warm-Up	Warm-Up	Warm-Up	Warm-Up	Warm-Up		
Cardio Intervals 20 min	Cardio 45 min	Cardio 45 min	Cardio Intervals 20 min	Cardio 45 min		
Chest	Leg Press	Ball Ab Crunches	Chest	Leg Press		
Upper Back	Leg Extension	Forearm Plank	Upper Back	Leg Extension		
Shoulders	Leg Curl	Bosu® Obliques	Shoulders	Leg Curl		
Biceps	Stretch	Bridge	Biceps	Stretch		
Triceps		Stretch	Triceps			
Stretch			Stretch			

Chapter Twelve
Specific Adaptations for Clients with MS

There are many exercises to choose from to create a workout program for your MS clients, literally thousands of them. As a trainer you have taught many standard movements that can easily be adapted to your MS client's limitations, symptoms and abilities. As they progress those limitations should decrease and their ability to have more range of motion, balance, mobility, strength and endurance will increase. Training MS clients is synonymous with ADAPTATION.

It is your job as your client's guide to an effective ongoing fitness regimen, to carefully evaluate each person and start them on a routine that ensures effectiveness and safety. The initial routine should be a full body workout that stimulates all the muscles and engages the mind/body connection to help activate and "fire" the nerves.

It is more important with MS clients to incorporate all aspects of a full exercise program which includes stretching, cardio and resistance movements and to focus on the client's weak areas then it is to try and get your client in top shape as you might for non-MS clients.

Progression and Regression

People with MS face many kinds of limitations, and it is impossible to address them all. However, this section provides important information and guidelines on how to adapt the program to your client's specific needs. Many trainers design a workout routine to take clients to a high level of fitness and intensity, which may not be the case for someone with MS who just desires to be fit and battle the disease. It is important to provide a higher level of training for people who are capable or wish to achieve an advanced level of fitness. However, your client may not have the desire for a high level of intensity, or they may have a limitation that will not currently allow them to train in this manner. It is important to understand that each phase of the program you develop is a progression of the previous phase and should only be attempted if, and when, that client is able to advance their training. In other words, some people—such as those simply looking to be more active—may never move on from your first phase. That's okay!

The basic strength-building effects of even a simple workout routine are sometimes all that are needed to live a more active and productive life. If that's the case for your client, we also provide several ways to progress the beginning phase of the program, so while your client continues to train in this phase they can improve and escalate results at their own pace.

The following are some options for adapting this program to your clients' specific needs and limitations:

Option 1: Increase Reps for Muscular Endurance
To take a beginning routine to the next step, have your client restart it and change the rep range to twenty to thirty reps to increase muscular endurance. Following this model, the repetitions could later be modified to an even higher range—fifty to one hundred—depending on ability and desired intensity level. At this high level of intensity, you cut your client's number of sets of each exercise to one or two to avoid overtraining.

Option 2: Decrease Reps for Strength Building
Start the client's first phase again with fewer reps, such as five to eight, to shift the focus toward building strength. The program could also be modified on a weekly basis, completing one week with all exercises performed in a low-rep range (five to ten repetitions), followed by a week where the exercises are performed in a high-rep range (twenty to thirty repetitions). Or you might choose a 3-week cycle for your client during which the rep range changes from low to medium to high, spending one week in each range (e.g., Week 1: perform all exercises with a rep range of five to ten; Week 2: perform all exercise with a rep range of twelve to fifteen; Week 3: perform all exercise with a rep range of twenty to thirty, and then start the cycle again with a week of low repetitions). Keep in mind that one should lift with heavy resistance at low rep volume and light resistance at high rep volume.

Option 3: Perform a Circuit to Elevate Heart Rate
The first phase can also be modified to be performed in a circuit format to add variety. Have your client perform one set of each exercise in the initial program you designed and move to the next with little or no rest in between. This helps keep the heart rate elevated.

Option 4: Use Supersets to Train Primary and Secondary Muscles Together
Your client can repeat your phase one program using supersets, pairing an exercise working a large muscle group, such as chest or back, with an exercise working a smaller muscle group, such as triceps or biceps, moving immediately from one to the other with no rest in between. Or they can pair exercises for opposing muscle groups, such as quadriceps and hamstrings. So, for the legs, you may choose to have your client do superset leg extensions with seated leg curls, or leg presses with stiff leg dead lifts.

Progression and Regression Tips:
- Within a training program, every exercise can be modified. Besides just adding more weight to the movements, there are progressions of the movement (making it harder) when an exercise becomes easy, and there are also regressions (making it easier) for when it is too difficult.
- Adding weight during progression is an individual adaptation that depends on your client's strength. The key is to use a slightly higher weight without jumping up too drastically in each progression.
- The point is to find a version of each exercise your client is comfortable to start with and gradually progress from there.
- Going from a supported movement where they hold onto something for balance to an unsupported variation, where they are able to let go, is a progression.
- Progress their movements at a rate comfortable and safe for them, especially if they are working without your help or the help of a training partner when you are not training them. If they do work with a partner, be sure they fully understand their limitations.
- Also, reinforce that they need to be patient with their progress. Encourage them not to be afraid to challenge themselves, but always do so in a controlled and safe way to avoid injury. Many injuries occur when we get impatient and try to accomplish too much too quickly. Small progress is still progress!
- Regress the movement if the basic form is too difficult until the client achieves a level that can be performed safely.
- If the client struggles with balance, coordination, or leg strength regress the movement.
- Identify if your client has asymmetric strength and ability. Asymmetric deficits are more common than symmetric deficits and should be addressed. For example, one may have a weaker left arm than the right arm. Be sure to adapt and train for symmetry.

Lower Body Example: Progression/Regression

Stationary Lunge Exercise

1. The client stands with his/her feet in a lunge position, one foot stepped forward in front of the other while maintaining a shoulder-width distance between the feet for balance. The feet should not be in line with one foot directly in front of the other. The front foot will be flat on the floor, while the back foot will be up on the ball of the foot.
2. While holding onto something for support, bend both knees and lower the hips straight down. The back knee should come down to where it lightly touches the floor while simultaneously bending at the front knee to a 90-degree angle, with the knee directly over the ankle.
3. To complete the repetition, extend both knees and raise the hips straight up, back to the starting position.

Progressions	Regressions
Add weight, such as holding dumbbells, a fixed-weight barbell, or bar, balanced across the upper back and shoulders.	Perform the stationary lunge in place where they can hold onto a wall, bar, or partner for balance.
Make it a walking lunge by stepping forward or backward with each repetition.	Perform a step-up or step-down onto a step or box with one foot, keeping the other foot planted, or step up or down alternating between both feet. Hold onto a wall, bar, or partner for balance, if needed. The step-up or -down works the same muscles as the lunge but provides more stability and lower intensity.
Perform the movement with either the front or back foot elevated to isolate the muscles further and challenge their balance and core strength.	

Upper Body Example: Progression/Regression
Any Chest Exercise

Progressions	Regressions
Add weight to challenge the muscle further.	Perform a push-up using only your body weight.
Shorten the range of motion to perform partial repetitions (press the weight only half way up off the chest and don't lock the arms out before lowering the weight back to the chest) to eliminate the help from the triceps in locking out the arms at full extension, thereby keeping the tension strictly on the chest muscles instead.	Perform a modified push-up with knees bent, touching the floor, rather than a regular push-up with knees straight and toes on the floor.
	Perform a hand-release push-up by lowering your body all the way down until you are lying flat on the floor. Raise your hands off the floor by your shoulders (in push-up position) and then, with a thrusting motion put your hands back on the floor and "push through" as if you were pushing the floor away from your body. The hand-release push-up does not require you to balance your body weight off the floor.
	Reduce the angle of your body in a regular push-up to reduce resistance.
	Perform a push-up with your hands on a bench, countertop, or against the adjustable height of the bar in a Smith Machine. You can even place your hands against a wall and push away instead of pushing up.

Adapting a Specific Routine for MS

When adapting a fitness program, the personal trainer needs to consider fitness level, overall health, limitations, and goals—but MS adds another complication. Just remember that working out is not an option but a necessity in overcoming the challenges that your MS clients face. When battling MS there are physical symptoms and limitations one must take into consideration before you begin developing a workout program for a client.

- **How Much Weight Should My MS Clients Lift?**
  When beginning any exercise program, the amount of weight used in each set is important. The goal is to perform every set to a failure point at the final rep instructed for each movement. In other words, if possible, one should increase the weight load as the reps decrease set by set. The more demand of the muscles without overtraining, the better the results. It is the same for people with MS as it is for clients who do not have any limiting conditions.

  Safety, proper form, and focus always comes first while exercising. You, as a personal trainer, will be instrumental in determining the amount of weight your clients need to use. Be patient and know it will take some trial and error to discover the correct weights for your clients (your patience will help them have some as well). This is a lifestyle, not a quick fix for their health. Many have been battling

MS for years and they have a lifetime ahead of them to overcome their obstacles, through fitness. Good form on all exercises is imperative. One should never sacrifice form to use a heavier weight. If so, the only thing that will be accomplished is increasing the risk of injury, and the risk of losing that client. The quality of the movement is more important than how much weight is lifted. Any quality movement for a client with MS is a step in the right direction.

- **Grip and Numbness**
  MS can affect people in different ways. For example, some may be left with nerve damage from the attack which affects either or both sides. As a result, the left hand does not close easily, the grip is impaired, and the hand goes numb. With these concerns, some exercises are problematic and may even cause an injury if the symptoms are not addressed and there is no adaptation to the movement. To compensate for these issues, one should not perform any HEAVY dumbbell movements that place the dumbbells above the head or face, or in any position that would injure the client if the dumbbells were to fall. Instead, one can adapt the exercises to use weight-stacked machines, weighted cable movements, or non-weighted resistance bands. It is recommended the same for clients with MS who have trouble holding free weights in either hand due to weakness, incoordination, or similar problems. Resistance bands (preferably with handles) can help clients perform the similar movements to free weights, dumbbells, fixed-weight barbells, bars (with or without weight plates), or machines. The challenge is creating enough resistance; a shorter band or one with more tension offers stronger resistance. Weightlifting straps are another way to help clients overcome the challenges with grip or feeling in the hands and fingers. The straps allow weight to be lifted by transferring the load to the wrists and avoiding limitations in fingers, the hand, or grip strength. Clients cannot get injured by a dumbbell they cannot drop.

Adapting in a Wheelchair

Even though it is challenging to train with MS, it is even more of an effort when clients with MS are in a wheelchair. It is extremely rewarding to train someone in a wheelchair and watch him/her progress to being able to stand out of that chair independently. Clients can do it, and you can be the reason they do! There are many upper body exercises that can be done from a wheelchair with weights and exercise bands. It is important, especially with MS from a wheelchair, to keep the body moving and staying active. Trainers must keep their clients motivated and never let them quit!

Resistance bands can be purchased with different levels of resistance and typically come in a package, allowing for increasing resistance as strength increases. Follow the same guidelines for sets and repetitions that you would establish for non-wheelchair movements, but use the bands while clients are sitting in their wheelchair. Make sure they exhale on exertion and inhale at release. Always have them sit tall in their chair and keep their abdominals tight.

When training MS clients in a wheelchair you must be creative as to how you position the resistance bands. With some chairs you can situate the band securely under the wheels while, with others, you must be creative as to where you secure the handles to keep the band from slipping out of position. Also, keep in mind that, although you want to have your clients do the movement as strictly to form as possible, some people with MS have more limited mobility and, until you can increase their range of motion, their form may be a bit off. For example, during the overhead triceps extensions, the elbows may point more outwards than forwards as the exercise form requires. This is due to the lack of ability to bring the elbows in because of chest size and tightness from bodybuilding or a specific daily activity. Each client will have a different range of motion and flexibility specific to them personally, especially when seated in a wheelchair.

See Appendix H for exercises using resistance bands. These exercises correspond to a beginner routine. More exercises can be added once your clients are comfortable. The key is to start somewhere.

Chapter Thirteen
Nutrition and Healthy Weight Management

Another important component of a comprehensive health and fitness program is proper nutrition. This involves choosing healthy foods that can work to heal and repair the body and make it stronger against disease. This section addresses how to eat healthy and achieve a healthy body weight. In order to educate Americans on the importance of healthy eating and exercise, the USDA and the US Department of Health and Human Services developed the Choose My Plate Food Guide. The Choose MyPlate Food Guide helps one choose the foods and amounts that are healthy and encourages one to be active every day. Food choices and activity level affect one's health – both now and in the future. To adopt a healthy lifestyle and maintain a healthy weight, one should set daily nutrition and activity goals. Living a healthy lifestyle and following the Choose My Plate Food Guide is important for people of all ages, with and without multiple sclerosis. One should consult with a registered dietitian about specific nutrition needs. (See Figure 13.1)

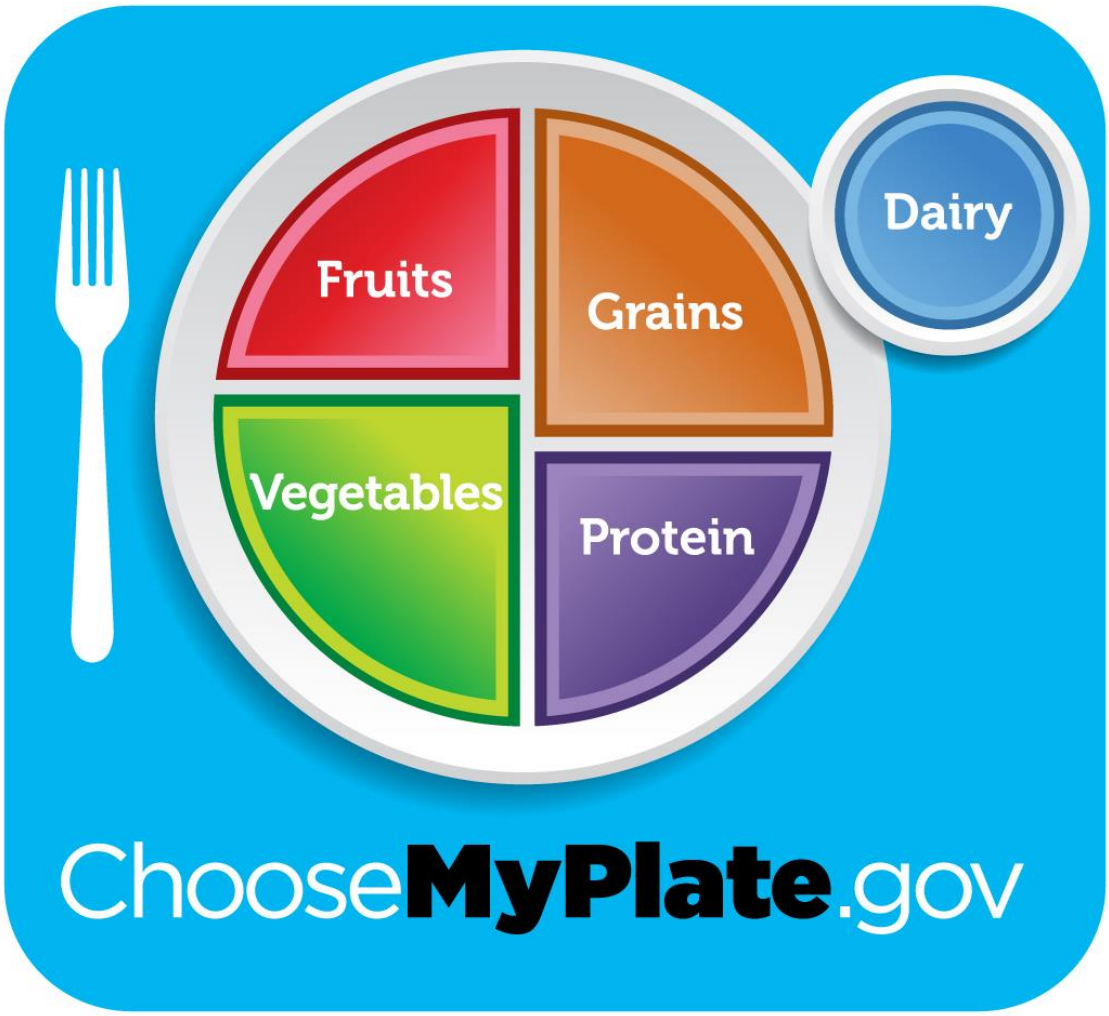


Figure 13.1

10 Tips to a Great Plate

1. Balance Calories: Find out how many calories YOU need for a day as a first step in managing your weight. Being physically active also helps you balance calories.
2. Enjoy Your Food but Eat Less: Take the time to fully enjoy your food as you eat it. Eating too fast or when your attention is elsewhere may lead to eating too many calories. Pay attention to hunger and fullness cues before, during, and after meals. Use them to recognize when to eat and when you've had enough.
3. Avoid Oversized Portions: Use a smaller plate, bowl, and glass. Portion out foods before you eat. When eating out, choose a smaller size option, share a dish, or take home part of your meal.
4. Foods to Eat More Often: Eat more vegetables, fruits, whole grains, and fat-free or 1% dairy products. These foods have the nutrients you need for health—including potassium, calcium, vitamin D, and fiber. Make them the basis for meals and snacks.
5. Make Half Your Plate Fruits and Vegetables: Choose red, orange, and dark green vegetables like tomatoes, sweet potatoes, and broccoli, along with other vegetables for your meals. Add fruit to meals as part of main or side dishes or as dessert.
6. Switch to Fat-Free or Low-Fat (1%) Milk: They have the same amount of calcium and other essential nutrients as whole milk, but fewer calories and less saturated fat.
7. Make Half Your Grains Whole Grains: To eat more whole grains, substitute a whole-grain product for a refined product such as eating whole-wheat bread instead of white bread or brown rice instead of white rice.
8. Foods to Eat Less Often: Cut back on foods high in solid fats, added sugars, and salt. They include cakes, cookies, ice cream, candies, sweetened drinks, pizza, and fatty meats like ribs, sausages, bacon, and hot dogs. Use these foods as occasional treats not everyday foods.
9. Compare Sodium in Foods: Use the nutrition facts label to choose lower sodium versions of foods like soup, bread, and frozen meals. Select canned foods labeled "low sodium," "reduced sodium," or "no salt added".
10. Drink Water Instead of Sugary Drinks: Cut calories by drinking water or unsweetened beverages. Soda, energy drinks, and sports drinks are a major source of added sugar and calories in American diets.

Maintaining a Healthy Weight

Achieving and maintaining a healthy weight is an important part of managing MS. Excess body weight can increase an unnecessary added pressure on muscles and joints which may lead to regular flare-ups. Insufficient body weight can decrease the ability to fight infections. A good way to determine if one needs to gain or lose weight is to look at body composition. A male's body fat should be between 10% to 20% of his total body weight whereas a female's body fat should range between 15% and 25% of her total body weight.

Weight Loss

If weight loss is the goal, one should focus on establishing a plan that includes a variety of foods. Avoid using the word "diet" as a diet is something one goes on and then goes off. One should try to make healthy lifestyle changes he/she can maintain for the long term. A healthy rate of weight loss is1-2 pounds per week. Rapid weight loss usually results in loss of fluid or muscle rather than body fat. Here are some weight loss tips:

- Do not skip meals.
- Include 3 food groups with each meal.
- Limit snacks to designated times, often midmorning and mid-afternoon.
- Limit sweetened beverages to no more than 12 ounces a day. This includes juice, soda, Kool-Aid

and lemonade to name a few.

- Keep high fat or high sugar foods out of the house.
- Limit serving sizes. Refer to the package for information on serving size.
- Be aware that most of today's foods come in super-sized versions that are not helpful for weight control. Resist the temptation to super-size your order or to purchase super-sized food items. Share an entrée when dining out. Limit use of high calorie condiments such as mayonnaise or salad dressing. Use lower calorie versions instead.
- Increase activity to help strengthen your body and lose weight. Remember what you learned in exercise section of this book.
- Meet with a registered dietitian (RD) for additional advice on meal planning.

Weight Gain

The best way to gain weight is to eat more. However, it is recommended to eat healthy foods in smaller amounts more often. Here are some tips for weight gain:

- Eat five to six small meals a day and snack whenever you are hungry.
- Keep your favorite foods on hand for snacking and meals.
- Fat is a concentrated source of calories. Small amounts of vegetable oil, butter or margarine can increase the calorie content of any food.
- Use higher calorie versions of foods you eat (butter crackers or cheese crackers instead of soda crackers).
- Avoid "lite" products (skim milk, low fat yogurt and cottage cheese, reduced calorie mayonnaise, low-fat salad dressings, etc.).
- Don't fill up on fluids. Drink fluids between meals rather than with meals. Drinking during a meal can make you feel full quickly.
- Avoid filling up on low calorie foods like salad at meal times; instead eat the heartier foods first.
- Choose nutritious drinks, such as whole milk, milkshakes, and juices. Consider supplemental drinks such as Boost®, Ensure®, or Scandishake®
- Meet with a registered dietitian (RD) for additional advice on meal planning.

Suggested Calorie Boosters

- butter/margarine
- cream cheese
- dried fruit
- dry milk powder
- granola
- honey/sugar
- peanut butter/nuts
- vegetable oils

Meal Time Tips

For someone with MS, doing even simple tasks can take a lot of energy. If one uses all his/her energy preparing a healthy meal, it may be difficult to eat and/or enjoy what has been prepared. Here are a few practical suggestions on how to conserve energy and get the most from mealtime:

- Eat six smaller meals instead of three big meals. Frequent meals are recommended since many people with MS feel more fatigued when their stomach is full.
- Plan to eat before you are too hungry or tired.
- If you do not have an appetite, use the clock to remind you when it's time to eat. Think of food as medicine and do your best to eat "healthy" foods throughout the day. Try to eat something every 2-3 hours, and do not go longer than 4 hours without eating.
- Breathe evenly while you are chewing and eating. Relax at mealtime.
- When cooking or baking, double or triple your favorite recipes to keep your freezer full for times when you do not feel like cooking. Freeze foods in small portions at this time.
- Use prepared foods to save time and energy in the kitchen. Healthy frozen meals, prepared foods or take-out meals from a restaurant can make your life easier. Remember, the sugar, salt or fat content of these foods may be higher than homemade.
- Do the tasks that require the most effort when you have the most energy. For example, many people would agree that grocery shopping is a tiring task. This chore can be done when you feel freshest, in the morning or after a rest. Better yet, make a list and have a friend or family member pick up your groceries for you!
- Don't stand in the kitchen when you can sit. Bring your chopping, cutting and mixing projects over to the kitchen table and sit while you prepare the food or keep a barstool by the kitchen counter.

Nutrition Mindsets for MS

Nutritional education is a stepping-stone to success in overcoming the typical ups and downs combined with failure of sticking with the right program. For MSers, it is especially critical that diet be considered as it plays a major factor in beating the symptoms. Poor nutrition depletes the body of strength and energy. Optimal nutrition propels the body forward to meet the challenges of life and overcome obstacles. When it comes to healthy eating, the approach is no different than any other health conscience behavior. Helping your MS client to find their inspiration and motivation is a crucial piece in the puzzle of success. This begins with food-related mindsets. The fact of life is that most of our daily activities are governed by unconscious patterns and perceptions. Whether we're trying to eat healthier, get fit, or lose weight, we always attach a mindset to our behaviors. The mindset your client uses to approach diet determines if his/her journey is filled with success leading behavior or riddled with roadblocks. Developing a long-term healthy lifestyle is hard enough; therefore, talk through the roadblocks from the start. Encourage your client to remove these roadblocks and chip away at the negative mindset in order to make productive change and overcome the symptoms of his/her MS.

From the beginning, help your client to kick a few self-defeating thoughts to the curb. Mindsets like, "I don't have the time, money, or energy for healthy food," or "I don't like the taste of food that's good for me," or even "I've tried before and I couldn't stick with it." None of these mindsets will get them to the place of breaking through the challenges they face. Instead, suggest to your client, "why not replace these ways of thinking with positivity? If you haven't tried a mindset change, then it certainly can't hurt, let's give it a try!"

Mindsets that promote an attitude of possibility and capability are what is needed to tap into motivation

and inspiration. These mindsets sound like: “I will learn how to do this.” “My health is important enough to keep trying.” “I can do this. I need to do this.” Your client may not know exactly how he/she is going to find time to cook instead of eating out, but trust that he/she will find a way to accomplish it. When one combines a positive mindset with a sense of what is realistic in one’s own life, there is tremendous potential for a strategy that can actually be successful for the long run.

Here are some additional must-have mindsets that are crucial as one embarks on the journey to reach optimal nutrition.

Must-have Mindset #1: Ditch Perfection

Perfectionism is one of the greatest barriers to long-term behavior change. A perfectionist’s mindset tends to be all or nothing. On a diet or off a diet. Deprivation or excess. Perfection or failure. These extremes do not help, because life is a series of progressions and regressions; smooth times and chaotic times. One will go on vacation, celebrate holidays, eat treats, get sick, juggle family emergencies, and more. Remind your clients that they are not perfect and can’t be perfect, and ‘perfect’ is not a reasonable expectation that is even close to achievable. You, their trainer, are here to remind them that they should expect the unexpected while working through health and fitness goals. Maintaining a healthy diet is a life-long process, being prepared for the guaranteed ups and downs is crucial to success. Your role as a personal trainer, of an MS client or an otherwise healthy client, is to support the training of both the brain, for better mental health and clarity, as well as the body, for better fitness when performing daily activities – it is a delicate balance, but not one that will ever be perfect. Patiently keep pressing the reset button (for both you and your clients). Progress, not perfection, is the goal. Instruct your clients to repeat the mantra, “progress, not perfection.” Give them a pat on the back and tell them to give themselves a pat on the back when making even the smallest step towards balance.

Must-have Mindset #2: Learn to Fish

“Give a man a fish and you feed him for the day. Teach a man to fish and you feed him for a lifetime.” (Chinese proverb.) Many people think they want to be given a fish (a.k.a. someone to tell them exactly what and how much to eat every day). There are several flaws in that approach. Mainly because it’s just not sustainable long-term, and one won’t “learn to fish” in the process. Any nutrition approach that’s truly centered on your client’s best interest is designed to empower him/her to create a sense of capability and ownership. With this kind of self-knowledge and personal responsibility, he/she will be able to assess the current status and the direction needed when challenges arise. Statements of someone learning to fish sound like this, “Hey I found this great app for meal planning,” or “I looked up some recipes that support my nutrition goals,” and “I tossed out all the junk that’s not supporting my health,” or even “I figured out a realistic way to divide the grocery shopping, cooking and clean up in my family.” Statements like these are all great signs that your client is taking ownership of the way he/she feeds him/herself and is becoming a problem-solver along the way. Taking ownership can be overwhelming when one doesn’t know where to start or not feeling well physically or mentally. The good news is that learning to fish does not have to be a solo journey. That’s where you come in! As their trainer, you are encouraging good behaviors and promoting consistent step-taking towards the goal.

Must-have Mindset #3: Reach for Support

As your client begins his/her journey to fitness (or even along the way) tell them to never be afraid to ask for help and support.

Health Professionals: As a personal trainer, you make this list of professionals that will support both short-term and long-term goals. However, it is important that you prove you are worth the investment. Investing in wellness with an expert can be life changing. It is incumbent on you to purposefully train

your client in a safe and effective way that shows results (in a reasonable amount of time, of course, which must also be made clear to your client, i.e. when can they anticipate seeing results in relation to the amount of time they are spending with you). There are several types of holistic health practitioners to which you may refer your client depending on their individual need, budget, willingness, and/or ability. Acupuncturists, Chiropractors, Massage Therapists, Dietitians, and Naturopaths are examples. The investment in personal training services in conjunction with holistic health experts can be worth it when taking full advantage of the resources (ultimately, saving your client money in the long run). Consider connecting with local health experts to create a referral base for your clients when needed. You may already know individuals in these fields and can exchange referrals with these colleagues. Ensure that these experts are of the same empowerment mindset as you whereby they will support and not enable or hold back, your client.

Friends, Family, Community: Encourage your clients to enlist people they can lean on when encouragement for healthy eating is needed. These 'accountability partners' don't need to share the same goals in order to be encouraging. They can simply cheer your clients on, ask for progress updates, or encourage them to talk about how they're feeling today. They can also engage in online communities for extra support and accountability where they can find guidance from people who have been through a similar process. In these social/online communities, your clients can be helped to avoid common setbacks and they can be better prepared for challenging events with tips and encouragement from the community. Social media is a great way to find support, motivation and inspiration from like-minded people--and it's free! Instagram, Pinterest, and Facebook all have great resources for recipes, people passionate about health, and attractive food photos that can inspire them to try something new. A comprehensive resource list is provided at the back of the manual that includes online communities and support groups.

Support Yourself: We can all be our own worst enemy. A lot of it has to do with our mindset. The goal is to avoid self-sabotage. Help your clients to support themselves and to avoid the trap of "failure" syndrome. This syndrome is typically caused by a harsh judgment of personal "mistakes" and the subsequent stream of negative feelings that are experienced after making them; anger, despair, hopelessness, numbness, etc. These negative feelings can lead to avoidance. "Tomorrow," I'll do something about it. This attitude prevents action for necessary problem-solving in the present. Encourage them to confront challenges as they arise, even if it is a very small step.

Must-have Mindset #4: Find Pleasure in the Foods that Lead You to Health

Most people can do anything for the short-term. They can "white knuckle it" through restrictive diets, desperately awaiting the day it's "over." The biggest challenge is not losing weight for a big event or going on a three-day detox. It's consistently finding pleasure in the choices that lead us to nutritional balance. Only when we find pleasure in balancing our nutritional needs does it become likely that we will maintain these healthy habits for a lifetime. Many people have negative mindsets when the words "health" and "food" come together. Nutritious foods don't have to taste like dirt. They don't have to make you suffer. Your clients do not have to give up all foods that they enjoy. Remind them that some of the most delicious foods on the planet are good for them. Sometimes it's a matter of training the palate, other times it's a matter of training the mind.

A key reason for failure is that we embark on dietary changes making it about deprivation of all our "likes." We see the process as all or nothing. Deprivation always leads to excess. This means that making adjustments over time, as opposed to eliminating everything overnight, is a better strategy. There is still room for treats and old favorites, all of which have healthier alternatives that your clients may even like better. For example, your clients many never even miss the white stuff after making the

switch from refined wheat pasta to brown rice pasta. Ask your clients to experiment with almond flour and see how they can use it to make the best muffins and cookies they'll ever taste. The possibilities are endless as long as your clients do not substitute the "bad" food for another food that may seem like a "healthy" choice yet is still inflammatory for them. Clients with MS are individuals and, although they have the same disease, certain foods are not always inflammatory or anti-inflammatory for every one of them individually. Therefore, when substituting, they need to test the waters and see how they feel; if they are feeling better or experiencing worsened MS symptoms by switching to that food. It certainly would make our lives as trainers easy if there was one absolute diet that worked 100% of the time for MS. But, unfortunately, we must take the time and have that trial and error phase of creating the nutritional program that fits each MS client. See the section on *Inflammation* for details on this subject.

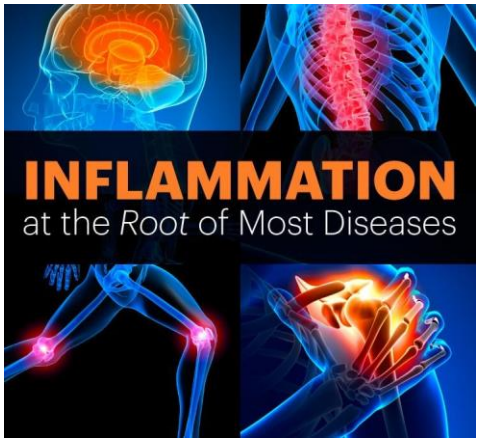
A general observation is that any time your clients feel like they can't stop eating a food, they should recognize it as probably being a "fake food." Those processed foods that are loaded with fat, salt, refined sugars and carbs, artificial sweeteners, and other chemicals are actually designed for addiction, engineered to trick our brain into wanting more and more. While there is some short-term pleasure that we receive from eating bags and cartons of these foods, they are the same substances that make us fat, sick, and unhappy, zapping our body of that necessary strength and energy needed to overcome our daily challenges. Remind your clients that the healthier their overall diet becomes, the stronger and wiser their taste buds become. It does take time to retrain the brain and the taste buds. When detoxing the junk out of their diet, the cravings subside, and their palate can heal. Our bodies are naturally inclined to find satisfaction in foods that sustain life and make us healthy. If your clients follow your nutritional advice, they can start to enjoy the foods that nourish them. They can find pleasure in those foods. If they haven't found them yet, tell them to keep looking…. Those foods do exist.

Change can be difficult, and new foods don't always taste good overnight. However, encourage your clients to keep this question in mind through the process, "Do I consistently find pleasure in my healthy food choices?" If the answer is yes, the chances for long-term success are excellent. If the answer is no, there is still more work to do. Setbacks are a normal part of the process. When your clients feel their motivation to keep eating well weaken, they need to go back to the mindsets and press the reset button. With the proper mindsets, the approach to nutrition becomes clearer.

When changing diet behavior, it is always helpful if one applies his/her journaling skills. Recording food choices alongside records of energy level, performance, mood, etc. is very helpful in one's overall MS management and goal achievement.

Inflammation

Nutrition is crucial to the health and function of every single cell in the body. What one eats and drinks either feeds disease or fights it. There are many types of eating plans from which to choose. One universal need for optimal health and disease prevention is to manage inflammation in the body. This is a basic starting point that allows the body to heal, repair and rebuild. In recent years, there's been much attention and research surrounding inflammation. Inflammation is a protective response by the immune system to any type of bodily injury and infection. Inflammation is a healthy and necessary part of a healthy immune response. However, there is concern regarding too much inflammation. Inflammation occurs when chemicals are released by your immune cells, producing swelling, redness, and pain. When the immune system is triggered to



release inflammatory chemicals in an on-going and uncontrolled manner, damage occurs, and health problems can manifest in any part of the body. Short-term inflammation is not a problem, it's a protection. The problem is an excessive inflammatory response, driven by foods and a lifestyle that promote inflammatory pathways. Certain conditions, such as asthma, allergies, arthritis, and autoimmune disorders, have an obvious inflammatory component. However, chronic, low-level inflammation—sometimes referred to as "silent" inflammation—has now been linked with diseases ranging from heart disease, diabetes, digestive disorders, cancer, depression, and Alzheimer's. Inflammation also appears to be a key factor in accelerating the aging process including skin aging and other outward signs of aging. It can also be a roadblock for weight loss. "Silent" inflammation often lurks below the threshold of perceptible pain. If one can't see it or sometimes feel it, how does one measure it? One of the most common chemical markers for inflammation is a protein called C-reactive protein (CRP). If you believe excessive inflammation to be present in your client, or if you would like to 'prove' this to the end of correcting nutritional habits, then CRP can be measured. Your client can consult their physician for a measurement of CRP, which can be done through a simple blood test.

Anti-inflammatory Lifestyle

Fortunately, there is much that can be done to take control of one's life. Research suggests that a total diet and lifestyle approach continues to be one the best prescriptions for reducing inflammation and other risk factors for disease.

Healthy lifestyle habits that help reduce inflammation are:

- Consuming an anti-inflammatory diet
- Exercising regularly
- Not smoking
- Reducing toxin load
- Maintain a healthy weight—Fat cells produce inflammatory chemicals at a rate far greater than other cells.
- Minimize stress—Hurt feelings can be inflammatory. A study showed social stresses such as feeling rejected were shown to increase inflammatory markers in humans.
- Get quality sleep—People who sleep poorly or do not get enough sleep have higher levels of inflammation.

Controlling Inflammation with Diet

One of the biggest factors in chronic, low-level inflammation may be the food that your client is eating every day. Certain foods promote inflammation while others stop inflammation. There is no one-size-fits-all anti-inflammatory diet per se. Many factors affect a food's inflammatory potential, including the amounts and proportion of various fatty acids, the number of antioxidants and other nutrients, and the food's glycemic impact, which is the effect on blood sugar levels.

The body creates both inflammatory and anti-inflammatory chemicals, called "prostaglandins" from nutrients in the food that we eat. Imbalances in the diet can lead to the creation of excessive amounts of inflammatory prostaglandins, which fuel the body's inflammatory response. Conversely, the consumption of certain nutrients, like Omega-3 fatty acids and antioxidants, allow the body to produce more anti-inflammatory prostaglandins, which it uses to reduce inflammation.

There are numerous resources that promote "anti-inflammatory" eating, and each one presents its own position. One noted expert is Dr. Andrew Weil. His *Anti- Inflammatory Food Pyramid* is an excellent dietary guide. His guide was used in the development of the anti-inflammatory foods listed in the chart

below. Other experts say that the anti-inflammatory diet is very close to the Mediterranean diet one rich in fruits, vegetables, beans, nuts, seeds, healthy whole grains, fish, and olive oil limiting meat, dairy, and red wine. This diet contains mostly plant-based foods, because phytochemicals – natural chemicals found in the plants – are believed to help reduce inflammation.

There are specific MS diets such as the Wahls Protocol, created by Dr. Terry Wahls, which she describes as a radical new way to treat all chronic autoimmune conditions using Paleo principles. When creating a nutrition plan for MS, use common sense and follow a diet that lays the best foundation for reducing inflammation since inflammation will not only increase MS symptoms but will make it difficult to get through an exercise program. Because individuals differ with unique allergies, sensitivities, tastes, and absorption of nutrients, trial and error on what works for your client is part of the search in finding the right anti-inflammatory nutrition plan. There are foods that may cause inflammation in one person but doesn't have the same effect in another person. Trial-and-error is the key to finding a satisfactory nutrition plan that works for your client. This means that keeping a food log is essential to keeping track of sensitivities, likes and dislikes, and reactions of certain foods. Based on the data from journaling, you can suggest the removal or incorporation of new foods into the diet.

Short List of 'Enjoy and Avoid' Foods to Reduce Inflammation

Top 10 Best Foods	Top 10 Worst Foods
Foods Rich in Vitamin D	Saturated Fats
Lean Meats	Alcohol
Whole Grains	Sugar
Fresh Fruit	Aspartame
Vegetables	Refined Grains
Fatty Fish	MSG
Plant Based Oils	Full Fat Dairy
Turmeric	Salt
Avocado	Caffeine
Ginger	Gluten

Foods to Enjoy

The following list provides an excellent starting point for anti-inflammatory foods & beverages. You can use this practical guide to suggest meal plans in accordance with your client's tastes, tolerances and preferences. There are additional foods, beverages and supplements that are anti-inflammatory as well. The list provided will equip you with a great foundation from which to recommend and educate.

The anti-inflammatory diet is not meant to be a short-term eating plan. Rather, it is an ideal every day nutritional foundation for every member of the family. The more anti-inflammatory choices that your clients make, the more they help themselves to maintain optimum health. In addition to influencing inflammation, this style of eating will provide steady energy, vitamins, minerals, Omega-3s, dietary fiber, and protective phytonutrients.

In the pages to follow, use this chart as a reference for suggested foods and guidelines as they pertain to MS client symptoms and needs.

Food Group	Guidance	Some Suggested Foods
Vegetables	• Choose a wide range of colors. • Try to include raw servings daily. • Green vegetables should be steamed or boiled in a little water and should not be overcooked to avoid losing much of the vitamin content. • Eat cruciferous (cabbage-family) vegetables regularly. • Eat plenty of green leafy vegetables. • Choose organic when possible. View the "Dirty Dozen" at www.ewg.org	Broccoli Cabbage Cauliflower Celery Cucumber Dark green leafy lettuce Brussels sprouts Collard Greens Bok Choy Green beans Jicama Mushrooms Sugar snap peas Pumpkin Carrots Squash Sweet potatoes Bell peppers Asparagus Artichoke Beets Bell peppers Tomato Zucchini Onions/garlic Shiitake Mushrooms Sea vegetables (ex. Seaweed salad) Micro greens Great for Green Smoothies Swiss chard Spinach Kale
Fruits	• Go for a wide range of colors. • Choose fruits that are fresh, in season, or frozen. • Choose organic when possible. View the "Dirty Dozen" at www.ewg.org to determine which are best to buy organic. • All fruits listed are lower in glycemic load than other fruits	Blueberries Raspberries Strawberries Blackberries Boysenberries Cranberries Cherries Red Grapes Pomegranate Oranges Tangerines Pink Grapefruit Lemon

		Lime Apples Pears
Whole Grains	• Trying a gluten-free diet may also be helpful. • Focus on grains that are less refined, less-processed, high fiber, slowly digested and with a low glycemic load. • Reduce your consumption of foods made with wheat flour and sugar, especially bread and most packaged snack foods (including chips, crackers and pretzels). • Eat more whole grains such as brown rice, in which the grain is intact. These are preferable to whole wheat flour products, which have roughly the same glycemic index as white flour products. • Cook pasta al dente	Amaranth Barley Buckwheat Basmati rice Brown rice moderation. Wild rice Groats Steel-cut Oats Quinoa Millet Spelt
Protein-Rich Foods	• Eat lean protein sources such as chicken; cut back on red meat. • Decrease your consumption of animal protein and balance with vegetable protein. • Choose grass-fed lean meats, free of preservatives, antibiotics, growth hormones, nitrates or coloring. • Choose organic when possible.	Skinless turkey breast Skinless chicken breast Wild Salmon (canned/fresh/frozen) Alaskan halibut Albacore tuna Bison Egg whites Sardines (packed in water or olive oil) Trout Mackerel Omega-3 enriched eggs
Beans & Legumes	• These are a great way to eat more vegetable protein on a daily basis. • Eat them whole or pureed into spreads like hummus. • Choose organic whole soy foods.	Pinto Kidney Mung Cannelloni Adzuki Black Garbanzo or chickpeas

	• Avoid heavily processed soy.	Black-eyed peas Navy Lima Fava Organic Soy Tofu Tempeh Edamame (boiled soybeans) Soy nuts
Healthy Fats	• Nuts/seeds ideally raw & unsalted. • Watch portion sizes to prevent weight gain. • Consume daily.	Avocados Extra Virgin Olive oil Organic Expeller-pressed Coconut oil Grape seed oil Cold-pressed sesame oil Nuts Walnuts Almonds Pecans Cashews Nut butters from these nuts (no added sugar) Seeds Sesame Sunflower Pumpkin/Pepita Flaxseed meal Chia Hemp
Dairy/Non-Dairy Alternatives	• High quality natural cheeses in moderation (1-2 ounces/week) • Cut back on full-fat dairy foods. • Choose versions of yogurt and non-dairy milks with no added sugar.	Organic plain Greek yogurt Goats milk yogurt Almond milk Organic coconut milk Goat or sheep's milk feta Romano Parmesan Manchego Swiss Jarlsberg
Herbs & Spices	• Use a variety of herbs & spices to season food. • Replaces salt, sugar, and added fat by boosting flavor.	Turmeric Curry Powder Ginger Cinnamon Chili Peppers Basil Rosemary Thyme Parsley Oregano Basil Chives

		Cilantro Dill Mint Citrus zest
Beverages	• Drink tea instead of coffee, especially good quality white, green or oolong tea. 2-4 cups/day is recommended. • If you drink alcohol, use organic red wine preferentially & in moderation. No more than 1-2 drinks/day. If you don't drink you don't need to start. • Drink pure water, free of toxic chemicals throughout the day. • Choose glass/stainless steel bottles over plastic.	
Sweat Treats	• Enjoy plain dark chocolate in moderation (with a minimum cocoa content of 70percent). 1 ounce a few times per week. • Experiment with natural sweeteners that are lower glycemic. • For zero calorie sweetness, ditch artificial sweeteners and use Stevia & Xylitol (derived from a non GMO source). • Fruit sorbet is a better option than most frozen desserts.	
Supplements	• Majority of nutritional needs are best met through fresh and wholesome food. • Nutritional gaps can be filled through high quality supplements. • It's important to remember that supplements are not an alternative to a healthy diet and you should still maintain a variety and balance. Common daily needs are: • Multivitamin/multimineral • Fish oil for Omega-3s (both EPA & DHA) • Vitamin D3 • Co-enzyme Q10 • Key antioxidants • Probiotics • Anti-inflammatory substances like turmeric can also be taken in supplement form if you don't include them in your diet.	

Foods to Avoid

Previously listed was recommended foods that can help strengthen and heal the body. For best results, your clients should also be familiar with foods to avoid, as these foods will only create barriers on the road to fitness. These barriers include inflammation, pain, fatigue, disease, dysfunction, mood swings, depression & anxiety, weight gain, and feelings of failure. Remember, perfection is not necessary (see Must-have Mindset #1). Balance, not deprivation, is the higher goal. Must-have Mindset #4 demonstrates that there are healthy foods that can be even more pleasurable than quick fix pleasures. Consistency is what counts the most.

The following foods should be consistently avoided in favor of more energizing and healing foods that will help your clients to reach their goals.

- Minimize processed foods and refined grains: Bread, white rice, pasta, pizza, potato chips, pretzels, French fries, corn chips and products made with white flour, such crackers, pretzels, and bagels.
- Minimize saturated and trans fats because they damage the cells lining blood vessels: Full fat

dairy, butter, cream, whole milk, ice cream, high fat cheeses and fried foods. Avoid margarine, vegetable shortening, and all products listing them as ingredients.

- Limit processed & high fat meats: Lunch meats, hot dogs, sausages, beef, lamb, pork, fast food.
- Avoid sugary foods and beverages: Sodas, pastries, presweetened cereals, corn syrup, and candy. These are loaded with calories but have little nutritional value and may trigger mood swings because of their sugar content.
- Remember a simple rule of thumb: If it contains refined flour, sugar or high fat meats, it will be pro-inflammatory.

Sugar

Sugar is one of the biggest barriers to health. There is a growing body of science that supports sugars' contribution to obesity, diabetes, heart disease, stroke, high blood pressure, high cholesterol & triglycerides, cancer, candida, inflammation throughout the body, mood swings and an assault to the immune system. A 2014 study published in the Journal of the American Medical Association (JAMA) showed that too much added sugar in the diet could significantly increase risk of dying from cardiovascular disease!

Another recent study found that eating high-glycemic foods (foods that raise blood sugar quickly) can create a sharp crash in blood sugar levels that lead to overeating at the next meal. And here's the mind-blower: researchers noticed that the rapid drop in blood sugar lit up the region of the brain connected to addictive behaviors. This gives credibility to the idea that we can develop an actual addiction to sugar-laden foods. Because of sugars' huge impact on heart health, the American Heart Association (AHA) has set some guidelines for intake.

- American Heart Association (AHA) Recommendations for Added Sugars:
  No more than 6 teaspoons (24 grams, or 100 calories) a day for women
  No more than 9 teaspoons (36 grams, or 150 calories) a day for men

- The Definition of Added sugar: Added sugars are sugars and syrups that are added to foods or beverages when they're processed or prepared. For example: table sugar, high fructose corn syrup, maltose, sugar cane syrup, molasses, fruit juice concentrate and other sweeteners. Added sugars contribute additional calories and zero nutrients to food. Naturally occurring sugars are found naturally in foods such as fruit (fructose) and milk (lactose). Most American adults consume about 22 teaspoons of added sugars a day. Sugar-sweetened beverages are the largest source of added sugars in the American diet. A can of regular soda packs about 35 grams of added sugars. Other major sources of added sugars are candy, cookies, ice cream, sweetened yogurt and cereals. Therefore, it is critical to health goals and a healthy lifestyle that you instruct your client to keep tabs on how much sugar they are ingesting each day. Many people consume much more sugar than they realize. On the Nutrition Facts panel, the line for sugars contains both the natural and added types as total grams of sugar. The twenty-year old label may be changing soon though and will make added sugars easier to detect. To tell if a processed food contains added sugars, you need to look at the list of ingredients. Sugar has many other names. Besides those ending in "-ose," such as maltose, dextrose or sucrose, other names for sugar include high fructose corn syrup, molasses, cane sugar, beet sugar, cane juice, corn sweetener, barley malt, raw sugar, corn syrup, and fruit juice concentrates. As consumers look for sugar alternatives, they tend to seek out synthetic artificial sweeteners like aspartame and Splenda®. These are horrible alternatives to sugar and will only harm health. Splenda® is disguised as sucralose in labeling and is being used in almost every fitness/bodybuilding supplement as a "natural" replacement for sugar. Do not be fooled by this claim and stay away from sucralose!

- Natural Sugar Alternatives: There are natural sugar alternatives that are not synthetically produced. These lower-glycemic sweeteners aren't all lower in calories, so moderation is still needed. Here is a list of some of the most beneficial natural sugars you can find.
    - Stevia: As an herb native to South America, stevia is 300 times sweeter than sugar. It has zero calories and no glycemic impact. You can purchase both organic liquid and powder stevia from most stores now. You can use it to sweeten your coffee, tea, and smoothies. If baking with stevia, it's best to use a recipe that is intended for the stevia substitute rather than regular sugar.
    - Coconut Palm Sugar: Produced from the sap of the coconut palm, coconut sugar is nutritious and has a low score on the glycemic index. It tastes similar to brown sugar but is slightly richer. You can substitute coconut sugar for traditional sugar.
    - Raw Honey: Make sure you always opt for raw honey to ensure all of the valuable nutrients and enzymes are retained. Raw and local honey is also good for seasonal allergies. There is nothing beneficial about processed honey.
    - Lucuma Powder: Touted as a super food, with a uniquely sweet and maple-like taste.
    - Dates: Can be used in smoothies, cooking and baking. They also pack a lot of fiber, nutrients, vitamins and minerals.

- Information for application: Below is an easy-to-follow list regarding information on how to properly apply dietary suggestions. Use this information with your clients. Recommend these suggestions to apply daily, maybe consider a printout for your clients to post to their refrigerator that reminds them of these ways to cut out added sugars.
    - Experiment with natural sweeteners
    - Reduce or cut out soda, sports and energy drinks as well as enhanced waters, sweetened teas and sugary coffee drinks
    - Cut back on the amount of sugar added to things you eat or drink regularly like cereal, coffee or tea
    - Avoid adding sugar to cereal or oatmeal, try fresh fruit (bananas, cherries or strawberries)
    - Avoid adding sugar in recipes, use extracts like almond, vanilla, orange or lemon
    - Enhance foods with spices instead of sugar. Try ginger, allspice, cinnamon, or nutmeg
    - Buy fresh fruits or fruits canned in water or natural juice and avoid fruit canned in syrup

In summary, the goal is to make this approach to nutrition a style of eating that is realistic and sustainable. It is important that your clients express and understand the difference between what is reasonable and what they are willing to do. Remind them that it is common to have a day where there's a combination of pro and anti-inflammatory foods. It's impossible to avoid all inflammatory foods all the time. If this process of making nutritional adjustments starts with the idea that they are required or expected to find perfect and optimal balance out of the gate, then they are setting up for failure. Help to bring them back to reality in reminding them that they are not perfect and cannot be perfect. Ensure to do this with balance whereby you are not enabling or ignoring consistently poor eating habits. Remind them that the primary goal is to bring their diet into balance, and this takes time. Therefore, encourage the decreasing of foods that contribute to disease and the increasing of healing foods so that the overall effect of their diet is anti-inflammatory. To accomplish this, meal planning and food forethought are needed. It takes time and energy to plan, shop, and prepare the foods that the body needs. Your clients will know the foods that make them feel tired, sick, and mentally low. To start, recommend that your clients avoid these foods. This may seem obvious, but if you ask them to avoid these foods for a week, and then two weeks, and so on, while keeping them accountable (not to perfection but to their goals) then you will ultimately make an impact in the way that your clients feel early on in your trainer-client relationship. You can empower your clients to take control and to trust in your recommendations while

supporting them in their journey to better health and establishing increased control of their MS symptoms through your fitness programming.

Meal Planning

Once one knows what variety of foods positively fuel MS clients, the trainer can begin to assist in building their meal plans. This correlates to *Must-Have Mindset #2: Learn to Fish*. Although there are thousands of meal plans from which to choose, the plan must be customized to an individual's needs. Meal plans are not necessarily *one size fits all*.

Many people think they just want to be told what to eat at every meal. But this short-cut won't empower your clients to gain the skills of learning how to feed themselves. Also, if you are not a registered dietitian, then you should remain within your personal trainer scope of practice by only offering recommendations and information to your clients. They then can use this information to structure their own specific meal plans. People that are the most successful with healthy eating long-term go through the personal process of meal planning that allows them also to find pleasure in the foods that lead them to health (Must-Have Mindset #4). The journey is exciting and rewarding. A client should take it one meal at a time.

It is imperative that clients document what works for them and what doesn't. There are many options for nutritional logging apps that can be used for this purpose. Documenting allows the clients to see if they're hitting personal nutritional targets. There are meal planning websites to help organize weekly plans and countless resources for recipes as well. Do this research for your clients and advise them on what apps and sites to use to their best advantage. Remind your client how important it is to eat regular meals (especially breakfast) and snacks throughout the day to maintain blood sugar levels and stimulate metabolism. Proper nutrition is a must on this road to better fitness and optimal health. You may have heard 'you can't out-work a poor diet', and sometimes you need to remind your clients of this also. Taking this long journey by using the right fuel is how they will get to the destination.

Client's Meal Plan EXAMPLE:

Sample Meal Plan for Anti-inflammatory Diet		
Day 1	**Day 2**	**Day 3**
Breakfast Super Green Smoothie (Blend frozen berries, organic kale, water, vegetarian protein powder). **Lunch** Asian bowl: Brown rice, vegetables, chicken **Dinner** Turkey Chili Muffin made with almond flour **Snack** Organic Greek style yogurt with sunflower seeds **Beverage** Roasted dandelion root tea *In addition to pure water	**Breakfast** Spinach & mushroom frittata **Lunch** Tuna salad on whole grain bread with apple slices **Dinner** Wild Salmon Quinoa Sautéed zucchini & garlic **Snack** Carrots & hummus Dark chocolate 70% cocoa **Beverage** Ginger lemonade (made with freshly grated ginger & lemon juice. Sweetened with Stevia) *In addition to pure water	**Breakfast** Oatmeal: (Gluten Free old fashioned oats, cinnamon, walnuts, almond milk) **Lunch** Lentil soup Mixed greens salad Flax crackers **Dinner** Stuffed bell peppers (quinoa & grass-fed ground beef) **Snack** Organic celery & apple slices with almond butter **Beverage** Green tea *****In addition to pure water

Nutrient Timing

Nutrition plays a very important role in exercise performance. Without adequate carbohydrates and fluid, the body tires very quickly. Protein is also needed to rebuild muscles. Without all three of these (carbohydrates, water and protein), plus adequate vitamins and minerals, potential can't be tapped into to its fullest. A poor diet returns poor performance as a result. Poor nutrition can also lead to injury and poor recovery, both of which can hinder ability to continue down the road to fitness. Your clients should think of their bodies like a machine in the way that it functions and in what it needs to function optimally. Quality fuel in the engine will prime it for optimal performance. Conversely, put lesser-quality fuel into the engine and performance can suffer. That's why it is important that, as their trainer, you are aware of when and what they're eating before, during, and after a workout. Encourage your clients to pay close attention to when and what they are eating because, without a good nutrition program, every aspect of their physical and mental abilities will decline and your work with them on fitness programming will be lessened tremendously.

Several variables to consider when determining nutrition in meal planning:

- Gender
- Body Weight
- Intensity
- Type
- Length of Workout

For example, choosing a meal or snack before and after a workout would largely depend on the time of day. It doesn't have to be complicated or difficult to fit into one's routine. Your clients should be reminded, maybe on a regular basis, that only a little preparation and planning will make big impact on their results. Suggest the following guidelines to your clients as a foundation for working through properly fueling their body, and at the best times of day for the most positive results.

Pre-Workout Nutrient Guidelines

Your Client Should:

- Choose easily digested carbohydrates and low-fat foods for quicker digestion.
- Avoid starting the workout when starved or stuffed.
- Pay attention to whole foods that are an important energy source vs. regularly choosing processed foods.
- Eat 30-60 minutes before cardio workout.
- Eat 1-2 hours prior to strength training workout.
- Eat carbs 30-60 min prior to workouts that contain both strength and cardio and protein within 2 hours prior.
- Drink plenty of water for proper hydration.

Pre-Workout Fuel Ideas:

- Whole-grain cereal and almond milk
- Carrots n' Hummus
- Whole-grain Waffle with berries
- Oatmeal with apples
- Organic unsweetened applesauce with cinnamon
- Banana and milk (non-dairy such as coconut or almond milk)
- Super green smoothie with fruit, greens and protein powder
- Roasted sweet potatoes
- Greek yogurt (if you can tolerate the dairy) and fruit
- Hard-boiled egg and slice of whole grain toast
- Dried fruit with no added sugar or preservatives

During Workout Nutrient Guidelines

- It is important for your client to drink plenty water, at least four ounces every 20 minutes of exercise. Perspiration and exertion deplete the body of fluids necessary for an optimal performance and lead to dehydration.
- Usually there is no need to worry about replacing carbohydrates during a workout unless the exercise lasts over 90 minutes and is hard and continuous. When this happens, drinking a sports drink or fruit juice diluted in water will provide fuel and water to the muscles being exercised.

Post-Workout Meal Guidelines

Your Client Should:

- Eat quality protein (10-20 grams) within 15-30 minutes after working out. Whole foods are best, but healthy bars and shakes are a quick fix.
- Remember:
    - Strength: Protein and carbs repair muscles and replenish glycogen stores
    - Cardio: Replace glycogen (stored carbohydrate) and electrolytes lost during workout
- Note that the longer a client waits to eat something, the longer it takes to recover. The enzymes that help the body resynthesize muscle glycogen and build muscle are most active in that first 15 minutes after the workout. Realistically the goal is to eat within a 1-hour post-workout window.
- Rehydrate with fluids. The average workout does not demand the extra calories and electrolytes in sports drinks, not to mention artificial coloring and junky sweeteners. Coconut water is a great alternative to sports drinks, for electrolyte balance.

Post-Workout Nutrient Guidelines:

- Purpose: Recovery, Restore Energy, and Rebuild Muscle
- Protein pancakes: Lots of recipes out there for all diets
- Super green smoothie with protein powder
- Protein bar: Look for 10-20 grams of protein, less than 5 grams of sugar
- Spinach and Egg Scramble
- Protein Shake: One scoop protein powder, a banana with 8 ounces water
- Sandwich: chicken, turkey, almond butter and jelly (sugar free), egg, salmon or tuna on whole grain bread with veggies of choice
- Bean burrito: organic corn tortilla filled with black beans, Greek yogurt and salsa
- Hummus and whole grain crackers
- Stir-fried chicken and vegetables over brown rice or quinoa
- Organic edamame
- Veggie omelet & slice of whole grain toast

Clients need to realize that these nutrient-timing snacks (pre and post workout snacks) should be included in the daily meal plan and not additional snacks. It is not recommended that one with MS exercise on an empty stomach, especially in the morning. It's a common practice for people to wake up early, skip breakfast, and jump right on the treadmill. There is a risk, however, that one will lose muscle when training in a fasted state. The benefits of eating before exercise, particularly carbs and protein, far outweigh any perceived benefits from fasting. Having these substances available as fuel will limit protein loss and thus maintain muscle mass, increase performance, and cause greater usage of fat post-workout.

Healthy Eating on a Budget

Motivation, energy, and strength aren't the only potential barriers on the road to fitness. Financial barriers are a common reality, especially for those with medical issues (and thus, medical bills). A healthy diet can be more expensive - fish, fruit and vegetables, specifically. However, eating healthy on a budget is attainable with the right approach. It would be unwise to skimp on the very investment that guarantees a great return. As the wise saying says, "You can pay at the grocery store or you can pay at the doctor's office."

Your Clients Should:

- Cook several portions of a dish and freeze some of them. This also saves you the effort of preparing meals every day.
- Use frozen fruit and vegetables as they are often cheaper than fresh produce and are good nutritionally.
- Buy fresh fruit and vegetables that are in season.
- Plan for some vegetarian meals. Beans and lentils are cheaper than meat.
- Choose canned wild salmon as it is an affordable protein and omega-3 source.
- Cut down on sugary drinks, junk food, and alcohol to make room for more quality food purchases.
- Plan meals as it is the best way to reduce waste. Food in the trash equals money in the trash. Before buying more food, look at what is already on hand, and plan meals around what's already in the pantry and refrigerator. Planning ahead helps with eating out less, which is a big money and health saver.

Meal planning, dieting, and healthy eating is a philosophy combined with a program. Your clients can have all the willpower in the world but, if they have no plan, then they are bound to fail. This is where you, as the trainer, come in. As their personal trainer, you are part of the action plan. You support the initiation of this plan, because you help them to build it. You, as the trainer, provide encouragement but also accountability to stick to the plan. Your clients will find their goals exceedingly difficult if they do not understand why they are doing it or how their fitness and nutrition program will impact their lives in an exponential way. The more that they stick with the program, and the more discipline that they have (made easier with their support 'team' by their side), the more and more successful they will become. Then, over time, that success will prove itself a worthwhile venture when their MS symptoms lessen and become more manageable because they are living a lifestyle that makes fitness and nutrition a priority. Knowledge is power in this case. Educate your clients on why your recommendations are important, even crucial, to their overall health and wellbeing.
Having a disability complicates the client's life and is burdensome to his/her daily living. It is important to be sensitive to how a disability adds another dimension to the plan of action. But the success of the plan is not impossible. Remind your client of the possibility and show them examples of a healthy lifestyle with a disability. Encourage them to join a support group that demonstrates the results of lifestyle change and hard work. One support group is the MS Fitness Challenge Group on Facebook. Once they make that decision to change the course of their disability and to take control of it by taking control of their fitness, their improved lifestyle will be as normal as brushing their teeth each day.

In summary, inflammation and anti-inflammation are unique to each individual with MS that you train. The nutrition guidelines used in this manual are the foundation to meal planning for those with MS. Apply the nutritional foundations as you work with each MS client as an individual with his/her own specific needs in creating a nutrition program.

Conclusion

Managing Multiple Sclerosis requires an active partnership. Taking medicine, staying active, eating healthy and working with one's doctor and the health and fitness professional are important. One is more successful in his health and fitness program if he/she has support. Support can come in a variety of forms. Family is often a support group. Spouse, adult children, siblings or other relatives can help meet the demands of one's management program on a daily basis. Other support groups include friends, people with MS, people with whom a hobby is shared, church groups and clergy, neighbors, volunteer organizations and even a pet. One should not be embarrassed or afraid to ask people for help when needed.

Fitness professionals can effectively work with those who have MS providing them with a better quality of life through movement. You as their health and fitness coach can provide a positive experience to facilitate an effective path to better health and wellness.

Chapter Fourteen
Health/Fitness Professional Evaluation Checklist

As a health and fitness professional working with clients with MS, it is imperative that he/she master the skills below and have a working knowledge of the fundamentals, principles, anatomy, and exercise programming for clients with MS. Take a moment and check off the skills that you have mastered and make notes and adjustments to the ones upon which you need improvement.

Definition of MS	
History of MS	
MS and Epidemiology	
Gender Differences	
Age	
Ethnicity	
Economic Implications	
MS Terms	
Types of MS	
Pathophysiology of MS and Affected Anatomy	
MS and the Brain	
MS and the Spinal Cord	
MS and the Optic Nerves	
MS Symptoms, Causes, Risk Factors, Diagnosis, & Treatments	
Symptoms	
Causes & Risk Factors	
Diagnosis	
Treatments	
MS Lifestyle Management	
Mental Fitness	
Make Lifestyle Changes for a Healthy Mind	
Meditation	
Yoga	
Positive Affirmations	
Vision Board	
Journaling	
The Power of Nature	
Dealing with Burnout	
Stress vs. Burnout	
MS and Exercise	
The Benefits of Exercise	
The Best Types of Exercise	
MS Exercise Limitations & Guidelines	
8 Key Components of MS Exercise	
FITT Principle and MS	
Exercise Safety and Proper Technique	
Scope of Practice for Health and Fitness Professionals	
Screening and Assessments	
Multiple Sclerosis Functional Composite (MSFC)	

Other MS Assessments	
Multiple Sclerosis Quality of Life Inventory (MSQLI)	
Specific MS Condition Assessments	
Par-Q	
Cardiorespiratory Assessment: Six Minute Walking Test (6MWT)	
Muscular Strength Assessment: Peripheral Muscle Strength	
Flexibility	
Posture Screening	
Goals and Program Design	
Goal Profile	
Concentric and Eccentric Contractions for Program Design	
Training Methods for MS	
The Goal of Each Exercise Designed for MSers (Concept and Theory)	
Program Design	
Exercise Session Format	
Sample Weekly Formats	
Specific Adaptations for Client with MS	
Progression and Regression	
Adapting a Specific Routine	
Adapting in a Wheelchair	
Nutrition and Healthy Weight Management	
10 Tips to a Healthy Plate	
Maintaining a Healthy Weight	
Weight Loss	
Weight Gain	
Mealtime Tips	
Inflammation	
Short List of Foods to Enjoy/Foods to Avoid	
Foods to Enjoy	
Foods to Avoid	
Mindsets for MSers	
Meal Planning	
Nutrient Timing	
Eating Healthy on a Budget	

Appendix A
PAR-Q

Data Collection Sheet

NAME:_____ DATE:_____
HEIGHT:_____in.WEIGHT:_____lbs.AGE:_____
PHYSICIANS NAME:_____ PHONE:_____

PHYSICAL ACTIVITY READINESS QUESTIONNAIRE (PAR-Q)

Questions	YES	NO
1 Has your doctor ever said that you have a heart condition and that you should only perform physical activity recommended by a doctor?		
2 Do you feel pain in your chest when you perform physical activity?		
3 In the past month, have you had chest pain when you were not performing any physical activity?		
4 Do you lose your balance because of dizziness or do you ever lose consciousness?		
5 Do you have a bone or joint problem that could be made worse by a change in your physical activity?		
6 Is your doctor currently prescribing any medication for your blood pressure or for a heart condition?		
7 Do you know of any other reason why you should not engage in physical activity?		

If you have answered "Yes" to one or more of the above questions, consult your physician before engaging in physical activity. Tell your physician which questions you answered "Yes" to. After a medical evaluation, seek advice from your physician on what type of activity is suitable for your current condition.

Appendix B
6-Minute Walk Test (6MWT)

According to ATS guidelines, a 30 m distance course is recommended. Turnaround points should be identified. Three-meter interval measurements are marked with colored tape on the floor. Shorter corridor lengths may increase the 6 MWD due to more frequent turns involved.

Required equipment

1. Stop watch or timer
2. Two small cones to mark the lap boundaries
3. Measurement scale for floor measurement
4. Mechanical lap counter
5. Resuscitation equipment

The 6 MWT is performed on a walking track in a facility. The track has been marked at 3-m intervals so that accurate measurement of the walking distance can be performed. Chairs are available at 30-m intervals in case the patients become so symptomatic that they have to stop and sit.

Client Preparation

1. Comfortable clothing should be worn
2. Environment temperature should be ambient
3. Shoes should be comfortable and any walking aids that the patient ordinarily uses should be used
4. Light meals are acceptable before morning and afternoon tests

Technique

1. Don't perform a warm up before the test.
2. The subject should rest comfortably for 10 minutes prior to the test. During this time blood pressure and heart rate should be measured and potential contraindications assessed.
3. Before the test starts, the subject should stand up and rate his/her dyspnea and fatigue. The Borg scale may be used for this.
4. Set the lap counter to zero and timer to 6 minutes. Assemble all necessary equipment and move to starting point.
5. The tester may walk a lap to demonstrate performance of the test to the client. During the test the tester should never walk with or in front of the subject as the subject may try to match the tester's pace. The tester may walk behind the subject to support him/her in case of staggering or to prevent falling. The subject is allowed to rest during the test if he/she gets fatigued.
6. Use standardized phrases and an even tone for encouragement at completion of each minute of the test. For an example of a standardized script, the reader is referred to the 2002 ATS guidelines. It is recommended to give standardized encouragement every 30 seconds using phrases "keep up the good work" or "you are doing fine".
7. Resting during the test is allowed, but don't stop the clock. If the subject cannot go any further, the test should be stopped and distance covered recorded.
9. Stop the test if patient develops chest pain, intolerable dyspnea, staggering, diaphoresis, intolerable cramps, and/or ashen appearance. Test supervisors should be trained to provide appropriate care at this point.
10. At the conclusion of the test, ask the subject to rate his/her dyspnea and fatigue levels. Record the reason for stopping the test.

Norms: The six-minute walk distance in healthy adults has been reported to range from 400m to 700m. Age and sex-specific reference standards are available and may be helpful for interpreting 6MWT scores for both healthy adults and those with chronic diseases such as MS. However, it is difficult to use normative values because of the differing methods used in studies. An improvement of 54m has been shown to be a clinically important difference.

6 Minutes WalkTest

Normal Range of Scores		
Age	Distance covered by Women in meters	Distance covered by Men In meters
60 - 64	498- 603	558 - 673
65 - 79	457 - 580	512 - 640
70 - 74	439 - 571	498 - 622
75 - 79	398- 535	430 - 585
80 - 84	352 - 454	407 - 553
85 - 90	311 - 466	347 - 521

Appendix C
30 second Chair Stand Test

Chair height: 17" (43 cm), placed against wall for stability
Starting position: sitting in the middle of the chair, back straight, arms crossed over chest, feet flat on floor.

1. Take resting vital signs.
2. Demonstrate the movement, first slowly, then quickly.
3. Have the patient/client practice one or two repetitions to ensure proper form, and adequate balance
4. On the signal "go" the patient/client rises to a full stand, then returns to a fully seated position, as many times as possible in 30 seconds.
5. If a person is more than half way up at the end of the 30 seconds, count it as a full stand.
6. One trial.
7. Take post exercise vital signs.
8. Document any modifications (chair height, assistance needed)

Age	Men: number of stands	Women: number of stands
60 - 64	14 - 19	12 - 17
65 - 79	12 - 18	11 - 16
70 - 74	12 - 17	10 -15
75 - 79	11 - 17	10 - 15
80 - 84	10 - 15	9 - 14
85 - 89	8 - 14	8 - 13
90 - 95	7 - 12	4 - 11

Scores less than 8 (unassisted) stands are associated with lower levels of functional ability

Rikli RE, Jones CJ (1999). Functional fitness normative scores for community residing older adults ages 60-94. Journal of Aging and Physical Activity, 7, 160-179.

Appendix D
The Arm (Bicep) Curl Test

The Arm Curl test is a test of upper body strength, and is part of the Senior Fitness Test (SFT) and the AAHPERD Functional Fitness Test, and is designed to test the functional fitness of seniors. This test is also used for subjects or clients with MS. There are slight differences between the protocols for the Senior and AAHPERD tests, such as the weight used for women. The differences are indicated below.

- **Purpose:** This test measures upper body strength and endurance.
- **Equipment required:** 4-pound weight (women, AAHPERD), 5-pound weight (women, SFT), 8-pound weight (for men). A chair without armrests, stopwatch.
- **Pre-test:** Explain the test procedures to the subject. Perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, height, body weight, gender, test conditions. Ensure that the subjects are adequately warmed-up
- **Procedure:** The aim of this test is to do as many arm curls as possible in 30 seconds. This test is conducted on the dominant arm side (or stronger side). The subject sits on the chair, holding the weight in the hand using a suitcase grip (palm facing towards the body) with the arm in a vertically down position beside the chair. Brace the upper arm against the body so that only the lower arm is moving (tester may assist to hold the upper arm steady). Curl the arm up through a full range of motion, gradually turning the palm up (flexion with supination). As the arm is lowered through the full range of motion, gradually return to the starting position. The arm must be fully bent and then fully straightened at the elbow. The protocol for the AAHPERD test describes the administrator's hand being placed on the biceps, and the lower arm must touch the tester's hand for a full bicep curl to be counted. Repeat this action as many times as possible within 30 seconds.
- **Target population:** the aged population which may not be able to do traditional fitness tests.
- **Comments:** It's important that the upper arm is stable throughout the test, and doesn't swing.
- **Scoring:** The score is the total number of controlled arm curls performed in 30 seconds. Below is a table showing some recommended ranges for this test based on age groups (Rikili and Jones, 2002).

Men's Results

Age	below average	average	above average
60-64	< 16	16 to 22	> 22
65-69	< 15	15 to 21	> 21
70-74	< 14	14 to 21	> 21
75-79	< 13	13 to 19	> 19
bo80-84	< 13	13 to 19	> 19
85-89	< 11	11 to 17	> 17
90-94	< 10	10 to 14	> 14

Women's Results

Age	below average	average	above average
60-64	< 13	13 to 19	> 19
65-69	< 12	12 to 18	> 18
70-74	< 12	12 to 17	> 17
75-79	< 11	11 to 17	> 17
80-84	< 10	10 to 16	> 16
85-89	< 10	10 to 15	> 15
90-94	< 8	8 to 13	> 13

Appendix E
Chair Sit and Reach

Purpose
This test measures lower body flexibility, specially the hamstrings. It is associated with the lifestyle tasks of movement in and out of a vehicle, walking and climbing stairs, and also with a person's gait and posture.

Equipment required
- ruler or tape measure
- straight back or folding chair (about 44 cm high)

Procedure
- Sit on the edge of the chair (placed against a wall for safety). One foot must remain flat on the floor. The other leg is extended forward with the knee straight, heel on the floor, and ankle bent at 90°.
- Place one hand on top of the other with tips of the middle fingers flush.
- Inhale, and then as you exhale, slowly reach forward toward the toes by bending at the hip. Keep the back straight and head up. Avoid bouncing or quick movements, and never stretch to the point of pain.
- Keep the knee straight, and hold the reach for 2 seconds. If your knee bends, straighten your leg and start again.
- The distance is measured between the tips of the fingertips and the toes. If the fingertips touch the toes then the score is zero. If they do not touch, measure the distance between the fingers and the toes (a negative score), if they overlap, measure by how much (a positive score). Record the measurement to the nearest 1 cm and which leg you performed the test.
- Repeat the test 2 times on each leg.

Contraindications
This test should not be done if you have severe osteoporosis.

Chair Seat and Reach Distance (inches)							
Age	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Men	-2.5 - +4.0	-3.0 - +3.0	-3.0 - +3.0	-4.0 - +2.0	-5.5 - +1.5	-5.5 - +0.5	-6.5 - -0.5
Women	-0.5 - +5.0	-0.5 - +4.5	-1.0 - +4.0	-1.5 - +3.5	-2.0 - +3.0	-2.5 - +2.5	-4.5 - +1.0

Chair Seat and Reach Distance (cm)							
Age	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Men	-6.4 - +10	-7.6 - +7.6	-7.6 - +7.6	-10 - +5.1	-14 - +3.8	-14 - +1.3	-16 - -1.3
Women	-1.3 - +13	-1.3 - +11	-2.5 - +10	-3.8 - +8.9	-5.1 - +7.6	-6.4 - +6.4	-11 - +2.5

Appendix F
Back Scratch Test

Purpose

The Back Scratch Test measures how close the hands can be brought together behind the back, so provides an indication of the general shoulder range of motion, and the upper body and shoulder flexibility. It is associated with lifestyle activities such as getting dressed, reaching for objects and putting on a car seat belt.

Required equipment

- ruler or a yardstick or a tape measure

Procedure

- Perform this test in the standing position.
- Place one hand behind the head and back over the shoulder, and reach as far as possible down the middle of your back, your palm touching your body and the fingers pointing downwards.
- Place the other arm behind your back, palm facing outward and fingers pointing upward and reach up as far as possible, attempting to touch or overlap the middle fingers of both hands.
- An assistant is required to direct you so that the fingers are aligned, and to measure the distance between the tips of the middle fingers.
- If the fingertips touch then the score is zero. If they do not touch, the assistant should measure the distance between the finger tips (a negative score), if they overlap, then measure by how much (a positive score). Practice two times with the arms in opposite positions to determine the preferred side for reaching over the shoulder, and then test two times. Record the best score to the nearest centimeter.

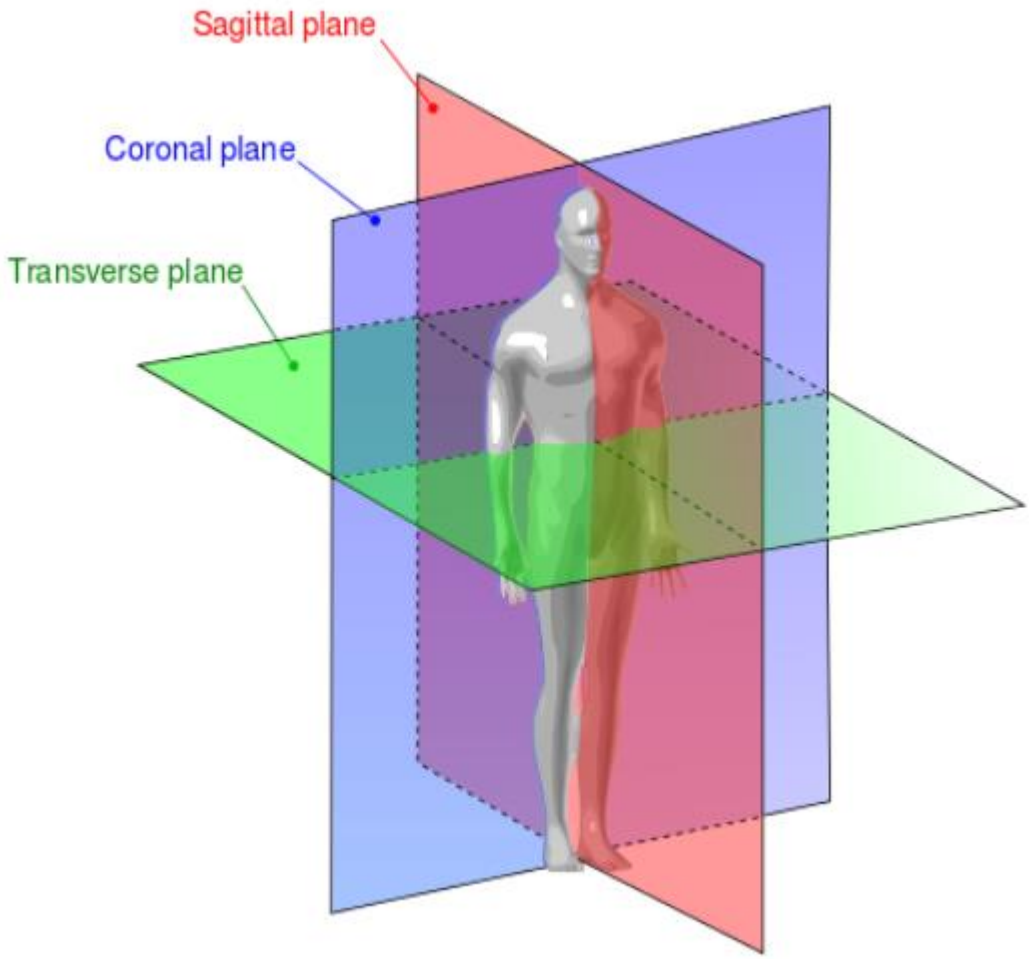
Safety issues

Stop the test if you experience pain.

Back Scratch Distance (inches)							
Age	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Men	-6.5 - +0.0	-7.5 - -1.0	-8.0 - -1.0	-9.0 - -2.0	-9.5 - +2.0	-9.5 - -3.0	-10.5 - -4.0
Women	-3.0 - +1.5	-3.5 - +1.5	-4.0 - +1.0	-5.0 - +0.5	-5.5 - +0.0	-7.0 - 1.0	-8.0 - -1.0

Back Scratch Distance (cm)							
Age	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Men	-16 - +0.0	-19 - -2.5	-20 - -2.5	-23 - -5.1	-24 - +5.1	-24 - -7.6	-26.7 - -10
Women	-7.6 - +3.8	-8.9 - +3.8	-10 - +2.5	-13 - +1.3	-14 - +0.0	-18 - 2.5	-20 - -2.5

Appendix G
Planes of Movement

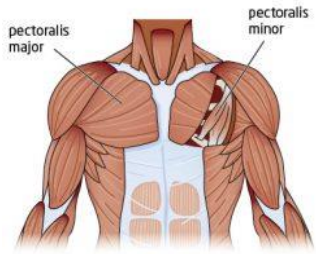
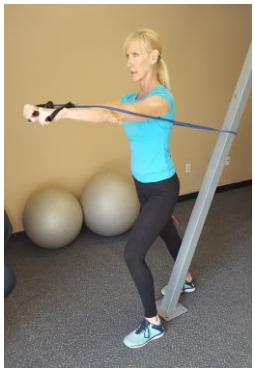
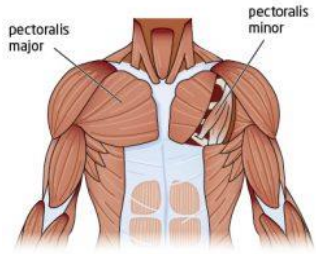
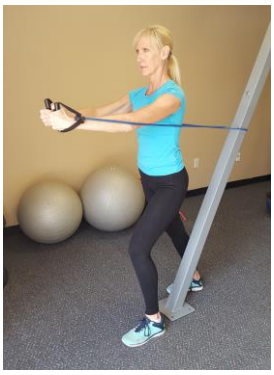
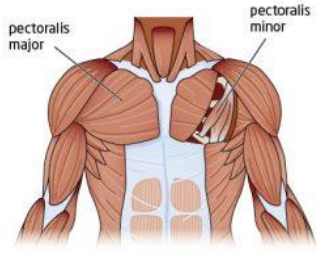
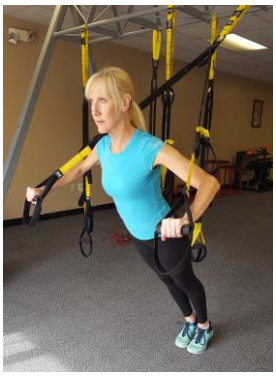


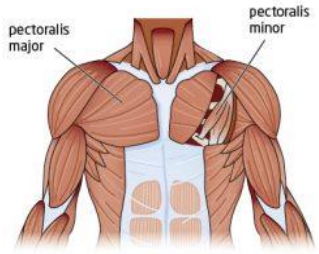
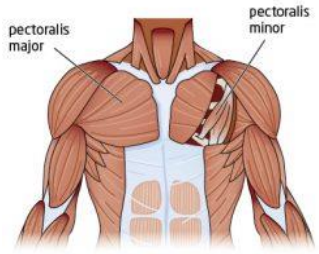
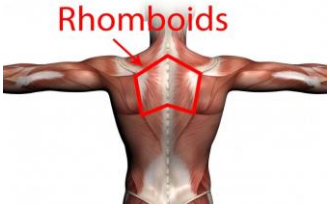
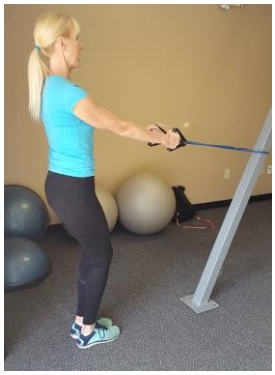
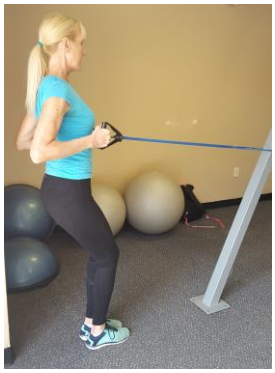
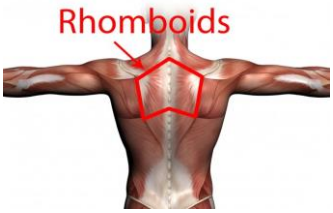
Planes of Movement: Imaginary lines that dissect the body into sections or planes. Movement occurs parallel to the plane of movement. The point at which all planes of movement intersect dictates one's center of gravity and balance.

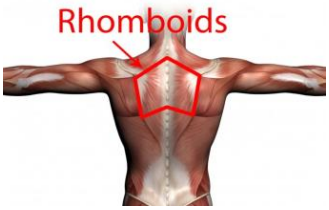
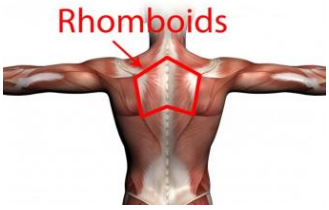
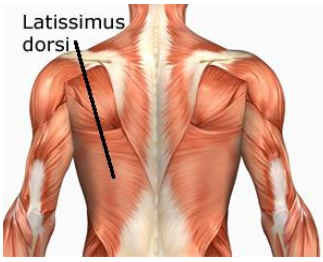
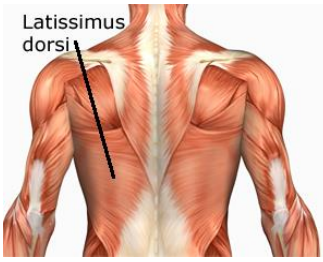
- Coronal or Frontal Plane: Front and Back Sides
    - Example Movement: Jumping Jacks
- Sagittal Plane: Left and Right Sides
    - Example Movement: Running
- Transverse Plane: Superior and Inferior Sections (top & bottom)
    - Example Movement: Oblique Crunches or Swinging a Bat

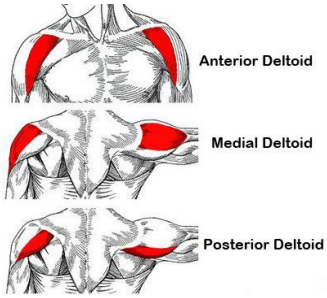
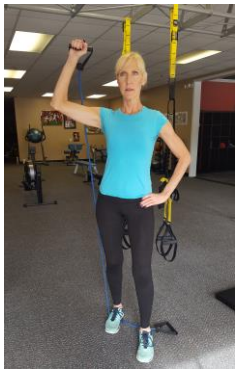
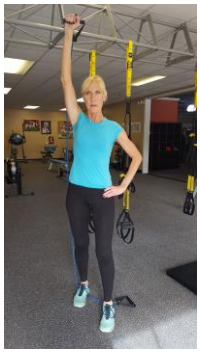
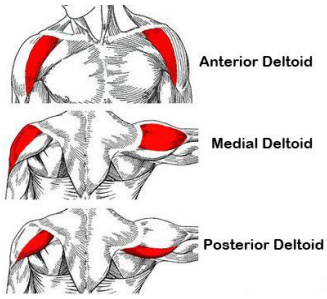
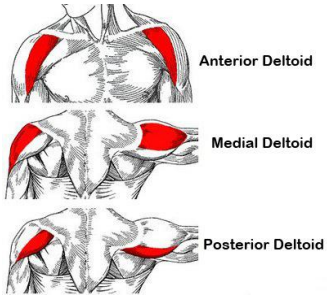
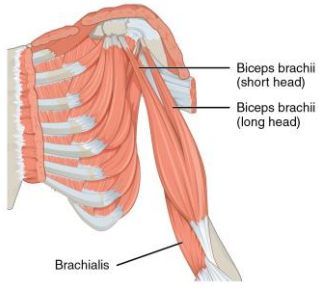
Appendix H
Exercise Library

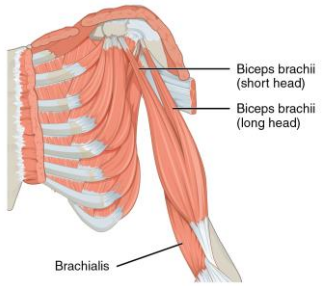
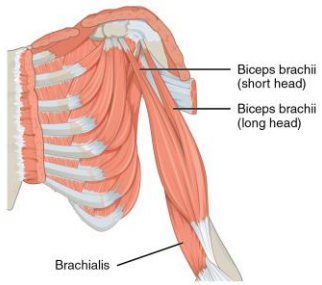
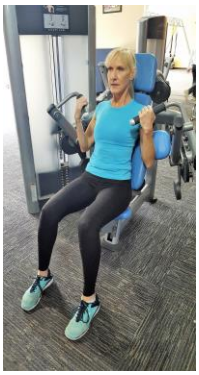
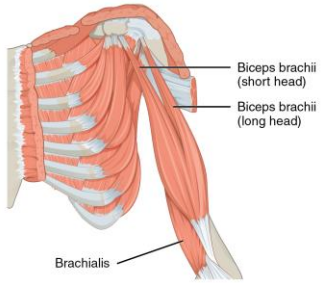
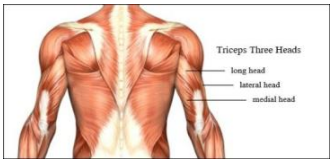
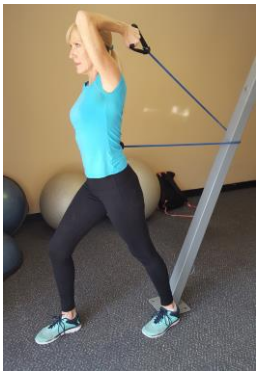
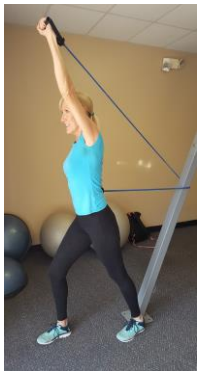
Each exercise is categorized by the muscle group being trained. Each muscle group can be trained using different pieces of equipment. For the most part, each exercise demonstrated in the library shows different versions of the exercise using an exercise band, suspension strap, machine, dumbbells, and exercise ball.

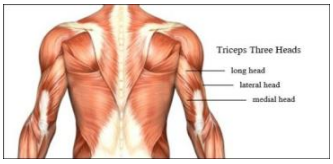
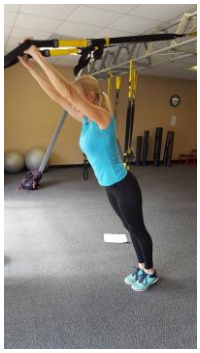
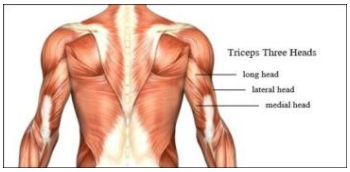
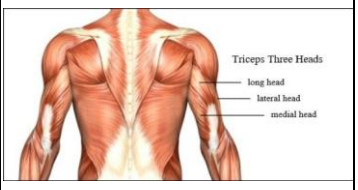
Upper Body Exercise	Equipment	Start Position	Contraction Position
Chest **Pectorals** 	**Chest Press Bands**		
Chest **Pectorals** 	**Chest Fly Bands**		
Chest **Pectorals** 	**Push Up Suspension Strap**		

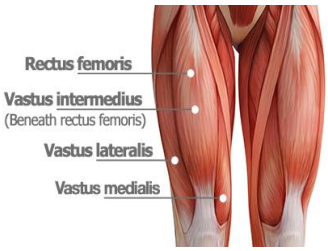
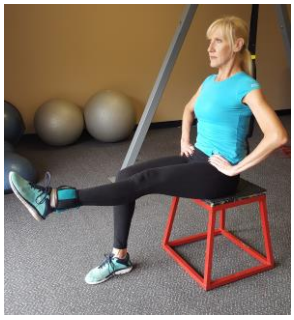
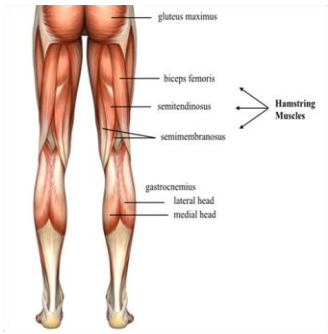
Upper Body Exercise	Equipment	Start Position	Contraction Position
Chest Pectorals 	**Chest Press Machine**		
Chest Pectorals 	**Incline Bench Chest Press Dumbbells**		
Upper Back Rhomboids 	**Upper Back Low Row Bands**		
Upper Back Rhomboids 	**Upper Back Low Row Suspension Strap**		

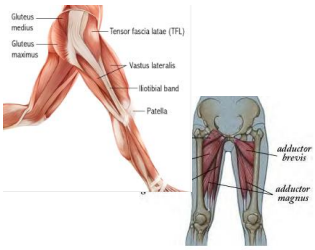
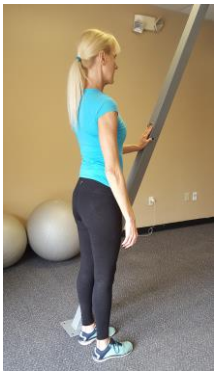
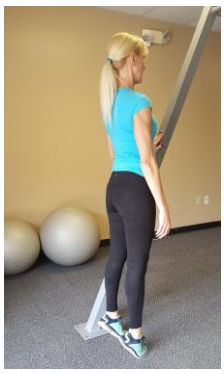
Upper Body Exercise	Equipment	Start Position	Contraction Position
Upper Back **Rhomboids** 	**Upper Back** **Seated Row** **Cable Machine**		
Upper Back **Rhomboids** 	**Back** **Bent Over Row** **Dumbbells**		
Back **Latissimus Dorsi** 	**Back** **Lat Pulldown** **Bands**		
Back **Latissimus Dorsi** 	**Back** **Lat Pulldown** **Machine**		

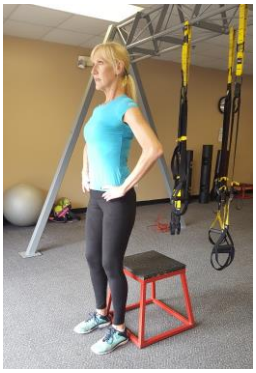
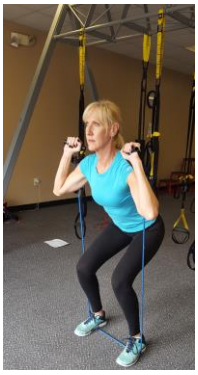
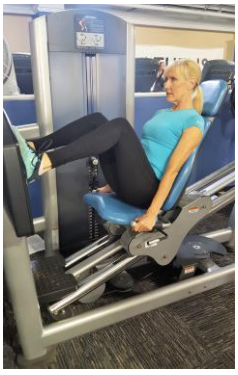
Upper Body Exercise	Equipment	Start Position	Contraction Position
Shoulders Deltoids 	**Medial Deltoid Shoulder Press Bands**		
Shoulders Deltoids 	**Overhead Shoulder Press Machine**		
Shoulders Deltoids 	**Overhead Shoulder Press Dumbbells**		
Biceps 	**Bicep Curl Bands**		

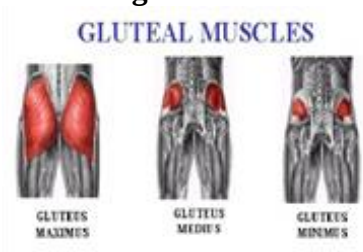
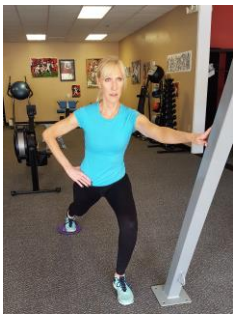
Upper Body Exercise	Equipment	Start Position	Contraction Position
Biceps 	**Bicep Curl Suspension Strap**		
Biceps 	**Bicep Curl Machine**		
Biceps 	**Bicep Curl Dumbbells**		
Triceps 	**Overhead Triceps Extension Bands**		

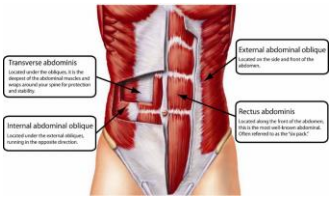
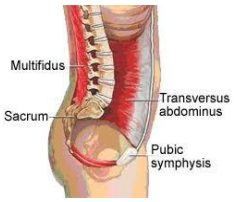
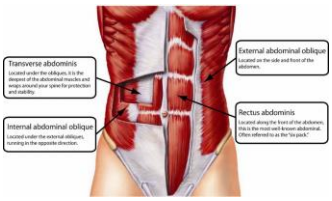
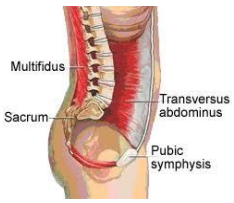
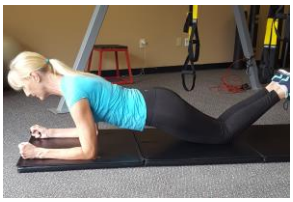
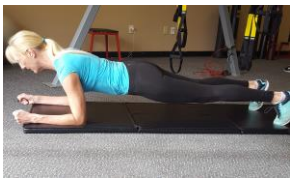
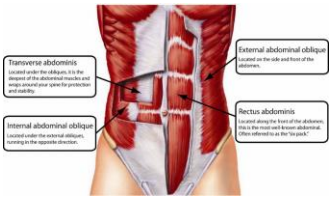
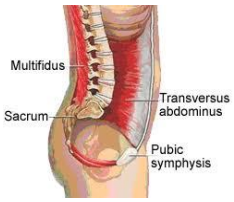
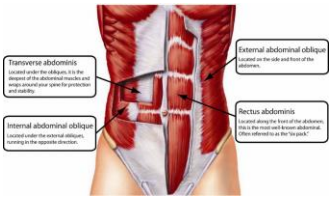
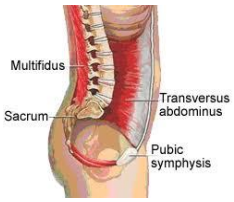
Upper Body Exercise	Equipment	Start Position	Contraction Position
Triceps 	**Overhead Triceps Extension Suspension Strap**		
Triceps 	**Triceps Press Down Machine**		
Triceps 	**Triceps Kick Back Dumbbells**		

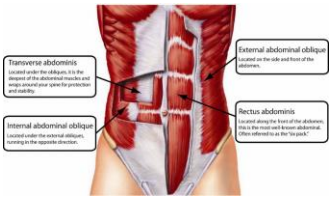
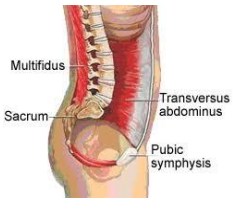
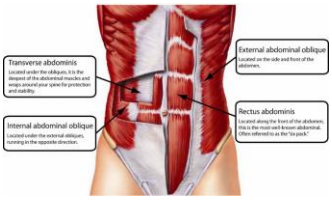
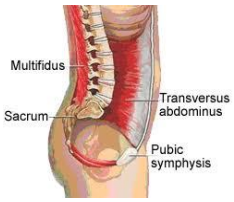
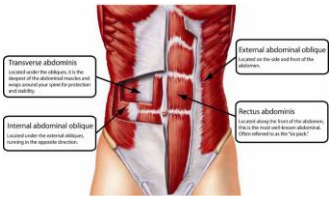
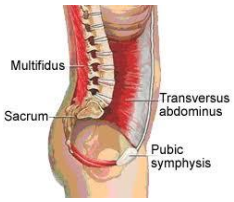
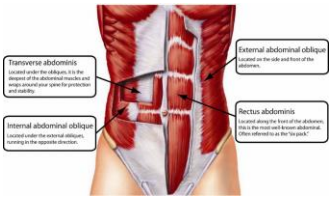
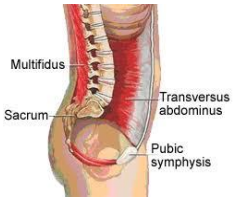
Lower Body Exercise	Equipment	Start Position	Contraction Position
Quadriceps 	**Seated Leg Extension with Ankle Weight**		
Quadriceps 	**Seated Leg Extension Machine**		
Hamstrings 	**Seated Leg Curl Machine**		
Abductors 	**Abductor Machine**		

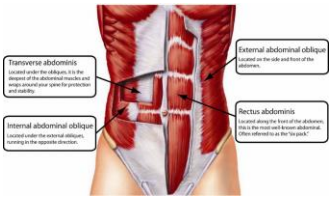
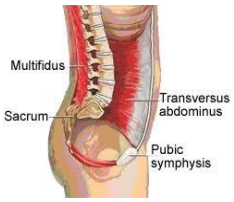
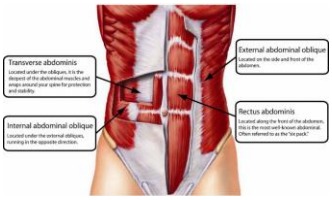
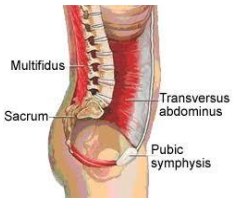
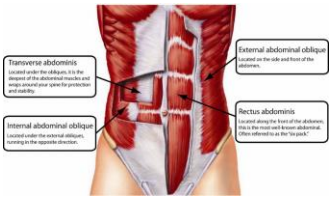
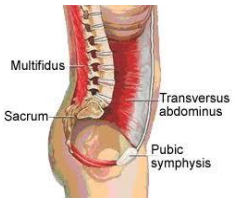
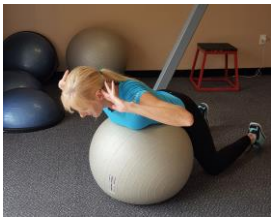
Lower Body Exercise	Equipment	Start Position	Contraction Position
Adductors 	**Adductor Machine**		
Abductors and Adductors 	**Side Lunge** **Disc** **Wall or Post**		
Gastrocnemius 	**Calf Extension Machine**		
Gastrocnemius 	**Standing Calf Raise**		

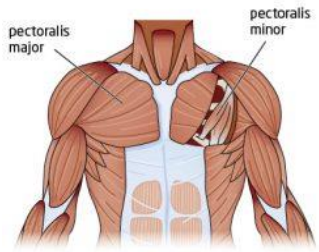
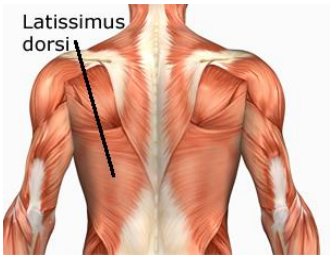
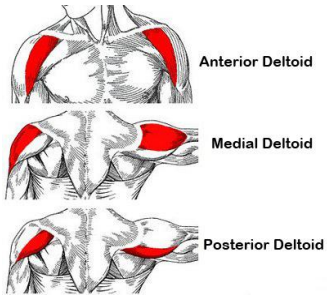
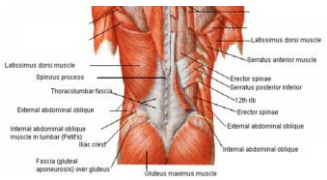
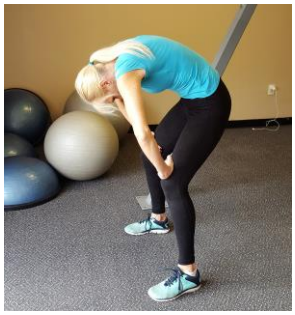
Lower Body Exercise	Equipment	Start Position	Contraction Position
Glutes, Quads, & Hamstrings 	**Squat Stand to Sit to Stand Box**		
Glutes, Quads, & Hamstrings 	**Squat Bands**		
Glutes, Quads, & Hamstrings 	**Squat Suspension Strap**		
Glutes, Quads, & Hamstrings 	**Seated Leg Press Machine**		

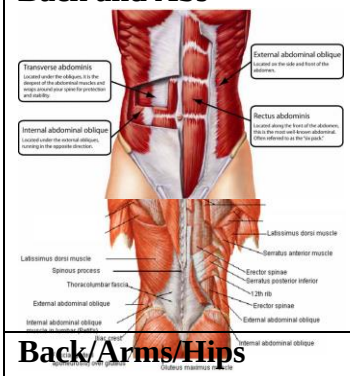
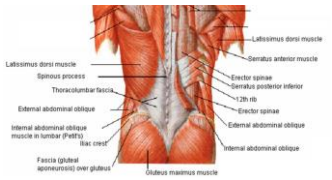
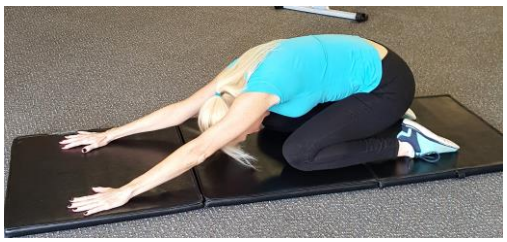
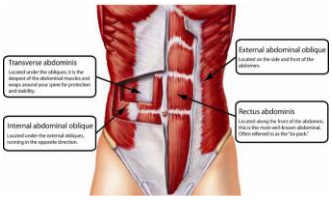
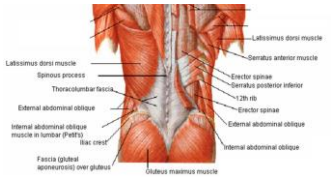
Lower Body Exercise	Equipment	Start Position	Contraction Position
Glutes, Quads, & Hamstrings 	**Lunge Disc with Wall or Post**		

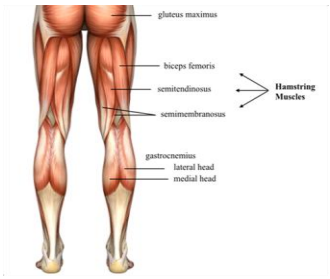
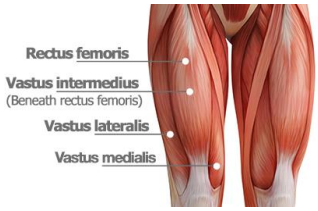
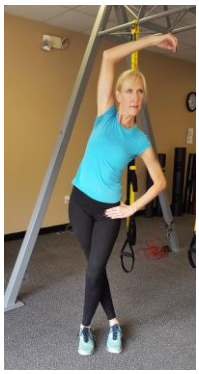
Core and Balance	Equipment	Start Position	Contraction Position
Balancing Core 	**Standing Balancing Bosu** 		
Balancing Core 	**Forearm Plank** 	**Knees** 	**Toes** 
Balancing Core 	**Forearm Plank Bosu** 	**Knees** 	**Toes** 
Balancing Core 	**High Plank Bosu** 	**Dome Side Up** 	**Flat Side Up** 

Core and Balance	Equipment	Start Position	Contraction Position
Balancing Core 	**Four Point Bridge** 		
Balancing Core 	**Four Point Bridge Bosu** 	**Fist** 	**Palm** 
Balancing Core 	**Abdominal Crunch Bosu** 		
Balancing Core 	**Oblique Crunch Bosu** 		

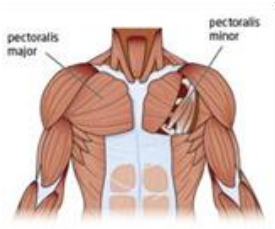
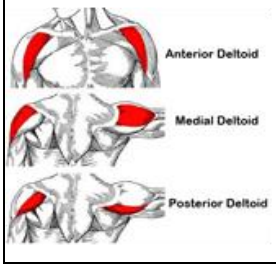
Core and Balance	Equipment	Start Position	Contraction Position
Balancing Core 	**Abdominal Crunch Ball** 		
Balancing Core 	**Oblique Crunch Ball** 		
Balancing Core 	**Back Extension Ball** 		

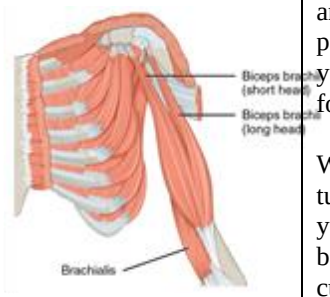
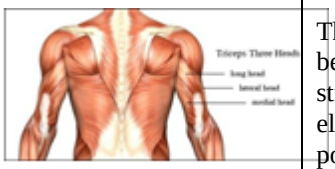
Stretch	Equipment	Start Position	End Position
Chest/Pectorals/Biceps 	**Body Weight or Wall or Post**		
Upper Back/Lats/Triceps 	**Body Weight or Wall or Post**		
Shoulders 	**Body Weight**		
Lower Back 	**Body Weight**		

Stretch	Equipment	Start Position	End Position
Back and Abs 	**Cat/Cow** **Body Weight**		
Back/Arms/Hips 	**Child's Pose** **Body Weight**		
Abs 	**Modified Cobra** **Body Weight**		
Lower Back 	**Knee Hug** **Body Weight**		

Stretch	Equipment	Start Position	Other Option
Hamstrings 	**Body Weight**		
Quadriceps/Hip Flexors 	**Body Weight**		
Adductors 	**Body Weight**		
Abductors 	**Body Weight**		

Stretch	Equipment	Start Position	End Position
Abductors 	**Body Weight**		

Specific MS Adaptations			
Strength	**Description**	**Start Position**	**Contraction Position**
Wheelchair Adaptation Using Bands Chest Press **Chest Pectorals**  	Loop the band around the back of the wheelchair and grasp the handles of the band in each hand at chest level. Grasp the band handles back far enough so you are able to feel the resistance. Next, press the bands forward until the arms are straight out in front of you. Do not lock the arms. You want to keep the tension throughout the movement and not relax in a locked position. Slowly return to the starting position.		
Wheelchair Adaptation Using Bands Shoulder Press **Deltoids**  	Secure the band, looping under the wheelchair wheels. Grasp the band handles and position them around the shoulder area. Keep your forearms straight and your hands at ear level. Next, press the bands over your head. The arms should extend just short of locking the elbows. Slowly lower the bands back to the starting position and repeat the movement.		

Wheelchair Adaptation Using Bands Bicep Curl **Biceps** 	With the band in the same secured position as shoulder press, and arms down at sides, grab the resistance band handles. Keeping elbows at the side, palms facing outward, slowly raise hands toward the shoulder and slowly return to starting position. Make sure to keep your wrists in line with the forearms, not bent. With a slight variation of turning the palms in towards your legs, the bicep curl now becomes a seated hammer curl. This movement is used to target primarily the biceps, however because the wrist remains perpendicular to the ground rather than parallel, the forearm also gets a workout.		
Wheelchair Adaptation Using Bands Overhead Triceps Extension **Triceps** 	With the band secured under the wheels grasp both handles of the bands and pull the arms close to the sides of your head, elbows pointing forward. Extend the arms up, lifting that handle toward the ceiling and slowly release back down to the start position. The only movement should be the elbows bending and straightening. Keep the elbows pointed forward, not out to the sides depending on person's range of motion.		

Wheelchair Adaptation Using Bands **Seated Leg Extension** **Quadriceps** 	Place the band's handle on your right foot, making sure it's secure. Place the band under the right wheel or connected to back wheelchair handle for resistance. Sit tall in your wheelchair without leaning into the back of the wheelchair if possible or lean back for support if needed. Lift your right leg up so that the back of your thigh comes off the wheelchair. Keeping your leg elevated, extend your leg out, straightening at the knee and then bend the knee. The only movement should come from bending and extending the knee. Keep your right thigh lifted off of your wheelchair the entire time if possible. Now switch the band to your left foot and move to the left leg extensions.	  
Wheelchair Adaptation **Seated Abdominal Crunch** **Rectus Abdominis** 	Sit at the edge of your wheelchair. With feet on the floor, slowly tighten your abdominal muscles "crunching" them forward. Do not lean your body forward more than slightly during the movement. The object is to compress the ab muscles, flexing them downwards. Release the crunch position and repeat for 20 reps.	 

Other Wheelchair Strength Exercises

Chest Pull

Fold your resistance band in half and grip each end in front of your chest, arms away from your body and elbows bent. Pull the band apart, bringing it closer to your chest and straightening your arms, and then slowly release it back to the start position.

Bent Over Row

Place the resistance band under wheels and grasp each handle. Bend forward from the waist until your back is parallel to the floor, stretching your arms down toward the floor. Pull the handles upward, evenly pulling your shoulder blades together and your elbows toward the ceiling and slowly stretch to the start position. Keep your abs engaged to protect your lower back. Move your feet closer to the handles to make it harder; closer to the center of the band to make it easier.

Lower Back Extensions

Place the resistance band under wheels and grasp each handle. Bend forward from the waist until your back is parallel to the floor. Keep your elbows bent and tucked into the sides of the waist. Keeping your spine as straight as possible, bend backward from the waist to sit back up and then slowly lower back down to the start position. Keep your abs and your spine lengthened. Move your feet closer to the handles to make it harder; closer to the center of the band to make it easier. Remember to avoid back injury you must do these exercises slowly without a jerking motion with your back.

Inner Thigh Adduction

Sit tall in your wheelchair without leaning into the back of the wheelchair. Place the band under the right wheel for resistance. Extend your left leg. Slowly bring your left leg toward the center of the body and then return back to the starting position while keeping your toes pointed towards the ceiling. Keep the band on your left foot and move to the next exercise.

Outer Thigh Abduction

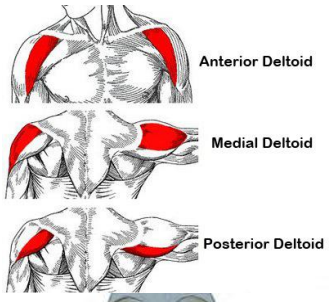
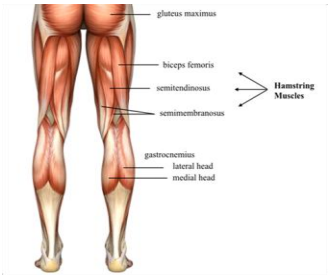
Sit tall in your wheelchair without leaning into the back of the wheelchair. Place the band under the right wheel for resistance. Extend your left leg. Slowly bring your left leg outward and then return back to the starting position. Keep your toes pointed towards the ceiling. Next, do these 3 exercises (Seated Leg Extensions, Inner Thigh Adduction, Outer Thigh Abduction) with the right leg positioning the band under the left wheel.

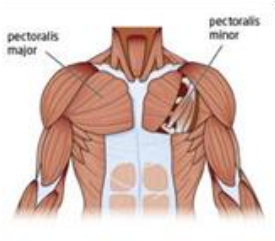
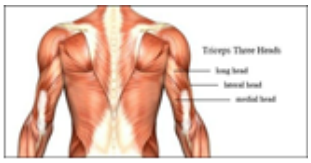
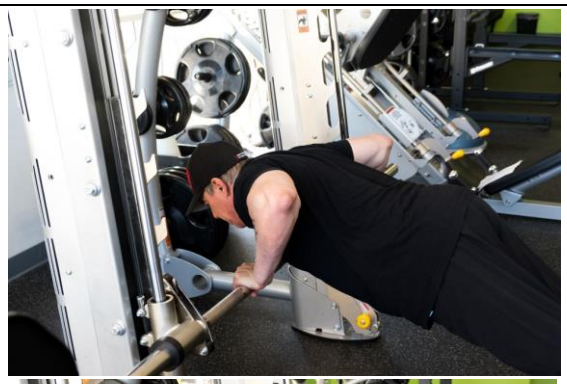
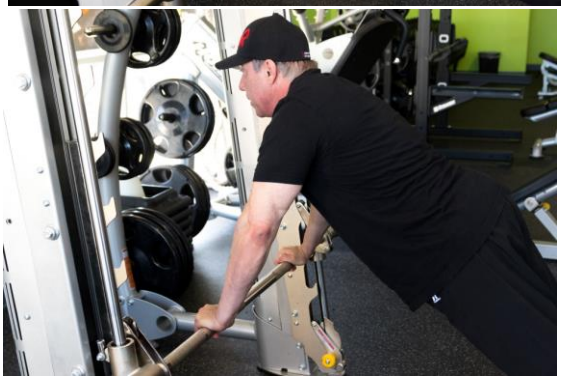
Calf Raises

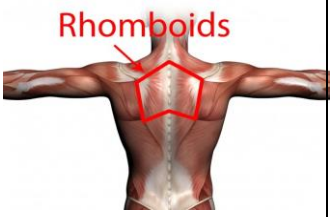
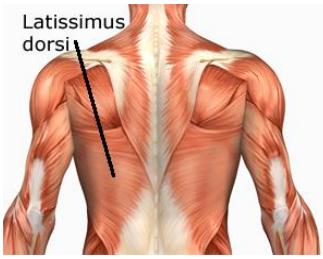
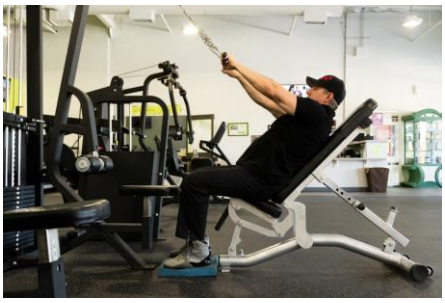
Place the middle of the band around your left foot, holding the handles in both hands securely with your elbows at your sides. Extend your leg. Point the toes forward and then slowly return to the starting position. Keep the band tight and concentrate on flexing and pointing the toes. Repeat on the opposite side.

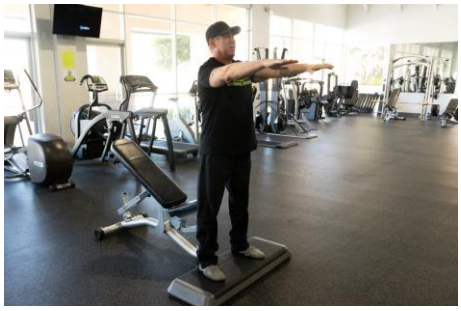
Seated Abs Stretch

Sit at the edge of your wheelchair. Extend your legs out and your arms up overhead, stretching through the abs. Hold for 10 to 30 seconds.

Total Body Strength Exercises	Equipment	Demonstration	Demonstration
Seated Inner Thigh Ball Squeeze 	**Bench and Inflatable Ball** • 4 sets of 12 repetitions holding for 5 seconds at mid-point. • 5th set as fast as possible for 15 repetitions.		
Bench Squat Press/Ball Squeeze Combo   	**Bench, Inflatable Ball, & Dumbbells** • Sets of 15, 12, 10, 8, 15 with dumbbells. • Dumbbells to increase in weight each set. Last set should be performed with the same weight performed on the second set. • While sitting on a bench with legs hip width apart and feet firmly planted on ground and parallel, lift dumbbells to each shoulder. Stand as your press dumbbells over your head, while squeezing ball and repeat. Breathe in before you begin and out as you perform the movement.		

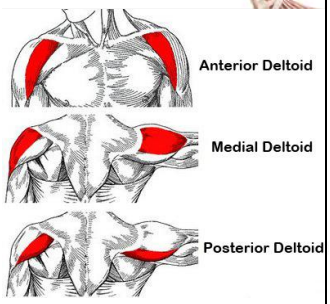
Smith Machine Rack Push-Up  	**Smith Machine** • Sets of 15, 12, 10, 8-15 • Begin with bar at a height between your navel and chest. Lower the bar one notch each set. The last is a drop set in which you perform 8 and 15 repetitions, consecutively, while raising the bar to the height of the second set while performing the last 15 repetitions as fast as you can while remaining in control.	 

Modified Bench Pulldown/Mid Row with Leg Press (to improve Muscle Sequencing)  	**Incline Bench, Cable Machine, & Square Balancing Pad** • Slide an adjustable bench to the front center of a lat pulldown machine or one side of a crossover cable machine. • Set bench to a 30- or 40-degree angle. • Put a soft 2-inch-thick square foam pad at foot of bench. This will help improve feeling at bottom of feet and through hips and buttocks as you perform exercise. • Attach a short straight bar to cable and possibly, a small chain may be needed to lower handle. • Sit upright on bench reach for handle while planting feet firmly on pad approx. 10 inches apart and parallel. • With the following sequence of: □ Press with legs into pad firmly □ Pull with back into bench □ Pull bar to lower chest with elbows neutral. • Perform sets of 12, 10, 8, 6-12 while increasing weight until last set of 12, in which tempo is increased to fast/controlled.	  

Sit Up Stand Up	Bench and Step	
	• Adjust an adjustable bench to the 45-degree angle. • Lie back and firmly place feet on ground shoulder width apart. • Cross arms in front of chest. • Sit up and stand up as fast as possible for 4 sets of 12. *Note: as you get stronger you can lower bench to 30 degrees and hold weighted plates. The key is to balance speed and resistance, as you are trying to change the pathway as to how the mind controls the motion from thought through the feet, back, abdominals, shoulders, hips and legs.*	  

Supine Knee Raise with Leg Extension 	**Bench and Possible Partner** • Lying on a flat bench or floor face up with hands holding back of bench or to the side on the floor, bring knees towards chest as you pull on bench or push into floor. As your knees come just past 90 degrees to your body, extend legs straight towards ceiling, while keeping both hips, knees, calves, ankle, feet and toes in line and even. (Very important and will help drop foot, if performed correctly.) Lower feet and then knees and feet again towards bench/floor and repeat. • Perform 4 sets of 12-15 reps Note: placing and squeezing a small rubber air filled ball between your calves or knees will help focus energy, maintain even tracking of both legs and improve your ability to straighten your legs.	  

One Arm Kettle Bell Swing



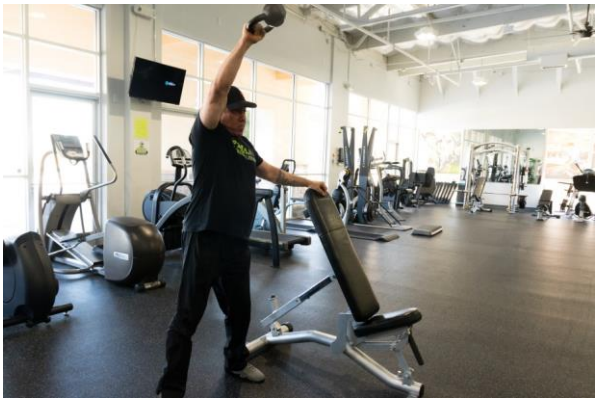
Incline Bench and Kettle Bell

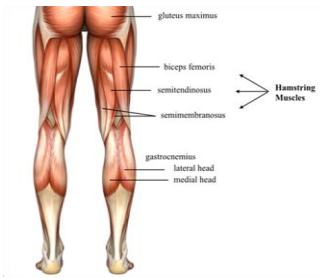
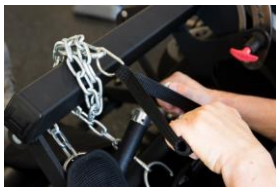
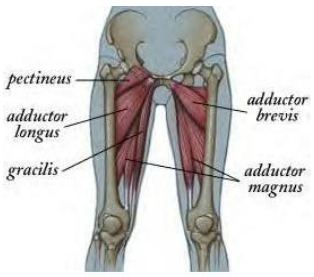
• Using an adjustable bench raised to a 90-degree angle as a balance point, grab top of bench with hand of one arm.

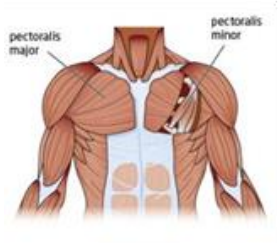
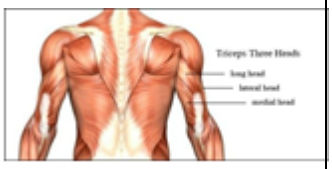
• While keep back flat, bend down with one hand and grab kettle bell, keeping lat muscle stretched out and slightly contracted. You must visualize holding the kettle bell with your lat, not your hand and arm.

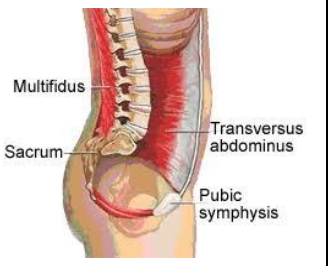
• Keeping your feet flat, planted and a few inches wider than shoulder width, rock weight forward with hips, while planting feet into ground and swing kettle bell upward to just above the height of your eyes and thrust hips forward at top of motion. Inhale as you
return, head slightly up, keeping back flat and lat contracted. Repeat.

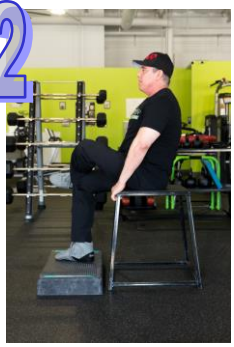
• Perform sets of 12, 10, 8, 6-12 with each arm. Increase weight each set, accordingly, until last set, in which you finish with the same weight as your second set.

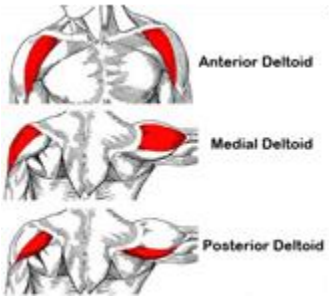
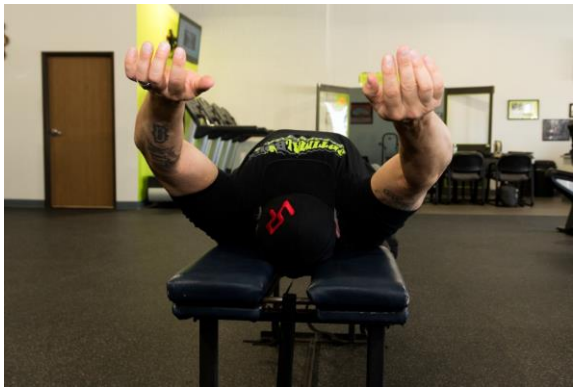
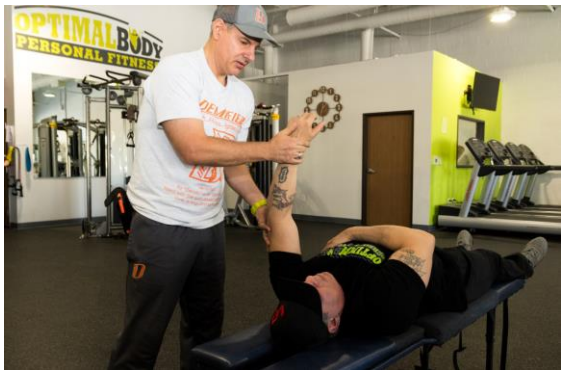
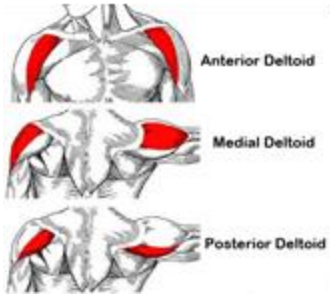
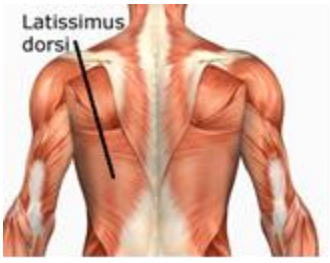
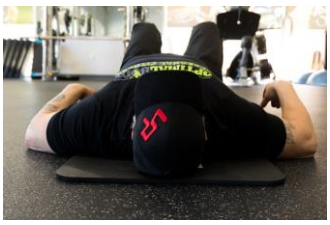


Leg Curl with Supported Chain or Wrap (seated or prone) 	**Leg Curl Machine, Strap or Chain** • Perform sets of 15, 12, 10, 8-15. Increase weight each set, accordingly, until last set in which you use the weight of the second set and increase tempo. Note: If you use a seated leg curl and cannot curl one leg, you must use a flat stretch band or towel/rope as sling to hold up the leg. If you keep the thigh from falling, you will be able to curl the leg.	   
Leg Press with Adduction  	**Leg Press Machine and Inflatable Ball** • Using a seated leg press or decline sled. Place small air-filled rubber ball between knees. Place feet hip width apart on platform. While pressing legs forward, squeeze rubber ball. Do not lock out legs and return about 2 inches before plates touch, maintaining tension in quads, hamstrings and buttocks, while letting tension off rubber ball. Repeat. • Perform sets of 15, 12, 10, 8-15, changing weight upward, accordingly, until last set in which weight is decreased to the weight of the second set and increase tempo of each rep.	 

Incline Dumbbell Bench Press with Rotation   	**Incline Bench and Possible Partner** • Set bench at 30-degree angle. • Lie back on bench while holding dumbbells and plant feet firmly into ground and even. • Bring each dumbbell to shoulders while stretching chest out slightly with palms facing out. Press dumbbells up, while turning counter-clockwise until bells are parallel and just before touching. Squeeze chest and keep hands in line and even. • Perform sets of 12, 10, 8, 6-12 while increasing weight, accordingly, until last set in which you lower weight to that of the second set and increase tempo. Note: by rotating and focusing on keeping hands in line, while barely touching each weight together, you help retrain your brain to control have movement and the result is better mind/muscle control and communication, which may help to improve total body movement.	 

Balance			
Marching Front and Sidestep with Pole or Rod  	**Pole or Rod** • Using a 1 1/2 diameter by 6 ft. High wooden closet pole. Hold rod vertically in front of you with arms partially extended at chest height. March each leg, simultaneously to each side of pole and back, just past buttocks. Repeat for a total of 24 repetitions. Rest for 20 seconds and then with feet together, still holding pole in front, extend right leg laterally to the right just past shoulder width and back to start. Repeat 10 times and the switch to left, repeat 10 times. Then perform same motion simultaneously (left/right) for a total of 20 repetitions. • Perform the above sequence for 3-4 sets. Note: As you gain speed, strength and coordination, you can add ankle weights, accordingly.	   	   

MS Specific Stretches			
Hip/Knee/Back 	1. Sit upright on a bench or chair. 2. Cross one leg over the other with the planted foot pointed straight forward and hip width apart.	1 	2 
Hip/Knee/Back with Partner 	3. Have a partner or trainer support the knee of leg crossed with one hand and with other hand placed flat on the knee apply pressure downward as you resist upward with 30% of your relative strength. Hold for 5 seconds. Repeat five times while increasing resistance to 50%, 80%, 100%, 100%, 100%, respectively holding for 5 seconds and then relaxing. 4. Switch legs and follow the same procedure.	3 	4 

Shoulders  	1. Lying supine on a bench or the floor, let arms fall stretched out behind your head. 2. Starting with the arm that the elbow is the highest, have your partner/trainer support your elbow with arm stretched out and pressure downward while you resist upward with 30% of your strength and hold for five seconds. Bring arm over shoulder then repeat while applying pressure upward at 50%, 80%, 100%, 100%, 100% of your strength, respectively, while holding for 5 seconds.	 
Shoulders/Back/Neck   	1. While lying supine on a mat, extend your arms at right angle to your torso at shoulder level and hands and forearm pointing up. 2. Let arms fall to each side. 3. Have your partner or trainer start with the arm in which the hand is furthest from the floor and apply pressure downward at the forearm, while supporting the shoulder. Resist upward at 30% of strength and hold for 5 seconds. Repeat at 50%, 80%, 100%, 100%, 100% respectively, while holding for 5 seconds. Note: you should practice this 2x daily in am and pm when pain or tightness is present or 1x every other day for maintenance.	   

Resources

- The MS Fitness Challenge: www.msfitnesschallenge.com
- Information on Multiple Sclerosis: www.multiplesclerosis.com
- The National MS Society: www.nationalmssociety.com
- Multiple Sclerosis Association of America: www.mymsaa.org
- Active MSers Forum: www.activemsers.org
- Information on Many Health Topics: www.healthline.com
- Biogen-Pioneers in Neuroscience. Biogen discovers, develops, and delivers worldwide innovative therapies for people living with serious neurological and neurodegenerative diseases: www.abovems.com
- Every Day Health Group: www.everydayhealth.com

References

American College of Sports Medicine. (2011). *American College of Sports Medicine position stand: quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise.* Med Sci Sports Exercise; 43:1334–1359.

American College of Sports Medicine. (2009). *American College of Sports Medicine position stand: progression models in resistance training for healthy adults.* Med Sci Sports Exercise; 41:687–708.

American Thoracic Society Pulmonary Rehabilitation. (1999). Am J Respir Critical Care Med; 159: 1666–1682. https://www.atsjournals.org/doi/full/10.1164/ajrccm.166.1.at1102.

American Thoracic Society. (2002). *ATS Statement Guidelines for the Six-Minute Walk Test* American Journal of Respiratory and Critical Care Medicine Vol. 166, No. 1.

Andreasen, A., Stenager, E. & Dalgas, U. (2011). *The effect of exercise therapy on fatigue in multiple sclerosis.* Multiple Sclerosis. 17, 1041–1054.

Blackwell DL, Lucas JW, Clarke TC. (2014). *Summary health statistics for U.S. adults: National Health Interview Survey 2012*. National Center for Health Statistics. Vital Health Stat 10(260).

Dalgas, U., Ingemann-Hansen, T. & Stenager, E. (2009). *Physical exercise and MS recommendations.* International MS Journal. 16, 5–11.

De Souza-Teixeira F1, Costilla S, Ayán C, García-López D, González-Gallego J, de Paz JA. (2009). *Effects of Resistance Training in Multiple Sclerosis.* International Journal Sports Medicine. April; 30(4):245-50. doi: 10.1055/s-0028-1105944.

Dorszewska, J, Florczak-Wyspianska, J, Kowalska, M, Stanski, M, Kowalewska, A, Kozubski, W. (2017). Serotonin in Neurological Diseases. InTech Open. DOI:10.5772/intechopen.69035.

Fischer JS1, LaRocca NG, Miller DM, Ritvo PG, Andrews H, Paty D. (1999). *Recent Developments in the Assessment of Quality of Life in Multiple Sclerosis (MS).* Multiple Sclerosis; Aug; 5(4):251-9.

Fisk, J. D., Pontefract, A., Ritvo, P. G., Archibald, C. J., and Murray, T. J. (1994b). *The Impact of Fatigue on Patients with Multiple Sclerosis.* Canadian Journal of Neurological Sciences, 21 (1), 9–14.

Furlanetto, T.S., Sedrez, J.A., Candotti, C.T., & Loss, J. F. (2016). *Photogrammetry as a tool for the postural evaluation of the spine: A systematic review.* World Journal of Orthopedics; 7(2): 136–148. http://dx.doi.org/10.5312/wjo.v7.i2.136.

Goodkin DE1, Hertsgaard D, and Seminary J. (1988). *Upper Extremity Function in Multiple Sclerosis: Improving Assessment Sensitivity with Box-And-Block and Nine-Hole Peg Tests.* Arch Phys Med Rehabilitation; Oct;69(10):850-4.

Gronwall DM. (1977). *Paced Auditory Serial-Addition Task: A Measure of Recovery from Concussion.* Percept Motor Skills; Apr;44(2):367-73.

Haber A, LaRocca NG. (1985). *Minimal Record of Disability for Multiple Sclerosis.* New York: National Multiple Sclerosis Society.

Halabchi, F., Alizadeh, Z., Sahraian, M. A., and Abolhasani, M. (2017). *Exercise Prescription for Patients with Multiple Sclerosis; Potential Benefits and Practical Recommendations*. BMC Neurology, 17(1), 185. doi:10.1186/s12883-017-0960-9.

Hauser SL, Dawson DM, Lehrich JR, Beal MF, Kevy SV, Propper RD, Mills JA,Weiner HL. (1983*). Intensive Immunosuppression in Progressive Multiple Sclerosis: A Randomized, Three-arm Study of High- Dose Intravenous Cyclophosphamide, Plasma Exchange, and ACTH.* New England Journal of Medicine; Jan 27;308(4):173-80.

Hersh, C., Fox, R., (2018). Multiple Sclerosis Cleveland Clinic.

Hoang PD1, Gandevia SC, Herbert RD. (2014). *Prevalence of Joint Contractures and Muscle Weakness in People with Multiple Sclerosis.* Disability Rehabilitation;36(19):1588-93. doi:10.3109/09638288.2013.854841.

Hohol MJ, Orav EJ, Weiner HL. (199). *Disease Steps in Multiple Sclerosis: A Longitudinal Study Comparing Disease Steps and EDSS to Evaluate Disease Progression.* Multiple Sclerosis; Oct;5(5):349-54.

Hooper K. (2011). *Managing Progressive MS.* New York, NY: National Multiple Sclerosis Society.

IDEA Health & Fitness Association (2001). *IDEA Health & Fitness Association's Opinion Statement: Benefits of A Working Relationship Between Medical and Allied Health Practitioners and Personal Fitness Trainers.* IDEA Health and Fitness Source, September 2001. www.ideafit.com.

Kappos L, Polman CH. Freedman MS, et al. (2006). *Treatment with Interferon Beta-1b Delays Conversion to Clinically Definite and Mcdonald MS in Patients with Clinically Isolated Syndromes.* Neurology. 67: 1242-1249.

Kobelt G, Berg J, Atherley D, Hadjimichael O, Jönsson B. (2004). *Costs and Quality of Life in Multiple Sclerosis.* SSE/EFI Working Paper Series in Economics and Finance No 594: 1-34.

Kompf, J., Tumminello, N., and Nadolsky, S. (2014). *The Scope of Practice for Personal Trainers.* Personal Training Quarterly Vol 1 Issue 4 p.4-8.

Kurtzke JF. (1983). *Rating Neurologic Impairment in Multiple Sclerosis: An Expanded Disability Status Scale (EDSS).* Neurology; Nov;33(11):1444-52.

Malinova TS1, Dijkstra CD2, de Vries HE2. (2018). *Serotonin: A Mediator of The Gut-Brain Axis in Multiple Sclerosis.* Multiple Sclerosis. Aug;24(9):1144-1150. doi: 10.1177/1352458517739975.

Mantero, V., Abate, L., Balgera, R., La Mantia, L., & Salmaggi, A. (2018). *Clinical Application of 2017 McDonald Diagnostic Criteria for Multiple Sclerosis.* Journal of Clinical Neurology (Seoul, Korea), 14(3), 387–392. doi:10.3988/jcn.2018.14.3.387. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6031991/

Minden SL, Frankel D, Hadden L, Perloff J, Srinath KP, Hoaglin DC. (2006). *The Sonya Slifka Longitudinal Multiple Sclerosis Study: Methods and Sample Characteristics.* Multiple Sclerosis. 12:24-38.

Motl, R. W., McAuley, E. & Snook, E. M. (2005). *Physical activity and multiple sclerosis: a meta-analysis.* Multiple. Sclerosis. 11, 459–463.

National Multiple Sclerosis Society (2006). Diagnosis. New York, NY: National Multiple Sclerosis Society. Multiple Sclerosis Basic Facts Series (brochure).

Netreba, AI, Popov, DV, Bravyi, I, Misina, SS, and Vinogradova, OL. (2009). *Physiological Effects of Low-Intensity Strength Training Without Relaxation.* Fiziol. Cheloveka; 35: 97-102.

Netreba, AI, Popov, DV, Liubaeva, EV, Bravyi, I, Prostova, AB, Lemesheva, I, and Vinogradova, OL. (2007). *Physiological Effects of Using the Low Intensity Strength Training Without Relaxation in Single-Joint and Multi-Joint Movements.* Ross. Fiziol. Zh. Im. I. M. Sechenova; 93: 27-38, 2007.

Nowinski, J. K., and LoPiccolo, J. (1979). *Assessing Sexual Behavior in Couples*. Journal of Sex Marital Therapy. 5: 225–243.

Popov, DV, Tsvirkun, DV, Netreba, AI, Tarasova, OS, Prostova, AB, Larina, IM, Borovik, AS, and Vinogradova, OL. (2006). *Hormonal Adaptation Determines the Increase in Muscle Mass and Strength During Low-Intensity Strength Training Without Relaxation.* Fiziol. Cheloveka 32: 121-127.

Rikli RE, Jones CJ (1999). *Functional Fitness Normative Scores for Community Residing Older Adults Ages*. Journal of Aging and Physical Activity, 7, 160-179.

Rudick, R, Antel, J, Confavreux, C, Cutter, G, Ellison, G, Fischer, J, Lublin, F, Miller, A,

Petkau, J, Rao, S, Reingold, S, Syndulko, K, Thompson, A, Wallenberg, J, Weinshenker, B, and Willoughby, E. (2001). *The MS Functional Composite (MSFC).* National Multiple Sclerosis Society Task Force.

Schoenfeld, BJ. (2013). *Potential Mechanisms for a Role of Metabolic Stress in Hypertrophic Adaptations to Resistance Training.* Sports Medicine; 43: 179-194, 2013.

Sherbourne CD1, Stewart AL. (1991). The MOS social support survey. Social Science Medicine; 32(6):705-14. DOI: 10.1016/0277-9536(91)90150-b.

Sonya Slifka (2006). *Longitudinal Multiple Sclerosis Study – Findings from the Baseline and Follow-Up Interviews.* NMSS research contract #HC 0032.

Stewart AL1, Hays RD, Ware JE Jr. (1988). *The MOS Short-Form General Health Survey. Reliability and Validity in a Patient Population.* Medical Care; Jul;26(7):724-35. DOI: 10.1097/00005650-198807000-00007.

Sullivan JJ, Edgley K, Dehoux E. (1990*). A Survey of Multiple Sclerosis. Part 1. Perceived Cognitive Problems and Compensatory Strategy Use.* Canadian Journal of Rehabilitation; 4:99–105.

Trisolini M, Honeycutt A, Wiener J, Lesesne S. (2010). *Global Economic Impact of Multiple Sclerosis.* Multiple Sclerosis International Federation. London, United Kingdom.

Veit, C. T., & Ware, J. E. (1983). *The Structure of Psychological Distress and Well-Being in General Populations.* Journal of Consulting and Clinical Psychology, 51(5), 730-742. doi.org/10.1037/0022-006X.51.5.730.

Vickrey, BG, Hays, RD, Harooni, R, Myers, LW, and Ellison, GW. (1995). *Quality of Life Research: A Health-Related Quality of Life Measure for Multiple Sclerosis.* Volume 4, Issue 3, pp 187–206. https://doi.org/10.1007/BF02260859.

Ware, JE, and Sherbourne, CD. (1992). The MOS 36-Item Short-Form Health Survey (SF-36): I. Conceptual Framework and Item Selection. Medical Care, Vol. 30, No. 6, pp. 473-483.

White, L. J., Castellano, V. & Mc Coy, S. C. (20016). *Cytokine responses to resistance training in people with multiple sclerosis.* Journal of Sports Science. 24, 911–914.

Zorina-Lichtenwalter, K., Meloto, C.B., Khoury, S., Diatchenko, L. (2016). *Genetic Predictors of Human Chronic Pain Conditions.* Neuroscience; Volume 338, Pages 36-62. https://doi.org/10.1016/j.neuroscience.2016.04.041

About the Authors

CarolAnn

MS, Exercise Science/Health Promotion
CPT, CN

Known as the trainers' trainer, CarolAnn, MS, CPT, CN has become one of the country's leading fitness educators, authors, and national presenters. Combining a Master's degree in Exercise Science/Health Promotion with several fitness certifications/memberships such as FiTOUR, IDEA, and AFAA, she has been actively involved in the fitness industry for over 25 years. She has executed her leadership and business skills within her career through various positions such as Wellness/Fitness Coordinator, General Manager, and Studio Owner. She is the creator and star of The Steel Physique Fitness on Demand series (www.CarolAnn.Fitness). She is a freelance health & fitness expert content provider for various companies and organizations such as MedFit, www.eHOW.com and www.LiveStrong.com. She is currently an education provider and ProTrainer with FiTOUR as well as the Founder and Director of Education for Chiseled Faith, a Faith Based Health and Fitness Program for churches (www.ChiseledFaith.com).

David Lyons

Founder of MS Fitness Challenge
CPT

In 2006, David was diagnosed with MS and at first, he felt hopeless, but then he realized that he could turn his condition around and not only help himself but others as well. He made it his life's work to help those who struggle with the symptoms of the debilitating MS disease as well as trainers who want to work with the MS community. He encourages those to live a lifestyle of health and wellness despite MS. He believes that MS doesn't have to be debilitating, but rather through education, the right mindset, and the correct training, those can conquer MS through fitness.

Not only is David a fitness professional co-authoring the course on MS and Exercise, but also, he is an end-user of the of the practical application that the MS and Exercise Course provides. He has the insight into MS because he has it. He also has dedicated himself to learning everything he could about the link between MS and exercise for the improvement of daily living and overall wellness of those affected by the disease. He has over 40 years of experience, education, and sheer will to never give up and never say quit! I hope that you enjoy

As co-founder, with wife Kendra Lyons R.N., of the MS Fitness Challenge, a charity to help those with MS conquer this disease through fitness and health; a competitive bodybuilder with MS; the recipient of the Arnold Schwarzenegger Health Advocate Lifetime Achievement Award; and the only MS fitness expert to be inducted in the National Fitness Hall of Fame, he can attest that exercise is one of the most important elements in battling MS, and winning.