Quality of life differences in multiple sclerosis patients determined by the amount of regular physical activity

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Quality of Life Differences in Multiple Sclerosis Patients, Determined by the Amount of Regular Physical Activity Experienced

Submitted by
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In partial fulfillment of the requirements for the degree of Master of Science in Biomedical Sciences

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Quality of life differences in multiple sclerosis patients, determined by the amount of regular physical activity

Kalika Lee Stavroulakis
Medical University of Ohio at Toledo
December 2005
Dedications

To my family and friends in California, who have supported my journey to this foreign side of the country eight years ago. Through the weather, academics, athletics, and lack of mountainous countryside, you have all been a call away whenever I was in need. For their positive encouragement, faith, and trust in me and my potential, in order to accomplish whatever I decided to put my heart into. Thank you for all of the weekends spent at the baseball fields, for the recruiting videos, the extra batting lessons, and the Mexican food that saved us at the park after playing 7 games. It was because of every weekend tournament and weekday practice that I was able to have this experience at school, receiving a wonderful education.

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CHAPTER I: INTRODUCTION

Introduction

Multiple Sclerosis (MS) is a profound disease that affects thousands of individuals. It is a disease that can be brought about gradually or very suddenly. MS has been studied since the late 19th century, but many questions still remain to be answered. The effects of MS can be unique and individual to those affected. MS is a disease with no known cause. Autoimmune, viral, and genetic causes are the current theories. Stages of the disease are not characteristic to all, and length of progression and remission, cannot be predicted. Many national groups are participating to increase the awareness of this disease process, and many trials continue to be tested to gain new information. Guidelines and medicinal management continue to be updated.

Some interest has been shown in discovering possible beneficial health affects that regular activity has on MS. Initiation of incorporating a regular exercise program has proven to increase health in numerous ways. Sedentary behavioral patterns that can lead to further complications might be prevented with integration of exercise.

This review will discuss the benefits associated with exercise on chronic disease conditions other than MS, as well as MS. Results of the current study of the perceived effects of regular exercise in MS will be preserved.

Problem Statement

Exercise and the effect it has upon MS, have not been researched extensively in the past. In the general population, health has been shown to be
improved with activity. Chronic disease ailments and prognoses have significantly been improved with the addition of regular exercise routines. Morbidity has been greatly decreased along with mental health dysfunction with the incorporation of exercise. Evidence investigating such a correlation between MS and exercise will be focused upon.

**Purpose**

The objective of this research survey is to determine whether regular exercise is correlated with improved quality of life or well-being in the MS population.

**Research Hypothesis**

The incorporation of regular activity or exercise has been shown to positively correlate with increased quality of life changes. Correlation between increased regular activity and MS patients will show a positive impact on perceived attitudes and outlook towards health and quality of life.

**Scope**

Surveys were distributed to volunteers in small groups affiliated with the National Multiple Sclerosis Society, Northwestern Ohio Chapter. The MUOT IRB approved the study (IRB #104955). The surveys were mailed to willing volunteers. Participants will consist strictly of volunteers. No identifying data was obtained or used in either of these surveys.
**Design**

An observational study design was utilized for this research project. A validated survey (MSQLI) and a second MS study questionnaire survey were distributed among volunteers with MS. The survey required volunteer participation in order to complete and return the surveys to the researchers.
CHAPTER II: LITERATURE REVIEW
Anatomy and Physiology

The central nervous system (CNS) and the peripheral nervous system (PNS), make up the entire nervous system. The nervous system allows contact between each nerve cell, a neuron, through an electrical stimulus. These stimuli result in almost immediate responses. Such responses are illustrated as thoughts, physical responses, emotional responses, and instincts (Marieb & Mallatt, 1997). Activation of a nervous response is defined in three steps. First, internal or external sensory receptors are stimulated by a specific change. The receptors that gather this information are said to have a “sensory input.” Once the change has been appreciated by the receptors, the information becomes processed and a decision to determine what response is needed occurs. This development is called integration. The final step is the actual effect upon our musculature or glands creating a “motor output” (Marieb & Mallatt, 1997).

Neurons are the specialized cells that conduct electrical impulses in our body. There are billions and billions of these special cells, which create action potentials that dictate our body’s reflexes. Neurons are composed of three main components. The cell body contains the nucleus, surrounded by cytoplasm. The nucleus is the center of a cell that contains genetic material. The plasma membrane of the cell body functions as a receptive surface that receives signals from other neurons. The cell bodies are located in the CNS where they are protected by bones of the vertebrae and skull. In the PNS, neurons are grouped into clusters called ganglia (Marieb & Mallatt, 1997).

There are two processes that are derived from the cell body called
dendrites and axons. The dendrites are branch-like processes that differ from axons in structure and function. Dendrites are responsible for receiving information from axons originating on other neurons. The signal moves from the dendrites towards the cell body. The axons are composed of a single strand that function to transport the information received in the cell body to another neuron, specifically the dendrite receptors (Marieb & Mallatt, 1997).

Electrical impulses that are transmitted from neuron to neuron are labeled action potentials. Action potentials are transmitted at different speeds depending upon which nervous system is conducting the stimulus. The CNS produces an extremely fast transmission speed. These neurons are capable of this high speed because of a specialized substance that makes up part of the neuron. This substance is called myelin.

Myelin is a fatty substance composed of lipoproteins. Myelin is located around the axons of thick neurons and acts as an insulator. A myelin sheath encompasses the myelin along the neuron. This insulation provides the ability for electrical impulses to jump along the axon, which is responsible for the increased conduction of signal transmission. Myelin sheaths also help to protect electrical current from escaping the axon and from becoming wasted (Marieb & Mallatt, 1997).

Specific cells termed oligodendrocytes compose the myelin sheaths in the brain and spinal cord. Oligodendrocytes are specific to the CNS, in that they consist of multiple processes that cover several axons. Loss of oligodendrocytes slows nervous impulses along these axons, resulting in sensory deficits, weakened movements, spasticity, tremors, and the loss of controlled muscle movement.
leading to poor coordination or partial paralysis (Marieb & Mallatt, 1997). These conditions may lead to heat insensitivity and lethargy in the individual affected. The loss of oligodendrocytes, are responsible for many of the symptomatic outcomes of the disease process of MS.

**Epidemiology**

The most common of the demyelinating diseases of the CNS is MS. There are around 350,000 persons affected with MS in the United States alone. Nearly 10,000 new cases are diagnosed annually in the United States (Tierney, McPhee, & Papadakis, 2004). Trends seen within the MS population include the female gender with familial tendencies, high socioeconomic class, living in equatorial climates (between latitudes 40° N and 40° S), and European descent (Tierney, McPhee, & Papadakis, 2004). MS is discovered in affected individuals between the peak ages of 18 and 40 years of age.

**Etiology**

The etiology of MS is unknown. MS is thought to occur because of an aggravation of an autoimmune process or slow virus. The disease is characterized as a demyelination of the CNS with residual plaque formations. Advancement of the disease leads the CNS to become affected and disrupted.

**Pathology**

The body is incredibly designed to accommodate a life fulfilled with many incidental stressors. The body has the ability to handle and relinquish many
harmful stressful elements, but reality proves that sometimes it is not capable of such a feat. Certain disease processes can create disability, hindering the body’s ability to protect and adapt to the stressors faced. Autoimmune diseases are just one of many processes that can affect the body’s normal functioning capability.

Autoimmune diseases are characterized as an inappropriate attack of the body’s immune system triggered by the body’s own proteins acting as antigens (Widmaier, Raff, Hershel, & Strang, 2004). This process results in normal and healthy proteins located within the body, continually being attacked by antibodies and T-cells of the immune system. The individual’s capability to defend against these attacks differ from person to person, and depends greatly on the strength of the immune system overall prior to the disease onset.

Studies have shown through indirect evidence that MS might involve an autoimmune process that causes T-cell mediated injury to the myelin sheaths surrounding the neurons. More specifically, the injury affects the oligodendroglial cells that make up the myelin sheath (Kumar, Cotran, & Robbins, 2003). T-cells are highly specialized cells that are responsible for antibody-mediated responses. Cytotoxic T cells are termed CD8 cells that attach to the antigen and aid in killing their targets. Helper T cells are termed CD4+ cells, and they enable stimulation to different cytokines in order to act as inflammatory mediators. Upon examination of the lesions in MS patients, CD4+ and CD8+ cells have shown to be reactive against the myelin sheaths. Cytokines are released towards the basic myelin protein and result in cytotoxicity and death to surrounding the areas, creating lesions. Lab rats whose immune systems have been sensitized and exposed to antibody-mediated injury have shown cytotoxic
insults present within localized lesions in the brain and spinal cord (Kumar, Cotran, & Robbins, 2003).

Another hypothesis that is yet to be confirmed suggests the possibility of a delayed or slowly progressive viral infection that affects the immune system during one’s reproductive years (Tierney, McPhee, & Papadakis, 2004). The attack against the immune system causes a development in the inflammatory process. Chronically inflamed areas over lengths of time create lesions along the white matter of the CNS, which ultimately turn into plaques. Over time the plaques progressively become firm and sclerotic, inhibiting electrical impulses.

Genetic testing includes a known set of class II HLA genes, suggested to have a significant role in regulating an autoimmune response. Genomic evaluation of MS patients, show HLA-DR2 genes are of higher incidence in monozygotic twins when compared with dizygotic twins. Only 25-30% of identical twins receive this characteristic, allowing room for other factors as causative agents, and ruling out a pure cause (Kumar, Cotran, & Robbins, 2003).

Alternative studies have shown that environmental factors impact one’s susceptibility in acquiring the disease. Persons originating from high-risk geographical areas vs. low-risk areas are less likely to be diagnosed with MS, if they relocated to a low-risk environment before the age of 15 years old.

**Clinical Course**

Signs and symptoms can mimic many other diseases or musculoskeletal insults. Symptoms of decreased strength, sensation, paresthesias of the extremities, increasing fatigue (worsening with activity or high temperatures),
constipation, sexual dysfunction, disequilibrium, urinary urgency or incontinence, difficulty speaking, and visual changes are the most frequently complained about. Upper motor neuron problems may be noted; hyperflexia, spasticity, and Babinski reflexes are good investigative leads. Common visual changes manifest themselves as blurred vision, diplopia secondary to internuclear ophthalmoplegia, optic neuritis associated with increased pain (20-40% of individuals are affected initially, 60% after 5-10 years post-diagnosis) (Kumar, Cotran, & Robbins, 2003).

The clinical course of MS can be described in many different fashions: benign, malignant, progressive, relapsing-remitting, or relapsing-progressive. Episodes or exacerbations of symptoms consist of neurological abnormalities that affect various regions of the CNS without consistency (Kumar, Cotran, & Robbins, 2003). Benign episodes consist of initial episodes of exacerbations followed by a life without reoccurring symptoms, or very subtle symptoms. Progressive and/or malignant MS is an intensified course that results in complete disability or fatality quickly from initial onset. Relapsing-remitting MS is episodic in nature and is the most common in nature. The affected individuals experience exacerbations for a length of time and then these symptoms dissipate. These episodes are cyclic in character and their length cannot be estimated. The majority of patients experience remission for several months after the initial episode occurs. Relapsing-progressive follows relapsing-remitting patterns, the difference being that the course of the disease becomes progressively worsened over time. To accurately diagnose MS, specific criteria should be followed.
**Diagnostic Testing**

Imaging studies such as MRI and CT scans are useful in providing evidence of lesions in the brain or spinal cord and excluding alternative causes of neurologic symptoms. MRI scans are the primary type of imaging used. A single lesion found alone, cannot lead to a diagnosis of MS; other regions must be affected. Imaging can exclude other diseases such as a stroke, congenital, or acquired malformations that could be causative for upper motor neuron symptoms.

Visual and auditory evoked potentials can show slowing of electrical transmission. Electrical stimuli of sensory or mixed peripheral nerve sensation have been used frequently to monitor the auditory and somatosensory channels. The dysfunction in transmission can identify silent lesions not found in imaging or upon clinical examination, and can be indicative of MS (Tierney, McPhee, & Papadakis, 2003).

Laboratory studies are very useful to exclude diseases other than MS. Vitamin B\textsubscript{12} deficiency can imitate neurological symptoms experienced by the individual. Mild lymphocytosis or increased protein levels (i.e. IgG index and oligoclonal bands) within the cerebral spinal fluid can occur with inflammatory changes from other disease, or in part due to MS and can support the diagnosis. ANA titers may be elevated in autoimmune diseases such as lupus. Lyme disease, which can mimic MS in various ways, can be evaluated with additional blood tests.

The clinical diagnosis of MS is concluded by the criteria of two or more separate regions of affected white matter on two or more occasions in absence of
a better explanation. Definite MS consists of disruptive lesions in the white matter. Probable MS consists of only one attack, or a history of two attacks with only one noted lesion (Tierney, McPhee, & Papadakis, 2003).

**Medication Management and Prognosis**

Untreated MS is a potentially progressive disorder. Disability will be unique to every individual and cannot be determined upon diagnosis. Statistics show that less than half of all patients have very minimal disability after 10 years post-diagnosis. Continual efforts are being made to prevent the disability that is associated with MS. Improvements in our research allowing us to better understand this disease process have lead to advances in medications currently utilized.

Research studies over past decades have yielded many new FDA approved medications. Although prophylactic measures do not lead to complete remission of MS, the continuing efforts of drug administration are being made to discover a treatment. Drug regimens that have been noted to have positive effects are currently the mainstream protocol in the treatment of MS. Improvements in MS patients have shown an increase in the quality of life and a decrease in the persistent symptoms associated with relapsing events.

Medication management in acute relapses differs from the protocol used with relapsing or progressive stages of the disease. Corticosteroid treatment can shorten the time to improvement. Relapsing-progressive and relapsing-remitting conditions are treated with parental beta interferon therapy or with subcutaneous administration of glatiramer acetate. This management reduces
the frequency and possibly the intensity of exacerbations in the patient (Tierney, McPhee, & Papadakis, 2003). Additional immunosuppressive agents have been shown to possibly decrease the course of consequential episodes of progression.

Other experimented methods that have been evaluated are plasmapheresis and intravenous immunoglobulin therapy. The principle behind performing plasmapheresis is to provide the beneficial effects of immunosuppression therapy. The principle reasoning behind immunoglobulin therapy is to reduce the rate of attack in the relapsing-remitting patterns of the disease (Tierney, McPhee, & Papadakis, 2003). Both of these treatments have been explored, with no conclusive results of positive effect.

**Evaluation of Exercise and Activity**

Exercise is a subclass of physical activity and is characterized as regular, repeated use of the body, for sake of development and maintenance of physical fitness (Webster’s Medical Dictionary, 1995). Exercise and knowledge of personal health and fitness is very important. Exercise can consist of aerobic and anaerobic bouts of physical activity. The benefit of exercise on one’s physical health has been emphasized through numerous studies. Studies have quantified physiologic, metabolic, and psychological health and fitness benefits (ACSM, 2000). Epidemiology studies support the theory that addition of a physically active lifestyle and a moderate to high intensity cardiorespiratory fitness level, will independently lower the risk for chronic disease. The benefits of regular activity and/or exercise can be characterized as the indications of:
- Increased maximal oxygen uptake by the central and peripheral arteriole and venous system adaptations.
- Lowering minute ventilation at a determined submaximal intensity.
- Lowering myocardial oxygen need at a determined absolute submaximal intensity.
- Lowering heart rate and blood pressure at a determined submaximal intensity.
- Increasing capillary density in skeletal muscle.
- Increasing the exercise threshold when there is an accumulation of lactate in the blood.
- Increasing exercise threshold for the onset of disease signs or symptoms such as; angina pectoris, ischemic ST-segment depression, and claudication.
- Reducing resting systolic/diastolic pressures.
- Increasing serum high-density lipoprotein cholesterol and decreasing serum triglycerides.
- Reducing total body fat and intra-abdominal fat.
- Reducing insulin needed by the body creating an improved glucose tolerance. (ASCM, 2000)

Considering the following factual information, exercise reduces the risk of coronary artery disease, hypertension, obesity, type II diabetes mellitus, osteoporosis, strokes, cancer, and raises the good cholesterol, high-density lipoprotein, (HDL) (Blair et al., 1995). In more recent studies, correlation between physical activity in sedentary persons, or persons which chronic conditions who involved regular activity into their lifestyle, produced significant reductions in mortality and morbidity (Paffenbarger et al., 1995).

In addition a number of studies have evaluated individuals with diagnosed chronic and acute problems and injuries, and have subjected them to individualized exercise regimens. These individuals were observed throughout the exercise protocol and conclusive results were comprehensively assessed following the series of activities required. The overall outcomes have been astonishing. The incorporation of regular exercise has a positive effect in a
significant majority of individuals, regardless of the individual’s condition, or the intensity or length of the program.

**Obesity and Exercise**

Obesity is defined as having a body mass index (BMI) of 30 or more. The BMI is defined as dividing a person’s body weight in kilograms by their height in meters squared. Obesity is different than being overweight they are two separate conditions. The increasing statistic of being overweight has topped the charts, affecting 127 million of the American population. Of the 127 million, 60 million or one-third of the American population is obese. The prevalence of adolescents and children who are obese has increasingly risen to 15.3 percent in the past 20 years (Childhood Obesity, 2002). Over 300,000 deaths are attributed to obesity every year, and costs the American people over 100 billion dollars (What is Obesity?, 2002). In the light of the recognized world obesity epidemic, it is more important than ever to manage appropriate weight loss, endurance, and muscle building strategies. Obesity is a chronic disease that has familial components. Increasing risks of developing hypertension, diabetes mellitus type II, heart disease, stroke, gallbladder disease, and cancer of the breast, colon, and prostate have all been correlated with obesity (What is Obesity?, 2002). These complications create increased medical bills, the number of needed medications, and doctor visits.

We know intuitively that treatment for obesity is exercise. The inverse correlation between weight loss and the increase in caloric expenditure is self explanatory. Energy expenditure can be divided into three separate aspects,
resting energy expenditure or basal metabolic rate (REE or BMR), the energy that can be expended after a meal (TEM), and energy used throughout physical activity, active energy expenditure (AEE) (Dohm & Fushiki, 2002). Sensible goals of exercise should consist of expending about 2,000 calories per week. The methodology and intensity should be considered individually dependent upon the amount of weight that should be lost, co-morbidities present, and the individual preference of exercise and activity regimens (Dohm & Fushiki, 2002). The greater one’s activity level the more predominant the total energy expenditure can amount to be. A realistic requirement of prescribed exercise should also be taken into account. A practical approach may be 30-60 minutes a day, 3 to 6 days a week (Dohm & Fushiki, 2002).

In the 1990’s, a study was conducted that took into account exercise and weight loss. The subjects were institutionalized and participated in exercise programs twice daily for 6 days a week. The subjects exercised at 55% of their predicted VO2 max, all the while their caloric intake was held constant (Dohm & Fushiki, 2002). The conclusion of the study showed that the subjects lost an average of 8 kg over 100 days. Exercise can be a predictor of weight loss when all other factors are held constant (Dohm & Fushiki, 2002).

Researchers have studied many aspects of obesity and exercise to prove the correlating benefits. A 2003 study evaluated 173 postmenopausal women who qualified as having an excess amount of intra-abdominal fat based upon a CT scan and their weight. The subjects were sedentary in nature, were all non-smokers, had no history of diabetes, and were not on hormone replacement therapy (Irwin, M.L., Yasui, Y., Ulrich, C.M., Bowen, D., Rudolph, R., Schwartz,
R., Yukawa, M., Aiello, E., Potter, J., & McTiernan, A., 2003). A one year study placed one group in an exercise program that required at least 45 minutes of aerobic activity at moderate intensity for at least 5 days a week. The participants were also encouraged to partake in strength training activities. The control group was instructed to participate in a 45 minute stretching group weekly, and not encouraged to become involved in any other activities. The exercise group averaged 3 hours of activity, in which the majority of activity was walking. The exercise group lost more weight and had larger reductions in intra-abdominal fat when compared with non-exercisers. Noticeable increases in cardiorespiratory function, health, and fitness levels were all noted by the participants. The significant amount of reduction of intra-abdominal obesity showed a decrease in diagnosis of diabetes mellitus type II, heart disease, and high blood pressure (Irwin et al., 2003). Although the study did not test men or younger women, there is a considerable amount of evidence demonstrating that exercise is extremely beneficial to the health of any individual at any age.

**Hypertension and Exercise**

Hypertension is another chronic disease that is characterized by a blood pressure of over 120 systolic and 80 diastolic. Hypertension results from three problems, too much fluid in the arteriole system, a narrowing of the vasculature, or both. Excess fluid can be caused by fluid exchange from 3rd spaces in chronic diseases. Narrowing of the vasculature is the second scenario. The formation of plaque in blood vessel, which narrow the diameter of the vessels and create an increase of pressure. The origin of primary hypertension is termed idiopathic
and affects about 90-95% of all patients. The remaining 5-10% of individuals affected, are secondary to elevation of blood pressure through another disease process. Hypertension affects 55-60 million American adults. Two out of every three are aware that they are affected, and only one-half of this group is treated. Of these one-half treated, only one-fourth of these individuals are controlled with diet, exercise, or medications (M. Keck, personal communication, 2004).

High blood pressure affects both men and women equally by middle age years and is predominant in African Americans. Hypertension has been correlated with an increase risk in stroke, end stage renal disease, coronary artery disease, and fatigue, changes in vision, headaches, left ventricular hypertrophy, trans-ischemic attacks (TIA’s), and sexual dysfunction.

Standard treatment of hypertension begins with increasing activity levels. The effects of exercise have already been well documented to benefit the cardiovascular system. Atherosclerosis, coronary heart disease, stroke, myocardial infarction, and TIA risk factors are associated with elevated blood pressure. Effective control of blood pressure through monotherapy of a long-term regular exercise is the desired result. Uncontrolled hypertensive patients will often need dietary and activity changes along with medicinal implementation.

The majority of hypertensive individuals under further investigation experience more invasive testing often proving arterial stiffness secondary to the narrowing of the vasculature. Arterial stiffness has been linked with increased cardiovascular risks and demise of cardiovascular performance (Edwards, David G., Schofield, Richard S., Magyari, Peter M., Nichols, Wilmer W., Braith, & Randy
Narrowing of the vessels can be invasively treated with stenting techniques, with expensive medications, and with exercise incorporation. Exercise, the most recommended first line of treatment, has suggested improvements in arterial stiffness in subjects with coronary artery disease (CAD). A non-invasive diagnostic testing procedure was used to assess the diameter and thickness of the involved plaque formations in the aorta. Subjects were only required to participate in moderate intensity exercise training or CAD standard care protocols for 12 weeks. An average of a 4% decrease in the thickness of the vasculature was denoted by the technique; a percentage that correlates with moderate reduction of future risk for the progression of heart disease, myocardial infarctions, stroke, and other macro- and microvascular complications (Edwards et al., 2004).

Benefits of exercise have been proven through comparisons between active and non-active persons, in numerous trials. In as little as 10 weeks, incredible reductions in systolic and diastolic blood pressure of 13.1 and 6.3, respectively, were recorded (Tsai, J.C., Yang, H.Y., Wang, W.H., Hsieh, M.H., Chen, P.T., Kao, C.C., Kao, P.F., Wang, C.H., & Chan, P., 2004). Subjects with no controlled exercise regimen showed a difference in exercise capacity as compared to the active group of subjects, but to a much lessened state. The ability of the exercise group to perform more proficiently at 2.2 METS (metabolic equivalents) was considerable over the non-exercise group. The changes in quality of life were determined through a standardized health-quality of life questionnaire fulfilled by each participant. The results showed improved satisfaction after the exercise regimen was completed by the exercise group vs. the control group (Tsai et al.,
An alternative aerobic study, consisting of a long-term enrollment, also compared hypertensive patients engaged in an exercise associated study. Middle-aged subjects with diagnosed hypertension were enrolled in a long-term aerobic training program. The subjects were not currently taking any type of blood pressure medication. Blood pressure at rest and during exercise, were both evaluated in this study. Subjects were instructed to exercise 2 times a week for a total amount of 60 minutes for 6 months. Systolic blood pressures were recorded and differences of 14 points systolic and 7 points diastolic were noted during exercise, after 6 months of regular activity. A follow-up study after 18 months showed another significant decline in systolic blood pressure of another 12 points systolic and 9 points diastolic when exercising. At rest a difference of 6 points systolic and 5 points diastolic were documented. Subjects were contacted a third time 3 years after the study, and even further decreases in systolic and diastolic pressures were recorded at 3 and 4, respectively, during exercise and at rest (Ketelhut, R.G., Franz, I.W., & Scholze, J., 2004). In conclusion, the long-term effects of regular moderate intensity activity will aid in reducing high blood pressure. This reduction will decrease the risk for many more complicated medical issues in the future.

**Cardiovascular Disease and Exercise**

Cardiovascular disease (CVD) is the nation’s leading killer in both men and women, and in all racial and ethnic groups, for all Americans over the age of 35. Almost 1 million persons die each year in relation to CVD, which equals out
to almost 50% of all deaths in the nation. About one out of every four Americans experiences CVD. Physiology shows that the heart is composed of a specialized type of muscle. The muscle that composes the heart works similarly to that of a skeletal muscle in that they both become significantly larger and stronger with the stress of exercise. CVD is defined as any dysfunctional condition of the heart, arteries, and veins that supply the necessary means of transporting oxygen and removing waste products to and from the heart, brain, and major organs of the body (Kaplan, G.E. & Keil, J.E., 1998). Coronary artery disease (CAD), ischemic heart disease, atherosclerosis, high blood pressure, and increased levels of cholesterol are all causative agents behind CVD.

CAD transpires due to four major risk factors: inactivity, smoking habits, uncontrolled cholesterol, and high blood pressure are causative for the CAD that affects millions of people yearly (Effects of exercise on heart and circulation, 2002). Reversal of these factors will help to decrease the associated amount of risk in all of these patients. Numerous studies have discovered that the greater intensity of activity the inverse proportionality of the risk of heart disease. Patients who have previously been diagnosed with CAD, undergoing light to moderate activity have shown consistent positive improvements in reducing their risk for CAD. Adaptations to a regular stress load helps to allow optimal and effective management of the heart without the strain and stress.

Of the four major contributors to CAD, all of the factors can be proactively changed. Modification of one’s activity level and diet, have been the most successful means of maintaining a healthy heart and lifestyle. A healthy diet can decrease the amounts of bad cholesterol and increase the amounts of good
cholesterol in an individual. Aerobic training dilates the blood vessels to allow for more adequate circulation, and in combination with the healthy diet, can improve blood-clotting factors. Strength training has also shown to benefit low-density lipoprotein (LDL) levels in active participants. Persons who partake in just as little as four hours of recreational activity throughout the course of a weekend show markedly reduced mortality and morbidity rates when compared with sedentary persons. Expending as little as 250 calories a day parallels an increase in HDL, and infers that the greatest protection against CAD can be through a minimal application of energy (Effects of exercise on heart and circulation, 2002).

A long term study consisted of evaluating almost 10,000 participants between the years of 1971-1975. The groups were evaluated by amount of physical activity, body mass index, and dietary caloric intake over 17 years, until 1992. Comparative studies surveying physical activity and heart disease, and caloric intake and heart disease, used the data from the 1,500 subjects whom had passed away during the 17 year follow up. When evaluating the amount of physical activity and caloric intake among the two groups, it was determined that caloric intake was unrelated to heart disease and mortality. Subjects, who were more active on a daily basis, averaged more caloric consumption, had leaner muscle masses, and experienced at least half the amount of cardiovascular related mortality. This data was comparative to subjects who had the lowest caloric intake during the 17 years. The individuals with the lowest caloric intake also were shown to have the least amount of daily physical activity, were the most overweight or obese, and had a 55% increase in mortality rate when compared
with the more active participants (Levin & Aaron, 2003).

**Cerebral Vascular Occlusion and Exercise**

Cerebral vascular occlusion, or stroke, occurs by means of a thrombus, embolism, or hemorrhage. Chronic diseases and unhealthy habits are common indications of one’s potential risk for having a stroke. Such conditions are hypertensive states, diabetes, hyperlipidemia, cigarette smoking, cardiac diseases, AIDS, recreational drug abuse, alcohol consumption, and genetic predisposition have all been correlated with an increased risk of stroke. When the cerebral vasculature becomes occluded, decreased amounts of circulating blood flow occurs. Lack of efficient circulation, due to a thrombus/embolism or a hemorrhage directly relates to diminished oxygen capacity and is the founding reason for the occurrence of a stroke.

Group studies comparing intensity of activity between hundreds of subjects participating in a calorie reduction study have demonstrated positive correlation between the two matters. In the study both active groups were separated by the amount of calories that were expended weekly. The group who expended 1,000 to 2,000 calories a week showed a preventative effect against the occurrence of a stroke. The group who expended 2,000-3,000+ calories through recreational activity showed a greater degree of protection against cerebral vascular disease (Effects of exercise on heart and circulation, 2002). Both genders were affected in a positive manner throughout the course of this study and other studies of this nature.
Diabetes Mellitus and Exercise

Diabetes is a chronic condition that occurs when the body cannot produce insulin or use insulin properly. Insulin is produced by beta cells in the pancreas, and is utilized to convert sugar, starches, and other foods into energy required to complete daily activities. Insulin is a hormone that allows for the uptake of glucose to enter a given cell. Over 18.2 million are affected by diabetes, equaling almost 6.3% of the American population. Diabetes affects individuals in either one of two ways. Type I or insulin dependent diabetes mellitus (IDDM), occurs secondarily to the body not being able to produce the insulin. Type I, is the least common of the two types, and only affects 5-10% of Americans (Yu, W., Stjewrnholm, M., & Munier, A., 2004). Type II diabetes mellitus, also known as non-insulin dependent diabetes mellitus (NIDDM), occurs in part to the resistance of insulin by the cells of the body. The body cannot effectively utilize the insulin produced, and it accumulates in the blood stream. Type II diabetes mellitus affects the remaining majority of Americans.

Diabetics are at high risk for cardiovascular diseases due to the correlation of increased circulating blood glucose. The traveling excess glucose binds to proteins in the collagen, blood vessel walls, and interstitial tissues accelerating atherosclerosis. The protective effects of exercise on the cardiovascular system, is extremely important for these affected individuals. Adaptations of the cardiovascular system from the damage of the condition of diabetes include hypertrophy, stiffening, and loss of functional reserve (McGavock, J.M., Eves, N.D., Mandic, S., Glenn, N.M., Quinney, H.A., & Haykowsl, M.L., 2004). This in turn causes a reduction of exercise capacity and cardiovascular fitness.
Regular exercise and activity can increase the sensitivity of insulin re-uptake by the cells in the body to protect and prevent the possibility of heart disease (Effects of exercise on diabetes, 2002). Restoration of normal glucose metabolism is partly achieved by the decline in body fat post-aerobic training. Strength training can also raise the metabolism in an individual, decreasing the body fat distribution. Insulin sensitivity has been discovered to remain elevated up to 48 hours post-exercise (McGavock et al., 2004). This result was discovered in part because of the amount of hypoglycemic episodes diabetics experienced after they had participated in a controlled exercise regimen.

Exercise has been noted to control diabetes in several ways by reversing insulin resistance overall. Insulin resistance occurs secondarily to excess weight or obesity. Low density lipoprotein cholesterol (LDL), is primarily responsible for creating the plaque that is documented to narrow the circulation of blood through the vessels, causing issues with the heart (Mullen, D.L., 2000). Ventricular and vascular hypertrophy reduction, along with increased functional reserve will be the likely positive outcomes of the incorporation of exercise.

**Cancer and Exercise**

Fatigue is one of the largest presenting symptoms voiced by an individual actively participating in cancer treatment regimens. Fatigue is a result of a possibility of different aspects, including diminished cognitive and physical functional capacity. Fatigue is dependent on the maximal aerobic capability of an individual. This measurement is termed VO2max and is predicative of the direct strength to circulate the hemoglobin that carries oxygen molecules,
through the body. Cancer patients can most often associate their symptoms of fatigue with the anemia, deconditioning, and muscle wasting secondary to cachexia. The above listed conditions and reasoning behind the fatigue theory can all be improved with the incorporation of exercise or daily activity (Evans, W.J., 2002). Cancer rehabilitation programs are commonly based around three main concerns. First, the anemia that is experienced by the individual can be corrected through external means which in turn increases the body’s ability to carry more oxygen. The stabilization of one’s blood storages can lead to an increased capability of conditioning aerobically. Second, through this correction in the blood levels, the VO2 max improves. Third, the advances in strength through exercise have reversed the muscle wasting and weakness encountered by the patient (Evans, W.J., 2002). The patients that were studied had further examinations and noticeable improvements in balance, coordination, muscle mass, and protein balance were noted secondarily to the increase in muscle mass adaptation (Evans, W.J., 2002).

Cancerous conditions most often require an individual to undergo medical treatment through medicinal methods, chemotherapy, and/or radiation. A physical activity training study incorporated a treatment plan of many individuals who had recently undergone chemotherapy. A 30-minute exercise daily regimen was necessary to evaluate the physical response attributed to the activity being performed. The exercise program duration differed in length, dependent upon the length of individual stay in the hospital. The evaluation of fatigue and psychological distress was determined through a validated assessment called the Profile of Mood States and Symptoms Checklist (Dimeo et
al., 1999). Assessments of the individual patients were completed upon admission and at the discharge.

At the conclusion of this study the patients in the exercise controlled group had scored quite significantly different than the control, non-exercise group. The number of fatigue and somatic complaints recorded by the advising staff and through the validated survey confirmed an improvement in these physical ailments. The exercise group had also scored significantly better in categories such as obsessive-compulsive traits, fear, interpersonal sensitivity, phobias, and feelings of anxiety (Dimeo et al., 1999).

Separate studies on specific cancers have evaluated the inverse relationship between the cancers and exercise frequency. A study conducted to evaluate colon and rectal cancer in association with an exercise program was completed in 2004 by the University of Utah health research center. A series of 13 separate studies evaluating the effects of exercise on colon and rectal cancer were completed at this time. Lowering the risk for each of these cancers with the incorporation of exercise, were found at the conclusion of this study. Furthermore, investigations to comprehend these results have been assessed. Hypotheses proposing a series of mechanisms are responsible for the good outcome of incorporating exercise into a daily regimen. Physical activity increases gut motility which is partly responsible for enhancing one’s immune system. Increasing activity level decreases obesity which can affect the positive uptake of insulin and decrease insulin-like growth factors which further advances the decrease of weight. The body is then able to better rid itself of free radicals and influence prostaglandin levels. The accumulation of these results has shown
a significant 12-14% decline in colon cancer and 6-7% declines in rectal cancer 
(Slattery, M.L., 2004).

There are many differences between men and women and the obstacles 
that each sex has to encounter when fighting a battle or recovering from cancer. 
In 2004, another study comparing the effects of exercise and ovarian cancer was 
completed. Physical activity reduces the amount of fat one has, which decreases 
the frequency of ovulation and the amount of inflammation in chronically 
diseased patients. Subjects were discovered through the Breast Cancer Detection 
Demonstration Project and given a questionnaire surveying their activity levels. 
The numbers of potential risk factors were also evaluated and calculated on an 
individual level. The resulting factor showed the probability of an inverse 
relationship between being diagnosed with cancer and the amount of exercise 
incorporated on a daily basis (Hannan, L.M., Leitzmann, M.F., Lacey, J.V., 

A similar study was conducted with the male population and a gender 
specific cancer that is very common. Prostate cancer is a cancer that affects many 
men in their older ages. It is the leading cause of mortality and morbidity of 
cancer in men. Similar to the effects of exercise on ovarian cancer, a decrease in 
obesity or fat is beneficial to an individual. The decrease in excess fat is 
associated with a decrease in hormone levels, oxidative stress levels, and free 
radicals circulating in the body, with a secondary enhancement in immune 
system function. Thus, deeming exercise as a very important preventative 
measure of prostate cancer (Torti, D.C. & Matheson, G.O., 2004). The better 
controlled the hormonal regulation and quantity of free toxic radicals in the body,
the less risk a prostate cancer will chance to emerge.

**Bone Density and Exercise**

Loss of bone density is an ever increasing issue in our society today. Osteopenia is rising steadily, especially in women. Sedentary habits, lack of proper nutrition and strengthening activities are the leading causes of osteopenia. Osteopenia is the reduction in bone density, without normal bone re-absorption that leads to osteoporosis. Osteoporosis is the chronic response of continued osteopenic condition. Decreased bone mass and density, fragility, and enlarged bone spaces define the state of osteoporosis.

Studies have shown that bone density in individuals is at maximum peak values between the ages of 20-30 years of age. The stress and torque experienced by the bones during exercise and resistance training enables the bone and musculature to breakdown minimally. This breakdown causes osteoblasts to form new bone where the breakdown had taken place. This deposition of new bone will act to strengthen the bone and increase bone density, thus decreasing the risk for fractures and broken bones. Exercise and resistance training will also aid an individual to gain endurance, balance, and coordination.

When a 24 week program of high impact aerobic activity was incorporated into a daily routine for post-menopausal women, positive statistical correlations were discovered. The activity included walking on a treadmill at an intensity of over 70% of their individual VO2max for 30 minutes, followed by a stepping machine for 10 minutes. The physical characteristics that were compared pre- and post-exercise were quadriceps strength, muscular endurance, and VO2max
(Torti & Matheson, 2004). Bone mineral densities were evaluated through means of a DEXA scan at the level of the lumbar spine at L2-L4 and at the femoral head. The bone mineral density following the study showed significant improvement in the lumbar spine by 2.0% and the femoral head by 6.8% over the control, non-exercise group (Torti & Matheson, 2004).

The same types of studies have incorporated subjects with osteoarthritis (OA) and rheumatoid arthritis (RA). Strong evidence that exercise and activity is beneficial for arthritis patients is shown through the decrease in joint inflammation, increased stabilization of the joints through development in muscle strength and endurance, decreases in body fat, and maintenance of bone density. Subjects whom received patient education vs. subjects’ whom participated in an exercise regimen, showed significantly more disability and increased pain while performing daily activities (Effects on muscles, bones, and joints, 2002).

In subjects with RA, exercise and/or activity levels have also been carefully considered when evaluating the extent of the disease. In a long term study that was conducted, RA patients were followed throughout the course of their disease. Behaviors such as sedentary lifestyles were noted and compared to the possible complications that these subjects experienced at a later time. The majority of sedentary subjects, whom were diagnosed with RA, had increased occurrences of being at risk for osteoporosis and experiencing osteoporotic injuries (DeJong, Z., Munneke, M., Lems, W.F., Zwinderman, A.H., Kroon, H.M., Pauwels, E.K., Jansen, A., Ronday, K.H., Dijkmans, B.A., Breedveld, F.C., Vliet Vlieland, T.P., & Hazes, J.M., 2004).
In 2004, the Rheumatoid-Arthritis-Patients-In-Training program was completed. The program consisted of hundreds of volunteers with RA to be involved with either a controlled exercise group or a usual care therapy program which is recommended to every RA patient. Subjects’ bone mineral density in the hip and spine were measured and recorded pre- and post-study. The study was conducted over the course of a year, and results of the long term treatment showed significant improvement. The average rate of BMD in the exercise group was significantly increased when compared to the standard care therapy. The BMD was noted to be appreciably improved in the hip vs. the spine, and was associated which beneficial changes in muscle strength and aerobic endurance (DeJong et al., 2004). BMD is often associated with age. Basic anatomy teaches us that the majority of one’s muscle mass and bone strength peaks in one’s 2nd to 3rd generation. There are no ultimate reversible changes after one ages, yet incorporation of exercise, strengthening techniques, proper nutrition, and essential vitamin supplements will aid in maintaining proper BMD.

**Multiple Sclerosis and Exercise**

Symptoms are often unexpected and are sometimes initially unrecognized by medical professionals. Prolonged physical symptoms are experienced by the patient and cannot always be outwardly visible to others. Frustration and confusion can easily lead to psychological changes of the individual. Persons aware of the differences their bodies are experiencing are often reluctant to participate in any activities. A decrease in physical activity can lead to muscle weakness, soreness, and dysfunction. Physical decline can possibly further
exacerbate physical symptoms and increase the despair experienced by the individual. A vicious circle can hinder the affected person into a downward spiral, making it harder to take control of one’s body and state of mind. To better prepare one for the rollercoaster of events, all efforts should be made to encourage a positive outlook and an active, meaningful lifestyle.

Because musculature is often affected, it would seem ideal to incorporate a regular exercise routine in MS affected individuals. The lack of insight on this matter has resulted in my studies to compare the benefits of evaluating exercise and activity in persons with MS. The benefit from the addition of activity in the other diseases is inspiring.

As previously stated exercise and/or physical activity can benefit all persons, healthy or diseased. The chronic conditions that were mentioned and assessed above had multiple positive outcomes when an exercise program was initiated. The short and long term effects on these conditions have increased cardiovascular function, respiratory function, overall strength, benefited hormone function and sensitivity, episodes of fatigue, quality of life, coordination, balance, mobility, and cognitive function at the least.

The cause of MS has yet to be discovered. Less than 2 decades ago, medication management was not available and exercise was disputed and not advocated. Populations of MS patients lived life experiencing frequent exacerbations with little remission. Studies evaluating MS and various physical and medical protocols have lead to improving treatment and comfort of these individuals. Reducing the intensity and frequency of the symptoms experienced is the objective of therapeutic outcome. Until MS is understood in entirety,
various measures (i.e. exercise) will be taken to ease the disabilities experienced.

Exercise in MS patients has been a topic that has minimal long term studies to justify the correlating benefits. When instructing exercise or evaluating activity levels in MS subjects, many confounding factors have to be incorporated. MS is a disease that affects each individual at different times, with different intensities, at different frequencies. The ability to determine when your subjects will be experiencing an exacerbation or whether they will be symptom free when evaluation is taking place is an uncontrollable factor in one’s study. Factors such as various types of MS pattern characteristics are also features that have to be accounted for. Variability of disease makes comparison of patients difficult. Studies evaluating exercise and activity studies have been able to generally determine positive outcomes among all subjects involved, regardless of what type of MS pattern they experience, and whether or not they are currently experiencing exacerbations.

Several types of studies will be reviewed in the following text. The first type of study will be evaluating aerobic means of exercise and/or activity among the MS population. Aerobic methods via land exercises are common implementations by neurologists, practitioners, and patients. Being that musculature strength, balance, and coordination abilities are commonly affected and become diminished in MS patients, many exercise protocols are programmed to evaluate the progression of these capabilities.

For many years exercise has been discouraged in MS patients. Symptoms have been thought to worsen temporarily upon physical exercise. Activity should be increased in a structured manner, on an individual basis. No definitive
correlations have discovered between exacerbations at a specific temperature. Temperature regulation is thought to affect persons on an individual basis. Progression of activity should be through passive range of motion, active resistance, specific strengthening, and integrated strength training exercises (Petajan, J.H., Gappmaier, E., White, A.T., Spencer, M.K., Mino, L., & Hicks, R.W., 1996).

Muscle properties of strength, flexibility, coordination, endurance, and such are dependent solely upon the regularity in which the muscle is utilized, the intensity it is used at, and the duration of time it is used for. Loss of nerve conduction potential may progressively lead to muscle wasting secondary to disuse (Widmaier, Hershel, & Strang, 2004). The muscle fibers will experience decline in metabolic capacity and atrophy. With the incorporation of exercise, muscle fibers will hypertrophy in size and become better equipped to handle metabolic capacity needs. Capillaries in the surrounding areas also increase in number with exercise, providing more efficient means of transporting oxygen, resulting in improved endurance. Improvements in cardiovascular function and respiratory function with regard to exercise implementation, enhances the body’s ability to compensate the extra use of oxygen and energy molecules to fuel the muscles (Widmaier, Hershel, & Strang, 2004).

Specific types of exercise training are complementary to one’s desired outcome. Changes in muscular strength, endurance, or coordination are primarily dependent upon the various exercises one participates in. Gaining endurance and longevity requires aerobic activities such as walking, bicycling, swimming, jogging, and running. These exercises predominantly affect the
“slow-twitch” fibers in a given muscle. Anaerobic exercises consist of sprinting, strength training with increased weights, and rapid movements that affect the “fast-twitch” fibers in a given muscle. Overall, exercise of any type will better condition the muscles in the body, and produce enhanced strength and endurance to various degrees (Widmaier, Hershel, & Strang, 2004).

MS patients are often guided to partake in specific exercises enhancing the possible amount of functional loss experienced. The optimal plan would be to incorporate exercises and/or activities that consist of replenishing the lost function and ability. MS patients are frequently advised to participate in aerobic activities. Aerobic exercises consist of more frequent repetitions at lower or decreased intensities. This allows the individual to gain endurance through the repetitive nature at a speed that requires minimal to moderate effort. The positive effect that lower intensities have upon MS patients allows them to control their internal temperatures. Exacerbations in MS patients have been correlated with increased internal temperatures. Strength training however is not forbidden in MS subjects. Recommendations to becoming physically aware of proprioception should be communicated when training occurs. Both types of exercises will be evaluated in order to demonstrate the various beneficial effects that exercise has on MS patients.

**The Benefits of Aerobic Exercise on Multiple Sclerosis**

The pathophysiology concept of MS is characterized by fatigue, motor weakness, spasticity, poor balance, heat sensitivity, and mental depression. Commonly these symptoms are correlated with development of secondary
diseases due to lack of physical activity. Typically, protocols involving cardiorespiratory fitness, muscle strength and mobility are observed to determine possible improved quality of life (White, L.J. & Dressendorfer, RH., 2004).

Improved quality of life has also been shown to improve psychological status along with the obvious physical benefits of exercise. Thirty minutes of minimal exercise only 3 times a week was as effective as medication in mild to moderately depressed persons with MS, even reducing the risk of relapsing (Exercise on other conditions, 2004).

Personal satisfaction with one’s condition and physical abilities are two important variables in assessing MS. A validated quality of life survey has been created specifically for MS patients, and is often used to evaluate certain subject matter pertaining to physical and mental concerns. A study that was conducted in 2001 compared the psychological aspect on personal health and exercise behaviors between MS patients and non-affected persons. Participants completed the Multiple Sclerosis Quality of Life Inventory survey (MSQLI) and the relationship between exercise and psychological well-being were studied. In the non-MS affected persons, a strong correlation was made between a decrease in depression and emotion-based coping with an increase in exercise. In the MS subjects, an inverse correlation was made between hopelessness and emotion-based coping decreasing with an increase in exercise. Psychological well-being is positively affected with the incorporation of an active lifestyle (Kasser, S.L. & Stuart, M.E., 2001).

Simple and basic fundamentals of movement are often overlooked, but are essential for determining the potential one has to complete daily activities. The
fundamentals are the building blocks in which we are able to become more efficient at carrying out physical behaviors. The elemental techniques for increasing flexibility, endurance, and strength in part depend upon muscle fibers that are warmed up and stretched to capacity. Stretching techniques allow muscle fibers to increase their potential for contractility by vasodilating surrounding small diameter blood vessels in multiunit skeletal muscles. The single-unit smooth muscles in the lungs, large vessels, and skin are not directly affected by stretching techniques, but are advantaged by the benefits resulting from the small changes within the single-unit smooth muscles (Kumar, Cotran, & Robbins, 2003). In a study completed in 2003, a short term 8 week program was regimented amongst MS patients to discover if any benefits resulted from simple stretching, balancing, and aerobic strengthening activities. An exercise group actively participated in individualized aerobic exercises based upon their fitness and function levels. Participants who completed this study showed significant improvements in gaining musculature strength, attaining balance and coordination, decreasing fatigue, and increasing motility along with benefiting personal enjoyment (Hale, L., Schou, E., Piggot, J., Littman, A., & Tumilty, S., 2003).

Fatigue or lethargy is a common symptom that is often reported by as many as one-third of all MS patients. It is a condition that is correlated with motor disturbances and mood disorders. One study suggested that effective management strategies include exercise therapy to reduce the onset of fatigue. Measurements included the Fatigue Index Scale, the Tempelaar Social Experience Check-list (SET) and the Beck Depression Inventory (BDI) to
conclude reduced total fatigue at the conclusion of this survey (Patti, F., Ciancio, M.R., Reggio, E., Lopes, R., Palermo, F., Cacopardo, M., & Reggio, A., 2002). These reviews suggest an improved quality and outlook on life can begin with a minimal incorporation of an exercise program.

A study conducted in 2001, evaluated an aerobic exercise training program involving MS patients with concentration on improving of quality of life. The study showed that overall the group had increased energy and vigor, better social and sexual functioning, less pain and fatigue than the controlled group (Sutherland, Anderson, & Stoove, 2001). The positive changes that exercise has on the body and state of mind can determine the outlook and effort made to limit the disease process, physically and mentally.

Improvements in aerobic capacity and function create secondary gains in maintaining a healthy lifestyle without the threat of other chronic diseases. Since aerobic capacity increases with regular activity, an analysis comparing two aerobic fitness plans was completed to evaluate what potential benefits. Physical therapists designed an exercise intervention program for each MS participant involved. Instruction on proper exercise techniques to increase maximal aerobic capacity was given to each participant. Participants monitored their own heart rates over a 3-month period of completing their unique programs. Subjects were also advised to modify their intensity if their physical conditions allowed. MS patients were re-evaluated at the conclusion of the study and not only did they show improvement in the quantitative measures, but also in qualitative aspects. Progressive diseases like MS can therefore benefit through specialized and direct individualized care. Substantial gains in self-assurance and in physical ability
and health suggest enhancement in patient care and prevention of disability (Kirsch, N.R., & Myslinski, M.J., 1999). A similar study also evaluated similar concepts, and included measurements of skin folds and blood lipid levels. A decrease in these parameters reduces the risks of further chronic diseases such as obesity, diabetes mellitus, CAD, CVD, and stroke. The evidence was conclusive that exercise had positively impacted these factors related to quality of life (Petajan et al., 1996).

Walking can be affected in patients with MS. Sensory function abnormalities, skeletal muscle weakness, increased spasticity, reduction in aerobic capacity, and gait ataxia all contribute to physical impairment. A 6-month exercise study that was designed to spotlight aerobic conditions, with focus on any changes in gait irregularities. Individuals were evaluated through their individual passive range of motion (PROM) of their lower extremities before and after exercise training. The differences were recorded after the sessions were completed and showed increases in flexibility, as the hip PROM increased, total knee flexion/extension decreased, ankle dorsiflexion decreased, and ankle plantar flexion increased in significant degree. Changes in these measurements showed that even minimal intensity exercise programs prove to be advantageous to MS subjects (Rodgers, M.M., Mulcare, J.A., King, D.L., Mathews, T., Gupta, S.C., & Glaser, R.M., 1999).

MS affected persons commonly experience physical ailments that limit socialization. Daily activities that require moving, walking, and reaching are improved through aerobic exercise. Yet basic functions are frequently affected by MS, including control of bowel and bladder movements. Benefits of exercise
incorporation can help to improve bladder and bowel function as well. Vahtera, Haaranen, Viramo-Koskela, and Ruutianen determined that as little as 6 separate sessions of strengthening the pelvic floor muscles, lessened urinary incontinence and frequency. Men and women subjects with urinary dysfunction both benefited from the program, with men responding slightly better. Pelvic floor muscle exercises were recommended for each of the subjects for 6-months post-study. The compliance was 60% after the study and the other 40% of subjects ended the exercises secondary to the disappearance of urinary dysfunction (Vahtera, T., Haaranen, M., Viramo-Koskela., A.L., & Ruutianen, J., 1997).

**The Benefits of Aquatic Exercise and Multiple Sclerosis**

Besides land based aerobic activity, aquatic exercise has been widely recommended for MS patients. The incorporation of aquatic technique was designed with thermal regulation in mind. Exercise in the water can eliminate the fear of exertion leading to an increase in core body temperature. A regulated water temperature is often suggested to remain from the mid-to high 80 degrees Fahrenheit. In addition to the positive effects of maintaining internal temperature, water resistance can improve one’s overall condition. Water aerobics, regardless of the intensity, conditions an individual aerobically and with resistance properties. The resistance of the natural properties of water creates a force that is about 12 times the force experienced when walking on land. Therefore, a significant improvement in resistance training can be attained through water aerobics, while receiving the benefits of aerobic methods of
Quality of life is a common subject when considering MS. Aquatic exercise also improves the quality of life. A moderate length training program of 12 weeks included several individuals who were evaluated for aerobic, strength, balance, and flexibility characteristics. Quality of life assessments and fatigue index scales were measured before and after exercise. For those who completed even as little as 25% of the required sessions of water aerobic classes, considerable improvements in both the quality of life and the fatigue index scales were shown. Improvements in general health, energy levels, mental health, and social interactions along with the physical benefits were quite important qualities in those persons with MS (Roehers, T.G. & Karst, G.M., 2004).

Evaluation of resistance training effects in conjunction to water aerobics, are proven to be beneficial to MS patients. Resistance training is moderately more intense in nature and can result in more injuries experienced by the participant, if not completed correctly. Using the buoyancy and resistive properties of water, weights are not required, eliminating most of the reasoning behind land based resistance training in affected persons. Instruments that are more buoyant than water are used under the water or against the resistance of the current to provide force.

Underwater apparatus which require the strength of the individual to overcome the mechanism, plus the resistance of the water, can prove to promote musculature strength. Subjects used a dynamometer to measure peak torque, work, and fatigue in the lower extremities, primarily focusing on the knee flexor and extensor muscles. Upper extremities were exercised using a biokinetic swim
bench, and measured muscular force, work, fatigue, and power. Participants were involved in a lengthy program which was divided into three stages. Each stage involved 5 different intensities of resistance. Differences between the pre-trial stage and the mid-trial stage indicated large improvements in peak torque among the lower extremities. A significant decrease in fatigue was noted in the lower extremities between the pre-trial and post-trial stages. The upper extremity re-evaluation showed improvement in force measurements, power, and total work capability in each stage between the pre-trial and post-trial stages. Aquatic exercise and training can generate positive changes in muscular strength, fatigue, work capacity, and power in subjects that participate in these types of programs (Gehlsen, G.M., Grigsby, S.A., & Winant D.M., 1994).

**The Benefits of Resistance Training on Multiple Sclerosis**

Resistance training is a component of a physical exercise. The intensity, duration, frequency, and type of activity should determine the amount of resistance utilized (ACSM, 2000). Contrary to aerobic methods of exercise, resistance training is not the primary recommendation for increasing VO2max. Resistance training facilitates more direct increases in musculature strength and endurance, decreases or maintains fat mass, and closely relates with the ability to perform activities of daily living. When advising weight training, considerations should be made prior to an exercise program. Overweight and non-experienced participants might be more prone to sustaining injury while associated with high-impact activities and weight training routines. MS affected populations should concentrate on training their most disabled musculature systems in order to gain
the best results. Methods to improving one’s ultimate muscular strength and endurance are specific to the musculature involved in the exercises.

Home programs are designed for the convenience of the subject involved. They allow each subject to complete the series of activities at the most convenient time, in a familiar setting, and in a cost-effective manner. The risks of injuries, non-compliance, and substandard technique can be detrimental to the outcomes if the protocol is not followed completely. Despite this home activity regimens have proven to be more beneficial than hazardous, though caution is advised. A simple lower extremity resistance activity was incorporated three times a week during the course of a short-term program evaluating balance, power, and mobility. During the study, subjects sustained no injuries and were able to fully complete the program without assistance. Leg strength and power were significantly improved, over 30%, as compared to pre-testing. Balance and mobility were evaluated on a disability scale which showed minimal, non-significant increases after an 8-week program. (DeBolt, L.S. & McCubbin, J.A., 2004).

Resistance training often is interpreted as weight lifting against large amounts of mass. Training to increase muscle mass and functional ability are the most common outcomes of this regimen. With disease progression persons with MS are unable to participate in a weight program. These subjects may be bedridden or confined to wheelchairs. Rehabilitation under these circumstances is still possible. Respiratory function can be as important as any type of energy expenditure. Assessment of respiratory status in subjects with MS can predict specific quality of life issues. Series of contractions against expiratory resistance
is capable of reducing the needed energy and strength when breathing, improves
cough efficiency, and functional breathing status when measured (Gosselink, R.,
Kovacs, L., Ketelear, P., Caron, H., & Decramer, M., 2000). Gosselink et al.,
2000, conducted an analysis which showed these significant improvements, in
addition to creating a more desirable quality of life in those MS patients limited
by their disease state.
CHAPTER III: METHODS
Methodology

The National MS Society, Northwestern Ohio chapter, was contacted and agreed to allow invitation of their members to participate in this study. The study used de-identified data for all of the subjects involved. The study consisted of two surveys. The surveys were numbered and packaged and distributed to the volunteering group leaders involved. The first survey included informational questions concerning regular activity, attitude concerning activity, and specific activities. A general baseline for each individual was identified concerning exercise, perception of health, and symptoms experienced. The participants also completed the Multiple Sclerosis Quality of Life Inventory (MSQLI), evaluating physical, mental, and emotional aspects that can be affected by the disease course of MS.

The surveys were mailed to each group, the number of surveys were dependent upon the group population via the group leaders. Pre-paid envelopes for the return of the completed surveys were included in the mailing. To increase response rate, the group leaders were contacted frequently and reminded about the completion of the surveys. The surveys were compared to evaluate the differences in the amount of activity versus the perception of quality of life issues.

Survey delivery, collection, and interpretation was conducted via postal mail. All data was entered into an Excel spreadsheet and each question comparison was entered into the Sigma Stat program. This data was recorded as either significant or not significant.
CHAPTER IV: RESULTS

A 34% response rate was obtained, 42 out of the 125 surveys that were distributed were returned. The MS study questionnaire (see appendix 1) was first evaluated separate from the MSQLI. Comparisons were evaluated between two primary questions on the MS study questionnaire. For an overview of results refer to Table 1.

MS study questionnaire

Positive attitude
The perceived notion of a positive attitude throughout the day was compared with the perception of regular daily activity and the frequency of weekly activity. Positive attitudes are affected by an increase in perception (P=0.011) and participation (P=0.027) in regular activity.

Fatigue
Persons with MS with fatigue both perceived that they participated in less physical activity (P=0.001) and participated in less physical activity (P=0.011).

Stress, anxiety & worry
Persons with MS with increased levels of stress/anxiety/worry perceived that they participated in less physical activity (P=0.015) and participated in less physical activity (P=0.001).

Depressive episodes
Persons with MS with increased depressive episodes perceived that they participated in less physical activity (P=0.001) and participated in less physical activity (P=0.006).
Comparisons between the MS study questionnaire and MSQLI (see appendix 2) were made to evaluate specific aspects of health to acquire an overview of a complete quality of life assessment.

**Health Status Questionnaire (SF-36)**

*Overall health status*
Perception of increased regular activity by the MS study questionnaire was associated with a perception of good, very good, or excellent overall health status (P=0.006). Regular weekly physical activity is associated with a positive perceived outlook on overall health (P=0.019). We compared participation in either aerobic or anaerobic forms of exercise with perceived overall health, there were no significant improvements (P=0.917).

*Pain*
Persons with MS with pain both perceived that they participated in less physical activity (P=0.008) and participated in less physical activity (P=0.179).

*Energy*
Persons with MS with energy both perceived that they participated in more physical activity (P=0.027) and participated in more physical activity (P=0.023).

*General happiness*
Persons with MS with general happiness both perceived that they participated in more physical activity (P=0.001) and participated in more physical activity (0.001).

*Worn out & tired*
Persons with MS with feelings of being worn out and tired both perceived that they participated in less physical activity (P=0.004 and P=0.047) and participated in less physical activity (P=0.008 and P=0.047).

**Modified Fatigue Impact Scale (MFIS)**

**Motivation & ability**

In persons with MS with greater motivation and ability to accomplish daily activities both perceived that they participated in more physical activity (P=0.001) and participated in more physical activity (P=0.019).

**Exercise limitations**

Persons with MS with more exercise limitations both perceived that they participated in less physical activity (P=0.001) and participated in less physical activity (P=0.036).

**Medical outcomes study (MOS) Pain Effects Scale (PES)**

**Unpleasant sensory symptoms**

Persons with MS with unpleasant sensory symptoms perceived that with physical activity the symptoms would somewhat dissipate, and enjoyment of life would increase (P=0.001). In persons with MS with unpleasant sensory symptoms, physical activity did not show to lessen the sensory symptoms and therefore, did not increase the quality of life (P=0.61).
**Sexual satisfaction**

Persons with MS perceived that physical activity would not improve sexual satisfaction (P=0.056). Persons with MS that participated in physical activity showed significant improvements in their sexual satisfaction (P=0.046)

**Bladder Control Scale (BLCS)**

**Bladder control**

Persons with MS perceived that the more physical activity participated in would lead to a more non-restrictive lifestyle secondary to bladder control (P=0.08). Participation in more physical activity in persons with MS, lead to a less restrictive lifestyle secondary to bladder control was not found to be significant (P=0.17).

**Bowel Control Scale (BWCS)**

**Bowel Control**

Persons with MS that perceived that physical activity would not lead to a more non-restrictive lifestyle secondary to bowel restriction (P=0.666). Persons with MS that participated in physical activity had a non-restrictive lifestyle secondary to bowel control (P=0.009).

**Impact of Visual Impairment Scale (IVIS)**

**Read or access printed materials**
Persons with MS perceived that physical activity would benefit changes in vision (P=0.041). Participation in physical activity in persons with MS did not benefit vision positively (P=0.320).

**Perceived Deficits Questionnaire (PDQ)**

*Memory, ability to concentrate, & attentiveness*

Persons with MS perceived that physical activity would not positively affect memory, ability to concentrate, and attentiveness (P=0.80). Persons with MS that participated in physical activity improved memory, ability to concentrate, and attentiveness (P=0.015).

**Mental Health Inventory (MHI)**

*Emotional stability*

Persons with MS with emotional stability both perceived that they participated in more physical activity (P=0.010) and participated in more physical activity (P=0.046).

**Discussion**

This study examined the perception of pertinent quality of life issues upon the amount of regular activity an individual partakes in. Based upon the responses received from the two surveys, various aspects pertaining to quality of life were greatly improved through the incorporation of regular activity and/or exercise. The overall prevalence of the responses and results from this study are
encouraging and suggests that action as simple as participating in physical activity will yield beneficial option for MS patients. This is consistent with the hypothesis that activity in any form or intensity will be beneficial to persons with MS.

One significant result was the positive correlation between optimistic outlook on attitude, health, and happiness when incorporation of regular activity is included into one’s lifestyle. The amount of positive outlook on health and life was not dependent upon excessive activity. Minimal incorporation of activity proved to be just as beneficial to individuals who participate in regular exercise. This statistic corresponded to a study completed by Sutherland, G., Anderson, M., & Stoove, M., 2001 and study from Kasser, S.L. & Stuart, M.E., 2001. Conclusive statistics were drawn from these two studies which presented benefits correlating exercise and psychological well being, energy and vigor, social and sexual functioning, with decreases in hopelessness and depression, bodily pain, and fatigue.

There were various notable limitations in this study. One of the limitations in this study was that only 34% of the MS group members responded to these questionnaires. This limitation could have easily affected the resulting statistical values that were received. Further studies are warranted with larger populations of MS affected individuals not limited to the Northwestern Ohio Chapter of the National Multiple Sclerosis Society. This study was also limited to a specific population of MS individuals, who were more likely to be mobile. The volunteers were currently enrolled in actively participating groups, and were less likely to be severely diseased. Further studies would ideally involve subjects
whom are not active in supportive groups. Better correlation could have been made to specific groups if identifiable data was sought. Various answers could be categorized more effectively between clinical disease pattern, gender, race, and age brackets for example. Another large issue was the length of the MSQLI survey. In future studies, specific material will be isolated to determine the information required. This 30-45 minute survey was not completely utilized in this project. Future studies should also incorporate the addition of regular activity as it may have a significant result on specific quality of life issues.

**Conclusion**

The results of this study showed that the respondents involved with the Northwestern Ohio Chapter of the National Multiple Sclerosis Society are positively affected with an increase in regular activity.

A significantly more positive attitude was perceived and experienced with the incorporation of physical activity. A significant decrease in fatigue, stress/anxiety/worry, and depression were also perceived and noted with participation in physical activity according to the MS study questionnaire.

The Health Status Questionnaire (SF-36) showed significance in perceived and experienced overall health with the incorporation of regular exercise. Bodily pain was perceived to be benefited with physical activity, but was not significant when persons with MS participated in physical activity. Perceived and participation in physical activity significantly increased the energy level in persons with MS. Happiness, when perceived and participated physical activity
was incorporated, was significantly increased. The feeling of becoming worn out or tired, were decreased with the perception and participation of physical activity.

The Modified Fatigue Impact Scale (MFIS) significantly shown that the perception and participation in more frequent the physical activity level, the less limitation one has towards participating in physical activities.

Uncomfortable sensory symptoms caused by MS did not significantly show that physical activity can improve the quality of life. The perception of MS persons when incorporating physical activity was believed to change the quality of life in the MOS Pain Effects Scale.

The Sexual Satisfaction Scale (SSS) significantly showed the improved quality of sexual satisfaction with the incorporation of physical activity, although the perception of this data did not support this data.

The Bladder Control Scale (BLCS) showed that the perceived notion and participation of physical activity did not significantly show a decrease in the quality of life secondary to bladder control.

The Bowel Control Scale (BWCS) showed that the perception of physical activity was not significant to improving quality of life secondary to bowel function. Participation of physical activity was significant in improving the quality of life secondary to bowel function.

The Impact of Visual Impairment Scale (IVIS) showed that the perception of physical activity would significantly benefit vision. Participation in physical activity did not show significant improvement in benefiting vision.

The Perceived Deficits Questionnaire (PDQ) showed that the perception of physical activity to benefit concentration and attentiveness was not significant.
Participation in physical activity did show significant improvement in improving the ability to concentrate and be attentive.

The Mental Health Inventory (MHI) showed that both the perception and participation of physical activity improved the degree of emotional stability.

There were no significant differences when aerobic means of activity were compared with anaerobic means of activity.

These results are important not only to the physician assistant profession, but the entire health care profession. It is imperative to know higher percentages of the health care population do not exercise even when the adverse effects are known. As physician assistants, we can encourage not only the MS affected patient to start an exercise program, but our patient population and colleagues in the health care field. This may make it easier to convince MS affected patients that exercising is beneficial in many more ways than one.
Reference List


M. Keck. (2004). Personal communication, class notes.


Multiple Sclerosis Study Questionnaire

1. I frequently have a positive attitude throughout the day...
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree

2. I frequently feel optimistic about my physical capabilities...
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree

3. I frequently feel optimistic towards the defeat of Multiple Sclerosis...
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree

4. I frequently experience flare-ups due to MS...
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree

5. I experience flare-ups...
   o Have not had a flare-up for over a year
   o At least once a day
   o At least once a week
   o At least once a month
   o At least once a year

6. I am excited to volunteer in this study...
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree
7. I feel that exercise/activity is important for me to be healthy...
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

8. I feel good about my current physical wellness and activity level...
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

9. I frequently exercise or am active on a weekly basis...
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

10. I currently exercise or am active...
    - Not at all
    - 1-2 days during the week
    - 3-4 days during the week
    - 5-6 days during the week
    - Every day of the week

11. If/When I exercise it is primarily
    - Aerobic (walking, bicycling, swimming, jogging, yoga...)
    - Anaerobic (weight lifting, sprinting...)
    - Some of both
    - None at all

12. I frequently feel mentally fatigued...
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

IRB# 104955
13. I frequently experience stress, anxiety, and/or worry...
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

14. I frequently experience depression...
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

15. I feel that routine exercise/activity will be beneficial towards my daily activities of life (dishes, laundry, job, gardening, driving...)
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

16. I would be interested in becoming more involved in activities or exercise programs...
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree

17. I receive positive support and encouragement from family, friends, medical personnel, and group leaders of the MS chapters...
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
Dear Group Leaders,

My name is Kalika Stavroulakis, and I am currently enrolled at the Medical University of Ohio at Toledo in the Physician Assistant program. A requirement of completion of the program involves a scholarly project, similar to a thesis paper. I have chosen to focus my study on Multiple Sclerosis and exercise. My intent is to discover if there is a change in attitude pertaining to life happiness, outlook on their diagnosis, and the future of MS with incorporation of a minimal exercise program.

I have received awareness of your groups through the Northwest MS Society office. I have been meeting with Tonya Partin and Erin Goff since the summer. I am asking for your permission to attend one meeting that you conduct throughout the year. I will require all of the willing volunteers to completely fill out two questionnaire forms. Both of these questionnaires will be confidential and no personal identification will be required. I would be available for any questions or comments from either the group leaders or the volunteers. The surveys will incorporate questions pertaining to each individual’s health and enquire about the amount of activity in a typical day.

I understand how important these group meetings are to you and your groups, and would not like to be a burden of any kind. I am very dedicated to the study of MS and the advancements that we have already made toward fighting this disease. It would be an honor if this study could be completed with your help. I hope that you inform me if you and your group are willing! Please send me a written statement acknowledging your willingness to let me approach your group members concerning this study, and that you are aware of this study’s intentions and purpose in correlating the benefits of activity in the Multiple Sclerosis population.

This is just a starting point for me in helping MS. I would be so grateful! My contact card is attached feel free to use it at any time. Thank you and hope to hear from all of you soon!

With Thanks and Appreciation,

Kalika Stavroulakis, PAS-II, R.K.T.

IRB# 104955
Dear Participant,

Thank you for voluntarily participating in this study intended to advance the knowledge that we have concerning MS. New knowledge is discovered everyday, and this is a chance for you to be a part of something great!

You have agreed to participate in completing in entirety 2 separate questionnaires. The surveys consist of questions pertaining to your health, physically and emotionally. Questions concerning the amount of activity in your life will be focused on with a little more attention. At completion of the survey you will be required to place your surveys into a file folder, which will eliminate any possibility of identifying specific individuals. Please do not hesitate to discuss any concerns or questions that you may have about the surveys with me! I would be more than happy to help in any way possible!

If you feel at any time throughout these 2 surveys that you would not like to continue for any reason, please understand that you are able. You have been a great help. Please understand that all information I collect from you will be entered at the time of receiving.

If you have any questions at all, please feel free to ask either your group leaders or I. My contact card is attached for your convenience. Please use it if you would need to. Again, thank you for participating in this study. Your help will contribute to advancing the knowledge that we have about MS!

With All of my Appreciation and Best Wishes,

Kalika Stavroulakis, PAS-II, R.K.T.
Table 1.

### MS study questionnaire

<table>
<thead>
<tr>
<th>Positive attitude</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td>Significant</td>
<td>Significant</td>
</tr>
<tr>
<td>Stress, anxiety, &amp; worry</td>
<td>Significant</td>
<td>Significant</td>
</tr>
<tr>
<td>Depression</td>
<td>Significant</td>
<td>Significant</td>
</tr>
</tbody>
</table>

**MS study questionnaire vs. MSQLI**

### Health Status Questionnaire

<table>
<thead>
<tr>
<th>Overall health status</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Significant</td>
<td>Significant</td>
</tr>
<tr>
<td>Energy</td>
<td>Significant</td>
<td>Significant</td>
</tr>
<tr>
<td>General happiness</td>
<td>Significant</td>
<td>Significant</td>
</tr>
<tr>
<td>Worn out &amp; tired</td>
<td>Significant</td>
<td>Significant</td>
</tr>
</tbody>
</table>

### Modified Fatigue Index Scale

<table>
<thead>
<tr>
<th>Motivation &amp; ability</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise limitations</td>
<td>Significant</td>
<td>Significant</td>
</tr>
</tbody>
</table>

### MOS Pain Effects Scale

<table>
<thead>
<tr>
<th>Unpleasant sensory symptoms</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Significant</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

### Sexual Satisfaction Scale

<table>
<thead>
<tr>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sexual satisfaction</td>
<td>Perceived physical activity</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Not significant</td>
<td>Significant</td>
</tr>
</tbody>
</table>

**Bladder Control Scale**

<table>
<thead>
<tr>
<th>Bladder control</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant</td>
<td>Not significant</td>
<td></td>
</tr>
</tbody>
</table>

**Bowel Control Scale**

<table>
<thead>
<tr>
<th>Bowel control</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not significant</td>
<td>Significant</td>
<td></td>
</tr>
</tbody>
</table>

**Impact of visual impairment scale**

<table>
<thead>
<tr>
<th>Read/Access printed material</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant</td>
<td>Not significant</td>
<td></td>
</tr>
</tbody>
</table>

**Perceived Deficits Questionnaire**

<table>
<thead>
<tr>
<th>Memory, ability to concentrate, &amp; attentiveness</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not significant</td>
<td>Significant</td>
<td></td>
</tr>
</tbody>
</table>

**Mental health inventory**

<table>
<thead>
<tr>
<th>Emotional stability</th>
<th>Perceived physical activity</th>
<th>Participation in physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant</td>
<td>Significant</td>
<td></td>
</tr>
</tbody>
</table>
The Multiple Sclerosis Quality of Life Inventory (MSQLI) validated survey is attached in PDF format. The actual survey that was used is contained on pages 43-65.
Quality of life differences in multiple sclerosis patients, determined by the amount of regular physical activity.

Kalika Stavroulakis
Dr. Boyd Koffman
Title:

Quality of life differences in multiple sclerosis (MS) patients, determined by the amount of regular physical activity experienced

Abstract:

OBJECTIVE: Research on the effects of exercise on MS is limited. The Multiple Sclerosis Quality of Life Index (MSQLI) and a questionnaire regarding physical activity were distributed to members of the local Multiple Sclerosis Society. Evaluation of effects of exercise on overall health, were assessed. METHODS: Subjects diagnosed with MS were targeted and completed two questionnaires. Responses to general health and quality of life were compared to time of activity involved. No identifiable date was asked for. RESULTS: Forty-three (34%) of 125 volunteers responded. Comparison between quality of life and regular activity showed increased positive attitude, happiness, motivation for daily activities, sexual satisfaction, memory, concentration, attentiveness, emotional stability. Decreased fatigue, stress, anxiety, worry, depression, tiredness, bowel restrictions, and paresthesias were noted in the group with regular physical activity. CONCLUSION: The perceived and physical benefits of regular activity impact favorably on health and quality of life issues in MS patients.