Running Head: EXERCISE AND MULTIPLE SCLEROSIS

Long-term exercise in multiple sclerosis: Consequences for symptoms and emotions.

Adam A Augustine

Randy J. Larsen

Washington University in St. Louis

Daryl Kucera

Fast Forward, LLC.

Word Count: 4,906 (Abstract: 198)

Keywords: multiple sclerosis, exercise, depression, symptom severity, affectivity

Adam A Augustine

Washington University in St. Louis

Campus Box 1125, Dept. of Psychology

One Brookings Drive

St. Louis, MO, 63130-4899

Phone: (314) 935-0475

Fax: (314) 935-7588

aaaugust@artsci.wustl.edu

Abstract

Objective: To investigate the impact of long-term engagement in a resistance training program on depression and symptom levels in individuals with multiple sclerosis.

Methods: Multiple sclerosis patients already engaged in a resistance training program completed measures of depression, affectivity, and symptoms. Relationships between time in program and these outcome variables (controlling other illness level data) were then examined.

Results: Those who had engaged in the exercise program for a longer period of time showed lower levels of depression ($r = -.36$, $p < .05$), higher levels of positive affect ($r = .32$, $p < .05$), and a generally more positive affective profile ($r = .32$, $p < .05$). These results held even when controlling illness level data (depression: $r = -.34$, $p < .05$; positive affect: $r = .30$, $p < .06$; general affect: $r = .29$, $p < .07$). In addition, no relationship was observed between symptom levels and time in program ($r = -.04$, *ns*).

Conclusions: Exercise has the same impacts on multiple sclerosis patients as it does on healthy individuals. It effectively treats depression and, perhaps due to the increased brain plasticity associated with exercise, can stave off the progression of symptoms in multiple sclerosis.

Long-term exercise in multiple sclerosis: Consequences for symptoms and emotions.

Multiple sclerosis is a chronic neurological disorder associated with demyelination of neurons in the central nervous system. The loss of myelin surrounding neuronal axons leads to a degradation of neuronal impulse transmission. This wide-spread impairment of neuronal impulse transmission leads to a host of sensory, movement, equilibrium, digestive, and cognitive symptoms (Walker, 1982). One would expect that a severe chronic illness with such a plethora of disruptive symptoms would impair psychological well-being. However, levels of psychological well-being vary widely between multiple sclerosis patients. In addition, illness level variance does not adequately explain psychological well-being (Pakenham, 1999; VanderPlate, 1984). Although a number of studies have found that increased illness severity is associated with decreased psychological well-being (Wineman, 1990; Devins, Seland, Klein, Edworthy, & Saary, 1993), others have observed no relationship (Devins, Styra, O'Connor, Gray, Seland, Klein, & Shapiro, 1996; Pakenham, Stewart, & Rogers, 1997) or a relationship in the opposite direction (Mclvor, Riklan, & Reznikoff, 1984). Similarly, observed relationships between psychological well-being and length of time since diagnosis have been inconsistent at best, with some studies finding no relationship (Rudick, Miller, Clough, Gragg, & Farmer, 1992) and others finding that longer time since diagnosis is associated with better adjustment (Pakenham, et al., 1997). Essentially, psychological well-being in multiple sclerosis patients is not dependent on illness level variance. While some individuals with multiple sclerosis successfully adapt to their illness, others experience psychological distress as a result of their

experience with the disorder (Fournier et al., 2002). This begs the question, how does one successfully adapt to multple sclerosis? The purpose of the current study is to examine exercise as a possible mechanism for successful adaptation to the affective (i.e. emotion and mood-level) consequences of multiple sclerosis.

Multiple Sclerosis and Affectivity

Although illness-level variance may not adequately explain psychological well-being among those with multiple sclerosis, group differences have been consistently observed in affectivity. Those with mutlple sclerosis experience an affective profile associated with illness in the general population. The experience of a negative affective profile (many negative and few positive emotions) has been consistently linked to poor health and lower quality of life in healthy populations (Dougall & Baumm, 2001; Suinn, 2001). Longer lasting positive affect is associated with higher life satisfaction while longer lasting negative affect is associated with lower life satisfaction (Shimmack, Oishi, Furr, & Funder, 2004). Additionally, the frequency of negative affect predicts overall happiness and subjective well-being, with those experiencing more frequent negative affect reporting the lowest happiness and subjective well-being (Diener, Sandvik, & Pavot, 1991). Frequent and intense negative affect also damages the immune and cardiovascular systems (Dougall & Baum, 2001; Suinn, 2001). On the other hand, the experience of positive affect leads to improvements in health and quality of life. The broaden-and-build model (Fredrickson, 1998) proposes that positive affect facilitates the building of various resources that promote healthy functioning, and findings reveal that positive affect speeds physiological recovery from negative affect (Tugade & Fredrickson, 2004) and predicts

longevity (Danner, Snowdon, & Friesen, 2001). The findings linking affect to health and well-being hold particular relevance for those individuals with multiple sclerosis.

Individuals with multiple sclerosis experience generally negative affective profiles (Devins & Seland, 1987; McCabe, 2005). In addition to higher non-clinical levels of negative affect, multiple sclerosis patients also show a much higher prevalance of depression (lifetime prevalance 37-54%) than the general population and even patients suffering from other neurological illnesses (Minden & Schiffer, 1990; Minden & Schiffer, 1991). Multiple sclerosis patients also report lower perceived quality of life than the general population (McCabe & McKern, 2002). Indeed, the experience of negative affect is the most common psychological consequence of multiple sclerosis (Rao et al., 1992). This heightened experience of negative affect and depression is also thought to be partially responsible for the memory and attentional deficits associated with multiple sclerosis (Arnett et al., 1999). Although demyelination itself may be partially responsible for the experience of negative affective states in multiple sclerosis (Devins & Seland, 1987), depression levels are also partially explained by fatigue and symptom severity (Voss, Arnett, Higginson, Randolph, Campos, & Dyck, 2002). Evidence for the symptom – affect link is strong, with affect and symptom levels covarying across time such that periods of increased symptoms are associated with higher levels of negative and lower levels of positive affect (Gatten, Brookings, & Bolton, 1993).

Thus, the affective profile of the multiple sclerosis patient is a generally negative one. To improve quality of life in multiple sclerosis patients, some type of intervention is required to reduce depression and break the symptom-affect link. Exercise offers a potential method for alleviating these affective (and other) symptoms.

Exercise and Multiple Sclerosis

Those with multiple sclerosis have long been discouraged from engaging in exercise and vigorous physical activity in general. Increased body temperatures and fatigue levels following exercise have thought to increase both symptom levels and negative affect in those with multiple sclerosis (Voss, Arnett, Higginson, Randolph, Campos, & Dyck, 2002). In other words, exercise is thought to spark a chain of negative consequences: exercise leads to fatigue, fatigue leads to depression, and depression leads to higher symptoms and lesser cognitive abilities. This idea is unfortunate. It is well known that exercise has myriad physical and psychological benefits in healthy populations. Moderate exercise (i.e. taking a brief walk; Thayer, 1987; Ekkekakis, Hall, VanLanduyt, & Petruzello, 2000) leads to affective benefits, with increases in positive and decreases in negative affect following exercise. Consistent exercise is also an effective treatment for a host of psychological disorders (i.e. depression, anxiety, schizophrenia, and drug dependence; Thachuk & Martin, 1999). As a treatment for mild to moderate depression, exercise is as effective as antidepressant medications (Thachuk & Martin, 1999; Sjosten & Kivela, 2006; Callahan, 2004). Exercise is also beneficial for brain development and repair; exercise increases brain plasticity which improves neural regeneration after damage (Ploughman, Attwood, White, Dore, & Corbett, 2007). With the ability to treat, in healthy populations, both the psychological (i.e. depression) and biological (i.e. neural degradation) symptoms associated with multiple sclerosis, exercise should be beneficial for those with multiple sclerosis. Recent evidence suggests that this may be the case.

Those who engage in resistant (DeBolt & McCubbin, 2004), endurance (Svensson, Gerdle, & Elert, 1993; Mount & Stacko, 2006), or aquatic (Gehlsen, Grigsby, & Winant, 1984)

exercise show improved balance, muscle strength, and an increased ability to move on their own accord (i.e. without a wheel-chair; Kraft, Alquist, Lateur, 1995). In addition, merely engaging in more physical activity is associated with increased confidence and fewer limitations (Motl, McAuley, & Snook, 2007). Preliminary evidence also suggests that aerobic exercise may reduce symptom levels (Kileff & Ashburn, 2005). Unfortunately, the majority of studies exploring the impact of exercise on multiple sclerosis have used relatively small samples (DeBolt, McCubbin, & Gappmaier, 2004). Despite the low sample sizes associated with these preliminary results, the extant literature seems to suggest that exercise increases mobility and decreases symptoms among those with multiple sclerosis. With such improvements in functioning, coupled with the likely independent effects of exercise on depression, multiple sclerosis patients engaging in exercise should also show improved affective profiles.

The Current Study

It has long been thought that exercise would be detrimental to those with multiple sclerosis. The increased fatigue and body temperatures associated with exercise should lead to increased symptoms and higher levels of depression in this population already at extreme risk for depression. However, evidence in healthy populations suggests that exercise should improve the affective lives and possibly stimulate neural generation in those with multiple sclerosis. Indeed, some preliminary evidence suggests that exercise improves mobility and symptom levels in multiple sclerosis. Unfortunately, these studies generally involve low sample sizes, short (a few weeks) exercise programs, and do not investigate the impact of exercise on depression and affectivity. The current study seeks to address these gaps by examining the long-term impacts of exercise on the symptoms and affectivity of a relatively large group of individuals with multiple

sclerosis. Multiple sclerosis patients already engaged in a long-term exercise program filled out a variety of questionnaires to assess their symptoms and affectivity.

In healthy populations, exercise is a long-term process, with definitive results coming only after a long period of hard work. This should also be the case in multiple sclerosis patients. As such, the impact of exercise is assessed by using the length of time an individual has been engaged in the program is used to predict symptoms and affect. Several steps are taken to ensure that any observed effects are not due to the characteristics of those individuals who engaged in the program for a longer period of time. First, illness stage, age, and age of diagnosis are controlled in the analyses. This will remove the impacts of illness severity and length of illness from the observed effects. Second, an analysis of program attrition will be carried out to determine the reasons for program dropout and their potential impact on our conclusions.

We hypothesize that engagement in a resistance training program will lead to improvements in both the symptoms and affective profiles of multiple sclerosis patients. The current study has three key strengths that will allow an examination of this hypothesis. First, a large sample of multiple sclerosis patients is used. Second, participants in this study have engage in the exercise program for a long period of time. Finally, important disease level information is controlled and attrition data is examined.

Methods

Participants

All participants were drawn from an exercise center in a large Midwestern city. All participants were engaged in the exercise program prior to being recruited for the study. A total of 43 participants completed the study (see Table 1 for participant characteristics).

Materials

Demographics

A number of items assessed demographic and relevant illness-level information including: age, gender, income, race, marital status, employment status, age diagnosed, disease stage, relapse rate, and length of time in program (in months).

Symptoms

Current symptom levels were assessed using a written version of the Guy's Neurological Disability Scale (Sharrack & Hughes, 1999; Fraser & McGurl, 2007). This scale consists of twelve subscales which assess specific classifications of common multiple sclerosis symptoms: cognitive, mood, visual, speech, swallowing, upper body, lower body, bladder, bowel, sexual, fatigue, and non-classified symtpoms. For the purposes of this study, a total score was calculated for each participant which, given our focus on depression and affectivity, excluded the mood subscale (M = 19.44, SD = 7.26, α = .83).

Depression

Depressive symptoms were assessed using the depression subscale of the Symptom Checklist 90 (Derogatis, 1994). The Symptom Checklist 90 assesses the impact of a number of depressive symptoms over the previous year using a 5-point, not at all distressed – very frequently distressed, Likert-type scale (M = 20.85, SD = 16.08, α = .94).

Affectivity

Non-depressive levels of affectivity were assessed using the Fordyce Emotions Questionnaire (Fordyce, 1988) and the Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985). The Fordyce Emotions Questionnaire assesses general affectivity using a single

9-point, extremely unhappy – very happy, Likert-type scale (M = 6.02, SD = 2.45), and assesses specific levels of positive (M = 53.70, SD = 26.45), negative (M = 24.18, SD = 23.13), and neutral (M = 22.11, SD = 16.19) affect by asking participants to estimate the amount of time they typically experience each class of emotions. The Satisfaction with Life Scale assesses general life satisfaction using a 6-point, strong disagreement – strong agreement, Likert-type scale (M = 18.38, SD = 6.33, α = .90).

Procedure

Participants were recruited in person during their regular exercise sessions. Participants were given information about the purposes of the study and then given all materials to complete on their own time. After completing all materials, the questionnaires were returned to the investigators via mail.

Exercise Program

The exercise program in which participants were enrolled consisted of basic weight resistance training utilizing free weights (e.g. dumbbells), machines (e.g. triceps pushdown), and bodyweight resistance (e.g. modified pushups, Pilates techniques). Individuals attended exercise sessions as often as was possible for each person (usually three times weekly), sessions were one hour in duration, and as many exercises as were possible were completed in each session (each exercise generally consisting of three sets of ten repetitions). The exercise program used by these MS patients deviated from standard weight training regimes in only four aspects: (1) lower weight and less resistance was utilized, (2) individuals were assisted (when needed) in moving from station to station, or with positioning their bodies for a particular exercise, (3) special equipment was in place to allow wheelchair-bound individuals to engage in lower-body exercise

(i.e. machines that allow one to stand with very little strain placed on the legs), and (4) all individuals in the exercise program and at each training session had been diagnosed with some form of neuromuscular disorder, allowing for a slower pace of exercise and additional consideration of physical limitations on days of increased symptom severity.

Results

Relationships between time in the exercise program and the measured outcome variables (see Table 2) generally indicate that those who had engaged in the exercise program for longer periods of time were significantly higher in their general affectivity and levels of positive affects, and lower in their depressive symptoms. Although non-significant due to the low sample size, meaningfully large effect sizes were also obtained for neutral and non-clinical negative affect as well as satisfaction with life, such that those who had participated in the program longer experienced lower levels of neutral and negative affective states and were more satisfied with their lives. When illness stage and other available temporal variable (age and age diagnosed) was entered as covariates, the same general pattern of results emerged. Depression was significantly and negatively associated with time in the exercise program. Due to the small sample size, the remaining effect sizes that were significant prior to including the covariates were reduced to marginal significance (although these effect sizes were still quite large). In both sets of analyses, no relationship (i.e. 0.0) was observed between symptom levels and time in the exercise program.

To examine any biases in the sample used for this study, an examination of the attrition records for the life of the program was conducted (see Table 3). Attrition data gathered to date indicates that, the vast majority of individuals are either still engaged in the exercise program or

left for a reason not related to a worsening of their MS symptoms. Although potential biases still exist, these data tentatively indicate that any biases remaining should not overtly influence the data gathered for this study.

Discussion

In this study, multiple sclerosis patients that were engaged in a long-term resistance training exercise program completed measures of their symptoms and affectivity. Results indicate that, consistent with our hypotheses, those individuals that had engaged in the exercise program for a longer period of time showed lower levels of depression, higher levels of positive affect, and generally more positive affective profile. These relationships held even when controlling illness stage, age, and age of diagnosis. Thus, the positive impacts of exercise on affect that are observed in healthy populations seem to hold for those with multiple sclerosis as well. Consistent with research demonstrating the efficacy of exercise as a treatment for depression (Thachuk & Martin, 1999), multiple sclerosis patients who engage in exercise show fewer symptoms of this clinical affective disorder, as well as higher levels of positive affect. Results also indicate no relationship between time in program and symptom levels (and this result held when controlling illness-level data). While this may seem to indicate that the program had no impact on symptoms, one must keep in mind the length of time that individuals were engaged in the program. The mean length of engagement for this sample was just under two years. In such a long period of time, one would reasonably expect symptoms to worsen, however this natural trajectory of illness severity was not observed in this population. Thus, at best, consistent exercise may stave off the progression of multiple sclerosis. At worst (and this

outcome is still beneficial), the exercise program is not having a detrimental effect on symptom severity.

Both long-standing beliefs and natural patterns of disease progression over time suggest that patients who had been exercising for a longer period of time should have been more depressed, less happy, and should have manifested more severe symptoms. With increased fatigue and body temperatures, these individuals should have exhibited higher levels of depression. With these higher levels of depression, the exertion involved in exercise, and the natural progression of the disease, those individuals should have exhibited more severe symptoms. Not only do our results fail to show these patterns, they indicate the opposite effect. Those individuals who exercised for a longer period of time were less depressed, happier, and seemed to stave off the progression of their symptoms. This may be due to the biological benefits of exercise that have been observed in healthy populations. Exercise increases levels of neurotransmitters that, when in deficit, may lead to depression (i.e. serotonin). With higher levels of these beneficial neurotransmitters, these patients should (and did) show lower levels of depression. In addition, exercise increases brain plasticity and can stimulate neural epigenesis (Ploughman, Attwood, White, Dore, & Corbett, 2007). In a disease associated with neural degradation, any increase in plasticity and neural growth should facilitate functioning. While not a cure for the disorder, our results and prior research indicate that exercise represents an effective management tool for multiple sclerosis.

Future Directions

The primary limitation of the current study is the lack of both random assignment and a control condition. However, four factors allow for a generalization to the wider population of

multiple sclerosis patients. First, the analysis of attrition data for the life of the exercise program indicates that the sample we obtained for this study should be indicative of the wider population of multiple sclerosis patients. The majority of individuals who began the exercise program were either still engaged or left for a reason not related to their multiple sclerosis (i.e. driving distance, schedule change). Second, the illness covariates included eliminate the effects of illness stage (severity) and time with the illness. Third, all individuals, regardless of illness stage or mobility limitations (i.e. wheelchair confinement), were able to engage in this program. Finally, the use of time in program as our predictor variable takes into account the need for long-term engagement in exercise for the accumulation of the positive effects o resistance training. Thus, the results of this study should be indicative of the effects of long-term exercise in the general population of multiple sclerosis patients. However, future investigations of the long-term impacts of exercise on multiple should strive to include a control group and use random assignment (although these investigations would be subject to the same attrition problems as this program).

This investigation was also limited to resistance training (weight training). Future research should examine other types of exercise and physical activity. Preliminary evidence suggests that endurance (Svensson, Gerdle, & Elert, 1993; Mount & Stacko, 2006), aquatic (Gehlsen, Grigsby, & Winant, 1984), and aerobic exercise may increase mobility (Kileff & Ashburn, 2005). These types of exercise may also decrease depression and stave off symptom progression. Indeed, any rigorous physical activity may improve the lives of individuals with multiple sclerosis.

As the search for a cure continues, those currently afflicted with multiple sclerosis must find ways to improve functioning, decrease depression, and control symptom severity. Exercise may represent an effective way to achieve these goals. A simple exercise program, carried out just a few days a week, can help to improve the lives of those with multiple sclerosis.

References

Arnet, P. A., Higginson, C. I., Voss, W. D., Wright, B., Bender, W. I., Wurst, J. M., & Tippen, J. M. (1999). Depressed mood in multiple sclerosis: Relationship to capacity-demanding memory and attentional functioning. *Neuropsychology, 13*, 434-446.

Callaghan, P. (2004). Exercise: A neglected intervention in mental health care? *Journal of Psychiatric and Mental Health Nursing, 11*, 476-483.

Danner, D. D., Snowdon, D. A., & Friesen, W. V. (2001). Positive emotions in early life and longevity: Findings from the Nun study. *Journal of Personality and Social Psychology, 80*, 804-813.

DeBolt, L. S., McCubbin, J. A. (2004). The effects of home-based resistance exercise on balance, power, and mobility in adults with multiple sclerosis. *Archives of Physical Medicine and Rehabilitation, 85*, 290-297.

DeBolt, L. S., McCubbin, J. A., & Gappmaier, E. (2004). Exercise helps multiple sclerosis patients resist further debilitation. *Biomechanics Online, Nov 04.*

Derogatis, L. R. (1994). *Symptom Checklist-90-R (SCL-90-R): Administration, Scoring, and Procedures Manual (3rd ed.).* Minneapolis, MN: National Computer Systems.

Devins, G. M., & Seland, T. P. (1987). Emotional impact of multiple sclerosis: recent research finding and suggestions for future research. *Psychological Bulletin, 101*, 363-375.

Devins, G. M., Seland, T. P., Klein, G., Edworthy, S. M., & Saary, M. J. (1993). Stability and determinants of psychosocial wellbeing in multiple sclerosis. *Rehabilitation Psychology, 38,* 11-26.

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*, 71-75.

Diener, E., Sandvik, E., & Pavot, W. (1991). Happiness is the frequency, not the intensity, of ositive versus negative affect. In Strack, F. & Argyle, M. (Eds.), *Subjective well-being: An interdisciplinary perspective. International series in experimental social psychology, Vol. 21* (pp. 119-139). Elmsford, NY: Pergamon Press, Inc.

Dougall, A. L., & Baum, A. (2001). Stress, health, and illness. In A. Baum, T. A. Revenson, & J. E. Singer (Eds.), *Handbook of health psychology* (pp. 321-338). Mahwah, NJ: Erlbaum.

Ekkekakis, P., Hall, E. E., VanLanduyt, L. M., & Petruzello, S. J. (2000). Walking in (affective) circles: Can short walks enhace affect? *Journal of Behavioral Medicine, 23*, 245-275.

Fordyce, M. (1988). A review of research on the happiness measures: A sixty second index of happiness and mental health. *Social Indicators Research, 20*, 355–381.

Fournier, M., de Ridder, D., & Bensing, J. (2002). How optimism contributes to the adaptation of chronic illness. A prospective study into the enduring effects of on adaptation moderated by controllability of chronic illness. *Personality and Individual Differences, 33*, 1163- 1183.

Fraser, C., & McGurl, J. (2007). *Journal of Neuroscience Nursing, 39*, 13-17.

Fredrickson, B. L. (1998). What good are positive emotions? *Review of General Psychology, 2*, 300-319.

Gatten, C. W., Brookings, J. B., & Bolton, B. (1993). Mood fluctuations in female multiple sclerosis patients. *Social Behavior and Personality, 21*, 103-106.

Gehlsen, G. M., Grigsby, S. A., & Winant, D. M. (1984). Effects of an aquatic fitness program on the muscular strength and endurance of patients with multiple sclerosis. *Physical Therapy, 64*, 653-657.

Kileff, J. & Ashburn, A. (2005). A pilot study fo the effect of aerobic exercise on people with moderate diability multiple sclerosis. *Clinical Rehabilitation, 19*, 165-169.

Kraft, G. H., Alquist, A. D., Lateur, B. J. (1995). Effect of resistive exercise on physical function in multiple sclerosis. *Rehabilitation Research & Development Progress Report,* 328-329.

McCabe, M. P. (2005). Mood and self-esteem of persons with multiple sclerosis following an exacerbation. *Journal of Psychosomatic Research, 59*, 161-166.

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

Mclvor, G. P., Riklan, M., & Reznikoff, M. (1984). Depression in multiple sclerosis as a function of length and severity of illness, age, remissions, and perceived social support. *Journal of Clinical Psychology, 40,* 1029-1033.

Minden, S. L., & Schiffer, R. B. (1990). Affective disorders in multiple sclerosis. *Archives of Neurology, 47,* 98-104.

Minden, S. L., & Schiffer, R. B. (1991). Depression and mood disorders in multiple sclerosis. *Neuropsychiatry, Neuropsychology, and Behavioral Neurology, 4,* 62-77.

Motl, R.W., McAuley, E., & Snook, E. M. (2007). Physical activity and quality of life in multiple sclerosis: Possible roles of social support, self-efficacy, and functional limitations. *Rehabilitation Psychology, 52,* , 143-151.

Mount, J. & Dacko, S. (2006). Effects of dorsiflexor endurance exercises on foot drop secondary to multiple sclerosis: A pilot study. *Neurorehabilitation, 21*, 43-50.

Pakenham, K. I. (1999). Adjustment to multiple sclerosis: Application of a stress and coping model. *Health Psychology, 18*, 383-392.

Pakenham, K. L, Stewart, C. A., & Rogers, A. (1997). The role of coping in adjustment to multiple sclerosis-related adaptive demands. *Psychology, Health and Medicine, 2,* 197-211.

Rao, S. M., Huber, S. J., & Bornstein, R. A. (1992). Emotional changes with multiple sclerosis and Parkinson's disease. *Journal of Consulting and Clinical Psychology, 60,* 369-378.

Rudick, R. A., Miller, D., Clough, J. D., Gragg, L. A., & Farmer, R. G. (1992). Quality of life in multiple sclerosis. *Archives of Neurology, 49,* 1237-1242.

Sharrack, B., & Hughes, R. A. (1999). The Guy's neurological disabilty scale (GNDS): A new disability measure for multiple sclerosis. *Multiple Sclerosis, 5*, 223-233.

Shimmack, U., Oishi, S., Furr, R. M., & Funder, D. C. (2004). Personality and life satisfaction: A acet-level analysis. *Personality and Social Psychology Bulletin*, 30, 1062-1075.

Sjosten, N. & Kivela, S. L. (2006). The effects of physical exercise on depressive symptoms among the aged: A systematic review. *International Journal of Geriatric Psychiatry, 21*, 410-418.

Suinn, R. M. (2001). The terrible twos - anger and anxiety: Hazardous to your health. *American Psychologist, 56*, 27-36.

Svensson, B., Gerdle, B., & Elert, J. (1994). Endurance training in patients with multiple sclerosis: Five case studies. *Physical Therapy, 74*, 1017-1026.

Thayer, R. E. (1987). Energy, tiredness, and tension effects of a sugar snack versus moderate exercise. *Journal of Personality and Social Psychology, 52*, 119-125.

Thachuk, G. A. & Martin, G. L. (1999). Exercise therapy for patients with psychiatric disorders: Research and clinical implications. *Professional Psychology: Research and Practice, 30*, 275-282.

Tugade, M. M., & Fredrickson, B. L. (2004). Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology, 86*, 320-333.

VanderPlate, C. (1984). Psychological aspects of multiple sclerosis and its treatment: Toward a biopsychosocial perspective. *Health Psychology, 3,* 253-272.

Voss, W. D., Arnett, P. A., Higginson, C. I., Randolph, J. J., Campos, M. D., & Dyck, D. G. (2002). Contributing factors to depressed mood in multiple sclerosis. *Archives of Clinical Neuropsychology, 17*, 103-115.

Walker, J. E. (1982). Management of the patient with multiple sclerosis. *Comprehensive Therapy, 8,* 20-23.

Wineman, N. M. (1990). Adaptation to multiple sclerosis: The role of social support, functional disability, and perceived uncertainty. *Nursing Research, 39,* 294-299.

Author Notes

Adam A Augustine and Randy J. Larsen, Washington University in St. Louis; and Daryl Kucera, Fast Forward, LLC.

Correspondence concerning this article should be addressed to Adam A Augustine, Washington University in St. Louis, Department of Psychology, Campus Box 1125, One Brookings Drive, St. Louis, MO, 63130-4899. Electronic mail may be sent to aaaugust@artsci.wustl.edu.

Table 1

Participant Characteristics

Age	48.93 (10.64)
Age diagnosed	35.93 (11.22)
Race	97.8% Caucasian
Gender	75.6% Female
Income	29.3% 0-40k
	39.0% 40-80k
	31.7% 80k+
Employment Status	25% Employed
Marital Status	75% Married
Disease Stage	62.2% Relapse Remitting
	22.2% Secondary Progressive
	8.9% Primary Progressive
	6.7% Progressive Relapsing
Time in program (months)	23.05 (18.24)

Note: $N = 43$, data represented as either *M (SD)*, or % of sample

Table 2

Correlations between time in program and symptoms/affectivity

	Time in Program	Time in Program (controlling illness stage, age, and age diagnosed)
MS symptoms	.03	-.04
Depression	-.36*	-.34*
General Affectivity	.32*	.30†
Positive Affect %	.32*	.29†
Negative Affect %	-.17	-.13
Neutral Affect %	-.27†	-.29†
Satisfaction with Life	.19	.24

Note: $N = 43$, *$p < .05$, †$p < .10$

Table 3

Attrition Data for Life of Program

Total Enrolled to Date	157
Still Enrolled	51.0%
Left due to driving distance/relocation	15.9%
Left due to scheduling problem	6.4%
Left to return to work force	6.4%
Left to join other gym	2.5%
Left due to medical issues	3.8%
Left for unknown reasons	12.7%
Deceased	1.3%