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The Role of Positive Lifestyle Activities on Mood, Cognition, Well-Being, and Disease Characteristics in Multiple Sclerosis

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Abstract

Multiple sclerosis (MS) is a neurological condition associated with a wide variety of physical, cognitive, and mood-related symptoms. While disease-modifying treatment has been shown to reduce the severity and frequency of MS symptom relapses, engagement in certain daily activities holds promise as an adjunctive treatment to better manage disease sequelae. The present study sought to determine whether healthy nutritional choices, exercise, and social/intellectual engagement impacts functioning in individuals with MS. Two hundred and forty-eight (248) MS participants completed a questionnaire assessing factors related to cognitive health (Cognitive Health Questionnaire; CHQ). They also endorsed measures assessing disease symptoms and management, mood, and well-being/quality of life. A measure of information processing speed was administered to a subset of participants. Findings indicated that a previously derived CHQ factor comprised of healthy nutritional habits and exercise items was associated with less fatigue, better sleep, reduced pain, and improved mood and disease management. A factor with items assessing social and intellectual engagement correlated with mood, disease management, and well-being. Endorsement of items in both CHQ factors was associated with better information processing speed. Subsequent regression analyses indicated that education and mood were most predictive of nutritional habits and exercise, while MS self-efficacy was particularly associated with engagement in social and intellectual activities. In sum, these findings suggest that self-reported engagement in healthy lifestyle habits has far-reaching effects on multiple aspects of daily living and disease management in MS.

Keywords

Multiple Sclerosis; Health; Cognitive Health; Fatigue; Well-being

Multiple sclerosis (MS), a demyelinating disease of the central nervous system (CNS), is the number one cause of neurological disability among young and middle-aged adults

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(Feinstein, 1995; Hakim et al., 2000; Shnek, Foley, LaRocca, Smith, & Halper, 1995), affecting women twice to three times as often as men (Harbo, Gold, & Tintoré, 2013) with an age of diagnosis ranging from 20 to 50 years of age (Shnek et al., 1995). Common primary symptoms of MS include difficulties or changes in gait, tremors, visual problems, bladder and bowel incontinence, numbness/tingling in extremities, chronic pain, spasticity, abnormal somatic sensations, sexual dysfunction, and speech disturbances (Smith, Samkoff, & Scheinberg, 1993). Secondary symptoms include fatigue, depression, sleep disturbance, and cognitive disturbance, all of which occur at high rates. In particular, fatigue occurs in approximately 53% to 90% of individuals with MS (Colosimo et al., 1995; Kaynak et al., 2006) and is reported by many individuals as their worst symptom (Fisk, Pontefract, Ritvo, Archibald, & Murray, 1994). Rates of lifetime depression in MS are also elevated, with point prevalence rates varying from 15–50% (Cetin et al., 2007). Further, available research suggests that individuals with MS are three times more likely to experience sleep difficulties than controls, with prevalence rates ranging from 36% to 62% (Bamer, Johnson, Amtmann, & Kraft, 2008; Merlino et al., 2009). Approximately 40–50% of community-based MS samples have also been shown to display cognitive impairment (Jönsson et al., 2006) with prevalence rates usually being higher in clinic based samples, around 55–65% (Amato, Zipoli, & Portaccio, 2006). Mood disturbance, fatigue, sleep difficulties, and cognitive dysfunction all significantly impact on quality of life (QOL) in MS (Amato et al., 2001; D'Alisa et al., 2006; Glanz et al., 2010; Lobentanz et al., 2004). Given the additional consideration that individuals with MS have a similar life expectancy as those within the general population (Ragonese, Aridon, Salemi, D'amelio, & Savettieri, 2008), it is important to explore strategies to manage disease symptoms, ward off further decline in functioning, and maintain overall well-being (Motl, McAuley, & Snook, 2007).

While MS is considered to be a progressive disease, there is increasing evidence that disease progression and symptom severity can be ameliorated by lifestyle changes. Lifestyle factors such as physical health habits, social engagement, and participation in cognitively engaging activities can all influence cognition, health, and well-being, as is evident in the aging population (de Frias & Dixon, 2014). With regard to cognition, systematic reviews and meta-analytic findings indicate that physical and intellectual interventions can result in improvements in cognitive functioning across the lifespan (Christie et al., 2017; Hertzog, Kramer, Wilson, & Lindenberger, 2008; Smith et al., 2010). Frequency of social activity and social network size also have positive and protective effects on cognitive status (Barnes, De Leon, Wilson, Bienias, & Evans, 2004; James, Wilson, Barnes, & Bennett, 2011). In a related vein, it is important to examine the influence these and related factors may have on cognitive health in MS, in hopes of maintaining and potentially improving cognitive and general functioning in daily life.

Some work has examined the effects of physical activity and dietary/nutritional factors on MS risk, progression, and symptom severity. Evidence suggests that increased physical activity results in improvements in physical functioning (e.g., balance, walking mobility, aerobic capacity, and strength) as well as reduced fatigue and depression. Increased social participation is also commonly reported as a benefit of physical activity (Learmonth & Motl, 2016). Physical fitness has the potential to reduce comorbidities, particularly cardiovascular disease, which is also known to be associated with more severe disability in MS (Conway,

Thompson, & Cohen, 2017; Marrie et al., 2010). There is also a two to threefold risk of MS associated with being overweight or obese (Amato et al., 2017). Further, it has long been known that lower systemic Vitamin D is a risk factor for developing MS and has been associated with higher levels of disability once diagnosed (Moss, Rensel, & Hersh, 2017). Regarding dietary patterns in MS, a randomized clinical trial found that a low fat, plant based diet was associated with a reduction in body mass index, while demonstrating no change on physical markers of disease progression (Yadav et al., 2016). A recent study found that a diet consisting of higher overall intake of fruit, vegetables, legumes, and whole grains, and low intake of sugar and red meat, was associated with lower levels of disability. Moreover, individuals who consumed such a diet were found to experience less depression, fatigue, cognitive difficulties, and pain (Fitzgerald et al., 2018). Other studies examining the intake of specific foods—namely salt, caffeine, and alcohol—found a negative effect for salt and positive effect for alcohol and caffeine consumption (Amato et al., 2017).

The present investigation sought to examine the effects of health-promoting lifestyle behaviors on disease/health, cognition, mood, and well-being in individuals with MS. More specifically, utilizing a novel measure assessing cognitive health factors, we examined the role of nutrition, physical activity, and engagement in social/intellectual activities on reported functioning in an MS sample. While this study was exploratory in nature given the paucity of related research in the MS literature, we predicted that self-reported engagement in various lifestyle factors would be positively associated with MS symptoms and disease management, cognition, mood, and well-being.

Methods

Participants

Participants were recruited nationally through online advertisements, flyer advertisements through MS clinics, and various chapters of the MS Society across the United States. All participants were diagnosed with clinically definite MS, with further inclusion requirements of being between 20 to 64 years of age, absence of other neurological disorders, and being employed. A total of 248 individuals were enrolled in the present study. The sample was primarily female (87%) with a mean age of 43 and mean disease duration of 7.88 years. Of the 248 participants, the majority (232; 94%) were diagnosed with relapsing remitting MS, 7 (2.8%) were diagnosed with primary progressive MS, 6 (2.4%) were diagnosed with secondary progressive MS, and one (0.4%) was diagnosed with progressive relapsing MS. Within the larger sample, 122 completed the Symbol Digit Modalities Test (SDMT), a measure of information processing speed (Please see Table 1 for demographics of sample subsets for participants with and without SDMT data).

Procedures

All participants completed a comprehensive online survey, which included measures assessing disease symptoms (i.e., fatigue, sleep disturbance, pain), depression, anxiety, and engagement in cognitive health habits. Nearly half of all participants also completed a brief assessment of cognitive functioning, either over the phone or in person, depending upon participant accessibility to the site, and measures of perceived stress and well-being; the

latter two measures were added to the study at a later time. All study procedures were approved by the Institutional Review Board. Informed consent was obtained from all participants.

Measures

Modified Fatigue Impact Scale (MFIS) (Fisk et al., 1994).—The MFIS is a modified form of the Fatigue Impact Scale based on items derived from interviews with MS patients concerning how fatigue impacts their lives in terms of physical, cognitive, and psychosocial functioning. The questionnaire is composed of 21 items, rated on a Likert scale ranging from “Never” to “Almost Always.” Items are preceded by the phrase, “Because of my fatigue during the past 4 weeks...”, and are then prompted with different statements, such as “I have had more difficulty paying attention for long periods of time” or “I have had to pace myself in my physical activities.” Participants then rate, based on the scale given, how frequently they experience that statement within the given time frame. We examined the MFIS physical functioning subscale in the present study. Higher scores indicate more reported fatigue.

Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989)—The PSQI is a measure of sleep quality assessing several domains of sleep (duration, sleep disturbances, latency, daily dysfunction due to sleepiness, sleep efficiency, overall sleep quality, use of sleep medication, and total score of sleep quality). The scale is comprised of 24 items rated by the individual and five items by a bed partner. Four of the total items assess nominal habits, such as bedtime, hours of sleep per night, wake up time, and how long it takes participants to fall asleep. Seventeen items assess frequency of sleep disturbances and utilize a Likert scale ranging from “Not during the past month” to “Three or more times a week.” The remaining two items utilize a coded response to rate sleep quality, degree of enthusiasm to accomplish things, or type of bed partner. Higher scores indicate more sleep difficulties.

MOS-Pain Effects Scale (PES) (Ritvo et al., 1997).—The PES is a brief measure within the Multiple Sclerosis Quality of Life Inventory assessing the experience and impact of pain. The measure yields a total score from the summation of its six items. Questions were prompted as, “During the past 4 weeks, how much did these symptoms interfere with your...?” Each item offers a different fill in the blank, such as “mood” or “sleep” for participants to rank using a 5-point Likert scale from “Not at all” to “An extreme degree.” Higher scores indicate more perceived pain.

MultiscaleChicago Multiscale Depression Inventory (CMDI) (Nyenhuus & Luchetta, 1998).—The CMDI is a 42-item inventory consisting of three subscales: mood (e.g., sadness), evaluative (e.g., feelings of uselessness), and vegetative (e.g., fatigue). Each subscale contains 14 items. These subscales can be used separately or in combination. Patients are asked to rate themselves on a 5-point Likert scale, indicating the extent to which each word/phrase describes them during the past week, including today, ranging from “Not at all” to “Extremely.” For our study, we considered the CMDI Mood and Evaluative scales in order to assess depressive symptoms that would not overlap with somatic MS-related symptoms. Higher scores indicate more depressive symptoms.

State Trait Anxiety Inventory (STAI) (Spielberger & Gorsuch, 1983).—The STAI is a 40-item measure divided into two, 20-item scales to assess both present (state) and longstanding (trait) anxiety. Patients are asked to describe how they feel at the present moment (state) as well as how they generally feel (trait). Ratings range from “Almost Never” to “Almost Always.” Higher scores reflect more reported anxiety.

Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983).—The PSS is a 10-item measure assessing the perception of stress in an individual’s life in the month prior to the assessment. Participants rank each item on a 5-point Likert scale denoting the frequency they experienced the item in question from “Never” to “Very Often.” Higher scores indicate more perceived stress.

Flourishing Scale (FS) (Diener et al., 2010).—The FS is an 8-item measure assessing one’s overall psychological well-being and purpose and meaning in life. Participants are prompted with a statement for each item and asked to rate, based upon a 7-point Likert scale, how much they agree with the statement, from “Strongly disagree” to “Strongly agree.” The composite of all item scores represents the flourishing score. Higher scores indicate more perceived well-being.

Cognitive Health Questionnaire (CHQ) (Randolph et al., 2014).—The CHQ was developed in an earlier study to assess individuals’ engagement in lifestyle factors that may maintain or promote cognitive health. The scale consists of 17 items, rationally derived based on face and content validity. Items were designed to gather self-report data on frequency of participation in different lifestyle activities known to impact cognitive health. Items assess levels of mild and moderate physical activity, social activity, intellectual activity including compensatory strategy use, sleep habits, and steps taken to maintain adequate nutrition (e.g., frequency of eating fruits and vegetables; frequency of eating meals and taking nutritional supplements). Items are ranked based on frequency of engagement varying from “never/rarely” to “more than three times per week.” The CHQ has two factor-analytically derived indices (Randolph et al., 2014) that were used in this paper: (1) a nutrition/exercise factor; and (2) a social/intellectual activities factor. Higher scores indicate more lifestyle activity engagement.

Disability Management Self-Efficacy Scale (DMSES) (Amtmann et al., 2012).—The DMSES is a 19-item measure assessing one’s perceived self-efficacy with regard to managing their MS. Participants are prompted with a statement (“How confident are you that...”) for each item and asked to rate, based upon a 5-point Likert scale, how much they feel they can manage their MS and not allow it to interfere with their day to day functioning. Higher scores reflect better perceived management of MS symptoms.

Symbol Digit Modalities Test (SDMT) (Smith, 1982).—The SDMT is a measure of speeded information processing. Participants are provided an 8 ½ x 11 inch sheet of paper with nine symbols, each paired with a number on top of the page. The remainder of the page consists of a pseudo-randomized sequence of these symbols. Patients are asked to respond orally with the number that corresponds with each symbol. The dependent variable is the

total number correct in 90 seconds. Higher scores indicate better processing speed performance.

Results

All analyses were completed using SPSS 21 computer software. Using the two indices of the CHQ as described above, we examined zero-order correlations among demographic variables, disease symptoms, cognition, mood, and well-being. Subsequent regression analyses were conducted with the two indices of the CHQ as dependent variables and variables found to be significantly correlated at $p < .01$ with the indices as predictors. We also included the SDMT given its significant correlation with CHQ indices and its status as the only objective cognitive indicator in our study. In light of the smaller sample size for participants that completed the SDMT, comparisons were made between those who completed the SDMT and those who did not to determine possible group differences. There were no significant differences with regard to age, gender, education, disease course, or disease duration across sample subsets. We also used casewise exclusion to ensure full data for all regression variables, which included the SDMT, resulting in 122 participants. After completing casewise exclusion, available data for the FS scale was reduced to 82 participants, so we opted to not include this variable in subsequent regression analyses.

Analyses related to healthy nutritional habits and exercise

Positive eating habits and engagement in exercise did not correlate with age or disease duration but did correlate with education. Engagement in healthy lifestyle habits was inversely related to reports of fatigue, sleep problems, pain, depression, anxiety, and perceived stress and positively related to disability management self-efficacy (Table 2). There also was a significant correlation between the nutrition/exercise factor and performance on the SDMT. A stepwise linear regression, controlling for education and including fatigue, sleep disturbance, depression (mood), anxiety (state), MS self-efficacy, and processing speed as predictors found only education and mood to be significantly associated with healthy eating habits and exercise (Table 3).

Analyses related to engagement in social and intellectual activities.

Engagement in social and intellectual activities was not associated with age, disease duration, or disease symptoms (i.e., physical fatigue, sleep problems, pain), but was positively correlated with education. This factor also correlated positively with well-being and MS self-efficacy and negatively with depressive symptoms and perceived stress (Table 2). Performance on the SDMT was also significantly correlated with the social and intellectual functioning index. A stepwise linear regression, controlling for education and including mood and evaluative depressive symptoms, MS self-efficacy, and processing speed as predictors found MS self-efficacy to be the only significant predictor of engagement in social and intellectual activities (Table 3).

Discussion

The aim of this investigation was to examine lifestyle engagement effects on MS participants' disease-oriented symptoms, cognition, well-being, and mood. Given the emerging emphasis on encouraging individuals with MS to engage in greater health-promoting behaviors, we sought to clarify related relationships here. Using a survey-based approach, we aimed to determine whether eating a healthy diet, exercising, and engaging in social/intellectual activities would reduce the negative impact of MS. Results suggest that increased engagement in healthy eating habits and physical activity is related to fewer reports of fatigue, sleep problems, pain, perceived stress, depression, and anxiety. Individuals with related engagement habits also report greater self-efficacy pertaining to managing their MS and show greater information processing speed. Thus, these activities have a far-reaching impact besides ameliorating disease symptoms. Further, while social and intellectual activity engagement had no bearing on MS disease symptomatology per se, it was associated with fewer depressive symptoms and perceived stress. Social and intellectual engagement in MS also correlated with better speeded processing and general well-being. Such findings suggest that while social and intellectual engagement may not directly impact the disease, it does hold promise in promoting emotional functioning, well-being, and cognition.

The finding that education was related to both cognitive health factors we examined, and was a particularly strong predictor of engagement in healthy eating habits and exercise, is not surprising given the known association between education and health outcomes (Feinstein, Sabates, Anderson, Sorhaindo, & Hammond, 2006). Similarly, the observation that depressive symptoms were most predictive of diet and exercise confirms previous assertions that exercise and depression are intricately tied, with the former even being considered an effective treatment for the latter (Craft & Perna, 2004). Given the cross sectional nature of the present study, causation cannot be determined, but future research should further explore the relationship between diet/exercise and depression. Finally, the finding that MS self-efficacy proved to be strongly associated with engagement in social/intellectual activities was illuminating. Though speculative, one possibility is that an individual's belief that they can manage their symptoms effectively (e.g., fatigue, bowel/bladder issues) may, in turn, reduce the intrusiveness of their symptoms on their overall functioning, leading to greater activity engagement. Interventions aimed at reducing depression and improving both self-efficacy and social participation in MS have been conducted with this possibility in mind (Kalina, 2015).

Taken together, our findings help clarify how lifestyle factors affect varying aspects of functioning in MS and suggest that a holistic approach that takes into account these wellness domains is optimal. This assertion is consistent with the theory of overall wellness, which can be defined by six dimensions: physical, social, intellectual, occupational, emotional, and spiritual engagement (Strout & Howard, 2012). Further, lifestyle factors have been recommended as an adjunctive therapy to conventional medical treatment of MS, with the overarching goal of achieving optimal health for those living with MS (Moss et al., 2017). Routine assessment of lifestyle habits and related interventions should be considered

important components of MS management, and further interventional studies aimed at diet, exercise, social participation, and engagement in intellectual activities are needed.

A limitation of the present study is that it employed a cross-sectional, correlational study design, so causative variable relationships cannot be determined. One possible conclusion from our findings is that a decrease in disease symptoms results in increased participation in health-promoting activities; conversely, more activity engagement may reduce disease symptomatology. Future longitudinal studies examining the influence of healthy lifestyle choices throughout the course of MS is warranted. The present study was also exploratory in nature, and future work could build on the present research by considering hypotheses related to the impact of specific lifestyle factors (e.g., social or intellectual engagement) on daily functioning in MS.

In summary, we found that engaging in certain lifestyle activities—healthy nutritional habits, exercise, social activity, and intellectual engagement—was associated with positive adjustment to MS and reduced perceived disease burden. While challenging to build into one's daily routine, straightforward lifestyle changes hold promise as an MS treatment modality with the potential to improve quality of life in individuals managing this condition over time.

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Table 1

Participant Demographics

	Total Sample (N=248) Mean (SD) or Frequency	SDMT Subset (N=122) Mean (SD) or Frequency
Age	43.37 (9.44)	42.74 (9.24)
Gender	Male: 32 Female: 216	Male: 12 Female: 110
Education	15.68 (2.17)	15.51 (2.08)
Disease Course	233RR/7PP/6SP/1PR 1Unkown	116RR/3PP/1SP/1PR 1 Unknown
Disease Duration	7.85 (6.77)	7.03 (6.23)

Note. RR=Relapsing Remitting; PP= Primary Progressive; SP= Secondary Progressive; PR= Progressive Relapsing.

Table 2

Correlations Between Cognitive Health, Demographics, Disease Variables, and Wellness Variables

	CHQ Nutrition & Exercise	CHQ Social & Intellectual Activities
Age	.08	.02
Education	.23 ***	.19 **
Disease Duration	.02	.00
MFIS	-.18 **	-.12
PSQI	-.19 **	-.09
PES	-.16 *	-.12
CMDI Mood scale	-.21 ***	-.21 ***
CMDI Evaluative scale	-.15 *	-.19 **
STAI State scale	-.18 **	-.11
STAI Trait scale	-.13 *	-.07
DMSES	.19 **	.27 ***
SDMT [†]	.22 *	.19 *
FS [‡]	.15	.36 ***
PSS [‡]	-.17 *	-.20 *

Note. CHQ= Cognitive Health Questionnaire; MFIS= Modified Fatigue Impact Scale; PSQI= Pittsburgh Sleep Quality Index; PES= MOS-Pain Effects Scale; CMDI= Chicago Multiscale Depression Inventory; STAI= State Trait Anxiety Inventory; DMSES= Disease Management Self Efficacy Scale; SDMT= Symbol Digit Modalities Test; FS= Flourishing Scale; PSS= Perceived Stress Scale

[†]N =122

[‡]N = 142

p .001

**
p <.01

*
p <0.05

Table 3

Stepwise Regression Findings Predicting Cognitive Health Factors

	β	F	sig.	R ²
Nutrition & Exercise Factor				
Step 1				
Education	.227	6.50	.012	.04
Step 2				
Education	.229	7.89	.009	
Depression (Mood)	-.256		.004	.10
Social and Intellectual Engagement Factor				
Step 1				
Education	.165	3.73	.069	.02
Step 2				
Education	.142	6.78	.0106	
MS Self-efficacy	.275		.002	.09