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Complementary and Alternative Medicine Usage by Multiple Sclerosis Patients: Results from a Prospective Clinical Study

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Abstract

Objectives: To investigate the factors associated with complementary and alternative medicine (CAM) usage by multiple sclerosis (MS) patients.

Design, Setting/Location: Single-center, prospective clinical study at an academic MS center in the northeastern United States.

Methods: This study included CAM data from 524 MS patients and 304 healthy controls (HC) enrolled in a prospective study of clinical, neuroimaging, and environmental risk factors in MS at an academic MS Center. Clinical, neuroimaging, and disease-modifying treatment data were obtained. In addition, data on usage of CAM modalities, including acupuncture, aromatherapy, Ayurveda, Chinese herbal medicine, chiropractor, electromagnetic therapy, homeopathy, hypnosis, massage, naturopathy, Qi gong, Reiki, therapeutic touch, and bee stings were collected in an in-person interview.

Results: The percentages of HC reporting usage of any CAM (32%) was similar to that in MS patients after diagnosis (30.5%). The usage of any CAM was higher in MS patients after MS diagnosis compared to before MS diagnosis ($p < 0.001$). The three most frequently used CAM for MS patients after MS diagnosis and HC were chiropractor, massage, and acupuncture. The most frequent reasons for CAM use were MS symptom relief, back problems, and pain. In multivariate analysis, female gender, higher education level, MS disease course, and not currently on disease-modifying therapies (DMT) treatment status were associated with CAM usage.

Conclusions: Gender, education level, DMT treatment status, and MS disease course are associated with CAM usage in MS patients. Ever-CAM usage patterns in MS patients are similar to those in HC.

Keywords: multiple sclerosis, alternative medicine, complementary medicine, disease-modifying therapy

Introduction

Multiple sclerosis (MS) is an inflammatory, demyelinating disease that causes lesion formation and atrophy. MS results in physical and cognitive disability.[1,2] Although there is currently no cure for MS, several injectable disease-modifying therapies (DMT) such as glatiramer acetate (e.g., COPAXONE® and GLATOPA®), several interferon-beta regimens (AVONEX®, REBIF®, BETASERON®, EXTAVIA®, and PLEGRIDY®), natalizumab (TYSABRI®), alemtuzumab (LEMTRADA®), ocrelizumab (OCREVUS™), and daclizumab (ZINBRYTA™), and oral DMT such as fingolimod (GILENYA®), dimethyl fumarate (TECFIDERA®), teriflunomide (AUBAGIO®), and others have become available. Not all patients respond well to their prescribed DMT, which have limited efficacy and side effects that may require additional

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management. MS is associated with a range of chronic symptoms, including fatigue, tremors, spasticity, pain, and cognitive problems. MS patients are therefore frequently prescribed individualized regimens of symptomatic therapies from diverse therapeutic classes to treat specific symptoms.

Many MS patients look to complementary and alternative medicine (CAM) options in hopes of improving their quality of life.[1,2] CAMs are defined by the National Institutes of Health as a group of diverse medical and healthcare systems, practices, and products that are not generally considered part of conventional medicine.[3] According to Nayak et al., 57.1% of MS patient population used at least one CAM modality.[4] Numerous CAMs are now available in large and mid-size U.S. cities, including acupuncture, Chinese herbs, massage, physical therapy, magnetic therapy, and yoga. CAM therapies such as yoga, massage, meditation, and mindfulness-based relaxation techniques, which help with balance, muscle strengthening, pain, and psychological stress, are more frequently used by MS patients.[4] The American Academy of Neurology issued evidence-based guidelines that noted the paucity of evidence regarding the efficacy of majority of CAMs in MS and lack of information on CAM interactions with DMT.[5,6]

Several studies have investigated the factors associated with MS patients' use of CAMs.[1,4,7–11] Patients who are unsatisfied with the conventional therapies are more likely to use CAMs.[4,8,10,12] Nayak et al. investigated the prevalence of CAMs and found the most frequently used CAMs were not necessarily the CAMs that were perceived as the most effective.[4] Marrie et al. analyzed a large patient-reported data set from the 20,778 MS patients in the North American Research Consortium on Multiple Sclerosis (NARCOMS) Patient Registry and noted that demographic factors contribute a smaller role as model predictors compared to clinical factors.[13] Huntley and Ernst conducted a systematic review of the 12 randomized controlled trials on nutritional therapy, massage, Feldenkrais bodywork, reflexology, magnetic field therapy, neural therapy, and psychological counseling CAM.[8] The clinical efficacy of the CAMs was inconclusive due to the significant methodological flaws and small sample size.[8] There is still a need for large-scale and well-designed research studies on CAMs in the MS population.

A more extensive understanding of CAM usage patterns of MS patients could allow healthcare providers to make recommendations and exercise appropriate levels of clinical vigilance for patients who are using CAM to cope with the disease. The objectives of this study are to compare the patterns of use of different CAMs by MS patients to controls and to identify the demographic and clinical factors associated with CAM usage.

Methods

Study population and design

The data were obtained from an ongoing prospective study of clinical, genetic, and environmental risk factors in MS at the MS Center of the State University of New York at Buffalo.[14,15] Written informed consent was collected from all participants and University at Buffalo Human Subjects Institutional Review Board approved the study protocol.

This substudy included 524 consecutive MS patients and 304 healthy controls (HC) from the ongoing prospective study. Patients with clinically isolated syndrome ($n=69$), neuromyelitis optica ($n=8$), and other neurological diseases ($n=69$) and children younger than 18 years were excluded. Subjects meeting the inclusion criteria, who did not respond to the question, ''Have you ever used alternative or complementary medicine approaches such as chiropractic, homeopathy, massage, hypnosis etc. for more than 3 months?'' were also excluded.

The enrolled patients underwent neurological examinations. Blood samples were collected for analyses of biomarkers and answers to a comprehensive questionnaire were collected in person by an interviewer. The responses to the questionnaire were transcribed to computer by the interviewer.

The questionnaire included subjects' responses to the use of CAM before and after MS diagnosis, and use of CAM by HC coded as Yes/No binary indicator variables. Data on usage of several CAM modalities, including acupuncture, aromatherapy, Ayurveda, Chinese herbal medicine, chiropractor, electromagnetic therapy, homeopathy, hypnosis, massage, naturopathy, Qi gong, Reiki, therapeutic touch, bee stings, or others, were also collected as Yes/No binary indicator variables. Subjects also provided comments on their reasons for using CAM.

Data analysis

Statistical analyses were conducted with the SPSS statistical program (version 24).

Data on gender (binary variable: female or transgender female and male or transgender male), age, education level (seven categories: not completed high school, completed high school, some college, associates or technical degree, bachelor's degree, graduate level education, and doctoral level degree), MS disease course (three categories: relapsing-remitting MS or RR-MS, secondary progressive MS or SP-MS, and primary progressive MS or PP-MS), and DMT treatment status (binary variable: on DMT treatment, not on DMT Treatment) were obtained from the study database.

The differences between the means of continuous demographic variables such as age, disease duration, and treatment duration were assessed with the *t*-test. The differences in the distributions of categorical variables such as gender, education level, disease course, and race/ethnicity were assessed with the Fisher's exact test for dichotomous variables and the chi-square test for non-dichotomous categorical variables.

The differences in proportions of CAM usage in MS patients before MS diagnosis, MS patients after MS diagnosis, and HC were assessed with the *z*-test, which was implemented in Microsoft Excel. The Benjamini-Hochberg method was used to control the false discovery rate to ≤ 0.05.[16] The unadjusted *p*-values are presented in the Tables.

The associations of CAM usage after MS diagnosis (dependent variable) with age were examined in univariate logistic regression.

Multivariate logistic regression was used to assess the associations of CAM usage after MS diagnosis (dependent variable) with gender, education level, DMT treatment status, and disease course as categorical predictors and age as continuous predictors. Similar multivariate logistic analyses were used to individually investigate acupuncture, chiropractor, and massage usage after MS diagnosis as dependent variables.

Results

Demographic and clinical characteristics

A total of 828 subjects comprising 524 MS patients and 304 HC were included for the analysis. The demographics of the MS patients and HC are shown in Table 1. The majority of the MS patients (66.4%) had RR-MS. The majority of the subjects were female; the percentage of females in the MS group was 70.8% and that in the HC group was slightly lower at 63.3% ($p=0.025$). Both groups had a predominance of Caucasians; the percentages of Caucasian subjects were 93.1% and 87.0% in the MS and HC groups, respectively ($p=0.001$). The average age of the MS group (47.6 ± 11.1 years) was not significantly different ($p=0.091$) from the HC group (45.9 ± 15.1 years).

CAM usage in MS patients versus controls

Table 2 summarizes the CAM usage patterns in HC and in MS patients before their MS diagnosis and after their MS diagnosis. We also obtained information on whether HC and MS patients had utilized CAM in the preceding 3 months. The percentage of HC using CAM (30.0%) was similar to the percentage of MS patients using CAM after MS diagnosis (30.5%). However, the CAM usage was higher in MS patients after MS diagnosis compared to before MS diagnosis (15.7%). Furthermore, MS patients (18.2%) were substantially more likely to report CAM usage in the preceding 3 months compared to HC (0.8%). This is not surprising given the chronic nature of MS.

The three most frequently used CAMs by MS patients after diagnosis were chiropractor (21.6%), massage (14.6%), and acupuncture (10.3%). For the HC, the three most commonly used CAMs were also chiropractor (27.3%), massage (16.7%), and acupuncture (6.5%). The frequency of the use of each CAM in MS patients and HC is shown in Table 2.

Table 1. Demographics of MS Patient Group Compared to Controls

Demographics	*MS*	*Controls*
Females: Males (% Female)	371:153 (70.8%)	192:112 (63.3%)[a]
Disease course		
Relapsing remitting	348 (66.4%)	
Secondary progressive	139 (26.5%)	
Primary progressive	37 (7.1%)	
Race/ethnicity (%)[b]		
Caucasian	486 (93.1%)	261 (87.0%)
African American	22 (4.2%)	23 (7.7%)
Hispanic Latino	9 (1.7%)	3 (1.0%)
Asian	2 (0.4%)	10 (3.3%)
Other	3 (0.5%)	0 (0%)
Age, years	47.6 ± 11.1	45.9 ± 15.1
Disease duration, years	15.2 ± 10.5	
Treatment duration, years	4.32 ± 3.88	
Median EDSS (IQR)	3.0 (4.0)	

[a]Males include two transgender males.
[b]Race data were missing for four HC and two MS patients.
HC, healthy controls; MS, multiple sclerosis.

Except for the modestly higher frequency of Aromatherapy usage in HC compared to MS patients after diagnosis (4.0% in HC vs. 1.0% in MS patients after diagnosis, $p=0.02$), we did not obtain evidence for significant differences in the frequencies of usage of other CAM modalities between the MS patients and HC.

CAM usage before MS diagnosis versus after MS diagnosis

The three most commonly used CAMs for patients before MS diagnosis were the same as those of after MS diagnosis: chiropractor (12.3%), massage (4.2%), and acupuncture (2.1%). The percentage of patients using chiropractor, massage, acupuncture, naturopathy, and homeopathy was higher among CAM in the MS patients after MS diagnosis compared to the MS patients before MS diagnosis.

MS patients' motivations for CAM usage

Our questionnaire included comments from MS patients regarding their reasons for CAM usage. Comments were provided by 157 (31.6%) of the included MS patients. MS patients reported diverse reasons for using CAMs (Table 3). The most frequently reported reason was to relieve general MS symptoms ($n=50$, 30.3% of responders) followed by back problems (23.6% of responders) and pain (11.5% of responders). Spasticity, numbness/tingling, and walking were the most commonly indicated MS symptoms in patients' CAM usage comments.

Demographic and clinical factors associated with CAM usage

We first conducted univariate analyses to identify individual factors potentially associated with overall CAM usage frequency after diagnosis of MS. In addition, the frequencies of acupuncture, chiropractor, and massage usage, which are the three most commonly used CAMs utilized by MS patients, were investigated.

Effect of disease course. Table 4 summarizes the frequencies of overall CAM usage and of acupuncture, chiropractor, and massage in the RR, and secondary progressive and primary progressive MS subgroups. CAM usage after MS diagnosis was associated with MS disease course ($p=0.026$, chi-square test). We did not find evidence for significant differences between the RR-MS versus PP-MS groups on any of the CAM usage variables after MS diagnosis. However, overall CAM usage ($p=0.008$, z-test for proportions) and chiropractor usage ($p=0.018$, z-test for proportions) were higher in PP-MS group compared to the SP-MS after MS diagnosis.

Effect of gender. The percentage of female MS patients (33.4%) utilizing CAM after MS diagnosis was greater ($p=0.021$, Fisher's exact test, odds ratio = 1.66) than the percentage of male MS patients (23.2%) utilizing CAM after MS diagnosis. We did not observe significant gender differences in the utilization of acupuncture and chiropractor in MS patients after MS diagnosis. However, female patients (17.3%) utilized massage more frequently than males

Table 2. Frequency of CAM in Controls and MS Patients Before and After MS Diagnosis

CAM	Controls Count (%)	Before MS diagnosis Count (%)	After MS diagnosis Count (%)	Controls vs. after MS diagnosis p-value[a]	Before MS vs. after MS diagnosis p-value[a]	Controls last 3-mo. Count (%)	MS last 3-mo. Count (%)
Valid cases, *n*	275	522	522	—	—	248	522
Overall CAM usage	88 (32.0%)	82 (15.7%)	159 (30.5%)	0.65	<0.001	2 (0.8%)	95[b] (18.2%)
Acupuncture	18 (6.5%)	11 (2.1%)	54 (10.3%)	0.08	<0.001	0 (0%)	11 (2.1%)
Aromatherapy	11[c] (4.0%)	5 (1.0%)	8 (1.5%)	0.02	0.40	0 (0%)	6 (1.1%)
Ayurveda	2 (0.7%)	1 (0.2%)	4 (0.8%)	0.95	0.18	0 (0%)	0 (0%)
Chinese herbal medicine	5 (1.8%)	3 (0.6%)	8 (1.5%)	0.76	0.13	0 (0%)	1 (0.2%)
Chiropractor	75 (27.3%)	64 (12.3%)	113 (21.6%)	0.08	<0.001	2 (0.8%)	58 (11.1%)
Electromagnetic therapy	6 (2.2%)	2 (0.4%)	8 (1.5%)	0.51	0.06	0 (0%)	2 (0.4%)
Homeopathy	14 (5.1%)	4 (0.8%)	15 (2.9%)	0.11	0.011	0 (0%)	9 (1.7%)
Hypnosis	4 (1.5%)	7 (1.3%)	4 (0.8%)	0.35	0.36	0 (0%)	1 (0.2%)
Massage	46 (16.7%)	22 (4.2%)	76 (14.6%)	0.42	<0.001	0 (0%)	44 (8.4%)
Naturopathy	7 (2.5%)	2 (0.4%)	13 (2.5%)	0.96	0.004	0 (0%)	3 (0.6%)
Qi gong, Reiki	6 (2.2%)	5 (1%)	13 (2.5%)	0.79	0.06	0 (0%)	6 (1.1%)
Therapeutic touch	9 (3.2%)	4 (0.8%)	7 (1.3%)	0.06	0.36	0 (0%)	3 (0.6%)
Bee stings	1[d] (0.4%)	1 (0.1%)	3 (0.6%)	0.69	0.32	0 (0%)	1 (0.2%)
Other	5[d] (1.8%)	3 (0.6%)	9 (1.7%)	0.92	0.08	0 (0%)	6 (1.1%)

[a]Z-test for proportions.
[b]$n=523$.
[c]$n=264$.
[d]$n=274$.
CAM, complementary and alternative medicine; MS, multiple sclerosis.

(7.9%) after MS diagnosis ($p=0.006$, Fisher's exact test, odds ratio = 2.41).

Effect of age. In univariate logistic regression, age was not associated with CAM usage after MS diagnosis. We did not obtain evidence for associations of acupuncture, chiropractor, or massage usage after MS diagnosis with age.

Effect of education. The distribution of educational levels in our MS patient group was as follows: 4.6% had not completed high school, 17.9% had completed high school, 17.9% had some college, 17.1% had an associate or technical degree, 22.7% had a bachelor's degree, 14.1% had graduate level education, and 5.6% had a doctoral level degree. The educational level was associated with usage of CAM after MS diagnosis ($p=0.034$, chi-square test). MS patients with a postgraduate degree (e.g., doctorate degree) utilized CAM more frequently (55.2%) after MS diagnosis compared to patients in the other educational levels (range: 22.1% in the group that completed high school to 34.8% in the group with an associate or technical degree). The usage of massage after MS diagnosis was associated with educational level ($p<0.001$, chi-square test); MS patients with a postgraduate degree (e.g., doctorate degree) utilized massage more frequently (41.4%) after MS diagnosis compared to patients in the other educational levels (range: 7.6% in the

Table 3. Reasons for Using CAMs as Described in MS Patients' Comments

Primary reason	Frequency (%)	Other keywords in comments
Help MS or MS symptoms	50 (30.3%	Spasticity (6), Numbness/Tingling (2), Back problems (2), MS diagnosis issues (2), Walking (2), Fatigue, Pain
Back Problems	39 (23.6%)	Pain (5), Disks (2), Legs, Injuries, Hip, Prevention, Scoliosis
Pain	19 (11.5%)	Migraines (2), Disks, Accident, Spasticity
Health	12 (7.27%)	Headaches
Relaxation or stress relief	11 (6.67%)	Flexibility, Health, Divorce
Other disease or conditions	10 (6.06%)	Cancer, Arthritis, RLS, Yeast infection, Pregnancy, Quit smoking (2)
Neck Problems	8 (4.85%)	Pain, Help MS
Alternative therapy	6 (3.64%)	Massage, Chelation, Natural option (2)
Curious	5 (3.03%)	Recommended, See how it works, Try it
Car Accident	2 (1.21%)	Feels good
Feel/s good	2 (1.21%)	
Fatigue or energy	1 (0.61%)	
Total responders	165	
No comment, declined	357	

Other keywords in the comments are also indicated. The frequency of keywords used more than once is shown in parenthesis.
CAM, complementary and alternative medicine; MS, multiple sclerosis; RLS, restless legs syndrome.

Table 4. Patterns of CAM Use by MS Disease Course

	Before MS diagnosis			*After MS diagnosis*			*Last 3 months*		
CAM	*RR-MS*	*SP-MS*	*PP-MS*	*RR-MS*	*SP-MS*	*PP-MS*	*RR-MS*	*SP-MS*	*PP-MS*
Valid cases, *n*	346	139	37	346	139	37	346	139	37
Overall CAM usage	62 (17.9%)	12 (8.6%)	8 (21.6%)	109 (31.5%)	33 (23.7%)	17 (45.9%)	61 (17.6%)	21 (15.1%)	13 (35.1%)
Acupuncture	7 (2.0%)	3 (2.2%)	1 (2.7%)	35 (10.1%)	13 (9.4%)	6 (16.2%)	6 (1.7%)	2 (1.4%)	3 (8.1%)
Chiropractor	49 (14.2%)	8 (5.8%)	7 (18.9%)	76 (22.0%)	24 (17.3%)	13 (35.1%)	40 (11.6%)	10 (7.2%)	8 (21.6%)
Massage	15 (4.3%)	3 (2.2%)	4 (10.8%)	51 (14.7%)	19 (13.7%)	6 (16.2%)	32 (9.2%)	9 (6.5%)	3 (8.1%)

CAM, complementary and alternative medicine; MS, multiple sclerosis; PP-MS, primary progressive MS; RR-MS, relapsing-remitting MS; SP-MS, secondary progressive MS.

group that completed some college to 20.2% in the group with an associate or technical degree). Chiropractor use was not associated with educational level.

CAM usage in patients not on disease-modifying therapies. CAM usage is often considered ''complementary'' when it is used in combination with approved DMT and ''alternative'' when it used instead of DMT. In our study, we had data on current DMT status and self-reported CAM usage in the last 3 months. In the DMT group ($n=393$), 27.1% of subjects indicated they used CAM, whereas the frequency of CAM usage in the group not on DMT ($n=115$) was significantly ($p=0.004$ in Fisher's exact test, odds ratio = 1.92) higher at 41.7%. This indicates that a subset of MS patients is possibly utilizing CAM as an ''alternative'' to conventional DMT after MS diagnosis. The demographics of patients using and not using DMTs are summarized in Table 5. The frequency of PP-MS was higher in the group not on DMT; this is not surprising given the lack of approved drugs for PP-MS. The usage of acupuncture after MS diagnosis was higher ($p=0.013$ in Fisher's exact test, odds ratio = 2.22 [Table 6]) in MS patients who were not on DMT (16.5%) compared to MS patients who were on DMT (8.2%). The findings for chiropractor and massage were not significant.

Multivariate analyses of CAM usage after MS diagnosis. To address the contribution of the covariates acting together, we conducted multivariate logistic regression analyses that included CAM usage after MS diagnosis as the dependent variable and with age, gender, education level, MS disease course, and DMT treatment status as predictors.

In the multivariate logistic analysis of overall CAM usage after MS diagnosis, gender ($p=0.002$, odds ratio = 2.10, for females with males as the reference group), education level ($p=0.014$), MS disease course ($p=0.014$), and DMT treatment status ($p=0.009$, odds ratio = 0.541 for group on DMT with the group not on DMT as the reference group) were significant predictors; age was not associated.

For acupuncture use after MS diagnosis, only DMT treatment status ($p=0.026$, odds ratio = 0.481 for group on DMT with group not on DMT as the reference group) was a significant predictor. For chiropractor use after MS diagnosis, gender ($p=0.046$, odds ratio = 1.70 for females with males as the reference group) and MS disease course ($p=0.042$) were significant predictors.

Table 5. Demographics of Patients Using and Not Using Disease-Modifying Therapy

Demographics	*On DMT*	*Not on DMT*	*p-value*
Females: Males (% Female)[a]	283:110 (72.0%)	77:38 (67.0%)[a]	0.30[b]
Disease course[a]			
Relapsing-remitting	270 (68.7%)	65 (56.5%)	<0.001[c]
Secondary progressive	106 (27.0%)	32 (27.8%)	
Primary Progressive	17 (4.3%)	18 (15.7%)	
Race/Ethnicity (%)			0.26[c]
Caucasian	361 (92.1%)	109 (95.6%)	
African American	21 (5.4%)	1 (0.9%)	
Hispanic Latino	7 (1.8%)	2 (1.8%)	
Asian	1 (0.3%)	1 (0.9%)	
Other	2 (0.5%)	1 (0.9%)	
Age, years	47.3 ± 11.3	48.9 ± 10.6	0.18[d]
Disease Duration, years	15.0 ± 10.6	15.8 ± 10.3	0.46[d]
Treatment Duration, years	4.38 ± 3.89	2.30 ± 0.366	0.079[d]
Median EDSS (IQR)	3.0 (4.5)	3.5 (3.8)	0.053[e]

[a]DMT usage data not available for $n=14$ subjects for gender and disease course crosstabs. Race data were missing for $n=16$ of 522 subjects. Treatment duration was available only for $n=11$ subjects in the Not on DMT group.
[b]Fisher s exact test.
[c]Chi-squared test.
[d]Independent sample *t*-test.
[e]Mann–Whitney test.
DMT, disease-modifying therapies.

Table 6. CAM Usage Patterns in Patients Not on Disease-Modifying Therapy Compared to Those on Disease-Modifying Therapies

	Before MS diagnosis		*After MS diagnosis*		*Last 3 months*	
CAM	*DMT*	*No DMT*	*DMT*	*No DMT*	*DMT*	*No DMT*
Valid cases	391	115	391	115	391	115
Overall CAM usage	55 (14.1%)	25 (21.7%)	106 (27.1%)	48 (41.7%)	64 (16.4%)	29 (25.2%)
Acupuncture	9 (2.2%)	2 (1.7%)	32 (8.2%)	19 (16.5%)	7 (1.8%)	4 (3.5%)
Chiropractor	42 (10.7%)	20 (17.4%)	77 (19.7%)	33 (28.7%)	40 (10.2%)	17 (14.8%)
Massage	13 (3.3%)	9 (7.8%)	52 (13.3%)	23 (20.0%)	32 (8.4%)	12 (10.4%)

CAM, complementary and alternative therapies; DMT, disease-modifying therapies.

For massage use after MS diagnosis, gender ($p = 0.002$, odds ratio = 2.90 for females with males as the reference group) and education level ($p < 0.001$) were significant predictors.

Discussion

In this study of CAM usage in MS, we found that three most commonly used CAMs for both MS patients and HC are chiropractor, massage, and acupuncture. Surprisingly, there was no significant difference in the pattern of CAM usage between MS patients after MS diagnosis and HC. However, MS patients reported a significant increase in CAM usage after the onset of MS. Gender, MS disease course, educational level and DMT treatment status were identified as covariates associated with CAM usage after MS diagnosis. The most frequent reasons indicated by MS patients for CAM usage were MS symptom relief, back problems, and pain.

Our findings were qualitatively similar to those reported in other studies on CAM use in the MS population. In the analyses of the NARCOMS data set from the 20,778 MS patients, Marrie et al. found chiropractors, massage, and nutritionists as the most frequently reported CAM.[13] As highlighted in the Introduction, these authors also found that demographic factors contribute a smaller role as model predictors compared to clinical factors.[13] Because our data set was obtained in a clinical setting, we were able to investigate the associations between CAM usage and clinical and demographic factors more extensively. Nayak et al. reported that MS patients frequently use CAMs for symptomatic relief, which was consistent with our results.[4] Campbell et al. investigated on CAM use in MS patients at a Veterans Administration healthy facility in the United States.[17] They found that most frequently used CAMs among veterans with MS, a population that is predominantly Caucasian males, was chiropractor followed by massage and acupuncture, which were similar to our result in our sample of MS patients.[17] Fawcett et al. also had a similar ranking of the most popular CAMs used by MS patients, with physical therapy (chiropractic) as the most frequent; however, counseling was the second most popular CAM, followed by massage and acupuncture.

We did not include herbal and dietary supplements in this analysis because we have previously reported our findings for herbal and dietary supplements.[18] We found that 26.6% of MS patients used herbals for at least one month.[18] Rates in other studies ranged from 12.4% to 49.1%.[4,11,19] The most commonly used herbal supplement was evening primrose oil (40.4%), which was also used frequently in other studies.[9,11,20] In addition, we did not have data on medical marijuana use because enrollment was completed in 2012 before medical marijuana legalization in New York in July 2014.

Although our subjects are drawn from Western New York region of the United States, our CAM results are concordant with other CAM studies in MS patients. Nonetheless, we note that the study sample had <5% of minority groups—the usage of CAMs in African Americans, Hispanic/Latino Americans, and Asian Americans warrants further systematic study. Another potential limitation of this study is the potential for recall bias, which can result because MS patients may search their memories and personal histories more actively or extensively than HC for potential environmental factors in their efforts to understand their disease state. One of the strengths of our study is that it includes the large sample size of 828 subjects. In addition, our study is one of few CAM studies that includes HC for comparison to MS patients. We also compare the pattern of usage of CAMs before and after MS diagnosis.

Access and availability of CAMs are rapidly increasing in the United States. Many herbal products and dietary supplements are easily available over the counter at the pharmacy. Patients are increasingly exposed to, and influenced by, potentially misleading and unreliable information in advertising, on the Internet and social media that emphasizes the potential benefits of CAMs while downplaying the risks. The increase in availability of more information and access to CAMs, and dietary (DS) and herbal supplements can affect patients' perception and adherence to the prescribed therapies. Other socioeconomic factors such as the availability of insurance coverage for selected CAM modalities have also been contributing factors to the increased social acceptance and popularity of some CAMs.[21] Given the increasing appeal of CAMs, it is important to conduct well-designed clinical trials to identify the specific modalities that hold promise for improving outcomes and quality of life for MS patients.

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Author Disclosure Statement

Soohyun Kim, Lawrence Chang, Sirin Gandhi, and Dejan Jakimowski have nothing to disclose.

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