



Original article

Cross-sectional survey of complementary and alternative medicine used in Oregon and Southwest Washington to treat multiple sclerosis: A 17-Year update



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ABSTRACT

Background: In 2001, we conducted a survey on use of complementary and alternative medicine (CAM) in people with multiple sclerosis (pwMS) in Oregon and Southwest Washington to treat their disease.

Objectives, Methods: In 2018, we administered a revised survey in the same region to describe updated patterns of CAM use in pwMS and to compare changes in use, perceived benefit, and patterns of communication between participants and providers regarding CAM over the past 17 years.

Results: 81% of respondents in 2018 ($n = 1014$) used a CAM supplement (vitamins, minerals, herbs), 39% used mind-body therapies (mindfulness, massage), 41% used specific diet, and 81% used exercise to treat their multiple sclerosis. Since 2001, use of supplements, exercise, and mind-body therapies have increased (65% to 81%, 67 to 81%, and 14% to 39%). Participants were also nine times more likely to speak to their neurologists about CAM use (6.7% to 55.4%). In 2018, factors associated with CAM use included female sex, progressive disease, and longer time since multiple sclerosis diagnosis.

Conclusion: These findings highlight the high and increasing prevalence of CAM use in pwMS and factors associated with CAM use, and underscore the importance of research to investigate safety and efficacy of these therapies.

1. Introduction

Multiple sclerosis (MS) is a chronic inflammatory and neurodegenerative disease that affects nearly 1 million people in the United States (Wallin et al., 2019) and leads to more than \$7 billion in annual health care costs in the United States (Group et al., 2017; Adelman et al., 2013). Despite over 17 FDA-approved disease modifying therapies (DMT), 70–95% of people with MS (pwMS) report ongoing bothersome symptoms, including fatigue, gait dysfunction, and spasticity (Krupp, 2006; Minden et al., 2006). PwMS frequently turn to complementary therapies to help address their MS and related symptoms.

The National Institutes of Health define complementary and alternative medicine (CAM) as the use of unconventional therapies (such as herbs, supplements, diet, and mind-body therapies) either in conjunction with or in place of conventional medicines

(Complementary, Alternative, or Integrative Health 2019). CAM use is common, with 30% of all US adults using some form of CAM (Tindle et al., 2005; Falci et al., 2016). Among pwMS, the prevalence of CAM use ranges from 50–80% (Nayak et al., 2003; Gotta et al., 2018; Marrie et al., 2003). Nevertheless, most CAM therapies lack high-quality evidence to support their safety and efficacy in MS. In addition, many patients do not share their CAM use with their neurologists, and most neurologists do not receive formal training in CAM (Yadav et al., 2006). In 2011, the American Academy of Neurology (AAN) published the first large-scale, comprehensive evidence-based review and guideline of CAM for MS (Yadav et al., 2014). To the best of our knowledge, no follow-up surveys have evaluated changes in CAM use in pwMS since these guidelines were released.

Between 2001 and 2002, the Oregon Health & Science University (OHSU) MS Center surveyed 1913 pwMS in Oregon and Southwest

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Table 1

Number of individuals solicited to complete a survey of complementary and integrative health modality use in the Pacific Northwest by recruitment method. Some individuals were recruited by more than one method.

Method	Number of Individuals Solicited
National MS Society Electronic Newsletter	1958
MS Society of Portland, Oregon Email Blast	589
Facebook page for MS Connect NW	223
Facebook page for Pacific NW MS Friends	634
Facebook page for MS Society of Portland	633
OHSU MS Center:	
Electronic links sent through EHR	2324
Paper surveys offered in clinic	352
Paper surveys mailed to patients*	1747

EHR: Electronic health record.

* Paper surveys were mailed to patients who did not receive or did not open link through EHR.

Washington evaluating use and perceived benefit of CAM for their MS and published these findings (Yadav et al., 2006; Shinto et al., 2006; Shinto et al., 2005). In 2018, we administered a revised version of this survey to pwMS in the same geographic region. Here, we describe updated patterns of use and perceived benefit of CAM therapy in pwMS in 2018 as well as a comparison of changes in use and patterns of communication regarding CAM between participants and providers over the past 17 years. We also explore demographic and disease-specific variables associated with CAM use.

2. Methods

2.1. Study design, setting, and participants

Between August 2018 and March 2019, we distributed a revised version of the original 2001 CAM survey (Yadav et al., 2006; Shinto et al., 2006; Shinto et al., 2005) to pwMS in the same geographic region of Oregon and Southwest Washington states. We recruited participants through: a regional National MS Society electronic newsletter, the MS Society of Portland email list, three Facebook pages for MS groups in the Pacific Northwest, and at the OHSU MS Center (Table 1). Patients of the OHSU MS Center received a paper copy of the survey (either in clinic or by mail with prepaid return postage), or were sent a link to the survey through their electronic health record. Consented respondents were included in analyses if they: 1) reported a diagnosis of MS, and 2) completed at least 75% of the survey. The study was approved by the OHSU Institutional Review Board.

2.2. The survey

Respondents completed paper surveys or electronic surveys through REDCap, an online platform designed for electronic data capture (Harris et al., 2009). The study staff manually entered completed paper survey responses into REDCap. Participants given the link to the survey were directed to fill in responses directly into REDCap, either by themselves or with assistance. Survey sections included demographic and clinical characteristics, use and perceived benefits of conventional treatments including DMT and vitamin D, and use and perceived benefits of CAM including herbs and dietary supplements (hereafter referred to as supplements), diets, mind-body therapies (such as acupuncture, massage, meditation, tai chi, or yoga), conventional exercise, and cannabis (see supplement 1). We additionally queried the use of health-care related apps. We queried an expanded list of conventional and CAM therapies between 2001 and 2018 surveys in order to appropriately mirror current available therapies and trends. A full list of all queried therapies is included as the supplemental table and newly queried therapies are denoted with an asterisk. We otherwise took every effort to maintain the structure of the 2001 survey in order to

allow for the most accurate comparisons between the two surveys. Finally, we asked participants about the types of providers they see for MS care and with whom they communicated about use of CAM modalities and apps. Of note, although vitamin D is not an approved therapy for MS, it is often recommended by MS providers and was therefore considered a conventional therapy and not a CAM supplement in these analyses.

Participants were instructed to consider only therapies used to manage MS (as opposed to those for general health). Response options for questions about therapy use were: “currently using”, “used in the past”, or “never used”. Response options for therapy benefit were: “very”, “somewhat”, “not”, “beneficial”, or “unsure of benefit”.

Electronic surveys allowed only one response per question and no responses were required to proceed in the survey. We managed written responses in a systematic fashion to address logic errors. This survey was developed for the purpose of this study in order to address CAM use in pwMS in Oregon and Southwest Washington. Every effort was made to maintain a similar question format and structure to the original 2001 survey to allow for comparisons between the two studies. The survey was piloted with MS volunteers. No further validation efforts were taken.

2.3. Statistical methods

We report demographic data, variables of therapy use and perceived benefit with descriptive statistics (frequencies and means). To calculate frequencies of use, the denominator was the number of participants with an MS diagnosis who provided consent and completed at least 75% of the survey items; blank responses were counted as a “never used” response. To calculate frequencies of perceived benefit, the denominator was the number of participants who reported having used that particular therapy. We describe changes in use and perceived benefit between 2001 and 2018 surveys using descriptive statistics. We categorized respondents according to 2018 CAM supplement use: none, low utilization (1–5 supplements), and high utilization (≥ 6 supplements). ANOVA or Chi-square tests were used to compare the distribution of continuous or categorical respondent characteristics across categories of supplement use, respectively. Linear regression, Mantel-Haenszel, or Cochran-Armitage tests were used to assess for trends across ordered categories of CAM supplement use (p for trend). We used multinomial logistic regression to estimate bivariate associations (odds ratios, 95% confidence intervals) between respondent characteristics and the number of CAM supplements used in 2018. Statistical analysis was conducted in STATA 14. 2.

3. Results

The number of invitations to participate in the survey sent is presented in Table 1. The response rate for the survey could not be calculated as some people received an invitation through more than one route. Of the 1188 people who opened the REDCap link ($n = 824$) or submitted a paper survey ($n = 364$), 174 people had incomplete surveys (85.3%). The remaining 1014 respondents were included in these descriptive analyses (Table 1).

The majority of respondents were white (88%), female (76%), and college educated (56%; Table 2). The median number of years since first symptoms was 18 (IQR: 10–28 years), the median number of years from diagnosis was 12 (IQR: 5.5 - 21 years). Most respondents had relapsing MS (68%) with ‘no to moderate disability’ (66.9%), with moderate disability defined as ability to walk at least 1 block without support. Annual income ranged from $< \$25,000$ (16%) to more than $\$100,000$ (33%), and nearly all respondents (96%) currently had health insurance, including private and federal plans.

Table 2
Demographic and clinical characteristics of survey respondents in 2018 (N = 1014) compared to 2001 (N = 1913).

	2018 SURVEY N = 1014 N (%)	2001 SURVEY N = 1913 N (%)
MS Type		
Relapsing remitting	688 (67.9%)	937 (49%)
Primary progressive	96 (9.5%)	210 (11%)
Secondary progressive	135 (13.3%)	306 (16%)
Unknown	95 (9.4%)	
Years Since Diagnosis, mean (sd)	14.2 (10.4)	19.5 (12.3)
Years Since First Symptom, mean (sd)	19.5 (12.6)	
Age, years, mean (sd)		51.6 (11.7)
18–30	39 (3.8%)	
31–40	159 (15.7%)	
41–50	215 (21.2%)	
51–60	272 (26.8%)	
61–70	219 (21.6%)	
71 +	77 (7.6%)	
Missing	33 (3.3%)	
Sex		
Female	766 (75.5%)	1473 (77%)
Missing	35 (3.5%)	
Race		
AI or Alaska Native	4 (0.4%)	
Asian	5 (0.5%)	
Black or African American	28 (2.8%)	
Native Hawaiian or other PI	4 (0.4%)	
White	889 (87.7%)	1836 (96%)
More than one race	34 (3.4%)	
Unknown	15 (1.5%)	
Missing	35 (3.5%)	
Ethnicity		
Hispanic or Latino	31 (3.1%)	
Not Hispanic/Latino	865 (85.3%)	
Unknown	37 (3.6%)	
Missing	81 (8.0%)	
Education		
College degree	576 (56.8%)	727 (38%)
Missing education	32 (3.2%)	
Income		
< \$25, 000	165 (16.3%)	
\$25, 000–49, 999	172 (17.0%)	
\$50, 000–100, 000	260 (25.6%)	
> \$100, 000	337 (33.2%)	
Missing	80 (7.9%)	
Has Health Insurance		
Yes	972 (95.9%)	
Missing	37 (3.6%)	
Disability Status		
None to moderate	678 (66.9%)	1664 (87%)
Need walking support	264 (26.0%)	
Unable to walk	52 (5.1%)	
Missing	20 (2.0%)	

AI: American Indian; PI: Pacific Islander

Note: Slightly different data was queried in 2001. Data reprinted with permission from Yadav V, Shinto L, Morris C, et al. Use and self-reported benefit of complementary and alternative medicine among multiple sclerosis patients *Int J MS Care*. 2006;8:5–10. Copyright Consortium of Multiple Sclerosis Centers.

3.1. Current use and perceived benefit of cam therapies in 2018

The top 5 most frequently reported therapies to manage MS from each section of the survey are reported in Table 3. Of the 70% of respondents currently using a DMT, 37.5% were using infusion-based therapies, 32.2% were using oral therapies, and 30.2% were using injection-based therapies. A majority of respondents (84%) were taking vitamin D. 81% of respondents reported use of at least one CAM supplement to manage their MS. In addition, 39% of respondents reported using at least one mind-body therapy for their MS. Only 7% of people reported using acupuncture, yet of those, 81% perceived acupuncture to be highly beneficial. The most commonly followed diets in 2018 included the anti-inflammatory, low carbohydrate/high protein, low

fat, gluten-free, and food allergy elimination diets. Among these, 70% following an allergy elimination diet reported this to be highly beneficial. Exercise was popular with 81% actively exercising. All forms of exercise received high scores for benefit. Use of cannabis by participants to treat their MS was common: nearly 30% of respondents were using cannabis in a variety of forms at the time of response in 2018. Specific analyses of exercise and cannabis use will be explored in detail in future publications. Finally, a small percentage of respondents reported using therapies we deemed invasive or high-risk, such as dental amalgam removal or plasma infusions; 13 respondents reported receipt of venous stenting in the past.

3.2. Comparison of 2001 and 2018 surveys: use, perceived benefit, communication

CAM therapies that were currently used at the time of 2001 and 2018 surveys are presented in Table 4. Overall use of supplements has increased (65% in 2001 to 80.6% in 2018). The use of some supplements increased, including vitamin B12, cod liver oil, magnesium, melatonin and CoQ10, whereas use of other supplements declined (e.g. vitamin E, soy isoflavones, and multivitamins). In general, use of herbs generally has remained stable (15.4% to 16.8%). Use of specific herbs decreased over time (e.g. ginkgo biloba decreased from 8.4% to 1.5%, ginseng from 4.5% to 0.8%), with the possible exception of turmeric which was not queried in 2001. The use of specific diets has fluctuated over time; low-fat diets were more popular in 2001 (26.9% to 11.6%) whereas high-protein/low carbohydrate, gluten free, and food allergy elimination diets gained favor in 2018 (5.2% to 12.6%, 2.5% to 11.5%, 3.7% to 10.0% respectively). Yoga specifically and mind-body practices generally have increased substantially since 2001 (7.8% to 15.3% and 14.3% to 39.4% respectively) and the perceived benefit of both has remained high over time. Similarly, use of exercise to manage MS has increased over time (67% to 81%), and a particularly high percentage of current users in 2018 reported high perceived benefit across stretching (71.5%), walking (69.6%), and cardiovascular exercises (84.3%). The number of people reporting use of invasive therapies decreased from 2.2% in 2001 to 1.7% in 2018. Finally, we queried respondents on communication regarding CAM use. In 2001, 6.7% of respondents discussed CAM with their neurologist. Over the past 17 years, communication has increased nearly 9-fold with 55.4% of respondents discussing CAM with their neurologist in 2018.

3.3. Factors associated with high use of cam supplements in 2018

In bivariate analyses, increasing use of supplements in 2018 (current use) was significantly associated with increasing age, female sex, progressive MS, more years since diagnosis, lack of DMT use, and concomitant use of diet, exercise, and other CAM therapies (e.g. acupuncture, massage, mindfulness; p for trend ≤ 0.04 for all bivariate associations; Table 5). Among respondents ≥ 61 years of age, odds of high supplement utilization were 205% higher (OR 3.05; 95% CI 1.66 – 5.59) than respondents aged 18–40 years. Women were more likely than men to report supplement use overall, and women were more likely to use a higher number of supplements as compared to men (p for trend < 0.001). The odds of high supplement utilization among women were 144% higher than the odds for men (OR 2.44; 95% CI 1.43 – 5.59). Respondents with progressive MS were more likely to use a higher number of supplements compared to those with a relapsing remitting phenotype. In addition, respondents with longer disease duration were more likely to use a higher number of supplements: for every five years since diagnosis, odds of low supplement utilization increased nearly 10% (OR 1.09; 95% CI 1.00 – 1.19) and odds of high supplement utilization increased nearly 20% (OR 1.19; 95% CI 1.08 – 1.31). Among respondents who were not on DMTs, odds of high supplement utilization were 88% higher compared to those on DMTs. Finally, high supplement utilization was more likely in those currently using other CAM therapies. Education, income, and type of insurance (federal vs. commercial) were not associated with either high or low CAM supplement use.

Table 3

Overall use in each category (gray bars) and top five therapies per category used by people with MS in Pacific Northwest (N = 1014).

	2018 CURRENT USE % Reporting Current Use (n)	% of Current Users Reporting Very Beneficial (n)	LIFETIME USE % Reporting Lifetime Use (n)	% of Lifetime Users Reporting Very Beneficial (n)
Disease Modifying Therapy*	70.3 (708)	59.2 (419)	89.4 (907)	51.6 (468)
Ocrelizumab	19.0 (194)	38.1 (74)	21.0 (213)	38.0 (81)
Dimethyl fumarate	14.2 (142)	51.4 (73)	32.7 (330)	26.1 (86)
Glatiramer	11.0 (109)	52.3 (57)	45.3 (454)	21.1 (96)
Interferons	10.6 (105)	61.9 (65)	55.7 (560)	26.1 (146)
Natalizumab	6.3 (64)	81.3 (52)	18.5 (188)	54.8 (103)
Vitamin D	84.1 (853)	41.1 (351)	93.0 (943)	38.9 (367)
Supplements and Herbs	81.3 (825)	57.3 (473)	93.8 (951)	49.7 (473)
Multivitamin	44.1 (447)	25.5 (114)	73.8 (748)	16.8 (126)
Vitamin B12	40.8 (414)	36.2 (150)	62.6 (635)	27.9 (177)
Magnesium	25.6 (260)	38.1 (99)	41.8 (424)	26.4 (112)
Fish oil	25.4 (258)	22.9 (59)	49.2 (499)	13.6 (68)
Vitamin C	24.4 (247)	34.8 (86)	55.7 (565)	20.9 (118)
Mind and Body Therapies	39.3 (399)	66.9 (267)	70.5 (715)	48.5 (347)
Mindfulness	22.9 (232)	60.8 (141)	42.2 (428)	40.7 (174)
Massage	17.3 (175)	43.4 (76)	47.4 (481)	31.4 (151)
Yoga	15.3 (155)	84.5 (131)	50.7 (515)	52.2 (269)
Music therapy	8.1 (82)	46.3 (38)	13.3 (135)	35.6 (48)
Acupuncture	7.3 (74)	81.1 (60)	36.2 (367)	30.8 (40)
Diet	41.8 (424)	61.8 (262)	70.1 (711)	44.3 (315)
Anti-inflammatory	13.3 (135)	61.5 (83)	24.0 (244)	43.0 (105)
Low carbohydrate/high protein	12.6 (128)	55.5 (71)	35.2 (357)	30.8 (110)
Low fat	11.6 (118)	45.8 (54)	31.5 (319)	25.4 (81)
Gluten-free	11.5 (117)	62.4 (73)	23.7 (240)	37.1 (89)
Food allergy elimination	10.0 (101)	70.3 (71)	14.7 (149)	52.3 (78)
Exercise	81.1 (822)	78.8 (648)	96.7 (981)	72.7 (713)
Walking	59.4 (602)	69.6 (419)	85.2 (864)	59.4 (513)
Stretching	57.8 (586)	71.5 (419)	80.0 (811)	60.3 (489)
Cardiovascular	13.8 (140)	84.3 (118)	16.5 (167)	79.6 (133)
Weight bearing	10.7 (109)	83.5 (91)	13.5 (137)	74.5 (102)
Cannabis	29.7 (301)	70.8 (213)	50.1 (512)	47.9 (245)
Invasive Modalities	1.7 (17)	58.8 (10)	14.2 (144)	23.6 (34)
Dental amalgam removal	1.0 (10)	30.0 (3)	9.4 (95)	11.6 (11)
Plasma/whole blood infusions	0.6 (6)	83.3 (5)	2.3 (24)	58.3 (14)
Heavy metal chelation	0.4 (4)	100.0 (4)	2.7 (28)	25.0 (7)
Hyperbaric oxygen chamber	0.0 (1)	0 (0)	1.3 (14)	14.3 (2)
Bee sting therapy	0.0 (1)	0 (0)	1.3 (13)	17.7 (1)
Venous stenting	0.0 (0)	–	0.6 (6)	16.7 (1)

Top five therapies were derived from current use. Gray bars represent overall use/benefit for all therapies that were queried in that category, not just the top five.

* Six respondents reported currently using two disease modifying therapies and were excluded for all DMT descriptive data.

4. Discussion

This study provides an update of CAM use in 2018 and describes changes in the patterns of use and perceived benefit of CAM used to treat MS as well as changes in CAM communication patterns between pwMS and physicians in Oregon and Southwest Washington between 2001 and 2018. We also explored the demographic and disease-specific variables associated with high supplement use; in 2018, CAM use was associated with female sex, progressive disease, and longer duration since MS diagnosis. Overall, CAM use in pwMS has increased over the past 17 years, even as more conventional DMTs have entered the market. We found the largest increases in the use of specific supplements and more generally for mind-body therapies and exercise.

Our findings are consistent with current literature showing that CAM use is high among pwMS in the United States (57.1–84%) (Nayak et al., 2003; Yadav et al., 2006; Shinto et al., 2006; Shinto et al., 2005; Masullo et al., 2015), as well as internationally (44–81%) (Gotta et al., 2018; Huybregts et al., 2018) and is substantially higher than adults with chronic medical diseases, such as hypercholesterolemia, hypertension, or diabetes (25–31.5%) (Mbizo et al., 2018), general physical disabilities (19%) (Carlson and Krahn, 2006) and other common neurological conditions, such as migraine (46.5%), dementia (18.4%), or stroke (30.6%) (Wells et al., 2010). Our respondents are similar overall in terms of age, ethnicity, and sex and our survey features a similar methodology as compared to other studies cited above performed in the United States, suggesting these results are generalizable.

One potential major driver of increased CAM use is the influence of internet and social media on mindfulness, diet, and exercise-based lifestyle trends. A 2011 North American survey of nearly 13,000 pwMS found that nearly 60% of respondents consult the internet as their first source of information about MS despite concerns about its quality (Marrie et al., 2013; Hirasawa et al., 2012; Fassier et al., 2016).

In addition, our survey demonstrates a substantial shift in communication patterns regarding CAM use in that pwMS are 9 times more likely to discuss their CAM usage with their neurologist in 2018 as compared to 2001. This shift is reflected more broadly within the general medical community. A series of surveys of over 600 internists between 2004 and 2012 at an academic medical center demonstrated that physicians became significantly more likely to discuss CAM therapies with their patients and increasingly felt that including CAM therapies in their overall treatment approach had a positive impact on patient satisfaction (Wahner-Roedler et al., 2014; Wahner-Roedler et al., 2006). Despite this, physicians also report feeling they had insufficient training, expertise, and time to adequately counsel patients on CAM use (Corbin Winslow and Shapiro, 2002).

There are several factors that may contribute to physician discomfort in advising patients about CAM therapy. One is a paucity of research evaluating efficacy of CAM therapies to treat MS as either disease-modifying or symptomatic therapy. In 2014, the AAN conducted a systematic review to develop evidence-based guidelines on commonly used CAM for MS (Yadav et al., 2014). However, the resultant recommendations were limited by the paucity of high quality data for most of these therapies; of the 29

Table 4
Therapeutic modality use among people with MS in the Pacific Northwest in 2001 (N = 1913) and 2018 (N = 1014).

	2001 SURVEY % Reporting Current Use (n)	% of Current Users Reporting Very Beneficial (n)	2018 SURVEY % Reporting Current Use (n)	% of Current Users Reporting Very Beneficial (n)
Supplements*	65.0 (1243)	37.9 (471)	80.6 (817)	44.1 (360)
Vitamin C	33.2 (636)	32.5 (207)	24.4 (247)	34.8 (86)
Vitamin E	33.9 (648)	26.7 (173)	11.8 (120)	32.5 (39)
B-Complex	21.9 (418)	32.5 (136)	<i>not asked in 2018</i>	
Vitamin B12	19.6 (374)	37.7 (141)	40.8 (414)	36.2 (150)
Cod Liver Oil	12.5 (239)	31.4 (75)	25.4 (258)	22.9 (59)
Magnesium	15.9 (305)	30.2 (92)	25.6 (260)	38.1 (99)
Zinc	14.0 (267)	30.0 (80)	8.6 (87)	32.2 (28)
Evening Primrose Oil	7.3 (139)	28.8 (40)	2.3 (23)	30.4 (7)
EFA's	9.9 (190)	36.3 (6)	10.6 (107)	24.3 (26)
Selenium	8.5 (162)	29.0 (47)	2.0 (20)	40.0 (8)
Beta-carotene	5.9 (113)	22.1 (25)	1.1 (11)	18.2 (2)
Soy/Isoflavone	8.7 (167)	35.9 (60)	1.3 (13)	30.8 (4)
Melatonin	3.3 (63)	34.9 (22)	14.5 (147)	48.3 (71)
CoQ10	4.8 (92)	28.3 (26)	10.5 (106)	23.6 (25)
Multivitamin	50.6 (968)	28.4 (275)	44.1 (447)	25.5 (114)
Herbs	15.4 (294)	39.5 (116)	16.8 (170)	31.2 (53)
Ginkgo	8.4 (161)	34.8 (56)	1.5 (15)	6.7 (1)
Ginseng	4.5 (87)	40.2 (35)	0.8 (8)	12.5 (1)
St John's Wort	2.6 (50)	40 (20)	0.8 (8)	50.0 (4)
Chinese Herbs	3.0 (58)	48.3 (28)	1.7 (17)	29.4 (5)
Valerian	2.1 (41)	46.3 (19)	0.6 (6)	50.0 (3)
Kava Kava	1.8 (34)	29.4 (10)	0.3 (3)	33.3 (1)
Licorice	1.4 (26)	19.2 (5)	1.1 (11)	27.3 (3)
Turmeric	<i>not asked in 2001</i>		12.8 (130)	31.5 (41)
Diet	37.1 (709)	44.0 (312)	41.8 (424)	61.8 (262)
High protein, low carb	5.2 (100)	40.0 (40)	12.6 (128)	55.5 (71)
Low fat, low cholesterol	26.9 (514)	34.2 (176)	11.6 (118)	45.8 (54)
Vegetarian	5.1 (97)	34.0 (33)	5.3 (54)	57.4 (31)
Swank	9 (173)	62.4 (108)	3.6 (37)	78.4 (29)
Food Allergy	3.7 (70)	60.0 (42)	10.0 (101)	70.3 (71)
Wheat-free/Gluten-free**	2.5 (47)	63.8 (30)	11.5 (117)	62.4 (73)
Macrobiotic	0.3 (5)	20.0 (1)	0.5 (5)	60.0 (3)
Mind and Body Therapies	14.3 (274)	69.0 (189)	39.3 (399)	66.9 (267)
Yoga	7.8 (149)	70.5 (105)	15.3 (155)	84.5 (131)
Meditation	9.3 (177)	63.3 (112)	22.9 (232)	60.8 (141)
Exercise	67.0 (1282)	59.3 (760)	81.0 (822)	78.8 (648)
Water Aerobics	6.2 (118)	76.3 (90)	4.7 (48)	83.3 (40)
Stretching	48.2 (922)	53.4 (492)	57.8 (586)	71.5 (419)
Walking	38.7 (741)	51.1 (379)	59.4 (602)	69.6 (419)
Swimming	8.7 (166)	71.1 (118)	9.0 (91)	81.3 (74)
Invasive treatments	2.2 (42)	38.1 (16)	1.7 (17)	58.8 (10)
Plasma/blood infusion	0.2 (3)	100.0 (3)	0.6 (6)	83.3 (5)
Dental Amalgam removal	1.6 (30)	20.0 (6)	1.0 (10)	30.0 (3)
Heavy Metal Detox	0.6 (11)	72.7 (8)	0.4 (4)	100.0 (4)
Bee sting therapy	0.2 (3)	33.3 (1)	0	–
Hyperbaric Oxygen Chamber	0.1 (2)	50.0 (1)	0.1 (1)	0 (0)
Venous stenting	<i>not asked in 2001</i>		0.1 (1)	0 (0)

Gray bars represent overall use/benefit for all therapies that were queried in that category. 2001 and 2018 surveys did not query the same number of therapies; the 2018 survey generally asked about a larger number of therapies in each category.

* Does not include vitamin D or herbs.

** 2001 survey asked about wheat-free diet, 2018 survey asked about gluten-free diet.

therapies reviewed, only 2 had sufficient level A evidence to support a definitive guideline establishing a therapy as effective, ineffective, or harmful (Yadav et al., 2014). Dissemination of these guidelines, such as the inefficacy of ginkgo biloba to improve cognitive function (Lovera et al., 2012), may be responsible for the nearly 50% drop in use of ginkgo over the past 17 years demonstrated in our survey, and highlights the importance of guideline development.

Another potential barrier to CAM counseling by MS providers is a lack of evidence regarding their safety and potential interactions with other prescription medications. While CAM users are more likely to perceive herbs and supplements as a natural and safe alternative to conventional medications (Salamonsen, 2015), excessive use of supplements can lead to toxicity and has been associated with serious neurologic and systemic disease (Evans et al., 2018; Kim et al., 2019). Further, polypharmacy is more common in pwMS (Frahm et al., 2019) and higher utilization of both

prescription medications and supplements increase the risk of injurious falls (Cameron et al., 2015). Our study demonstrates increased use of supplements in those also using other forms of CAM. In light of this, physicians should engage those patients with high CAM supplement use, including patients who are older with longer-standing, progressive disease, in discussions regarding the risks and benefits of CAM therapy to manage their MS.

Several solutions can help bridge the divide between patient and provider demand and the lack of robust evidence-based guidelines regarding CAM use for MS. First, we need a more efficient feedback loop between patient and provider interest and the high-quality funded research focused on safety and efficacy necessary to provide updated evidence-based recommendations surrounding CAM therapies. The National MS Society developed a Wellness Research Work Group in 2015 (Motl et al., 2018) in order to prioritize this important work and

Table 5

Factors associated with increasing current supplement/herb use among people with MS in the Pacific Northwest (2018; N = 1014).

	None n = 183	1–5 Supplements n = 632	≥ 6 Supplements n = 199	p for trend	1–5 vs. None OR (95% CI)	≥ 6 vs. None OR (95% CI)
Age				<0.0001		
18–40	48 (27.7%)	123 (20.1%)	27 (13.8%)		1.00	1.00
41–60	83 (48.0%)	308 (50.2%)	96 (49.2%)		1.45 (0.96 - 2.19)	2.06 (1.18 - 3.59)
61 +	42 (24.3%)	182 (29.7%)	72 (36.9%)		1.69 (1.05 - 2.71)	3.05 (1.66 - 5.59)
Sex				0.0007		
Male	49 (28.3%)	137 (22.4%)	27 (13.9%)		1.00	1.00
Female	124 (71.7%)	475 (77.6%)	167 (86.1%)		1.38 (0.93 - 2.01)	2.44 (1.43 - 4.17)
MS Type				0.036		
RR	137 (83.0%)	420 (73.0%)	131 (73.2%)		1.00	1.00
Primary	13 (7.9%)	64 (11.1%)	19 (10.6%)		1.61 (0.86 - 3.01)	1.53 (0.73 - 3.22)
Secondary	15 (9.1%)	91 (15.8%)	29 (16.2%)		1.98 (1.11 - 3.53)	2.02 (1.04 - 3.94)
Years Since Diagnosis, mean (sd)	12.41 (9.30)	14.16 (10.37)	16.19 (11.39)	<0.0001	1.09 (1.00 - 1.19)*	1.19 (1.08 - 1.31)*
Years Since First Symptom, mean (sd)	16.46 (11.91)	19.59 (12.67)	21.79 (12.41)	<0.0001	1.11 (1.03 - 1.20)*	1.19 (1.10 - 1.30)*
Disability Status**				0.10		
None/Mild	97 (54.5%)	264 (42.4%)	87 (44.8%)		1.00	1.00
Moderate	61 (34.3%)	255 (41.0%)	81 (41.8%)		1.54 (1.07 - 2.21)	1.48 (0.95 - 2.30)
Severe	20 (11.2%)	103 (16.6%)	26 (13.4%)		1.89 (1.11 - 3.22)	1.45 (0.76 - 2.78)
College degree	99 (57.6%)	354 (57.6%)	123 (63.1%)	0.27	1.00 (0.71 - 1.41)	1.26 (0.83 - 1.92)
Income: 4 categories				0.21		
<\$25K	35 (20.7%)	104 (17.9%)	26 (14.1%)		1.00	1.00
\$25K-49,999	30 (17.8%)	105 (18.1%)	37 (20.0%)		1.18 (0.67 - 2.06)	1.66 (0.82 - 3.34)
\$50K-100,000	47 (27.8%)	162 (27.9%)	51 (27.6%)		1.16 (0.70 - 1.92)	1.46 (0.77 - 2.78)
>\$100K	57 (33.7%)	209 (36.0%)	71 (38.4%)		1.23 (0.76 - 2.00)	1.68 (0.91 - 3.10)
Type of Insurance Plan				0.62		
Federal	55 (32.9%)	209 (34.5%)	68 (35.2%)		1.00	1.00
Commercial	112 (67.1%)	397 (65.5%)	125 (64.8%)		0.93 (0.65 - 1.34)	0.90 (0.58 - 1.40)
Not Using DMT	43 (23.6%)	175 (28.0%)	72 (36.7%)	0.005	1.25 (0.85 - 1.84)	1.88 (1.19 - 2.96)
Using any						
Diet	54 (29.5%)	272 (43.7%)	134 (67.7%)	<0.0001	1.86 (1.30 - 2.66)	5.00 (3.12 - 8.01)
Mind and body therapies	47 (26.0%)	268 (43.2%)	118 (59.6%)	<0.0001	2.16 (1.49 - 3.14)	4.21 (2.64 - 6.70)
Exercise	128 (69.9%)	524 (83.3%)	183 (92.4%)	<0.0001	2.14 (1.46 - 3.15)	5.24 (2.76 - 9.97)

OR: Odds ratio; CI: Confidence interval.

* Odds ratio associated with 5-year increase since diagnosis or symptom onset.

** Moderate disability includes "Moderate Symptoms" and "Some Walking Support Needed", Severe disability includes "Walking Support Required" and "Unable to Walk".

we hope this will incentivize physicians and scientists to continue to pursue this line of research. Second, regular didactics at national conferences and online should be developed to provide timely dissemination of new CAM-related research in order to keep physicians updated and to enhance effective patient education. Finally, physicians can incorporate CAM providers into an integrative care model, similar to those in oncology (Dobos et al., 2012), as a means to provide more effective, patient-centered care and to provide guidance on supplement-medication interactions.

Our study has several key strengths. First, to the best of our knowledge, this is the largest survey to provide an update on CAM use in pwMS. Second, 83% of respondents completed the survey, suggesting that survey fatigue was not a significant limitation of participation. Third, while many CAM surveys describe prevalence of use, our survey also highlights patterns of communication between providers and pwMS, making it directly applicable to healthcare professionals.

This study also has several limitations. First, the 2001 and 2018 surveys were slightly different: the updated 2018 survey queried an expanded list of CAM compared to 2001 in order to reflect changing trends in CAM therapies. This created challenges in comparing overall use of CAM within categories (e.g. 'supplements' or 'herbs'). Second, while participants were asked specifically to describe their use of therapies for MS management, some patients may have misunderstood the questions and responded with answers that reflected CAM utilization for overall health. Third, because we did not gather specific data on the reasons participants used CAM, we are unable to determine if CAM was being used in order to treat MS disease activity or MS-related symptoms. Fourth, the two surveys queried slightly different populations. While 2018 and 2001 populations are well-matched on sex (75% in 2018 vs. 77% female in 2001) and current use of DMT (73% vs.

68%), 2018 respondents had a higher level of education (31% vs. 17% graduate school or higher degree) and were more racially diverse (87.7% white vs. 96%). While this could represent shifts in the population of Oregon and Southwest Washington over the past 17 years, methodological factors such as administration of the survey online could have created selection bias and made the two surveys less comparable. Finally, the mostly white, highly educated, and affluent population that responded to the 2018 survey may limit generalizability.

In summary, our study provides an important update to CAM use by pwMS in Oregon and Southwest Washington between 2001 and 2018. CAM use overall has increased and pwMS are communicating more with their MS providers about their CAM use. Both pwMS and providers need high-quality evidence-based research to guide appropriate education regarding both safety and efficacy when CAM is in the MS treatment strategy.

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CRediT authorship contribution statement

Elizabeth Silbermann: Conceptualization, Investigation, Methodology, Writing - original draft. **Angela Senders:**

Conceptualization, Investigation, Methodology, Data curation, Formal analysis, Writing - original draft. **Lindsey Wooliscroft:** Conceptualization, Writing - review & editing. **Jessica Rice:** Conceptualization, Writing - review & editing. **Michelle Cameron:** Conceptualization, Writing - review & editing. **Carin Waslo:** Data curation, Writing - review & editing. **Anna Orban:** Data curation, Project administration, Writing - review & editing. **Emma Chase:** Data curation, Project administration. **Vijayshree Yadav:** Conceptualization, Writing - review & editing. **Dennis Bourdette:** Funding acquisition, Writing - review & editing. **Rebecca I Spain:** Funding acquisition, Conceptualization, Methodology, Investigation, Supervision, Writing - review & editing.

Declaration of Competing Interest

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Supplementary materials

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