Summary of evidence-based guideline: Complementary and alternative medicine in multiple sclerosis

ABSTRACT

Objective: To develop evidence-based recommendations for complementary and alternative medicine (CAM) in multiple sclerosis (MS).

Methods: We searched the literature (1970–March 2011; March 2011–September 2013 MEDLINE search), classified articles, and linked recommendations to evidence.

Results and recommendations: Clinicians might offer oral cannabis extract for spasticity symptoms and pain (excluding central neuropathic pain) (Level A). Clinicians might offer tetrahydrocannabinol for spasticity symptoms and pain (excluding central neuropathic pain) (Level B). Clinicians should counsel patients that these agents are probably ineffective for objective spasticity (short-term)/tremor (Level B) and possibly effective for spasticity and pain (long-term) (Level C). Clinicians might offer Sativex oromucosal cannabinoid spray (nabiximols) for spasticity symptoms, pain, and urinary frequency (Level B). Clinicians should counsel patients that these agents are probably ineffective for objective spasticity/urinary incontinence (Level B). Clinicians might choose not to offer these agents for tremor (Level C). Clinicians might counsel patients that magnetic therapy is probably effective for fatigue and probably ineffective for depression (Level B); fish oil is probably ineffective for relapses, disability, fatigue, MRI lesions, and quality of life (QOL) (Level B); ginkgo biloba is ineffective for cognition (Level A) and possibly effective for fatigue (Level C); reflexology is possibly effective for paresthesia (Level C); Cari Loder regimen is possibly ineffective for disability, symptoms, depression, and fatigue (Level C); and bee sting therapy is possibly ineffective for relapses, disability, fatigue, lesion burden/volume, and health-related QOL (Level C). Cannabinoids may cause adverse effects. Clinicians should exercise caution regarding standardized vs nonstandardized cannabis extracts and overall CAM quality control/nonregulation. Safety/efficacy of other CAM/CAM interaction with MS disease-modifying therapies is unknown.

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GLOSSARY

AAN = American Academy of Neurology; AE = adverse effect; CAM = complementary and alternative medicine; CBD = cannabidiol; CI = confidence interval; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, 4th edition; EDSS = Expanded Disability Status Scale; FDA = US Food and Drug Administration; FSS = Fatigue Severity Scale; GB = ginkgo biloba; GNDS = Guy’s Neurological Disability Scale; HRQOL = health-related QOL; MFIS = Modified Fatigue Impact Scale; MS = multiple sclerosis; MSIS = Multiple Sclerosis Impact Scale; OCE = oral cannabis extract; PPMS = primary progressive MS; QOL = quality of life; RCT = randomized controlled trial; RRMS = relapsing-remitting MS; SAE = serious adverse effect; SPMS = secondary progressive MS; THC = tetrahydrocannabinol; VAS = visual analog scale.

Complementary and alternative medicine (CAM) therapies are nonconventional therapies used in addition to or instead of physician-recommended therapies. CAM use is prevalent in 33%–80% of patients with MS, particularly among those who are female, have higher education levels, and report poorer health. This document summarizes extensive information provided in the complete...
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Cannabinoids. Cannabinoids are a group of compounds with psychoactive properties. Tetrahydrocannabinol (THC) and cannabidiol (CBD) are the major cannabinoids of cannabis. Synthetic cannabinoids are chemically related to THC. Orally administered cannabinoids (cannabis extract, synthetic THC), mucosally delivered cannabinoids (cannabis extract oral spray, nabiximols [trade name Sativex]), and smoked cannabis have all been studied for therapeutic effects in MS.

Oral cannabinoids (cannabis extract and THC). The search identified 9 studies (3 Class I,13-15 2 Class II,16,17 and 4 Class III18-21).

A large Class I study13 (N = 630; patients with relapsing-remitting MS [RRMS], primary progressive MS [PPMS], and secondary progressive MS [SPMS]; 15 weeks) found that neither oral cannabis extract (OCE, THC with CBD) nor synthetic THC (Marinol) had greater effect than placebo on the primary outcome measure of spasticity as measured by total Ashworth scale22 change from baseline (mean change ± SD: OCE: 1.24 ± 6.60, THC: 1.86 ± 7.95, placebo: 0.92 ± 6.56; p = 0.40). However, in this same study,13 significantly more patients reported reduced spasticity symptoms in the treatment groups (secondary outcomes spasticity/pain: OCE [52/46%], THC [51/50%], placebo [37/30%]). Sleep and muscle spasms also improved in the treatment groups.

In a second Class I study14 (N = 249; “stable MS,” type unspecified; 12 weeks) the proportion of patients achieving relief of muscle stiffness was 29.4% in the OCE group compared with 15.7% in the placebo group (odds ratio 2.26, 95% confidence interval [CI] CI 1.24–4.13). Secondary outcomes (muscle stiffness and spasms, pain, sleep) also improved in the cannabis group.

A third Class I study15 (N = 57; RRMS, SPMS, PPMS), insufficiently powered, found no significant difference in objective spasticity (Ashworth scale) or patient-reported spasm frequency.

In both adequately powered Class I studies,13,14 significantly more patients treated with cannabinoids reported reduced pain, whereas disability measures and health questionnaire results were not significantly different between groups. One Class I study13 assessed tremor and bladder symptoms and noted no significant difference in outcomes between patients treated with cannabinoids and placebo.

Conclusions. OCE is established as effective for reducing patient-reported spasticity symptoms and pain.
<table>
<thead>
<tr>
<th>CAM intervention</th>
<th>Description</th>
<th>Evidence</th>
<th>MS types studied</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mind-body medicine</strong></td>
<td></td>
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<tr>
<td>Biofeedback</td>
<td>Active physiologic monitoring of a body system (e.g., EMG activity). The results of the monitoring are provided to the patient in real time.</td>
<td>1 Class IIIe38</td>
<td>MSU</td>
<td></td>
</tr>
<tr>
<td>Music therapy</td>
<td>Uses music prescribed in a skilled manner by a music therapist</td>
<td>2 underpowered Class IIe49,e50</td>
<td>RRMS, PPMS, SPMS</td>
<td></td>
</tr>
<tr>
<td>Mindfulness-based training</td>
<td>Mental training by nonjudgmental awareness of moment-to-moment experience by mindfulness exercises including observation of sensory, affective, and cognitive domains of perceptible experience</td>
<td>1 Class IIIe51</td>
<td>RRMS, SPMS</td>
<td>None described</td>
</tr>
<tr>
<td>Hypnosis</td>
<td>Induction followed by a series of suggestions for analgesia and comfort. Patients practiced the skills by listening to an audio recording and using a cue to re-experience hypnotic effects.</td>
<td>1 Class IIIe42</td>
<td>Unspecified</td>
<td>None described</td>
</tr>
<tr>
<td><strong>Biologically based practices</strong></td>
<td></td>
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<tr>
<td>Padma 28</td>
<td>Ayurvedic mixture of 22 herbs with presumed immunologic effects on the suppressor lymphocytes and the endogenous interferon production</td>
<td>1 Class IIIe46</td>
<td>Progressive MS, type unknown</td>
<td></td>
</tr>
<tr>
<td>Linoleic acid</td>
<td>An unsaturated omega-6 fatty acid</td>
<td>2 underpowered Class IIe46,e47</td>
<td>MSU</td>
<td></td>
</tr>
<tr>
<td>Creatine monohydrate</td>
<td>A naturally occurring nitrogenous organic compound involved in energy metabolism (phosphocreatine)</td>
<td>1 underpowered Class IIe48</td>
<td>RRMS, MSU</td>
<td></td>
</tr>
<tr>
<td>Acetyl-L-carnitine</td>
<td>A naturally occurring compound that is the acetylated form of L-carnitine (synthesized from lysine and methionine)</td>
<td>1 underpowered Class IIe49</td>
<td>RRMS, SPMS</td>
<td></td>
</tr>
<tr>
<td>Inosine</td>
<td>Ribosylated precursor of uric acid, which raises uric acid levels. Uric acid is a scavenger of peroxynitrate, a highly reactive compound postulated to cause potentially toxic changes in MS plaques, including nitrination of tyrosine residues.</td>
<td>1 underpowered Class IIe50, 3 conflicting Class IIe51-e54</td>
<td>RRMS, SPMS</td>
<td>4/16 patients in 1 Class III study developed kidney stonese56</td>
</tr>
<tr>
<td>Threonine</td>
<td>Naturally occurring amino acid observed to increase glycine in rat spinal cord and therefore proposed as a treatment of spasticity</td>
<td>1 Class IIIe57</td>
<td>Progressive MS, type unspecified</td>
<td></td>
</tr>
<tr>
<td>Glucosamine sulfate</td>
<td>An amino sugar and a prominent precursor in the biochemical synthesis of glycosylated proteins and lipids, with potential immunoregulatory effects</td>
<td>1 underpowered Class IIe58</td>
<td>RRMS</td>
<td></td>
</tr>
<tr>
<td>Low-dose naltrexone</td>
<td>Long-lasting opiate receptor antagonist; may intermittently block opiate receptors resulting in increased endogenous production of endorphins and opiate receptors, promoting psychological well-being and general health</td>
<td>1 underpowered Class IIe59</td>
<td>All MS subtypes</td>
<td></td>
</tr>
<tr>
<td>Transdermal histamine with caffeine</td>
<td>Histamine is a neurotransmitter</td>
<td>1 Class IIIe61</td>
<td>RRMS and progressive MS, type unspecified</td>
<td></td>
</tr>
<tr>
<td>Hyperbaric oxygen therapy</td>
<td></td>
<td>1 Class I noninterpretable due to suboptimal control intervention (10% oxygen with nitrogen)</td>
<td>MS type unspecified</td>
<td></td>
</tr>
<tr>
<td><strong>Manipulative and body-based practices</strong></td>
<td></td>
<td></td>
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<tr>
<td>Hippotherapy</td>
<td>Therapeutic horseback riding where the subject is described as being passive</td>
<td>3 Class IIIe62-e74, 1 underpowered, 2 noninterpretable statistically evaluating effect on gait, balance, and mood</td>
<td>RRMS, SPMS, type unspecified</td>
<td>All MS subtypes</td>
</tr>
<tr>
<td>Yoga</td>
<td>Mind-body approach that has components of meditation, breathing, and postures</td>
<td>4 Class IIIe75-e76, 3 underpowered: evaluating effect on disability, spasticity, fatigue, cognition, mood, balance, and walking speed</td>
<td>MS types unspecified</td>
<td>All MS subtypes</td>
</tr>
</tbody>
</table>

Continued
**Table 1  Continued**

<table>
<thead>
<tr>
<th>CAM intervention</th>
<th>Description</th>
<th>Evidence</th>
<th>MS types studied</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Massage therapy</strong></td>
<td>Procedures involving penetration of the skin with needles in order to stimulate certain points on the body</td>
<td>1 Class III evaluating effect on QOL in SPMS</td>
<td></td>
<td>SPMS</td>
</tr>
<tr>
<td><strong>Chinese acupuncture</strong></td>
<td>Insertion of metallic needles into specific points and stimulating them electrically</td>
<td>1 Class III evaluating effect on disability, QOL, and pain</td>
<td></td>
<td>RRMS</td>
</tr>
<tr>
<td><strong>Electroacupuncture</strong></td>
<td>Therapist instructs patients to contract and release different muscle groups</td>
<td>1 Class III evaluating effect on pain, disability, spams, fatigue, cognition, and depression</td>
<td></td>
<td>RRMS, SPMS, PPMSe77</td>
</tr>
<tr>
<td><strong>Progressive muscle relaxation therapy</strong></td>
<td>A modified form of acupuncture with local anesthetic injections</td>
<td>1 Class III evaluating effect on disability</td>
<td></td>
<td>All MS subtypes</td>
</tr>
<tr>
<td><strong>Energy medicine</strong></td>
<td>Multimodal therapy including diet, herbs, nutritional supplements, homeopathy, physical medicine, and counseling</td>
<td>1 Class III evaluating effect on QOL, cognition, disability, depression, and fatigue</td>
<td></td>
<td>RRMS</td>
</tr>
</tbody>
</table>

Abbreviations: CAM = complementary and alternative medicine; MS = multiple sclerosis; MSU = MS type unspecified; PPMs = primary progressive MS; QOL = quality of life; RRMS = relapsing-remitting MS; SPMS = secondary progressive MS.

Studies cited using reference list in summary guideline article (appearing in print).

(12–15 weeks; 2 Class I,31-34 1 Class III19). This subjective benefit is possibly maintained for 1 year (1 Class II2). THC is probably effective for reducing patient-reported symptoms of spasticity and pain (15 weeks, 1 Class I3). This subjective benefit is possibly maintained for 1 year (1 Class II2).

OCE and THC are probably ineffective for reducing both objective spasticity measures and MS-related tremor symptoms (15 weeks, 1 Class I3). OCE and THC are possibly effective for reducing symptoms and objective measures of spasticity over 1 year (1 Class II2).

**Sativex oromucosal cannabinoid spray.** The search identified 3 Class I,25-27 2 Class II,26-27 and 3 Class III28-30 studies in patients with MS, type unspecified.

A Class I study, a randomized controlled trial (RCT)25 (N = 160, 6 weeks), evaluated the effect of Sativex spray (GW Pharmaceuticals, Salisbury, UK) delivering THC 2.7 mg and CBD 2.5 mg. Spasticity visual analog scale (VAS) was the only outcome measure on which scores improved significantly after Bonferroni correction (active −31.2, placebo −8.4, difference −22.79, 95% CI −35.52 to −10.07, p = 0.001). Scores on physician-evaluated spasticity measures (Ashworth) did not change between groups.

A Class I RCT25 (N = 66, MS type unspecified, 5 weeks) in MS-related central neuropathic pain found that oromucosal cannabinoids were superior for reducing mean pain intensity (number needed to treat to reduce pain by 50%: 3.7 [95% CI 2.2–13]). Another Class I RCT25 (N = 135, 10 weeks, MS type unspecified) did not find improvement in the number of incontinence episodes with Sativex. However, the daily number of bladder voids (change from baseline: treatment −1.95, placebo −0.9; p = 0.049) decreased significantly.25 A Class II RCT (N = 337, all MS types, 15 weeks)26 observed that tremor did not improve with Sativex.

**Conclusions.** Sativex oromucosal cannabinoid spray is probably effective for improving subjective spasticity symptoms (6 weeks, 1 Class I2), pain (5 weeks, 1 Class I2), and urinary frequency (10 weeks, 1 Class I2). Sativex oromucosal cannabinoid spray is probably ineffective for reducing objective spasticity measures over 6 weeks (1 Class I2) or bladder incontinence episodes over 10 weeks (1 Class I2).

Sativex oromucosal spray is possibly ineffective for reducing MS-related tremor over 15 weeks (1 Class II2).

**Smoked cannabis.** We reviewed 2 Class III studies.21-22 One Class III crossover study21 (37 patients, RRMS and SPMS, 2 weeks), reported spasticity reduction (modified Ashworth scale) in the cannabis group (standardized effect size 2.74, 2.2–3.14). Pain, the secondary outcome measure, also improved. After cannabis treatment, the subjects consistently showed reduced cognitive performance (Paced Auditory Serial Addition Test).23

A second Class III study22 (N = 20, MS type unspecified) found that both normal subjects and patients with MS fared worse on measures of posture and balance 10 minutes after smoking 1 marijuana cigarette. After Bonferroni correction, the effect was significant only for patients with MS (p = 0.018).

**Conclusions.** Data are inadequate to determine the safety or efficacy of smoked cannabis used for spasticity/pain (1 Class III19), balance/posture (1 Class I20), and cognition (1 Class I20).
**Table 2  CAM therapies with sufficient evidence to support practice recommendations in multiple sclerosis**

<table>
<thead>
<tr>
<th>CAM intervention</th>
<th>Number and class of studies</th>
<th>MS types studied</th>
<th>Outcome</th>
<th>Recommendation level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cannabinoids</strong></td>
<td></td>
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</tr>
<tr>
<td>OCE</td>
<td>2 Class I,13,14 1 Class II,17</td>
<td>RRMS, SPMS, PPMS, MSU</td>
<td>Symptoms of spasticity, pain</td>
<td>A Effective</td>
</tr>
<tr>
<td></td>
<td>1 Class III,18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Class I,13</td>
<td>RRMS, SPMS, PPMS</td>
<td>Signs of spasticity (short-term), tremor (short-term)</td>
<td>B Ineffective</td>
</tr>
<tr>
<td></td>
<td>1 Class II,17</td>
<td>MSU</td>
<td>Signs and symptoms of spasticity (long-term)</td>
<td>C Effective</td>
</tr>
<tr>
<td></td>
<td>2 Class I,15 1 Class II,16</td>
<td>RRMS, SPMS, PPMS, MSU</td>
<td>Bladder symptoms, urge incontinence</td>
<td>U</td>
</tr>
<tr>
<td>Synthetic THC</td>
<td>1 Class I,13 1 Class II,17</td>
<td>RRMS, SPMS, PPMS</td>
<td>Symptoms of spasticity, pain</td>
<td>B Effective</td>
</tr>
<tr>
<td></td>
<td>1 Class I,13</td>
<td>RRMS, SPMS, PPMS</td>
<td>Signs of spasticity (short-term), tremor (short-term)</td>
<td>B Ineffective</td>
</tr>
<tr>
<td></td>
<td>1 Class II,17</td>
<td>MSU</td>
<td>Signs and symptoms of spasticity (long-term)</td>
<td>C Effective</td>
</tr>
<tr>
<td></td>
<td>1 Class I,15 1 Class II,16</td>
<td>RRMS, SPMS, PPMS, MSU</td>
<td>Bladder symptoms, urge incontinence, central neuropathic pain</td>
<td>U</td>
</tr>
<tr>
<td>Sativex oromucosal spray</td>
<td>3 Class I,23-25 2 Class II,28,27</td>
<td>MSU</td>
<td>Symptoms of spasticity, pain, urinary frequency</td>
<td>B Effective</td>
</tr>
<tr>
<td></td>
<td>3 Class III,28-30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Signs of spasticity, incontinence episodes</td>
<td>B Ineffective</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tremor</td>
<td>C Ineffective</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Anxiety/sleep, cognition, QOL, fatigue</td>
<td>U</td>
</tr>
<tr>
<td>Smoked cannabis</td>
<td>2 Class III,31,32</td>
<td>RRMS, SPMS, MSU</td>
<td>Spasticity, pain, balance and posture, cognition</td>
<td>U</td>
</tr>
<tr>
<td><strong>Other CAM</strong></td>
<td></td>
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<tr>
<td>Ginkgo biloba</td>
<td>2 Class I,23-25 2 Class II,28,27</td>
<td>RRMS, SPMS, PPMS</td>
<td>Fatigue, Cognitive function</td>
<td>C Effective A Ineffective</td>
</tr>
<tr>
<td>Lofepramine plus phenylalanine with B12 (Cari Loder regimen)</td>
<td>1 Class II,16</td>
<td>RRMS, SPMS, PPMS</td>
<td>Disability, symptoms, depression, fatigue</td>
<td>C Ineffective</td>
</tr>
<tr>
<td>Reflexology</td>
<td>1 Class I,13 2 Class II,20,21</td>
<td>MSU</td>
<td>Paresthesia</td>
<td>C Effective</td>
</tr>
<tr>
<td></td>
<td>1 Class II,22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bee venom</td>
<td>1 Class II,16</td>
<td>RRMS, SPMS</td>
<td>Pain, HRQOL, disability, spasticity, fatigue, cognition, bowel/bladder function, depression, anxiety, insomnia</td>
<td>U</td>
</tr>
<tr>
<td>Magnetic therapy</td>
<td>1 Class I,20,21 2 Class II,28,27</td>
<td>RRMS, SPMS, PPMS</td>
<td>Fatigue, Depression</td>
<td>B Effective B Ineffective</td>
</tr>
<tr>
<td></td>
<td>3 Class III,21-14</td>
<td></td>
<td></td>
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<tr>
<td>Low-fat diet with omega-3</td>
<td>1 Class I,13 1 Class II,13</td>
<td>RRMS</td>
<td>Relapses, disability, MRI lesions, fatigue, QOL</td>
<td>B Ineffective</td>
</tr>
<tr>
<td>supplementation</td>
<td>1 Class I,14</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Abbreviations: CAM = complementary and alternative medicine; HRQOL = health-related QOL; MS = multiple sclerosis; MSU = MS type unspecified; OCE = oral cannabis extract; PPMS = primary progressive MS; QOL = quality of life; RRMS = relapsing-remitting MS; SPMS = secondary progressive MS; THC = tetrahydrocannabinol. A = established as effective or ineffective; B = probably effective or ineffective; C = possibly effective or ineffective; U = insufficient evidence to determine effectiveness or ineffectiveness.

Studies cited using reference list in summary guideline article (appearing in print) and e-references for print article (online data supplement).

**Cannabinoid practice recommendations.** Clinicians might offer OCE to patients with MS to reduce patient-reported symptoms of spasticity and pain (excluding central neuropathic pain) (Level A) and might counsel patients that this symptomatic benefit is possibly maintained for 1 year (Level C), although OCE is probably ineffective for improving objective spasticity measures (short-term) or tremor (Level B).

Clinicians might offer THC to patients with MS to reduce patient-reported symptoms of spasticity and pain (excluding central neuropathic pain) (Level B). Clinicians might counsel patients that this symptomatic benefit is possibly maintained for 1 year (Level C), although THC is probably ineffective for improving objective spasticity measures (short-term) or tremor (Level B).

Clinicians might offer Sativex oromucosal cannabinoid spray (nabiximols), where available, to reduce symptoms of spasticity, pain, or urinary frequency, although it is probably ineffective for improving objective spasticity measures or number of urinary incontinence episodes (Level B).

Clinicians might choose not to offer Sativex oromucosal cannabinoid spray to reduce MS-related tremor (Level C).

Data are inadequate to support or refute use of the following in MS (Level U):

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1. OCE/THC for bladder urge incontinence and overall symptoms
2. Synthetic THC (Marinol) for central neuropathic pain
3. Sativex oromucosal cannabinoid spray for overall bladder symptoms, anxiety symptoms/deep problems, cognitive symptoms, quality of life (QOL), and fatigue
4. Smoked cannabis for spasticity, pain, balance/posture, and cognition

Data are inadequate to determine the abuse potential or effect on psychopathologic symptoms of Sativex cannabinoid spray (Level U).

Clinical context. The cannabinoid studies have limitations that physicians and patients must be aware of. Most studies were of short duration (6–15 weeks). Another limitation was the potential for central side effects to unmask patients to treatment assignment—a concern with regard to all masked trials involving treatments with prominent side effects. It is also important to recognize that the Ashworth scale used for objective measurement may be insensitive to spasticity changes. These factors may contribute to the discordant effects of cannabinoids on subjective and objective spasticity measures.

Adverse effects. Cannabinoids were generally well tolerated, although some SAEs were reported. Few studies reported deaths in the cannabinoid-treated groups (1 due to pneumonia, 1 to seizure-related aspiration pneumonia, and 2 to cancer, presumed unrelated). Mild/moderate adverse effects (AEs) were common (approximately 50%–80% of subjects) and appeared to be equally prevalent in subjects receiving cannabinoids or placebo. No significant laboratory, hematologic, urologic, or cardiac changes, or differences in vital signs, were noted. CNS AEs (e.g., dizziness, somnolence, drowsiness, lightheadedness, memory disturbance, difficulty concentrating) were more common in subjects receiving cannabinoids vs placebo. Dizziness was most common (15%–50% of subjects). Gastrointestinal AEs, including increased appetite, nausea, vomiting, constipation, and dry/sore mouth, occurred in about 10% of subjects receiving cannabinoids and were more common in those receiving cannabinoids than placebo. Other less common AEs included myalgia, increased spasticity, seizures (4/137 subjects had seizures), lower limb weakness, hemorrhagic cystitis, dehydration, temporary psychosis (1 rated as severe), hallucinations, and oral ulceration.

Because cannabinoids have known psychoactive properties, their potential for psychopathologic and neurocognitive AEs is a concern, especially in a patient population that may be vulnerable due to underlying disorders. Depression and predisposition to psychosis have been reported with long-term cannabis exposure. Development of marijuana addiction is controversial; however, long-term heavy marijuana use has been associated with tolerance and dependence.

Evidence is also available, albeit inconsistent, for impairments in memory, concentration, and executive functions in chronic cannabis users, although it remains unclear how long these deficits persist after abstinence and whether there is permanent neurotoxicity. In 1 study, patients with MS and prolonged use of "street" cannabis had cognitive function impairments relative to patients with MS who did not use cannabis. Patients with MS who smoked cannabis regularly had more extensive cognitive abnormalities and were more likely to meet criteria for a lifetime DSM-IV psychiatric diagnosis. Although not generalizable to medical cannabis, the associations from these studies of street cannabis raise concerns. A substudy of the large Class I study reviewed here, available only in abstract form, reported a significant reduction in verbal learning and memory in patients with MS receiving cannabis extracts vs those receiving placebo. Several of the reviewed studies assessed psychopathology and cognition as secondary outcomes without significant AEs; however, these studies were short-term and inadequately powered to exclude an effect.

Clinicians should therefore counsel patients about the potential for psychopathologic/cognitive and other AEs associated with cannabinoids. Sativex oromucoal cannabinoid spray is not US Food and Drug Administration (FDA) approved and is unavailable in the United States. In the United States, caution should be exercised with regard to extrapolation of results of trials of standardized OCEs (which are unavailable commercially) to other nonstandardized, nonregulated cannabis extracts (which may be commercially available in states with medical marijuana laws).

Ginkgo biloba. We reviewed 4 studies (2 Class I, 2 Class II). A Class I RCT evaluating cognitive function (N = 39; RRMS, SPMS, PPMS) found that subjects taking GB 120 mg twice a day for 12 weeks had a 4.5-second greater (95% CI = −7.6–0.9, p = 0.015, nonsignificant [p < 0.008 significant per authors] after Bonferroni correction) improvement in the Stroop Color Word test than those taking placebo. A second Class I study (N = 121; RRMS, PPMS, SPMS, relapsing-progressive MS; 12 weeks) also found no difference in cognition measures with GB 120-mg administration twice a day compared with placebo, confirming the pilot study results.

The Class II study (N = 22, all MS types) found significantly greater fatigue reduction with GB 240 mg/day for 4 weeks relative to placebo (Modified Fatigue Impact Scale [MFIS] baseline: GB 37.8 ± 14.7, placebo 39.8 ± 15.1; postintervention: GB 30.5 ± 10.7, placebo 37.6 ± 11.8). GB 120-mg administration twice a day was associated with significantly greater fatigue reduction compared with placebo (p = 0.03).
The Cari Loder regimen is possibly ineffective for reducing MS-related disability, symptoms, depression, or fatigue (all MS subtypes, 1 Class II). The Class I study (underpowered RCT; N = 71; RRMS, SPMS, PPMS) compared 10 weekly 45-minute sessions of sham reflexology (foot massages) with precision reflexology. Both groups showed reductions in pain (VAS), disability (Roland Morris Disability Questionnaire), spasticity (VAS), fatigue (Multiple Sclerosis Impact Scale [MSIS]), Fatigue Severity Scale [FSS], MPIS), and depression (Beck Depression Inventory). Differences between groups were nonsignificant.

One Class II RCT (MS type unspecified, N = 71) found significantly greater reductions in paresthesia, urinary symptoms, and spasticity (Ashworth Scale) with 11 weekly reflexology treatments plus calf massage relative to calf massage alone. After Bonferroni correction, only the difference in paresthesia reduction remained significant (mean ± SD difference pre-/posttreatment in treated group −1.49 ± 2.11, controls 0.16 ± 2.11; p = 0.04).

Another Class II RCT (underpowered; SPMS, PPMS; N = 20; 16 weeks) of reflexology compared with sham treatments did not reveal improvement in the primary outcome of HRQOL (change in MSIS: 17; 95% CI −4.121 to 40.21, p = 0.112). Secondary outcomes of pain, spasticity, sleep, mood, and bowel/bladder function also did not change.

Conclusions. Reflexology is possibly effective for reducing MS-associated paresthesia over 11 weeks (MS type unspecified, 1 Class II). Data are inadequate to support or refute the use of reflexology for pain, HRQOL, disability, spasticity, fatigue, cognition, bowel/bladder function, depression, anxiety, or insomnia in MS.

Reflexology practice recommendation. Clinicians might counsel patients with MS that reflexology is possibly effective for treating disability, symptoms, depression, or fatigue (Level C).

GB is possibly effective for reducing fatigue (Level C). Clinicians might counsel patients that GB is established as ineffective for improving cognitive function (Level A).

Omega-3 practice recommendation. Clinicians might counsel patients that a low-fat diet with fish oil supplementation is probably ineffective for reducing MS-related relapse, disability, or MRI lesions, or for improving fatigue or QOL in MS (Level B).

Lofepramine practice recommendation. Clinicians might counsel patients with MS that lofepramine plus L-phenylalanine with vitamin B12 (Cari Loder regimen) is possibly ineffective for treating disability, symptoms, depression, or fatigue (Level C).

Conclusions. GB is established as ineffective for improving cognitive function in MS (12 weeks, 2 Class I). GB is possibly effective for reducing fatigue in MS (1 Class II).

Conclusion. The Cari Loder regimen is possibly ineffective for reducing MS-related disability, symptoms, depression, or fatigue (all MS subtypes, 1 Class II).

Low-fat diet with omega-3 fatty acid supplementation (omega-3). We reviewed 3 studies (1 Class I, 1 Class II, and 1 Class III). The Class I study (RRMS, N = 92) of omega-3 fatty acids (1,350 mg eicosapentaenoic acid and 850 mg docosahexaenoic acid daily) revealed no difference in the cumulative number of gadolinium-enhancing MRI lesions at 6 months, relapse rates at 6 and 24 months, disability progression, fatigue, or QOL.

The Class II study (1-year underpowered RCT, N = 27, RRMS) evaluated a low-fat diet supplemented with either omega-3 fatty acid (fish oil) or olive oil. There was no significant difference in health-related QOL (HRQOL), relapse rates, or disability.

Conclusion. A low-fat diet with fish oil supplementation is probably ineffective for reducing MS-related relapse, disability, or MRI lesions, or for improving fatigue or QOL (RRMS, 1 Class I).

Omega-3 practice recommendation. Clinicians might counsel patients that a low-fat diet with fish oil supplementation is probably ineffective for reducing relapses, disability, or MRI lesions, or for improving fatigue or QOL in MS (Level B).

Lofepramine. Lofepramine (a tricyclic antidepressant structurally related to imipramine and desipramine) combined with L-phenylalanine and IM vitamin B12 is known as the Cari Loder regimen. One 24-week Class II RCT (N = 138, all MS subtypes) compared the Cari Loder regimen with placebo pills and IM vitamin B12 (1 mg weekly). The primary outcome measures of disability did not change significantly (Guy’s Neurological Disability Scale [GNDS] −1.16 [95% CI −2.75 to 0.43], Expanded Disability Status Scale [EDSS] −0.17 [95% CI −0.39 to 0.05]). There was a small improvement in fatigue and symptoms, nonsignificant with Bonferroni correction. Depression did not improve.

Conclusion. The Cari Loder regimen is possibly ineffective for reducing MS-related disability, symptoms, depression, or fatigue (all MS subtypes, 1 Class II).

Reflexology. Reflexology involves applying manual pressure to points on the feet. We evaluated 4 studies (1 Class I, 2 Class II, and 1 Class III). The Class I study (underpowered RCT; N = 71; RRMS, SPMS, PPMS) compared 10 weekly 45-minute sessions of sham reflexology (foot massages) with precision reflexology. Both groups showed reductions in pain (VAS), disability (Roland Morris Disability Questionnaire), spasticity (VAS), fatigue (Multiple Sclerosis Impact Scale [MSIS]), Fatigue Severity Scale [FSS], MPIS), and depression (Beck Depression Inventory). Differences between groups were nonsignificant.

One Class II RCT (MS type unspecified, N = 71) found significantly greater reductions in paresthesia, urinary symptoms, and spasticity (Ashworth Scale) with 11 weekly reflexology treatments plus calf massage relative to calf massage alone. After Bonferroni correction, only the difference in paresthesia reduction remained significant (mean ± SD difference pre-/posttreatment in treated group −1.49 ± 2.11, controls 0.16 ± 2.11; p = 0.04).

Another Class II RCT (underpowered; SPMS, PPMS; N = 20; 16 weeks) of reflexology compared with sham treatments did not reveal improvement in the primary outcome of HRQOL (change in MSIS: 17; 95% CI −4.121 to 40.21, p = 0.112). Secondary outcomes of pain, spasticity, sleep, mood, and bowel/bladder function also did not change.

Conclusions. Reflexology is possibly effective for reducing MS-associated paresthesia over 11 weeks (MS type unspecified, 1 Class II). Data are inadequate to support or refute the use of reflexology for pain, HRQOL, disability, spasticity, fatigue, cognition, bowel/bladder function, depression, anxiety, or insomnia in MS.

Reflexology practice recommendation. Clinicians might counsel patients with MS that reflexology is possibly effective for reducing paresthesia (Level C).
significant effect on the number of new gadolinium-enhancing lesions on MRI, volume of enhancing lesions, total lesion volume, relapses, disability (EDSS, Multiple Sclerosis Functional Composite, \textsuperscript{27} GNDS), fatigue (Shortened Fatigue Questionnaire, \textsuperscript{28} Fatigue Impact Scale, \textsuperscript{29} or HRQOL (Short Form-36, \textsuperscript{30})).

AEs included tenderness, swelling, and redness at the sting sites; itching (4 subjects); and flu-like symptoms (5 subjects). \textsuperscript{31}

Conclusion. Bee sting therapy is possibly ineffective for reducing MS-related relapses, disability, fatigue, total MRI lesion burden, new gadolinium-enhancing lesion volume, or HRQOL (RRMS, SPMS; 1 Class II). \textsuperscript{31}

Bee venom practice recommendation. Clinicians might counsel patients with MS that bee sting therapy is possibly ineffective for reducing relapses, disability, fatigue, total MRI lesion burden, new gadolinium-enhancing lesion volume, or HRQOL (Level C).

Clinical context. Bee stings can be associated with anaphylactic reaction and possible death.

Magnetic therapy. The search identified 6 studies (1 Class I, \textsuperscript{31} 2 Class II, \textsuperscript{32,33} and 3 Class III). \textsuperscript{34-36}

The Class I 12-week RCT (N = 41; RRMS) reported significantly less fatigue (MFIS) with low-frequency pulsed electromagnetic field therapy (bioelectromagnetic-energy-regulation device, in the form of a metal mat upon which subjects lay for 8 minutes twice a day) (active 26.84 ± SE 12.061, placebo 36.67 ± 13.253; p = 0.024). Fatigue, measured by FSS, a secondary outcome measure, also decreased in the treated group (FSS mean [SD]: placebo 4.7 [1.6], treatment 3.5 [1.3], t = −2.53; p = 0.016). There was no change in depression or disability (EDSS). \textsuperscript{33}

However, an EDSS change may not have been detected because of the study’s short duration (EDSS may be insensitive to change in short-term disability).

A Class II underpowered RCT (N = 30; RRMS/progressive MS) found no significant change after Bonferroni correction in disability (EDSS) or patient-reported performance scale related to bladder control, cognition, fatigue, mobility, sensation, spasticity, vision, total performance, or hand function between subjects wearing wristwatch-size magnetic pulsing devices (Enermed device) (10–24 hours/day for 2 months) or inactive devices.

Another Class II underpowered RCT (N = 50; RRMS, SPMS, PPMS) found no significant difference in fatigue (MFIS, FSS) with low-frequency magnetic stimulation 3 sessions per week for 8 weeks (intensity 37.5 mT and a sequence of pulses at 4–7 Hz). \textsuperscript{35} Magnetic therapy was generally well tolerated; most studies reported no AEs. \textsuperscript{34-36} One study reported headache, spasms, and burning sensation. \textsuperscript{32}

Conclusions. Magnetic therapy is probably effective for reducing fatigue in RRMS (1 Class I, \textsuperscript{31} 1 Class III) and probably ineffective for reducing depression in RRMS over 15 weeks (1 Class I). \textsuperscript{31}

Data are inadequate to support or refute the effect of magnetic therapy on reducing MS-related disability (1 Class I with insensitive outcome measure; 1 underpowered Class II, \textsuperscript{32} bladder control problems, or spasticity, or on improving cognition, mobility, sensation, or vision (1 underpowered Class II, \textsuperscript{33} 3 underpowered/inconsistent Class III). \textsuperscript{34-36}

Magnetic therapy practice recommendation. Clinicians might counsel patients with MS that magnetic therapy is probably effective for reducing fatigue (Level B) and probably ineffective for reducing depression (Level B).

Other CAM therapies practice recommendation. Clinicians should counsel patients with MS that the safety and efficacy of other reviewed CAM, or the interaction of CAM with disease-modifying therapies for MS, are unknown (Level U).

LIMITATIONS This review has several limitations. Because the search strategy is limited only to MS, some potentially important AEs (e.g., bleeding risk with GB) \textsuperscript{37} of the reviewed therapies noted when they were evaluated in other diseases were not apparent in the MS population. Therapies that have received much press attention (e.g., dental amalgam removal, transdermal histamine) have little evidence to support recommendations.

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CONFLICT OF INTEREST

The American Academy of Neurology is committed to producing independent, critical and truthful clinical practice guidelines (CPGs). Significant efforts are made to minimize the potential for conflicts of interest to influence the recommendations of this CPG. To the extent possible, the AAN keeps separate those who have a financial stake in the success or failure of the products appraised in the CPGs and the developers of the guidelines. Conflict of interest forms were obtained from all authors and reviewed by an oversight committee prior to project initiation. AAN limits the participation of authors with substantial conflicts of interest. The AAN forbids commercial participation in, or funding of, guideline projects. Drafts of the guideline have been reviewed by at least 3 AAN committees, a network of neurologists, Neurology peer reviewers and representatives from related fields. The AAN Guideline Author Conflict of Interest Policy can be viewed at www.aan.com. For complete information on this process, access the 2004 AAN process manual.12

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