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REVIEW

Effects of Mind-body Movement Interventions for Managing Symptoms in People with Multiple Sclerosis: An Overview of Reviews

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Abstract

Purpose of Review Exercise is a recommended non-pharmacological approach to treat multiple sclerosis (MS) symptoms. Mind-body movement interventions (MBMIs) offer a multi-component exercise option that integrates movement, breathwork, and mindfulness. Using an umbrella review, we assessed the current best evidence on MBMIs (ai chi, dance, Pilates, qigong, tai chi, and yoga) for managing MS symptoms.

Recent Findings MBMIs significantly improved balance, equal to or superior to active controls (AC) or usual care (UC). Ai chi/tai chi/qigong significantly improved depression. Analyzed with other mind-body therapies, yoga reduced pain compared to AC/UC. Mixed results were found for fatigue. Physical function and quality of life were comparable to AC/UC. The certainty of evidence was low to very low for most MBMIs. Most reviews were “critically low” quality.

Summary MBMIs are commonly included in MS exercise reviews and may improve balance, pain, and depression. However, larger trials with active comparators and comprehensive reporting are needed to improve quality and certainty.

Keywords Mind-Body · Multiple sclerosis · Movement interventions · Yoga · Tai chi · Pilates · Qigong · Ai chi · Dance

Introduction

Exercise is recommended within clinical practice guidelines as a non-pharmacological approach to treat many symptoms of multiple sclerosis (MS) [1]. Meta-analyses of clinical trials find that exercise significantly improves balance, functional mobility, walking ability, endurance, fatigue, mental health, and quality of life in people with MS [2–6]. Research also suggests that exercise has disease-modifying as well as preventive effects on MS [7]. Despite these benefits, only about 20% of people with MS meet exercise recommendations [8, 9], with participation declining as disability increases due to deconditioning, fatigue, pain, and limited accessibility [9]. Low-impact exercises that integrate behavioral and physical activities, are enjoyable, and accessible, may facilitate engagement in exercise and manage MS symptoms.

Mind-body movement interventions (MBMIs) combine gentle movement, mental focus, and breathwork, making them potentially more accessible to people with more severe disability status. Examples include dance, Pilates, qigong, tai chi, and yoga. MBMIs also integrate physical, emotional, and cognitive domains, making them

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multicomponent interventions. MBMIs have been shown to support neuroplasticity, executive function, dual-task abilities, and memory [10–12]. Additionally, MBMIs often incorporate a mindfulness-based component, such as cultivating awareness of body sensations with curiosity, acceptance, and non-reactivity [13]. This is thought to enhance interoception, self-regulation, and emotional and physical resilience [13]. Recognizing their potential, the National Center for Complementary and Integrative Health included in its 2021–2025 strategic plan a call for more research on multicomponent interventions (e.g., MBMIs) as a means of promoting whole-person health [14].

MBMIs for MS

A growing body of research exists on the effects of MBMIs for individuals with MS, and multiple systematic reviews and meta-analyses have been conducted for MBMIs alone, as well as in combination with conventional exercise. However, results are often conflicting and may be subject to various biases and heterogeneity, leading to uncertainty regarding the most effective or appropriate interventions for people with MS. This report uses an "overview of reviews" methodology (hereafter referred to as "umbrella review") to assess the current best evidence on MBMIs for MS. Specifically, we aimed to understand both the content and quality of the existing evidence on MBMIs for people with MS to inform clinical guidelines and future research. Utilizing the internationally accepted Standard Outcome Set for MS, we evaluated three domains: (1) MS symptoms (fatigue, depression, and pain); (2) MS functional status, including cognition, physical function (e.g., walking, balance, muscle strength, endurance, and activities of daily living); and (3) health-related quality of life [14].

Methods

Descriptions of Selected MBMIs

Brief descriptions of modalities included in this study's definition of MBMIs are first provided, recognizing that this is not an exhaustive list, and that these modalities may be combined with other therapies. MBMIs are often delivered in a group setting, adding opportunities for social engagement and support, but may also include one-on-one sessions with a trained therapist.

Qigong, Tai Chi, and Ai Chi

Qigong, tai chi, and ai chi can be considered forms of traditional Chinese exercises (TCEs). Qigong dates back over 5,000 years and is based on the philosophical principles of classical Chinese medicine, focusing on balancing the flow of energy (or "qi") in the body. There are thousands of styles of qigong, which typically combine physical movements, mindfulness, and breathwork, and can also include visualization, vocalization, and self-massage [15]. Bodily movements are commonly performed while standing or sitting and can include stretching, shaking, and/or synchronizing arms and legs in rhythmic formation. Tai chi was initially developed as a martial art and considered a subtype of qigong [15]. Postures and movements are generally upright and involve long, choreographed "forms" that often include walking. Over the last 50 years, tai chi has gained popularity as a wellness exercise, with forms adapted for elderly populations and those with limited mobility (e.g., "Tai chi for arthritis and fall prevention" program [16]). Ai chi is a modern, aquatic adaptation of tai chi, and can be considered a form of aquatic exercise or hydrotherapy. Participants are shoulder-depth in warm water, conducting slow movements of the arms, legs, and torso, with emphasis placed on abdominal breathing synchronized to movement [17]. All TCEs emphasize body awareness combined with a relaxed mind and body.

Dance

Dance is defined as movement synchronized to rhythm or music [18]. Dance incorporates physical and motor skills, including stretching, balance, coordination, and aerobic exercise, with cognitive processes, including memory and perception [19]. It is commonly delivered in a culturally relevant context, with social, emotional, spiritual, and artistic aspects that make it enjoyable, thus promoting adherence [18]. In addition to more recreational or exercise-based dance, dance movement therapy is a type of psychotherapy administered by a trained therapist to specifically address psychological and/or medical conditions [20]. Dance movement therapy often incorporates aspects of mindfulness and somatic awareness [21, 22].

Pilates

Pilates is a mind-body exercise founded in the 1920 s by Joseph Pilates, a physical trainer and inventor. Emphasis is placed on building strength, flexibility, and core stability, particularly in the torso, low back, and pelvic regions, through proper muscle control, posture, and breathing [23]. Because much of the focus is on core stabilization, Pilates is often prescribed for lower back pain and injury [24]. Movements are performed either standing, sitting, or lying on a mat or spring-resistant reformer. Unlike the TCEs and yoga, which have philosophical and spiritual aspects stemming from ancient contemplative practices, Pilates can be considered more of a physical exercise. However, it does incorporate awareness of bodily sensations, postural control, and breathwork.

Yoga

Yoga originated in ancient India 2500–3000 years ago as a contemplative practice to achieve spiritual enlightenment [25]. Modern yoga is practiced primarily to promote physical and mental health, emphasizing postures (asanas) and breathing techniques (pranayama), but may also include meditation and chanting [26]. Different styles of yoga include traditional (e.g., hatha and ashtanga), which incorporate more meditation, chanting, and breathwork; exercise-based (e.g., vinyasa, power), focused more on physical movements; and therapeutic (e.g., restorative, gentle) [26]. Yoga is commonly performed on a mat, combining standing, seated, and reclined postures, but can be modified (i.e., chair yoga) for those with limited mobility.

Protocol Registration

To assess the evidence on MBMIs for MS, we followed the recommended conduct guidelines for umbrella reviews from the Cochrane Handbook of Systematic Reviews [27] and reporting guidelines for umbrella reviews from the Preferred Reporting Items for Overviews of Reviews (PRIOR) framework [28]. We also developed an a priori protocol, which was prospectively registered in the International Prospective Register of Systematic Reviews (PROSPERO) on March 25, 2025, at https://www.crd.york.ac.uk/PROSPERO/view/CRD420251019568.

Eligibility Criteria

Our review focused on peer-reviewed systematic reviews and meta-analyses. Unpublished grey literature (e.g., theses, dissertations) was also eligible if it met the inclusion criteria. A “systematic review” was defined a priori as a study that reported a clearly stated research question, conducted a systematic search of at least two databases, and employed a structured data synthesis to compare populations, interventions, and outcomes. Studies identifying themselves as scoping reviews were also included if they met the above criteria. Our population consisted of adults diagnosed with MS, regardless of subtype, disease severity, or duration.

We included reviews with at least one primary MBMI study (either stand-alone or combined with other therapies), including the following: qigong/tai chi/ai chi (or TCEs), dance therapy, Pilates, and yoga. Data from control or comparator groups were included when available. Reviews must have reported on at least one of the following domains: mood (e.g., depression), pain, cognition, balance, fatigue, physical function (e.g., walking ability, gait, muscle strength), and quality of life.

To reduce redundancy, only reviews published between 2015 and 2025 were included. We excluded narrative reviews that did not meet our criteria for a systematic review. Other umbrella reviews were excluded but were used for backward citation searching, consistent with the TARCiS statement [29]. We anticipated many reviews would have a mix of eligible and ineligible studies (e.g., both aerobic exercise and yoga).

Information Sources

We conducted database searches in PubMed/MEDLINE, EMBASE, Web of Science, Scopus, Academic Search Elite, AMED, Alt Health Watch, CINAHL Plus with Full Text, Health Source, Epistemonikos, PsycINFO, and the China Knowledge Resource Integrated Database. Additional sources included PROSPERO and the Cochrane Database of Systematic Reviews. We searched the grey literature using ProQuest (theses, dissertations) and the first 300 results from Google Scholar using a WebCrawler strategy [30]. Authors of potentially eligible but unpublished reviews were contacted to confirm publication status. No language restrictions were applied; articles in languages other than English were translated using DeepL Translate® and confirmed by native speakers when feasible. We investigated any discrepancies or uncertainties in a review by returning to the original primary study to verify data accuracy and context. A medical librarian peer-reviewed the PubMed search strategy using PRESS criteria [31]. A PubMed search filter for systematic reviews and meta-analyses was obtained from the University of Pittsburgh Health Sciences Library System [32]. The search strategy for each database, including terms, filters, limits, and search date, is available in Supplemental Table 1. The last search was conducted on April 22, 2025.

Selection Process

All citations were imported into Covidence software [33], and screened independently and in duplicate by two reviewers (LB, AB). Screening occurred in two stages: title/abstract and full text. Discrepancies were resolved through consensus. Reasons for exclusion at the full-text stage were recorded and presented in a flow diagram.

To address potential overlap of primary studies, we created a citation matrix of all relevant primary studies in each review. We removed reviews that included all primary studies found in other reviews and were rated “low” or “critically low” methodological quality (based on A MeaSurement

Tool to Assess systematic Reviews-2 (AMSTAR-2) scores) to avoid double-counting outcomes. We retained all reviews that (1) included a meta-analysis of relevant MBMI studies, (2), were rated "high" quality on AMSTAR-2, or (3) contained relevant primary studies not found in any other review to prevent data loss.

Data Collection Process

A standardized data extraction form was developed in Covidence and pilot tested by two authors (LB, AB). Data extraction was conducted independently and in duplicate with paired reviewers (AB, LB, OG, TM, RW), with discrepancies resolved through consensus. Extracted data included review-level characteristics (authors, publication year, list of included primary studies, and date of last search). We also collected population characteristics (age, sex, disease subtype), interventions (type, dose, frequency), comparators, outcomes, and follow-up duration if data specific to MBMIs were presented in the text. Methodological characteristics such as review design, synthesis methods, and heterogeneity metrics (e.g., I^2) were also recorded. Discrepancies in data across reviews were noted.

Primary outcomes included MS-related (1) symptoms (fatigue, depression, pain); (2) functional status (cognition, walking, balance, muscle strength, endurance, activities of daily living); and (3) health-related quality of life. These domains align with core outcome recommendations by Motl et al. (2017) and Daniels et al. (2023) [14, 34]. Secondary outcomes included other related measures within these domains. Outcome definitions were grouped based on similarity, and author-reported subgroup definitions were used when available.

Risk of Bias Assessment

Methodological quality of reviews was assessed using the AMSTAR-2 tool [35]. Ratings were completed independently and in duplicate, and checked for consensus among reviewer pairs (AB, LB, OG, TM, RW) in Covidence, with discrepancies resolved through discussion. Reviews were then given an overall score of "high," "moderate," "low," or "critically low" credibility based on the number of "Yes," "Partial Yes," or "No" answers, with more consideration given to critical domains identified by Shea et al. (2017) as Items 2, 4, 7, 9, 11, 13, and 15 [35]. Per published guidance, reviews were rated "high" if they had 0–1 non-critical weakness and no critical weaknesses; "low" if they had one critical weakness; and "critically low" if they had ≥ 1 critical weakness [35].

To assess the risk of bias (RoB) of primary studies, we documented the RoB ratings reported in each review, noting discrepancies between different reviews. We modified the assessment guidelines to calculate an overall "low" or "high" score for each study using the following process. For reviews using the Cochrane Risk of Bias tool (CRoB), we followed Cochrane's 2019 guidance [36] and rated a study as "low risk of bias" if all domains scored "low" or included one "unclear." A study was given an overall rating of "high risk of bias" if one domain was "high" or two or more were "unclear." Blinding in exercise studies is challenging, as the type of exercise may be evident to both participants and facilitators. However, this issue can be addressed by including an active comparator group (e.g., aerobic exercise). Because the CRoB tool deducts points for unblinded participants, we re-rated any primary study with an active comparator group by not marking down for participant blinding. For reviews using the Physiotherapy Evidence Database (PEDro) tool, we used the same criteria for blinding participants. Studies were rated "low" RoB if the total score was ≥ 6 (out of 10), and "high" if the score was ≤ 5, per published guidance. For the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument tool (JBI-MASTARI) guidelines, ≥ 7 points was "low" RoB, and < *6* points was "high," also per standard published guidance.

Synthesis Methods

A qualitative synthesis was conducted for meta-analyzed data from reviews that separately analyzed MBMIs. We did not re-analyze pooled data, but instead reported results as presented. Data from network meta-analyses comparing MBMIs to other treatments were also extracted. Measures of statistical heterogeneity (e.g., I^2) were extracted where reported. Umbrella-level heterogeneity was also considered, including variations in MS subtype, intervention characteristics, and review methodologies. Assessments of reporting bias (e.g., funnel plots, publication bias analyses) were extracted as reported in the included reviews.

Certainty Assessment

To assess the certainty of the evidence, we used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework for meta-analyses [37]. If a review conducted its own GRADE assessment, we used what was reported [37]. When GRADE was not provided or lacked sufficient detail, our team conducted GRADE independently and in duplicate. For network meta-analyses, we used the GRADE Working Group's framework for assessing the certainty of evidence in network meta-analyses [38]. To assess RoB for the GRADE framework, we used the RoB assessments described above. If ≥ 50% of studies within a review were rated as high RoB, the outcome was rated as having a "serious risk of bias" on the GRADE table and rated down one level of certainty.

Deviations from Original Protocol

Initially, we planned to assess all reviews that included MBMI studies. However, we discovered that many exercise reviews included a small number of MBMI studies, which were often analyzed together with conventional exercises or other interventions. To avoid redundancy and focus on reviews with the broadest coverage, we limited data extraction to reviews with ≥4 (or ≥50%) eligible studies. Furthermore, we discovered that synthesized outcome data for MBMIs were often not readily available because the data were combined. Therefore, we analyzed outcomes only for reviews that provided meta-analytic data for MBMIs.

Results

Review Selection

Our search yielded 1740 articles, and after removing duplicates, 965 titles and abstracts were screened, followed by 160 full text reviews (Fig. 1). We excluded 56 articles (see Supplemental Table 2), leaving 104 reviews with at least one relevant MBMI study. Within these, we created a matrix of primary studies and reviews to identify overlapping studies (Supplemental Table 3a, 3b). After selecting only reviews with ≥4 (or ≥50%) MBMI studies, we had 38 reviews. These were referred to as our "Main" reviews (Supplemental Table 4a), while all others were called "Supplement" reviews (Supplemental Table 4b). We then removed 10 reviews with overlapping studies (covered in other reviews) and "low" to "critically low" AMSTAR-2 scores [6, 39–47], leaving 28 reviews. Of these, only 7 reviews included meta-analytic

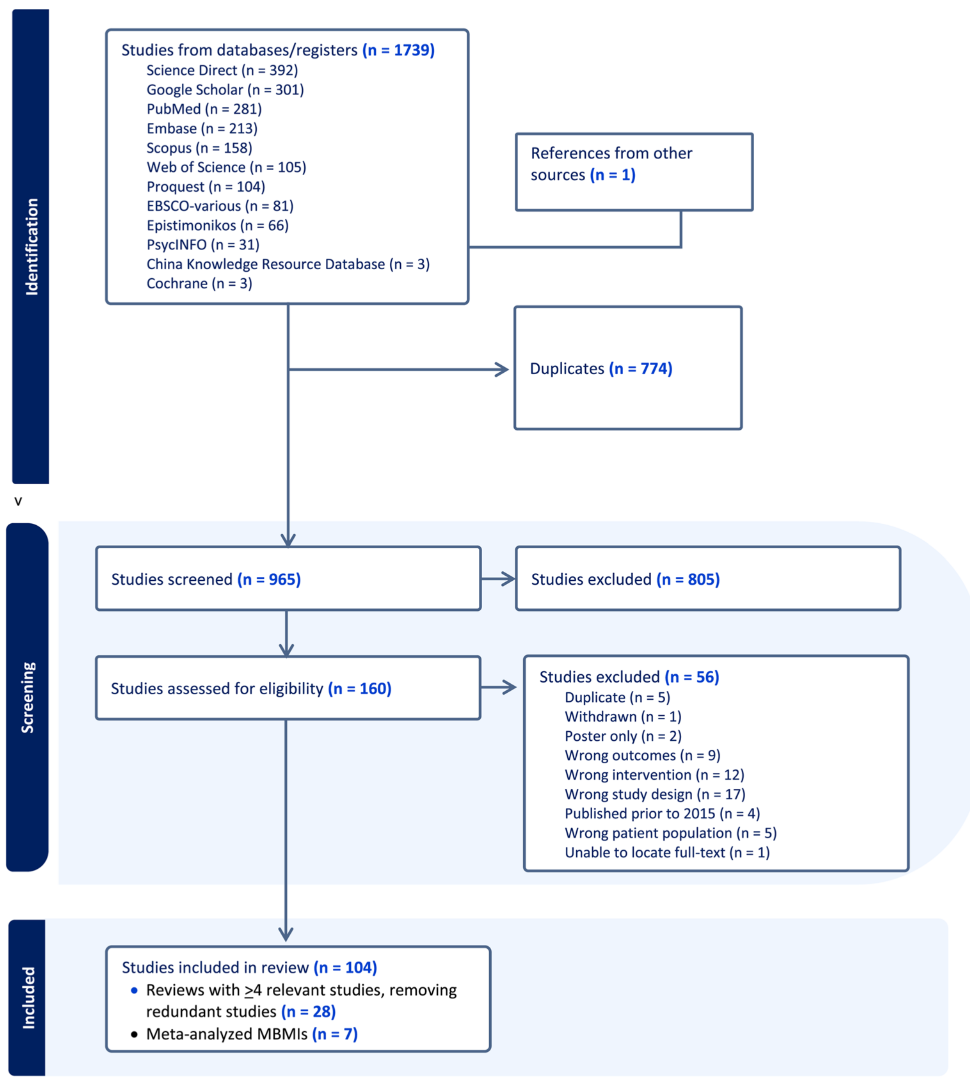

Fig. 1 Flow diagram for selection of reviews included in the umbrella review of mnd-body movement interventions (MBMIs) for multiple sclerosis

outcome data specific to our MBMIs of interest; thus, we limited outcome data to these 7 reviews [48–54].

Characteristics of Systematic Reviews

Table 1 provides a list of characteristics of the 28 reviews. The median number of MBMI primary studies in a review was 8 (range: 4 (our cut-off value) to 23). All reviews included randomized controlled trials, and 14 also included non-randomized studies. Of the 28 reviews, 4 included ai chi, 3 dance, 5 qigong, 15 Pilates, 9 tai chi, and 17 yoga.

Risk of Bias in Systematic Reviews and Primary Studies

Assessment of methodological quality (AMSTAR-2 ratings) for the 28 reviews found only 2 reviews rated "high," 6 rated "low," and 20 rated "critically low" (Table 2). "Critically low" reviews had 2 to 6 critical weaknesses. Most of the critical weaknesses pertained to a lack of an a priori protocol (Item 2); use of a comprehensive search strategy (e.g., checking published reviews and reference lists, justifying any language restrictions, and including grey literature) (Item 4); providing a list of excluded studies with justification for exclusion (Item 7); and accounting for RoB in individual studies when interpreting and discussing results (Item 13).

Risk of bias for the 7 meta-analyses used different tools. Four reviews used the CRoB tool [49, 50, 53, 54], 3 used PEDro scale [48, 51, 52], 1 used Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument tool [48], and 1 used Quality Assessment Tool for Before–After Studies with No Control Group [51].

Heterogeneity was assessed in 5 of the 7 meta-analyses, with high heterogeneity reported by Arik (2022) [48] and Hadoush (2022) [49], mixed high and low heterogeneity reported by Shi (2024) [52] and Shohani (2020) [53], and low heterogeneity reported by Sanchez-Lastra (2019) [51] and Zhang (2024) [55]. Five of these meta-analyses conducted subgroup analyses or meta-regressions, except for Hao (2022) and Zhang 2024, which were network meta-analyses.

Certainty of Evidence from Meta-analyzed Outcomes

Meta-analyzed outcomes included balance (11 analyses), cognitive function (1), fatigue (5), physical function (12), psychological function/mood (4), quality of life (3), and pain (1), though domains were not mutually exclusive and were sometimes combined (Table 3).

Certainty of evidence, based on GRADE assessments, is reported in Supplemental Tables 5a-d. In brief, reviews were marked down if ≥ 50% of studies had high RoB, high heterogeneity, and imprecision. For Pilates, the 8 meta-analyzed outcomes were all classified as having "very low" certainty. For TCEs, 8 outcomes were "very low" and 1 was "low" certainty (balance). For 10 yoga outcomes, 3 were rated "very low," 3 were "low," and 4 were "moderate" certainty (cognitive and psychological function compared to usual care; fatigue and physical function compared to exercise).

Balance

Overall, studies of MBMIs showed improved balance for people with MS, either better than or equivalent to conventional exercise; however, the certainty of evidence is "low" to "very low." Arik (2022) found that Pilates significantly improved balance compared to control groups (standard-of-care, home exercise, or physical therapy), based on the Berg Balance Scale (BBS; standardized mean difference [SMD] = 1.02; 95% confidence interval [CI]: −0.04, 1.99; $p = 0.04$), the Activities-Specific Balance Confidence scale (ABC; SMD = 0.60; 95% CI: −0.08, 1.13; $p = 0.02$), and Timed-Up-and-Go (TUG; SMD=−0.94; 95% CI:−1.87, 0.02; $p = 0.45$), a measure of functional mobility and balance [56], but not the Functional Reach Test (FRT) [48].[1] We included TUG in both balance and physical function outcomes since this outcome is relevant to both [56]. All outcomes from Arik (2022), however, had a very low certainty of evidence.

Hao (2022) similarly found that Pilates improved balance scores on the BBS (mean difference [MD] = 2.70; 95% CI: 0.71, 4.69; p-value not provided) and TUG (MD=−1.36; 95% CI: −1.83, −0.88) compared to conventional rehabilitation [50] with very low certainty. Sanchez-Lastra (2019) found that Pilates was no different at improving balance (TUG) compared to conventional physical therapy or other active controls [51], with very low certainty. Hao (2022) found yoga improves balance based on the TUG (MD = 5.50; 95% CI: 2.55, 8.45) [50], with very low certainty. Shi (2024) found that traditional Chinese exercises (TCEs; ai chi/qigong/tai chi) improved balance based on combined measures (the BBS, single-leg stand, and static/dynamic balance; SMD = 0.88; 95% CI: 0.45, 1.31; $p < 0.001$) compared to usual care or active comparator as well as the ABC (SMD = 1.30; 95% CI: 0.41, 2.18; $p < 0.001$) compared to active comparator, but no benefit was observed on the TUG [52], with low to very low certainty.

[1] Arik 2022 stated they used SMD as an effect size, so data are presented as SMDs; however, forest plots showed unusually large ranges (-8 to 8) suggesting mean difference (MD) was mistakenly reported. The authors did not respond to attempts at contact for clarification.

Table 1 Characteristics of included reviews

Review	Total studies	Mind-body studies[1]	Study designs	Types of interventions[2] (# studies)	Total # PwMS[2]	Types of MS	Outcomes
Ahola 2024	22	7	RCT	Dance (1); Pilates (2); qigong (1); yoga (3)	219	RR; SP; NR	Mood
Arik 2022	8	8	RCT; NRS	Pilates (8)	349	NR	Balance; Physical function
Asadi 2022	27	7	RCT; NRS	Pilates (5); tai chi (1); yoga (1)	NR	NR	Balance; Cognition; Fatigue; Mood; QoL
Dauwan 2021	122	6	RCT	Pilates (2); yoga (4)	NR	NR	Cognition; Mood; QoL
Davis 2023	13	13	RCT; NRS	Dance (13)	174	RR; Progressive	Balance; Cognition; Fatigue; Mood; Pain; Physical function; QoL
Du 2024	40	11	RCT	Pilates (3); qigong (1) yoga (7);	829	NR	Balance; Fatigue; Physical function; QoL
Hadoush 2022	29	4	RCT; NRS	Ai chi (1); yoga (3)	NR	RR; PP; SP; PR	Pain
Han 2022	18	6	RCT	Yoga (6)	445	RR; PP; SP; PR	Cognition; QoL
Hao 2022	31	9	RCT	Pilates (7); yoga (2)	328	NR	Balance; Physical function
Harrison 2021	135	15	RCT; NRS	Ai chi (1); tai chi (2); Pilates (6); yoga (8)	NR	NR	Fatigue
Heine 2015	45	7	RCT	Ai chi (1); tai chi (1); yoga (5)	691	RR; PP; SP; PR; CIS	Fatigue
Kong 2023	12	5	RCT; NRS	Dance (5)	127	NR	Balance; Fatigue; Physical function; QoL
Legault 2021	50	23	RCT	Yoga (23)	1122	RR; PP; SP; PR	Balance; Cognition; Fatigue; Pain; Physical function; QoL
Marques 2020	12	12	RCT	Pilates (12)	423	RR; SP; NR	Balance; Cognition; Fatigue; Mood; Pain; Physical function; QoL
Nagy 2025	11	11	RCT; NRS	Pilates (1); yoga (7)	324	RR; NR	Fatigue; Pain; Balance; Physical function; QoL
Ng 2024	33	5	RCT; NRS	Qigong/tai chi (1); yoga (4)	228	NR	Balance; Cognition; Fatigue; Mood; QoL
Rodríguez-Fuentes 2022	20	20	RCT	Pilates (20)	266	RR; PP; SP	Balance; Cognition; Fatigue; Physical function; QoL
Sánchez 2024	6	6	RCT	Pilates (6)	208	NR	Balance; Fatigue; Mood; Physical function; QoL
Sánchez-Lastra 2019	13	13	RCT; NRS	Pilates (13)	507	NR	Balance; Fatigue; Mood; Physical function; QoL
Shariat 2022	16	4	RCT; NRS	Ai chi (2); Pilates (1); yoga (1)	193	RR; PP; PR	Balance; Cognition; Fatigue; Mood; Pain; Physical function; QoL
Shi 2024	11	11	RCT; NRS	Tai chi (7); qigong (4)	461	RR; PP; SP	Balance; Fatigue; Mood; Physical function
Shohani 2020	10	10	RCT	Yoga (10)	693	NR	Cognition; Fatigue; Mood; QoL
Simpson 2023	14	4	RCT	Yoga (4)	300	NR	QoL
Taylor 2017	8	8	RCT; NRS	Tai chi (8)	193	RR; SP; CIS; CP	Balance; Fatigue; Mood; Physical function; QoL
Torres-Costoso 2022	58	15	RCT	Pilates (6); yoga (9)	966	NR	Fatigue
Wang 2022	58	5	RCT; NRS	Tai chi (5)	142	NR	Balance; Fatigue; Mood; QoL

Table 1 (continued)

Review	Total studies	Mind-body studies[1]	Study designs	Types of interventions[2] (# studies)	Total # PwMS[2]	Types of MS	Outcomes
Zhang 2024	84	NR	RCT	Pilates; tai chi; yoga[3]	NR	RR; PP; SP; NR	Fatigue; Physical function
Zou 2017	10	10	RCT; NRS	Tai chi (10)	245	NR	Balance; Fatigue; Mood; Pain; Physical function; QoL

[1]*As reported in the review. Review differed in how they classified studies.*

[2]*If studies contained multiple interventions (i.e.,a Pilates group and a yoga group), each was counted so total counts may be higher than number of studies.*

[3]*Zhang (2024) did not report the number of studies of each type.*

Abbreviations:*CP*, chronic progressive;*CIS*, clinically isolated syndrome; DRMA, dose-response meta-analysis; NMA, network meta-analysis; NR, not reported; NRS, non-randomized studies; PP, primary progressive; PR, progressive-relapsing; PwMS, people with multiple sclerosis; RCT, randomized controlled trials; RR, relapsing-remitting; SP, secondary progressive

Table 2 Methodological quality of included reviews based on AMSTAR-2 rating scale

Study	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9a	Item 9b	Item 10	Item 11a	Item 11b	Item 12	Item 13	Item 14	Item 15	Item 16	# CF Items	Overall Quality
Ahola 2024	Y	Y	Y	Y	Y	Y	N	Y	Y	N/A	N	Y	N/A	N	Y	Y	Y	Y	1	Low
Arik 2022	Y	PY	Y	PY	Y	N	N	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	3	Crit. Low
Asadi 2022	N	N	N	N	N	N	N	N	N	N	N	N/A	N/A	N/A	N	N	N/A	N	6	Crit. Low
Beratto 2024	Y	Y	Y	PY	Y	Y	N	Y	Y	N/A	Y	Y	N/A	N	Y	Y	Y	Y	1	Low
Boda 2025	Y	Y	Y	PY	Y	Y	N	Y	N	N	N	N/A	N/A	N/A	N	Y	N/A	Y	4	Crit. Low
Cordeiro 2020	Y	PY	Y	PY	N	N	N	N	Y	N/A	N	N/A	N/A	N/A	N	N	N/A	Y	2	Crit. Low
Corrini 2023	Y	Y	Y	Y	Y	Y	N	Y	Y	N/A	N	Y	N/A	Y	N	Y	Y	Y	2	Crit. Low
Dauwan 2021	Y	N	Y	PY	Y	N	N	Y	Y	N/A	N	Y	N/A	Y	Y	Y	Y	Y	2	Crit. Low
Davis 2023	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	N/A	N/A	N/A	Y	Y	N/A	Y	1	Low
Du 2024	Y	Y	Y	PY	Y	Y	N	Y	Y	N/A	N	Y	N/A	Y	Y	Y	Y	Y	1	Low
Green 2019	Y	N	Y	N	N	N	N	N	Y	Y	N	N/A	N/A	N/A	Y	Y	N/A	N	3	Crit. Low
Hadoush 2022	Y	N	Y	PY	N	Y	N	PY	Y	Y	N	N	N	Y	Y	Y	Y	Y	4	Crit. Low
Han 2022	Y	N	Y	PY	N	N	N	Y	Y	N/A	N	N	N/A	Y	Y	N	N	Y	4	Crit. Low
Hao 2022	Y	N	Y	Y	Y	N	N	Y	Y	N/A	N	Y	N/A	Y	Y	Y	Y	Y	2	Crit. Low
Harrison 2021	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	1	Low
Heine 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N/A	Y	Y	Y	Y	Y	0	High
Kong 2023	Y	Y	Y	PY	Y	N	N	Y	Y	Y	N	N/A	N/A	N/A	N	Y	N/A	Y	2	Crit. Low
Legault 2021	Y	N	Y	N	Y	Y	N	Y	N	N	N	N/A	N/A	N/A	N	Y	N/A	Y	6	Crit. Low
Lenoir dit Caron 2021	Y	N	Y	PY	Y	Y	N	Y	Y	N/A	N	N/A	N/A	N/A	Y	Y	N/A	Y	2	Crit. Low
Marques 2020	Y	Y	Y	N	Y	N	N	Y	Y	N/A	N	N/A	N/A	N/A	N	Y	N/A	Y	3	Crit. Low
Nagy 2025	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	N/A	N/A	N/A	N	Y	N/A	Y	4	Crit. Low
Ng 2024	Y	Y	Y	PY	Y	Y	N	PY	N	N	N	N/A	N/A	N/A	N	N	N/A	Y	4	Crit. Low
Reina-Gutierrez 2022	Y	Y	Y	PY	Y	Y	N	Y	Y	N/A	N	Y	N/A	Y	Y	Y	Y	Y	1	Low
Rodriguez-Fuentes 2022	Y	N	Y	PY	Y	Y	N	Y	Y	N/A	N	N/A	N/A	N/A	Y	Y	N/A	Y	2	Crit. Low
Sanchez-Lastra 2019	N	Y	Y	PY	Y	Y	N	PY	PY	PY	N	Y	Y	N	N	N	N	Y	3	Crit. Low
Sanchez-Lozano 2024	Y	N	Y	N	N	N	N	PY	N	N/A	N	N/A	N/A	N/A	N	N	N/A	Y	5	Crit. Low
Selph 2021	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A	Y	Y	Y	N	Y	1	Low
Shariat 2022	Y	N	Y	N	Y	N	N	Y	Y	Y	N	Y	Y	N	N	Y	N	Y	5	Crit. Low
Shi 2024	Y	N	Y	PY	Y	Y	N	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	4	Crit. Low
Shohani 2020	Y	Y	Y	N	Y	Y	N	Y	Y	N/A	N	Y	N/A	Y	N	N	Y	Y	3	Crit. Low
Simpson 2023	Y	Y	Y	Y	Y	Y	N	Y	Y	N/A	N	Y	N/A	Y	Y	Y	Y	Y	1	Low
Taylor 2017	Y	N	Y	PY	N	N	N	Y	PY	PY	N	N/A	N/A	N/A	Y	Y	N/A	Y	2	Crit. Low
Torres-Costoso 2022	Y	Y	Y	PY	Y	Y	Y	Y	Y	N/A	N	Y	N/A	Y	Y	Y	Y	Y	0	High
Veneri 2018	Y	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	9	Crit. Low
Wang 2022	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	N/A	N/A	N/A	Y	N	N/A	Y	3	Crit. Low
Zhang 2024	Y	Y	Y	PY	Y	Y	N	N	Y	N/A	N	Y	N/A	N	N	Y	N	Y	3	Crit. Low
Zou 2017	Y	Y	Y	PY	Y	Y	N	Y	Y	Y	N	N/A	N/A	N/A	Y	Y	N/A	Y	1	Low
Zuliani 2023	Y	Y	N	PY	Y	Y	N	PY	N	N	N	N/A	N/A	N/A	N	N	N/A	Y	4	Crit. Low

Abbreviations: Y = yes, PY = partial yes, N = no, N/A = not applicable, Crit. Low = critically low, CF = critical flaw

No critical weakness; Non-critical weakness; Critical weakness; Not applicable; Critical domain

Fatigue

MBMIs were found to be equivalent or superior to active controls/other exercise in improving fatigue, with certainty of evidence ranging from very low to moderate. Four reviews assessed Pilates, TCE, and yoga interventions for fatigue [51–54]. Sanchez-Lastra (2019) found Pilates was no different in improving fatigue than other active controls [51], with very low certainty. Shi (2024) similarly found that TCEs showed no significant improvement in fatigue compared to controls [52], also with very low certainty. In contrast, Shohani (2020) found that yoga was effective in reducing fatigue compared to the standard of care (SMD=−0.87; 95% CI: −1.47, −0.28) with low certainty,

Table 3 Quantitative outcomes from meta-analyses of mind-body studies

Review	Study designs	Intervention	Outcomes	Studies (k)	Summary estimate[1]	*P*-value	Summary of quantitative results	Methodological quality (AMSTAR-2)
Arik 2022	RCT; NRS	Pilates (8)	Balance (BBS)	6	SMD[2] = 1.02; 95% CI= −0.04, 1.99	0.04	_Pilates_: Improved **balance** on **BBS**, **ABC**, and **TUG** but not FRT	Crit. Low (3 CW)
			Balance (ABC)	2	SMD = 0.60; 95% CI= −0.08, 1.13	0.02		
			Balance/physical function (TUG)	6	SMD= −0.94; 95% CI= −1.87, 0.02	0.045		
			Balance/fall risk (FRT)	3	SMD = 1.85; 95% CI = 0.08, 3.77	0.06		
Hadoush 2022	RCT; NRS	Yoga (3) (pooled w/13 other mind-body therapies)[3]	Pain (VAS, NRS, PES, and PROMIS)	16	SMD =−0.45; 95% CI= −0.82, −0.07	0.02	_Yoga (and other mind-body therapies)_: Reduced **pain** compared to active or inactive controls	Crit. Low (4 CW)
Hao 2022	RCT	Pilates (7)	Balance (BBS); Physical function	6	MD = 2.70, 95% CI = 0.71, 4.69	NR	_Pilates_: Improved **balance** on **BBS** and TUG compared to conventional rehabilitation.	Crit. Low (2 CW)
			Balance/phyical function (TUG)	4	MD= −1.36; 95% CI= −1.83, −0.88	NR		
		Yoga (2)	Balance (BBS)	2	MD = 5.50, 95% CI = 2.55, 8.45	NR	_Yoga_: Improved **balance** on **BBS** compared to conventional rehabilitation	
Sanchez-Lastra 2019	RCT; NRS	Pilates (14)	Balance/physical function (TUG)	8	SMD: −0.09; 95% CI: −0.36, 0.17	0.48	_Pilates_: No more effective at improving balance (TUG), fatigue, quality of life, or physical function (6MWT) compared to other active controls (e.g., physical therapy).	Crit. Low (3 CW)
			Fatigue	6	SMD = 0.04; 95% CI = − 0.27, 0.36	0.78		
			Quality of Life	6	SMD = 0.03; 95% CI = − 0.28, 0.34	0.86		
			Physical function (6MWT)	2	SMD = 0.20; 95% CI = − 0.25, 0.66	0.38		
Shi 2024	RCT; NRS	Ai chi (1); tai chi (6); qigong (4)	Balance (combined measures)	4	SMD = 0.88; 95% CI: 0.45, 1.31	< 0.001	_Tai chi/qigong_: Improved **balance (BBS, ABC)**, **activities of daily living (Barthel index)**, **MSIS scores**, and **depression** compared to control. For **depression**, a higher exercise frequency (2-3x/week) improved the effect, without heterogeneity. No benefit on **TUG**, **T25-WT**, **fatigue**.	Crit. Low (4 CW)
			Balance confidence (ABC)	2	SMD = 1.30; 95% CI: 0.41, 2.18	< 0.001		
			Balance/physical function (TUG)	3	SMD = 0.44; 95% CI: −0.16, 1.04	NR		
			Physical function/ ADL (Barthel index)	3	SMD = 1.17; 95% CI: 0.30, 2.04	0.01		
			Physical function/ mood (MSIS)	3	SMD = 0.53, 95% CI: 0.12, 0.93	0.01		
			Physical function (T25FWT)	2	SMD = 0.32, 95% CI: −0.43,1.07	0.40		
			Fatigue (MFIS, FSS, FSMCF)	5	SMD = 0.28, 95% CI: −0.15, 0.71	0.20		
			Depression (APMS)	4	SMD = 0.66, 95% CI: 0.003, 1.32; and SMD = 1.33, 95% CI: 0.82, 1.85 (with practice 2-3x/week)	0.049		

Table 3 (continued)

Review	Study designs	Intervention	Outcomes	Studies (k)	Summary estimate[1]	*P*-value	Summary of quantitative results	Methodological quality (AMSTAR-2)
Shohani 2020	RCTs	Yoga versus standard-of-care (8)	Fatigue	6	SMD= −0.87; 95% CI: −1.47, −0.28	<0.01	<u>*Yoga*</u>: More effective at reducing **fatigue** than standard-of-care. Not more effective at improving quality of life, physical symptoms, psychological symptoms, or cognitive function than standard-of-care.	Crit. Low (3 CW)
			Quality of Life	4	SMD=0.71; 95% CI −0.17, 1.59	0.11		
			Physical function	7	SMD=0.28; 95% CI:−0.16, 0.72	0.21		
			Psychological component/mood	4	SMD=0.25; 95% CI: −0.13, 0.63	0.20		
			Cognitive function	3	SMD=−0.39; 95% CI: −0.01, 0.79	0.06		
		Yoga versus exercise (10)	Fatigue	7	SMD=−0.09; 95% CI: −0.35, 0.17	0.48	<u>*Yoga*</u>: Not significantly different than exercise in reducing fatigue or improving quality of life, physical or psychological function.	
			Quality of Life	2	SMD=0.45; 95% CI: −0.23, 1.1	0.11		
			Physical function	6	SMD=0.07; 95% CI:−0.13, 0.27	0.47		
			Psychological component/mood	2	SMD=−0.27; 95% CI: −0.81, 0.27	0.33		
Zhang 2024	RCTs	Tai chi; yoga; Pilates[4]	Fatigue		SMD=−0.94; 95% CrI: −1.3, −0.6; SUCRA: 86.53% (highest)	NR	<u>*Mind–body exercise*</u>:[4] Had the most significant effect on reducing **fatigue**, followed by resistance training, combined exercise, and aerobic exercise. High-intensity interval training (HIIT) did not reduce fatigue. HIIT was most effective in improving **muscular fitness**, followed by combined, *mind-body*, and resistance training. Aerobic exercise did not improve muscular fitness.	Crit. Low (3 CW)
			Physical function		SMD=−0.94; 95% CrI: −1.3, −0.6; SUCRA: 59.2%	NR		

[1]Displayed as negative or positive based on how it was presented in the original meta-analysis (e.g., whether a negative effect size confers benefit or harm depends on the scoring of the original outcome(s) measures in use).

[2] Whether Arik 2022 used a mean difference (MD) or standardized mean difference (SMD) as an effect size was unclear.

[3]Other mind-body therapies include: Mindfulness, hypnosis, cognitive behavioral therapy, muscle relaxation, breathing techniques, and self-management; [4] Zhang 2024: Mind-body exercise is not clearly defined. Number of studies in each meta-analysis not reported.

Abbreviations: *6MWT*, 6-minute walk test. *ABC*, Activities-Specific Balance Confidence. *APMS*, Adult Psychiatric Morbidity Survey. *BBS*, Berg Balance Scale. *CI*, confidence interval. *CrI*, credible interval. *Crit. low*, critically low. *CW*, critical weaknesses. *FRT*, functional reach test. K, number of studies. *MD*, mean difference. *MSIS*, Multiple Sclerosis Impact Scale. *NR*, not reported. *NRS*, Numerical Rating Scale. *NRS*, non-randomized study. *PES*, Pain Effects Scale. *PROMIS*, Pain Interference Scale. *RCT*, randomized controlled trial. *SAD*, standard-of-care treatment. *SMD*, standardized mean difference. *SUCRA*, surface under the cumulative ranking curve. *T25-FW*, timed 25-foot walk test. *TUG*, Timed Get Up and Go. *VAS*, Visual Analog Scale

but not significantly different from other types of exercise (e.g., aerobic and resistance) [53], with moderate certainty. Zhang (2024), in a network meta-analysis, found that mind-body exercises (including Pilates, tai chi and yoga) had the largest effect on reducing fatigue compared to other exercises, such as resistance training (low certainty), aerobic exercise (moderate certainty), high-intensity interval training (very low certainty), and combined exercise (low certainty) [54].

Mood

Two reviews reported effects on mood [52, 53]. Shi (2024) found that TCEs significantly improved depression compared to usual care and active comparators combined, with greater benefits with higher exercise frequencies (e.g., 2–3 times per week) when compared to active comparators (SMD = 1.33; 95% CI: 0.82, 1.85; $p = 0.049$) [52], with very low certainty. Shohani (2020) found that yoga was not more effective at improving psychological symptoms compared to the standard of care (moderate certainty) or other forms of exercise (very low certainty) [53].

Cognitive Function

One review by Shohani (2020) assessed the impact of yoga on cognitive function, finding a non-significant trend toward improvements in cognitive function compared to usual care or active comparator (SMD = 0.039, 95%CI: −0.01, 0.79; $p = 0.06$), with moderate certainty.

Physical Function

Six reviews assessed various aspects of physical function [48, 50–54]. Arik (2022) and Hao (2022) both found Pilates significantly improved scores on the TUG test (reported in the *Balance* section), with very low certainty [48, 50]. However, Sanchez-Lastra (2019) found that Pilates was not significantly different in improving TUG scores or 6-Minute Walk test scores, a measure of functional walking capacity and endurance [57], compared to conventional rehabilitation or other control, with very low certainty [51]. Shi (2024) found that TCEs improved activities of daily living via the Barthel index (SMD = 1.17; 95% CI:0.30, 2.04; $p = 0.01$) and the MS Impact Scale (MSIS) score, which includes self-reported assessments of physical function (SMD = 0.53; 95% CI:0.12, 0.93; $p = 0.01$), with very low certainty [52]. Shohani (2020) found yoga to be no more effective at improving physical symptoms in MS than usual care (low certainty) or other exercise (moderate certainty) [53]. Zhang (2024) found mind-body exercises to be less effective than high-intensity interval training and combined exercise, but better than resistance training and aerobic exercise at improving muscular fitness (low to very low certainty) [54].

Pain

One study by Hadoush (2022) examined MBMIs for pain [49]. These authors found that mind-body therapies (which included three yoga studies, combined with 13 other studies of mindfulness, hypnosis, cognitive behavioral therapy, muscle relaxation, breathing technique, and self-management) improved pain compared to active or inactive control groups (SMD=−0.45; 95% CI: −0.82, −0.07; $p = 0.02$), with very low certainty.

Quality of Life

Two reviews of Pilates [51] and yoga [53] assessed quality of life, finding no difference compared to usual care or active controls. Sanchez-Lastra (2019) found no significant improvement from Pilates on QoL compared to active controls (very low certainty), while Shohani (2020) found yoga to be no more effective on QoL than usual care (very low certainty) or other exercise (low certainty) [51, 53].

Discussion

This umbrella review provides a comprehensive assessment of the existing evidence on the effects of MBMIs for people with MS, including identifying 104 systematic reviews and meta-analyses with MBMI studies. Of these, 28 of the most recent, highest quality reviews were covered in depth; 7 of which contained meta-analyses on MBMIs, finding significant benefits from Pilates, TCEs, and yoga on balance symptoms. Yoga, assessed with other mind-body therapies, was found to significantly improve pain. TCEs were found to significantly improve depression. Mixed results were found for the effects of MBMIs on symptoms of fatigue and physical function, with some reviews reporting superiority to other exercise [48, 50, 54], and some reporting no difference [51–53]. Improvements in quality of life were found for MBMIs, but were no different from other exercise or usual care.

In addition to understanding the effects of MBMIs on MS symptoms, network meta-analyses by Hao (2022) and Zhang (2024) quantitatively compare the efficacy of MBMIs head-to-head with other exercise interventions [50, 54]. Hao (2022) found that yoga was the most effective at improving balance (e.g., BBS) compared to conventional rehabilitation, followed by virtual reality exercise, aerobic exercise, aquatic exercise, and Pilates [50]. Zhang (2024) compared "mind-body exercises" (grouping 20 studies of yoga, Pilates, and tai chi) to aerobic exercise, resistance training, combined exercise, and high-intensity interval training (HIIT) [54]. They found that all types of exercise, except HIIT, improved fatigue, but mind-body exercises had the greatest significant effect. They also identified a dose-response relationship for each type of exercise, concluding that 165 min per week (delivered at either 4, 40-minute sessions or 3, 55-minute sessions) was the ideal dose for mind-body therapies to maximize fatigue improvement. In assessing muscular fitness, improvements were found in all types of exercise except aerobic, with the greatest benefit from HIIT, followed by combined, mind-body, and resistance exercise. The recommended dose to maximize muscular fitness was 135 min per week of mind-body exercise. They also found, through network meta-regression, that age influenced the effect of exercise on fatigue and muscular fitness, while disease duration also had an impact on the effects of exercise on fatigue.

Certainty of evidence was low to very low for most MBMIs but ranged from very low to moderate for yoga studies. This could be explained by yoga being the most studied MBMI for MS, thereby providing larger sample sizes and increased precision. Of the 28 reviews included in our study, 17 included at least one yoga study, and 22 primary yoga studies were covered in our 28 reviews. In the reviews by Hadoush (2022) and Shohani (2020) on yoga, risk of bias was the primary contributor to lowering certainty [49, 53]. In contrast, factors that downgraded the evidence certainty for Pilates and TCEs were primarily the inclusion of non-randomized controlled trials, and imprecision (attributed to low sample size/number of studies and wide confidence intervals) [48, 51, 52]. These results align with the umbrella review by Momsen et al. (2021) on rehabilitation interventions for balance, depression, fatigue, mobility, fitness, and quality of life in people with MS, which found no evidence for Pilates and low evidence for tai chi [58]. An umbrella review by O'Malley (2021) on interventions for fall prevention in people with Parkinson's disease, MS, and stroke found that exercise-based interventions for MS overall were the least comprehensive, with the smallest amount of primary studies, especially high-quality RCTs and systematic reviews, compared to Parkinson's disease and stroke [59].

The large number of exercise reviews for MS that include MBMIs suggests a growing interest and evidence base. However, the methodological quality of most reviews, based on AMSTAR-2 ratings, was critically low, indicating the need not only for larger, higher-quality primary studies, but also for improvements in the quality of systematic reviews.

Limitations

There are several limitations to this umbrella review. Given the low methodological quality of most of the reviews, our ability to draw conclusions about the efficacy of MBMIs for MS is limited. Reviews were also inconsistent in their presentation and evaluation of MBMI studies, with some reviews grouping these into larger exercise categories, making assessment of outcomes difficult. We were only able to assess meta-analytic data from seven studies, and the quality of these studies was mixed, with low to moderate certainty of evidence, and high variability in the outcomes assessed.

Implications for Practice

Clinicians interested in recommending MBMIs for MS patients should consider several factors, including the patient's disease and disability status, as well as how and where delivery happens, and who is delivering the intervention. Although specific MS guidelines for MBMIs have yet to be developed, general recommendations from MS exercise guidelines are relevant, including the types and frequencies of exercise, methods of promotion, and training for exercise providers [60]. For example, current exercise guidelines for people with mild to moderate MS (EDSS $\leq$ 6.5) include moderate-intensity aerobic and strength training 2–3 times a week, daily flexibility training, and 3–6 days of neuromotor exercise for stability and falls prevention [60]. For more severe MS disability, breathing exercises are recommended every other day; daily flexibility; aerobic and functional strength exercises every other day; and core activation twice daily [60]. Because MBMIs tend to be multimodal and incorporate different types of exercise, they could be added as exercise options. For example, dance could provide aerobic exercise; yoga and qigong used for flexibility; Pilates and tai chi for core stability; tai chi and qigong for balance; qigong and yoga for breathwork; and Pilates, yoga, qigong, and dance for strength training.

It is essential that, as with any exercise, the patient finds a practice that accommodates their specific needs to ensure safety and effectiveness. Group MBMI classes specializing in people with mobility limitations may be a safe starting point for referral to MS patients. Examples such as chair yoga and "Tai Ji Quan: Moving for Better Balance" have been shown to be safe and effective for people with neurodisability and the elderly, respectively [61, 62]. These types of classes may be available at community centers and through a growing number of virtual options. Another model currently being piloted is Shared Medical Appointments, focused on MBMIs for specific patient populations. For example, a Virtual Yoga Shared Medical Appointment for cancer patients, covered by health insurance and co-led by a specially trained yoga instructor and an integrative medicine physician, demonstrated positive outcomes and acceptability [63]. To expand the pool of exercise options available to people with MS, MBMI instructors and therapists might consider more specialized training in working with this population.

Implications for Future Research

Future research should include larger, high-quality randomized controlled trials of MBMIs that include active comparator groups. Additional research on people with MS with higher levels of disability (e.g., Expanded Disability Status Scale $>$ 5.5), as well as populations early in the disease process (e.g., clinically isolated syndrome), is also needed. The field would also be strengthened by evaluating the enjoyment, acceptability, accessibility, and long-term adherence of MBMIs. More research on understanding possible mechanisms of MBMIs on MS symptoms may help to refine and tailor MBMIs specifically to different populations with MS. Finally, specific guidelines, protocols, and monitoring assessments are needed to expand the knowledge base of MBMIs for MS and support a referral network.

Conclusions

Many systematic reviews and meta-analyses have included MBMI studies conducted with people with MS. This umbrella review summarizes the findings of these reviews to understand current trends in outcomes and quality of evidence, as well as assesses the methodological quality of reviews. Results suggest potential benefits of MBMIs for balance, physical function, depression, pain, and fatigue. However, the certainty of evidence was very low to moderate for MBMIs, and the methodological quality of most reviews was critically low. This highlights a critical need for larger trials with active comparators and comprehensive reporting of results, including heterogeneity (both clinical and methodological), to enhance the quality and certainty of findings.

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Data Availability Data are available in the Supplemental Tables or by contacting the primary author at [lbuttolph@nunm.edu](mailto: lbuttolph@nunm.edu).

Declarations

Competing Interests Lita Buttolph has received payment for teaching qigong since 2005. All other authors declare no conflicts of interest.

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