Review

Yoga Interventions used for the Rehabilitation of Stroke, Parkinson's Disease, and Multiple Sclerosis: A Scoping Review of Clinical Research

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ABSTRACT

Objectives: The current body of literature was reviewed in order to compile and describe yoga interventions that have been applied in clinical research and neurological rehabilitation settings with patients affected by stroke, Parkinson's disease, and multiple sclerosis.

Design: Available literature on yoga therapy was mapped following a five-stage framework to identify key concepts, knowledge gaps, and evidence to inform practice. Publications were identified through Medline, CINAHL, EMBASE, PsycInfo. Selected studies required subjects with a clinical diagnosis of stroke, Parkinson's disease, and multiple sclerosis to participate in a yoga intervention and have physical, cognitive, and/ or psychosocial outcome measures assessed.

Results: A total of 50 studies were included in this review. Study characteristics, patient demographics, description of the yoga intervention, reported outcome measures and the main findings were extracted from the studies.

Conclusion: Implementing YT in neurorehabilitation can help health care professionals integrate a more holistic approach that addresses the fundamental physical and psychological challenges of living with a chronic and debilitating neurological disorder. The included studies described yogic interventions consisting of group or individual therapy sessions lasting 60 to 75 minutes that were carried out one to three times per week for eight to twelve consecutive weeks across all three conditions. All studies described in this scoping review used different yoga protocols confirming the lack of specific interventional parameters available for implementing yoga into the rehabilitation of individuals affected by stroke, Parkinson's disease or multiple sclerosis.

Key words: YT: yoga therapy, MS: multiple sclerosis, PD: Parkinson's disease

1. Introduction

Stroke, Parkinson's disease (PD) and multiple sclerosis (MS) are among the most prevalent, non-traumatic causes of disability in adults worldwide.[1] Individuals living with these neurological conditions commonly present with long-term physical, cognitive, and psychosocial impairments that negatively impact their quality of life (QoL).[2] Physical functioning deficits (e.g. hemiparesis, muscle rigidity, or persistent fatigue) may severely limit a person's ability to carry out basic activities of daily living and often prevent autonomous ambulation in the community.[2] With a reduced ability to participate in social events and leisure activities, neurological patients are likely to adopt a more sedentary lifestyle, further increasing the risk of chronic functional decline.[2] Concurrent cognitive and psychosocial changes in emotion, personality, and behaviour can negatively influence interpersonal relationships, impede reintegration into the community, and promote feelings of social isolation, anxiety and depression.[3–5] Existing rehabilitation programs predominantly place emphasis on optimizing physical function while often overlooking the psychological manifestations of these neurological illnesses.[3,6] This is significant given that high levels of psychological suffering have been repeatedly documented across all three conditions to not only be associated with higher levels of physical disability and increased morbidity,[3,7,8] but also to be a primary determinant contributing to increased health care costs and resource utilization.[3,9,10] Thus, there is an urgent need to explore alternative and adjunctive strategies that address both the physical and psychosocial challenges of living with these debilitating neurological disorders.

The mind-body practice of yoga represents one promising therapeutic intervention that can be used across a variety of clinical settings and easily modified to meet the complex needs of neurological patients.[11,12] Originating in India, yoga describes a spiritual practice that encompasses many different elements, including physical activity (*asana*), breath work (*pranayama*), meditation (*dhyana)*, contemplative practice, and advice for living an ethical and disciplined lifestyle.[12] Therapeutic yoga or yoga therapy (YT) refers to the use of yoga in order to specifically address various health-related outcomes among clinical populations.[13] Yoga addresses the functional deficits that manifest in neurological conditions through a variety of physiological mechanisms related to either the physical component or the breathing and meditative techniques that are practiced in yoga.[11] The health-related benefits of exercise are well understood, and accordingly, the regular practice of yoga has been demonstrated to improve muscular strength and

endurance, balance, flexibility and motor coordination.[14] Breathing and meditation techniques used in yogic interventions have been reported to improve sensory awareness and interoception, increase parasympathetic activity, enhance the regulation of autonomic input and modulate the body's pain response system.[15] In addition, the emphasis on mindful awareness and relaxation during the practice may contribute to the cognitive and psychological benefits described, such as an increased ability to sustain attention, enhanced executive function and problem solving, promotion of personal acceptance, and an improved ability to cope in the face of adversity.[3,11,14]

The holistic nature of yoga suggests it can simultaneously facilitate physical and emotional healing among those experiencing neurological disorders.[11,14] Furthermore, yoga is cost-effective, feasible, and willingly accepted by the elderly,[16] a population that makes up the vast majority of patients affected by neurological disease.[17] While there have been a number of recent studies investigating the use of YT for managing the consequences of stroke, PD, and MS, the optimal treatment dose required to maximize the effectiveness of YT has been rarely studied. In addition, the literature repeatedly fails to adequately describe how yoga protocols are developed and employed making it difficult to apply the research findings in a clinical setting.[18] Given the aforementioned shortcomings of the field, a scoping review of the literature can provide a better understanding in determining how YT can best be implemented into neurorehabilitative care. Scoping reviews are particularly useful for exploring how research is conducted on a given topic while also identifying gaps for further investigation.[19] The primary objective of this scoping review was to provide a comprehensive overview of YT interventions that have been utilized in the clinical management of adults post-stroke or living with PD or MS. A particular focus was placed on research that addresses the physical, cognitive and psychosocial components of functional recovery. By compiling detailed descriptions of clinical yoga protocols into a single resource the present study hoped to direct clinicians on best practices and guide researchers in further evaluating the efficacy of utilizing YT in neurological rehabilitation.

2. Methods

2.1 Study Design

The study was conducted following the methodological framework for scoping reviews laid out by Arksey & O'Malley.[19] A five-stage process was followed comprised of: (i) identifying the

research question; (ii) identifying relevant studies; (iii) selecting the studies that correspond to the inclusion criteria; (iv) data extraction; and (v) collating, summarizing, and reporting the results.

2.2 Search Strategy and Study Selection

A comprehensive search strategy of published literature was used to ensure the inclusion of all relevant information. The choice of databases to be searched was recommended by a professional librarian at McGill University and included Medline (1946-present), CINAHL (1937-present), EMBASE (1947-present), and PsycInfo (1806-present). Studies published in English or French that evaluated the effect of yoga on physical, cognitive, and/or psychosocial health in individuals who were at least 18 years of age with a diagnosis of stroke, PD, or MS were included for eligibility. Other neurological conditions as well as studies on multimodal interventions that combine yoga with other interventions were excluded. Interventions based on yoga, but not characterized as such were excluded. There were no restrictions made with respect to the type of yoga used, nor the length, frequency, or duration of the intervention. No restrictions were made based on the clinical setting, study design, study location, or year of publication.

After completing the database searches, the articles were imported into Rayyan QCRI where the title and abstract of each article was screened by two independent researchers who categorized them as ‘included’, ‘excluded’, or ‘maybe’. The researchers then proceeded to read the full text articles from the ‘included’ and ‘maybe’ categories to determine whether they met the eligibility criteria. Any indecisions regarding the inclusion of a particular study was discussed by two independent researchers until a consensus was reached. If necessary, a third researcher was asked to assist in resolving any disagreements.

2.3 Data Extraction

Two researchers independently extracted data from articles meeting the inclusion criteria using Microsoft Excel and then compared the obtained data to ensure consistency of reporting. The data was organized into tables and grouped by neurological condition (Tables 1-3).

3. Results

3.1 Study Selection

The database search yielded 1114 potentially relevant articles of which 226 duplicate studies were removed. The remaining 888 studies were evaluated and screened for eligibility with a total

of 50 articles meeting the inclusion criteria for the scoping review. The study selection process is outlined in Figure 1.

3.2 Study Characteristics

The studies were all published between 2001 to 2020 with 44 of the 50 studies being published in the last 10 years. Across all three neurological conditions, most studies investigated the impact of yoga on physical function (n = 37), followed by psychosocial outcomes (n = 22), and cognitive factors (n = 8). Commonly used physical outcome measures included the Berg Balance Scale (BBS; n = 15), [20] either the 6-minute or 10-metre walking test (6MWT/10mWT; n = 11), [21,22] and the Timed Up and Go test (TUG; n = 6).[23] Fourteen of the included studies looked at the influence of yoga on measures of anxiety and depression using an assortment of standardized instruments such as the Beck Anxiety and Depression Inventories (BAI/BDI).[24,25] Population specific measures such as Stroke Impact Scale (SIS; n = 1),[26] the Unified Parkinson's Disease Rating Scale (UPDRS; n = 8),[27] the Expanded Disability Status Scale (EDSS; n = 4),[28] or the Multiple Sclerosis Impact Scale (MSIS; n = 4)[29] were often administered to assess the subject's baseline status and progression.

The YT interventions were generally administered by a certified yoga instructor (n = 28), a registered yoga therapist (n = 7) or a physical therapist with a personal background in yoga (n = 5). The majority of YT programs involved a combination of traditional and adapted postures, breathing exercises, meditation and relaxation techniques that progressed in difficulty over time. To adapt the yogic postures to the neurological population, the equipment identified in the studies included chairs, yoga mats, yoga balls, yoga blocks, straps, horizontal bars, blankets, sandbags, cushions, eye pillows, and bolsters. Many studies began each session with a didactic component such as a group discussion on topics of mindfulness or yogic principles and ended the sessions with deep relaxation techniques such as *Savasana* or yoga *Nidra*. Group classes in a community setting were more commonly administered compared to one-on-one therapeutic sessions or individual home practice. Pre-recorded audiotapes, videos, or instructional handouts were often provided to guide and aid individual home practice.

3.3 Stroke

Eleven studies investigating the use of yoga-based interventions for patients in the chronic stage of post-stroke recovery were included in this review (Table 1). Across the studies, participants were on average 61.7 (SD 4.9) years old and participated in YT after having completed

their post-acute rehabilitation. Nine studies delivered a Hatha or adapted yoga protocol, one investigated the effects of unilateral nostril breathing, and one study explored the use of Kundalini yoga. The intervention parameters varied between studies. Five studies implemented 60 or 90-minute yoga sessions twice per week. The length of the intervention period ranged between 6 to 24 weeks and was most frequently administered on a weekly basis for either 8-weeks (n = 3), 10-weeks (n = 3), or 12-weeks (n = 3). Three studies combined a weekly 90-min group session with a shorter 40-min individual home practice that was carried out 4 or 6 times per week. The average dose or total treatment time of YT delivered across the eleven studies for patients' post-stroke was 26.5 hours (~1590 minutes).

3.4 Parkinson's Disease

Sixteen studies investigated the use of yoga-based interventions for patients with PD afflicted by mild, moderate, and severe neurological impairments (Table 2). All studies used the Hoehn and Yahr scale to describe the symptoms and level of disability of the participants.[30] Subjects were on average 66.7 (SD 4.9) years old and were predominantly at or below stage 3 on the Hoehn and Yahr scale. Eleven studies delivered a Hatha or an adapted yoga protocol, one investigated the effects of laughter yoga, another looked at the impact of high-speed power yoga, and one administered a comprehensive yoga-based lifestyle program. Yoga classes varied in length between 30 to 90-minute sessions and were administered between one to seven times per week. The most common parameters were 60-minute sessions delivered twice per week (n = 6). The intervention period ranged from a single session to 12 weeks with seven studies delivering an 8-week intervention and six studies delivering a 12-week intervention. The average dose or total treatment time of YT delivered across the sixteen studies for patients with PD was 17.4 hours (~1042.5 minutes).

3.5 Multiple Sclerosis

Twenty-three studies investigating the use of yoga-based interventions for patients with MS were included in this review (Table 3). On average, subjects were 43.8 (SD 8.4) years old with various clinical courses of the disease. Eleven studies used the EDSS score to determine the stage of disease, while others used years since diagnosis or standardized instruments like the Multiple Sclerosis Documentation System (SR-MSDS),[31] the Guy's Neurological Disability Scale (GNDS),[32] or the Patient Determined Disease Steps (PDDS).[33] The most common type of yoga used in clinical research was Hatha yoga or an adapted-Hatha protocol (n = 17). A few studies explored

Iyengar yoga (n = 1), Ananda yoga (n = 1), yoga Nidra (n = 1), and cyclic meditation (n = 1). As in the two previous conditions, the intervention parameters varied between studies. Sessions most commonly lasted between 60 and 90 minutes (n = 17) and were performed one to three times weekly (n = 20). Session structure is particularly important in this population to avoid fatigue during YT. Allowing patients to take 30 to 60 second breaks between poses can avoid overexertion in patients with MS.[65,70,7] The treatment period ranged from two sessions to 24 weeks with the most common intervention lasting 12 weeks (n = 7), 8 weeks (n = 4), 10 weeks (n = 4) and 24 weeks (n = 3). The average dose or total treatment time of YT delivered across the twenty-three studies for patients with MS was 23 hours (~1390 minutes).

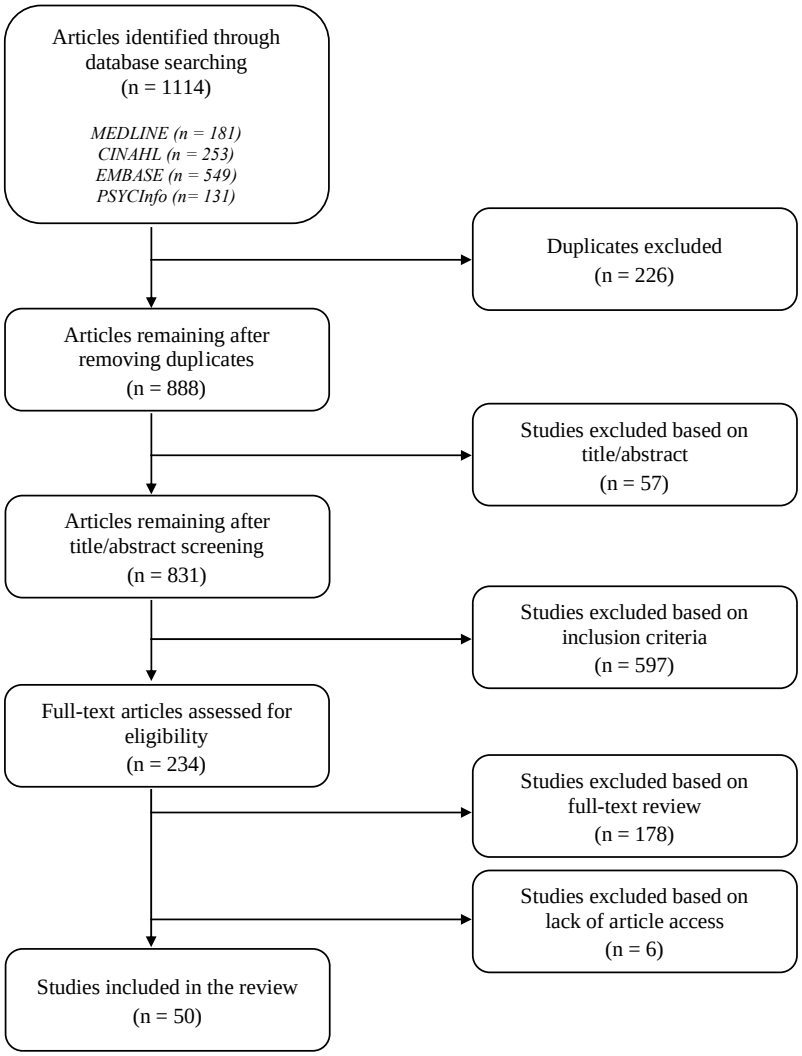

Figure 1
Process of identification and selection of studies that were included in this review.

Table 1
Description of Included Studies that used Yoga Therapy Interventions for Post-Stroke

Reference	Details of Study	Patient Characteristics	Intervention Parameters	Description of Protocol	Outcome Measures	Principal Findings
Bastille et al. [34] **Year:** 2004	**Design:** Single-subject case-study design **Sample:** N = 4 (♂: 1 ♀: 3) **Objective:** Investigate the effects of a yoga-based exercise program on balance, mobility, and QoL for people with post-stroke hemiparesis	**Dx:** Stroke with hemiparesis **Stage:** Chronic (> 9 months) **Age:** 60 (9.02)	**Frequency:** 2 x per wk **Session Duration:** 90 min **Intervention Period:** 8 wks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha **Structure:** 5-10 min of education; 10-15 min of body awareness practice; 5 min of breathing exercises; 30-40 min of physical poses; 10-15 min of guided imagery and relaxation; 5 min of seated silent meditation; 5 min of personal expression verbally or through drawing.	**Physical:** BBS, TMB **Multidimensional:** SIS	**Results:** 2 subjects demonstrated significant improvements in balance as measured by BBS; 3 subjects demonstrated significant increases in TMB. **Conclusion:** A yoga-based exercise program may be able to improve impairments and mobility limitations in people with chronic post-stroke hemiparesis.
Chan et al. [35] **Year:** 2012	**Design:** RCT (pilot study) **Sample:** N = 14 (♂: 12 ♀: 2) Yoga (n = 8) Control (n = 6) **Objective:** Investigate whether supplementing exercise with a yoga program would provide further improvements in self-reported symptoms of depression and anxiety post-stroke	**Dx:** Stroke with hemiparesis **Stage:** Chronic (> 6 months) **Age:** Yoga ~ 67.1 (15.4) Control ~ 71.7 (12.7)	**Frequency:** Group ~ 1 x per week Home ~ 4 x per week **Session Duration:** Group ~ 90 min Home ~ 40 min **Intervention Period:** 6 weeks **Dose (total time):** 25 hrs	**Style of Yoga**: Hatha **Structure:** Group Classes ~ 10-min didactic activity on yoga-relevant topics; 30 min of modified *asana* practice; 5 min of *pranayama* practice involving gentle breathing with concentrated attention; 30 min of guided meditation (*Y*oga Nidra*)*; and 15-min of group discussions. Home Practice ~ 10 min of Hatha yoga; and 30 min of Yoga Nidra.	**Psychosocial:** GDS-15, STAI-Y1, STAI-Y2	**Results:** Changes in depression and state anxiety did not significantly differ between treatment groups; greater clinical improvements observed in intervention group. **Conclusion:** Supports the notion that individuals with stroke-related disability may achieve additional mental-health benefits from an integrative approach involving participation in a combined exercise and yoga program.
Garrett et al. [13] **Year:** 2011	**Design:** Secondary analysis of RCT **Sample:** RCT: N = 22 Yoga (n = 10) Control (n =12) 2° Analysis: N = 9 (♂: 4 ♀: 5) **Objective:** Investigate the personal experiences and perceived outcomes of a yoga programme for stroke survivors	**Dx:** Stroke with hemiparesis **Stage:** Chronic (> 9 months) **Age:** *N/D*	**Frequency:** Group ~ 1 x per week Home ~ 6 x per week **Session Duration:** Group ~ 90 min Home ~ 35-42 min **Intervention Period:** 10 weeks **Dose (total time):** 50-57 hrs	**Style of Yoga**: Hatha **Structure:** Didactic activity to educate participants about concepts in yoga and provide focus for the subsequent practices; 30 min yoga-based exercises; 10-12 min of breathing practices; 20-30 min of Yoga Nidra meditation; 8-10 min discussion and questions.	**Multidimensional:** Interview (interpretative phenomenological analysis)	**Results:** Subjects revealed perceived physical improvements in strength, range of motion, walking ability, feeling calmer, becoming connected and possibility of accepting a different body. **Conclusion:** Yoga participation after stroke can provide a number of meaningful physical, psychological and social benefits.
Immink et al. [36] **Year:** 2014	**Design:** RCT **Sample:** N = 22 (♂: 9 ♀: 13) Yoga (n = 11) Control (n =11) **Objective:** Assess the efficacy of a yoga intervention for motor function, mental health, and QoL outcomes in persons with chronic post-stroke hemiparesis	**Dx:** Stroke with hemiparesis **Stage:** Chronic (> 9 months) **Age:** 59.6 (15.7)	**Frequency:** Group ~ 1 x per week Home ~ 6 x per week **Session Duration:** Group ~ 90 min Home ~ 35-45 min **Intervention Period:** 10 weeks **Dose (total time):** 50-60 hrs	**Style of Yoga**: Hatha **Structure:** Group Classes ~ 10-min lecture on yoga concepts; 30 min of physical poses; 10-12 minutes of breathing exercises; 20-30 min of s*atyananda Yoga Nidra*; 8-10 min discussion and questions. Home Practice ~ 10-20 min of daily poses and breath work; 25 min of *satyananda Yoga Nidra*.	**Physical:** MAS, BBS, 2MW, CGS **Psychosocial:** GDS-15, STAI-Y1, STAI-Y2 **Multidimensional:** Informal interview	**Results:** Yoga intervention did not result in any significant improvements in objective motor function measures; significant improvements in QoL associated with perceived motor function, and decreases in state and trait anxiety. **Conclusion:** Yoga participation after stroke might benefit individuals in terms of their emotional well-being, QoL, and management of physical disability.
Ji & Yu. [37] **Year:** 2018	**Design:** RCT **Sample:** N = 20 (♂/♀: *N/D*) **Objective:** Explore the effects of yoga on cognitive ability and motor function of stroke patients and further elucidate the physiological mechanism of yoga in therapeutic recovery	**Dx:** Stroke **Stage:** *N/D* **Age:** Yoga ~ 61.2 (4.15) Control ~ 61.3 (2.33)	**Frequency:** 7 x per week **Session Duration:** Stage 1 & 2 ~ 30 min Stage 3 ~ 60 min **Intervention Period:** 12 weeks **Dose (total time):** 56 hrs	**Style of Yoga**: Adapted Yoga **Structure:** Stages lasted 4 weeks each: Stage 1 ~ introduction to daily practice of adapted yoga poses and breathing patterns. Stage 2 ~ consolidate daily practice and increase complexity of yoga poses. Stage 3 ~ increase intensity of yoga practice and add exercises with yoga ball.	**Physical:** MB**I,** Blood O_2 measurements, Nerve excitability	**Results:** Significant increases in all components of blood O_2 measurements and higher scores on the MBI in the yoga group. **Conclusion:** Yoga exercise therapy can improve cognitive ability of patients with stroke and promote recovery of motor function by increasing blood oxygen content in the brain.

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Lynton et al. [38] **Year:** 2007	**Design:** Pilot study **Sample:** N = 3 (♂: 2 ♀: 1) **Objective:** Determine if a 12-week Kundalini Yoga practice leads to an improvement in aphasia and fine motor coordination in stroke patients	**Dx:** Stroke with aphasia **Stage:** Chronic (> 6 months) **Age:** 68.7 (6.03)	**Frequency:** 2 x per week **Session Duration:** 90 min **Intervention Period:** 12 weeks **Dose (total time):** 36 hrs	**Style of Yoga**: Kundalini **Structure:** A series of physical exercises specifically chosen to benefit individuals with aphasia; followed by an 11-min meditation consisting of spoken mantra; repeated each class.	**Cognitive:** CPT, BDAE **Physical:** O'Connor Tweezer, Dexterity Test **Psychosocial:** SF-36	**Results:** All three patients demonstrated a substantial improvement on dexterity outcome measures and a reduction in aphasia. **Conclusion:** Positive trends in this study suggest that further research should be done to examine the benefits of Kundalini yoga in post-stroke patients with speech and motor impairments.
Marshall et al. [39] **Year:** 2014	**Design:** Pre-Test Post-Test **Sample:** N = 11 (♂: 9 ♀: 2) Stroke without aphasia (n = 6) Stroke with aphasia (n = 5) **Objective:** Explore whether unilateral nostril breathing (UNB) influences measures of attention, language, spatial abilities, depression, and anxiety post-stroke	**Dx:** Stroke with and without aphasia **Stage:** Chronic (4 months - 6 years) **Age:** Stroke without Aphasia ~ 58.2 (*N/D*) Stroke with Aphasia ~ 52.4 (*N/D*)	**Frequency:** 6-7 x per week **Session Duration:** 5-40 min **Intervention Period:** 10 weeks **Dose (total time):** 5 to 47 hrs	**Style of Yoga**: Unilateral Nostril Breathing **Structure:** 4-weeks of guided instruction and 6-weeks of individual practice. Participants were asked to close the left nostril using whichever hand was unaffected by the stroke and focused on extending the exhalation as twice as long as the inhalation.	**Cognitive:** ADP, COWAT, RTT, CPT, BJLOT **Psychosocial:** BDI-II, BAI	**Results:** UNB significantly decreased levels of anxiety in both groups; performance on language measures increased for individuals with aphasia. **Conclusion:** Preliminary evidence for improved affect and language, along with participant self-report of UNB benefits, indicates that UNB may be a low-cost adjunct strategy to consider using for ameliorating certain post-stroke effects.
Miller et al. [40] **Year:** 2013	**Design:** Secondary analysis of RCT **Sample:** N = 9 (♂: 2 ♀: 7) **Objective:** Examine the effect of group therapeutic-yoga delivered in two dosing protocols (8 weeks and 12 weeks) on walking recovery after stroke	**Dx:** Stroke **Stage:** Chronic **Age:** 63 (*N/D*)	**Frequency:** 2 x per week **Session Duration:** 60 min **Intervention Period:** 12 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha **Structure:** Each session involved: breath work to promote awareness, chest expansion, and parasympathetic influence; physical poses in sitting, standing and supine for strength, flexibility and balance; and guided relaxation techniques.	**Physical:** 10-MWT, 6MWT, Spatiotemporal step parameters measured with GAITRite software	**Results:** Non-significant improvements in walking distance between baseline and 12-weeks; negative change demonstrated in step length symmetry indicating more asymmetry. **Conclusion:** Yoga was mostly ineffective for walking recovery in this group which may be due to a lack of task-oriented activities incorporated into the routine (i.e. transitional movements).
Schmid et al. [41] **Year:** 2012	**Design:** RCT (pilot study) **Sample:** N = 47 (♂: 38 ♀: 9) Yoga (n = 37) Control (n =10) **Objective:** Assess the impact of a yoga-based rehabilitation intervention on balance, balance self-efficacy, fear of falling (FoF), and QoL after stroke	**Dx:** Stroke **Stage:** Chronic (> 6 months) **Age:** 63.1 (8.8)	**Frequency:** 2 x per week **Session Duration:** 60 min sessions **Intervention Period:** 8 weeks **Dose (total time):** 16 hrs	**Style of Yoga**: Adapted (therapeutic) **Structure:** Modified postures with a focus on hip/ankle flexibility and strength; breathing and meditation; participants randomized to the yoga-plus group completed an additional 20-min relaxation audio recording.	**Physical:** mRS, BBS, ABCS **Psychosocial:** Dichotomous variable used to measure FoF **Multidimensional:** Stroke-specific QoL scale	**Results:** No significant differences between groups; with-in group comparison demonstrated significant improvements in balance and FoF in yoga group. **Conclusion:** A group yoga-based intervention for people with chronic stroke has the potential in improving multiple post-stroke variables.
Schmid et al. [42] **Year:** 2014	**Design:** Secondary analysis of RCT **Sample:** N = 47 (♂: 38 ♀: 9) Yoga (n = 37) Control (n = 10) **Objective:** Assess changes in physical functioning (i.e. measures of pain, ROM, strength, and endurance) after 8 weeks of a therapeutic yoga program	**Dx:** Stroke **Stage:** Chronic (> 6 months) **Age:** 63.1 (8.8)	**Frequency:** 2 x per week **Session Duration:** 60 min sessions **Intervention Period:** 8 weeks **Dose (total time):** 16 hrs	**Style of Yoga**: Adapted (therapeutic) **Structure:** Standardized and progressive protocol comprised of modified yoga postures, breathing, and relaxation in sitting, standing and supine.	**Physical:** PEG, ROM, arm curl test (5 or 8lbs), chair-to-stand test, 6MWT, modified 2-min step test	**Results:** Pain, neck ROM, hip passive ROM, upper extremity strength, and the 6-min walk scores all significantly improved after 8 weeks of engaging in yoga. **Conclusion:** A group therapeutic-yoga intervention may improve multiple aspects of physical functioning after stroke.

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Wang et al. [43] **Year:** 2018	**Design:** Quasi-experimental **Sample:** N = 64 (♂/♀: *N/D*) Yoga (n = 33) Control (n =32) **Objective:** Investigate the effects of yoga on recovery of motor ability and cranial nerves of stroke patients	**Dx:** Stroke **Stage:** *N/D* **Age:** Yoga ~ 57 (5.27) Control ~ 59.1 (4.98)	**Frequency:** *N/D* **Session Duration:** *N/D* **Intervention Period:** 24 weeks **Dose (total time):** *N/D*	**Style of Yoga**: Adapted (therapeutic) **Structure:** Three stage implementation of a progressive therapeutic yoga program: Stage 1 ~ beginner yoga practice Stage 2 ~ yoga with combined exercise practice Stage 3 ~ conventional yoga practice	**Physical:** BBS, TUGT, One-leg standing, Nerve excitability test **Psychosocial:** SF-36	**Results:** No effect on QoL; significant improvement in balance, walking ability, and ability to stand on one leg demonstrated in yoga group**;** yoga exercises enhanced the amplitude of muscle movement potential. **Conclusion:** Yoga practice can effectively improve health outcomes in patients recovering from stroke.

Abbreviations:

Cognitive Outcome Measures

ADP = Aphasia Diagnostic Profiles; **BDAE** = Boston Diagnostic Aphasia Exam; **BJLOT** = Benton Judgement of Line Orientation Test; **COWAT** = Benton Controlled Oral Word Association Test; **CPT** = Conner's Continuous Performance Test II**; RTT** = Revised Token Test.

Physical Outcome Measures

ABCS = Activities-specific Balance Confidence Scale; **BBS** = Berg Balance Scale; **CGS** = Comfortable Gait Speed; **MAS**= Motor Assessment Scale; **MBI** = Modified Barthel Index; **mRS** = Modified Rankin Scale; **PEG** = Pain, Enjoyment of Life and General Activity scale; **ROM** = Range of Motion; **TMB** = Timed Movement Battery; **TUG** = Timed Up and Go; **2MWD** = 2-minute Walk Distance; **6MWT** = 6-minute Walk Test, **10mWT** = 10 Meter Walk Test.

Psychosocial Outcome Measures

BAI = Beck Anxiety Inventory; **BDI** = Beck Depression Inventory; **GDS15** = Geriatric Depression Scale; **SF-36** = Short-Form 36; **STAI** = State Trait Anxiety Inventory.

Multidimensional Outcome Measures

SIS = Stroke Impact Scale.

*Age = mean (SD); *N/D* **=** not defined in study.

Table 2
Description of Included Studies that used Yoga Therapy Interventions in Rehabilitation of Individuals with Parkinson's Disease.

Reference	Details of Study	Patient Characteristics	Intervention Parameters	Description of Protocol	Outcome Measures	Principal Findings
Boulgarides et al. [44] **Year:** 2014	**Design:** Pre-post quasi-experimental (pilot study) **Sample:** N = 10 (♂: 7 ♀: 3) **Objective:** Identify outcome measures that are responsive to change in individuals with PD after an 8-week adapted yoga program	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 1-3 **Age:** 65.7 (10.4)	**Frequency:** 1 x per week **Session Duration:** 60 min **Intervention Period:** 8 weeks **Dose (total time):** 8 hrs	**Style of Yoga**: Adapted (therapeutic) **Structure:** Warm up activities such as gentle general movements; breath work; facial poses and vocal sounds; transition to standing, seated and supine poses; concluded with meditation and deep relaxation.	**Physical:** mDGI, BBS, FRT, STR, TSCS, SLB, AST **Psychosocial:** HADS **Multidimensional:** UPDRS	**Results:** Outcome measures that approached near significant improvement were for depression (HADS), lower extremity functional strength and flexibility (TSCS, SLB, SRT). **Conclusion:** Future research required to evaluate the usefulness of yoga practice for individuals with PD.
Cheung et al. [45] **Year:** 2018	**Design:** RCT (pilot study) **Sample:** N = 20 (♂/♀: *N/D*) Yoga (n = 10) Control (n =10) **Objective:** Examine the feasibility, acceptability, and effects of Hatha yoga on oxidative stress, motor function, and non-motor symptoms in patients with PD	**Dx:** Idiopathic Parkinson's disease **Stage:** H&Y Scale: Stage 1-3 **Age**: 63.0 (8.0)	**Frequency:** 2 x per week **Session Duration:** 60 min **Intervention Period:** 12 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha **Structure:** Used protocol developed by Justice et al., 2018 ~ focus on increasing range of motion, improving balance/safety with transitions, and fostering mindfulness, acceptance and self-love; classes included thematic discussions, seated guided meditation and breath work, physical and restorative poses.	**Cognitive:** MoCA **Physical:** mUPDRS, PDSS, Oxidative stress, LAPQ **Multidimensional:** UPDRS	**Results:** Motor function (mUPDRS scores) significantly improved in yoga group; no change in oxidative stress levels. **Conclusion:** Findings suggest yoga is a feasible and acceptable intervention in PD and may serve as an adjunctive method for improving motor function.
Colgrove et al. [46] **Year:** 2012	**Design:** RCT (pilot study) **Sample:** N = 13 (♂: 6 ♀: 7) Yoga (n = 8) Control (n =5) **Objective:** Assess the feasibility and effects on motor function of Iyengar-based Hatha yoga in people with PD	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 1-2 **Age:** Yoga ~ 62.8 (13.2) Control ~ 73.4 (6.5)	**Frequency:** 2 x per week **Session Duration:** 60 min **Intervention Period:** 12 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Iyengar-Based Hatha **Structure:** 5-10 min of deep breathing and relaxation; 40 min of 5 to 8 progressive physical postures held for 3 to 7 min; 10-15 min of meditation including breathing, visualizations, and positive affirmations.	**Physical:** BBS, ROM, strength, posture, postural sway and gait initiation **Multidimensional:** UPDRS	**Results:** Significant improvement in mUPDRS and BBS in yoga group; positive trend toward improvement in strength, ROM, flexibility and qualitative improvements in posture in yoga group. **Conclusion:** Yoga may be an effective intervention for improving motor function in individuals with PD.
DeCaro et al. [47] **Year:** 2016	**Design:** Pretest-Post-test (pilot study) **Sample:** N = 86 (♂: 36 ♀: 49) PD (n = 47) Care (n =38) **Objective:** Explore if a single session of laughter yoga can benefit adults with PD and their caregivers	**Dx:** Parkinson's disease **Stage:** *N/D* **Age:** PD ~ 70 (8.19) Care ~ 65 (12.05)	**Frequency:** Single Session **Session Duration:** 45 min **Intervention Period:** Single Session **Dose (total time):** 0.75 hrs	**Style of Yoga**: Laughter Yoga **Structure:** Developed by Dr. Kataria ~ utilized breathing techniques, laughter activities, core exercises and meditation.	**Multidimensional:** HDYF	**Results:** Significant improvement in self-rated well-being for individuals with PD and their caregivers. **Conclusion:** Laughter yoga may be a valuable tool for individuals with PD who are suffering from low-mood.
Hall et al. [48] **Year:** 2011	**Design:** Case Study **Sample:** N = 1 (♂: 0 ♀: 1) **Objective:** Investigate the effects of 8 weekly yoga sessions on balance, mobility and reported QoL in an individual with PD	**Dx:** Idiopathic Parkinson's disease **Stage:** H&Y Scale: Stage 2 **Age:** 69	**Frequency:** 1 x per week **Session Duration:** 60 min **Intervention Period:** 8 weeks **Dose (total time):** 8 hrs	**Style of Yoga**: Adapted (therapeutic) **Structure:** Physical poses tailored to physical limitations of participants progressed from sitting to supine and prone to standing; focus on posture and alignment.	**Physical:** BBS, TUG, AROM, H & Y scale **Multidimensional:** PDQ-39	**Results:** Improvement on the BBS and TUG (not clinically significant); no change in QoL (PDQ-39); participant reported sense of enjoyment and relaxation. **Conclusion:** Larger sample sizes and individuals at different stage of disease are required in order to draw generalizable conclusions about the benefit of yoga in PD.

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Jasti et al. [49] **Year:** 2020	**Design:** Case Study **Sample:** N = 1 (♂: 0 ♀: 1) **Objective:** Examine the impact of yoga therapy on self-empowerment, reducing the severity of symptoms, improving functional autonomy and well-being	**Dx:** Idiopathic Parkinson's disease **Stage:** H&Y Scale: Stage 5 **Age:** 55	**Frequency:** 6 x per week **Session Duration:** 60 min **Intervention Period:** 4 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Lifestyle-Based Program **Structure:** Combination of *asana, pranayama*, meditation, chanting, relaxation techniques, devotional sessions, lifestyle counselling based on yoga philosophy and dietary modifications based on yogic principles.	**Cognitive:** Short-term memory on digit span test **Physical:** BBS, VAS (pain and symptoms), YPA **Psychosocial:** HAM-A, HAM-D **Multidimensional:** UPDRS	**Results:** BBS improved from 13 to 23; YPA improved from 15 to 32; scores on VAS for pain fell from 7 to 3; significant reductions demonstrated for UPDRS, HAM-A, and HAM-D in both the ON- and OFF-states. **Conclusion:** An intensive lifestyle-based yoga program may be beneficial adjunctive therapy for reducing tremor, bradykinesia, rigidity and improving balance and QoL in patients suffering from PD.
Justice et al. [18] **Year:** 2018	**Design:** RCT **Sample:** N = 19 (♂/♀: *N/D*) Yoga (n = 9) Control (n = 10) **Objective:** Develop and test a bi-weekly 12-week yoga program to determine its safety and feasibility for people living with PD	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 1-3 **Age:** Range: 49 – 75 Mean (SD): 63.0 (8.0)	**Frequency:** 2 x per week **Session Duration:** 60 min **Intervention Period:** 12 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha and Vinyasa **Structure:** Classes included: thematic discussions; seated guided meditation and breath work; physical and restorative poses focused on increasing range of motion/improving balance/safety with transitions; and fostering mindfulness, acceptance and self-love.	**Feasibility/Safety:** Adverse-event Reporting **Satisfaction:** 3- Survey Questions **Multidimensional:** Subjective Feedback	**Results:** The yoga program was safe, feasible and enjoyable for the participants; to encourage safety, mats should be positioned next to the walls and extensive use of yoga props are recommended to aid with stability. **Conclusion:** This PD yoga protocol can be used as a template for future studies on the therapeutic use of yoga for PD.
Khuzema et al. [50] **Year:** 2020	**Design:** RCT **Sample:** N = 27 (♂: 19 ♀: 8) Yoga (n = 9) Tai Chi (n = 9) Control (n = 9) **Objective:** Determine whether 8-weeks of home-based Tai Chi or yoga is more effective than regular exercise on balance and mobility	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 2.5-3 **Age:** Yoga ~ 68.1 (4.23) Tai Chi ~ 72.0 (5.22) Control ~ 70.9 (6.01)	**Frequency:** 5 x per week **Session Duration:** 30 - 40 min **Intervention Period:** 8 weeks **Dose (total time):** 20 - 27 hrs	**Style of Yoga**: Adapted (therapeutic) **Structure:** Yoga exercise program included six poses (4 standing, 1 supine, and 1 prone) repeated five times each and progressively increased to 10; intensity ranged from 11 to 15 on the Borg Rate of Perceived Exertion Scale (i.e. light to somewhat hard).	**Physical:** BBS, 10-MWT, TUG	**Results:** All three groups showed significant improvement after 8 weeks in balance and functional mobility; no significant main effect between groups for both balance and stability. **Conclusion:** Yoga could be a potential therapy for improving balance and functional mobility for individuals with mild to moderate idiopathic PD.
Kwok et al. [51] **Year:** 2019	**Design:** RCT **Sample:** N = 138 (♂:65♀: 73) Yoga (n = 71) Control (n =67) **Objective:** Compare the effects of yoga vs. stretching and resistance training on psychological distress, physical health, well-being and QoL in patients with mild-to-moderate PD	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 1 **Age:** 63.6 (8.7)	**Frequency:** Group ~ 1 x per week Home ~ 2 x per week **Session Duration:** Group ~ 90 min Home ~ 20 min **Intervention Period:** 8 weeks **Dose (total time):** 17.3 hrs	**Style of Yoga**: Hatha **Structure:** Mindfulness yoga protocol with three themes: (i) intro to mindfulness, (ii) embracing mindfulness of the body and mind, and (iii) cultivating loving-kindness and compassion. Progressive and stepwise delivery of 12 basic Hatha yoga poses with controlled breathing and mindfulness meditation exercises.	**Physical:** TUG **Psychosocial:** HADS, HWS **Multidimensional:** MDS-UPRDS, PDQ-39	**Results:** Yoga was superior to conventional exercise for managing anxiety, and depressive symptoms, perceived hardship, equanimity, and health related QoL; yoga was as effective as conventional exercise for improving motor function. **Conclusion:** Mindfulness yoga is an effective treatment option for patients with PD to manage psychological distress and improve physical symptoms.
Memarian et al. [52] **Year:** 2017	**Design:** Pre-Test Post-Test **Sample:** N = 24 (♂: 14 ♀:10) Yoga (n = 12) Control (n =12) **Objective:** Evaluate the effects of Laughter Yoga exercises on anxiety and sleep quality in patients with PD	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 1-3 **Age:** *N/D*	**Frequency:** 2 x per week **Session Duration:** 45 min **Intervention Period:** 8 weeks **Dose (total time):** 12 hrs	**Style of Yoga**: Hatha **Structure:** Developed by Dr. Kataria ~ utilized breathing techniques, laughter activities, core exercises and meditation	**Physical:** PSQI **Psychosocial:** BAI	**Results:** Significant differences in average stress change and sleep quality following an 8-week laughter yoga program; improvements noted in subjective sleep quality and latency. **Conclusion:** Laughter yoga can significantly improve anxiety and sleep quality in patients with PD and may serve as a beneficial complementary therapy to standard treatment.

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Myers et al. [53] **Year:** 2020	**Design:** RCT **Sample:** N = 26 (♂: 15 ♀: 11) Yoga (n = 13) Control (n =13) **Objective:** Determine the feasibility and effect of a 12-week yoga intervention on balance, lower back pain and anxiety	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 2-3 **Age:** Yoga ~ 70.5 (8.7) Control ~ 65.0 (8.7)	**Frequency:** 2 x per week **Session Duration:** 60 min **Intervention Period:** 12 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Beginner Vinyasa **Structure:** 5-min relaxation and guided meditation; 10 min of gentle spinal movements; 30-35 min of standing poses; 5-10 min cool down; 5 min of rest and relaxation. Progressively increased in intensity over 12-week intervention period.	**Physical:** BESTest, ROWS **Psychosocial:** BAI **Multidimensional:** MDS-UPRDS (part III)	**Results:** Yoga group showed significant improvements across individual balance systems; significant reductions in low-back pain; high levels of overall enjoyment; no significant changes observed in anxiety. **Conclusion:** Yoga is feasible for people with PD and is a non-pharmacological intervention that can improve balance and low-back pain.
Ni et al. [54] **Year:** 2016	**Design:** RCT **Sample:** N = 37 (♂: 24 ♀: 13) Yoga (n = 14) Power (n = 13) Control (n = 10) **Objective:** Compare the effects of power training and a high-speed yoga program on physical performances in older patients with PD	**Dx:** Idiopathic Parkinson's disease **Stage:** H&Y Scale: Stage 1-3 **Age:** 72.2 (6.5)	**Frequency:** 2 x per week **Session Duration:** 60 min **Intervention Period:** 12 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Power Vinyasa **Structure:** High-speed yoga session involving quick transitions from one pose to the next while connecting the breath to the movements.	**Physical:** BBS, TUG, SLS, 10-MWT, Mini-BESTest, FRT, SLS, 1-RM, PPW **Multidimensional:** MDS-UPRDS	**Results:** No differences detected between yoga program and power training; both groups reported alleviation of motor symptoms and significant improvements in balance, function, gait, leg muscle strength and power. **Conclusion:** A high-speed yoga program can improve physical performance in older persons with PD.
Sharma et al. [55] **Year:** 2015	**Design:** RCT (pilot study) **Sample:** N = 13 (♂: 6 ♀: 7) Yoga (n = 8) Control (n = 5) **Objective:** Determine whether a yoga intervention can improve physiological outcomes and QoL in individuals with PD	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 1-2 **Age:** Yoga ~ 62.8 (13.2) Control ~ 73.4 (6.5)	**Frequency:** 2 x per week **Session Duration:** *N/D* **Intervention Period:** 12 weeks **Dose (total time):** *N/D*	**Style of Yoga**: *N/D* **Structure:** *N/D*	**Physical:** Modified FES, weight, resting HR, respiratory rate, BP, standard PFT **Psychosocial:** GDS, SF-36 **Multidimensional:** UPRDS	**Results:** Yoga group demonstrated significant improvement in UPDRS scores, diastolic BP, and average FVC; positive trends were observed in depression scores, body weight, FEV. **Conclusion:** Yoga may improve aspects of QoL and physiological function in mild-to-moderate patients with PD.
Taylor et al. [56] **Year:** 2001	**Design:** Case Study **Sample:** N = 1 (♂: 0 ♀: 1) **Objective:** Report the clinical-decision making involved in using yoga therapy with a patient with PD	**Dx:** PD **Stage:** *N/D* **Age:** 59	**Frequency:** 7 x per week **Session Duration:** 30 min **Intervention Period:** 3 weeks **Dose (total time):** 10.5 hrs	**Style of Yoga**: Adapted (therapeutic) **Structure:** Involved breathing exercises and modified yoga postures in sitting, standing and supine.	*N/D*	**Results:** Patient reported significant improvement in vocal projection, facial awareness, improved gait efficiency, and emotional boost. **Conclusion:** Yoga therapeutics may have the potential to complement traditional neurological physical therapy.
Van Puym-broeck et al. [57] **Year:** 2018	**Design:** RCT **Sample:** N = 27 (♂:17♀: 10) Yoga (n =15) Control (n = 12) **Objective:** Examine the impact of an 8-week yoga intervention on motor function, balance control, postural stability and freezing of gait in persons with PD	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 1.5-3 **Age:** 67.7 (5.89)	**Frequency:** 2 x per week **Session Duration:** *N/D* **Intervention Period:** 8 weeks **Dose (total time):** *N/D*	**Style of Yoga**: Hatha **Structure:** Modified yoga postures in sitting, standing and supine; breath work (*pranayama*); meditative techniques (*Dhyana*) and deep relaxation.	**Physical:** Modified H&Y scale, Mini-BESTest, FGA, FoG **Multidimensional:** MDS-UPRDS	**Results:** Yoga group demonstrated clinical important differences in MDS-UPRDS scores and significant improvement in Mini-BESTest, FGD and FoG. **Conclusion:** A yoga intervention appears to improve motor function, postural stability, functional gait and freezing of gait in patients with PD and thus may have the potential to reduce fall risk in this population.

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Walter et al. [58] **Year:** 2019	**Design:** RCT **Sample:** N = 27 (♂: 17 ♀: 10) Yoga (n = 15) Control (n =12) **Objective:** Examine changes in nonmotor symptoms of fatigue, activity constraints, balance, balance confidence, fall management, and overall PD-specific health related QoL for individuals with PD following an 8-week standardized Hatha yoga intervention	**Dx:** Parkinson's disease **Stage:** H&Y Scale: Stage 1.5 **Age:** 67.6 (5.89)	**Frequency:** 2 x per week **Session Duration:** 60 min **Intervention Period:** 8 weeks **Dose (total time):** 16 hrs	**Style of Yoga**: Hatha **Structure:** Adapted sequence for PD to focus on balance, strength and mobility. Involved physical postures, breath work and meditation.	**Physical:** PFS-16. ACS, ABV, FMS, FCS **Multidimensional:** PDQ-8	**Results:** Yoga group demonstrated greater reduction in perceived constraints to activity, and improvement in measures of fatigue, beliefs in one ability to manage falls, and health related QoL. **Conclusion:** Yoga may be an effective complementary and integrative health approach to help improve non-motor symptoms for people with PD.

Abbreviations:

Cognitive Outcome Measures

MoCA = Montreal Cognitive Assessment.

Physical Outcome Measures

ABC = Activities-Specific Balance Confidence Scale; **ACS** = Activities Constraint Scale; **AST** = Apley Scratch Test; **BBS** = Berg Balance Scale; **BESTest** = Balance Evaluations Systems Test; **FCS** = Fall Control Scale; **FGA** = Functional Gait Assessment; **FMS** = Fall Management Scale; **FoG** = Freezing of Gait Questionnaire; **FRT** = Functional Reach Test; **HR** = Heart Rate; **LAPAQ** = Longitudinal Aging Study Amsterdam Physical Activity Questionnaire; **Mini-BESTest** = Mini-Balance Evaluations Systems Test; **mDGI** = Modified Dynamic Gait Index; **Modified FES** = Modified Falls Efficacy Scale; **Modified H&Y Scale** = Modified Hoehn & Yahr Scale; **mUPDRS** = Motor portion of the Unified Parkinson's Disease Rating Scale; **PFT** = Pulmonary Functions Test**; PDSS** = Parkinson's Disease Sleep Scale; **PFS-16** = Parkinson Fatigue Scale; **PPW** =Peak Power; **PSQI** = Pittsburgh Sleep Quality Inventory; **ROM** = Range of Motion; **ROSW** = Revised Oswestry Disability Index; **SLB** = Single Leg Balance**; SLS** = Single leg stance; **SRT** = Sit and Reach Test; **TSCS** = 30 sec. Chair Stand; **TUG** = Timed Up and Go; **VAS** = Visual Analog Scale; **YPA** = Yoga Performance Assessment scale; **1 RM** = 1 Repetition Maximum; **10mWT** = 10m Walk Test.

Psychosocial Outcome Measures

BAI = Beck Anxiety Inventory; **BDI** = Beck Depression Inventory; GDS = Geriatric Depression Scale; **HADS** = Hospital Anxiety and Depression Scale; **HAM-A** = Hamilton Anxiety Rating Scale; **HAM-D** = Hamilton Depression Rating Scale; **HWS** = Holistic Well-Being Scale; **PDQUALIF** = Parkinson's Disease Quality of Life Questionnaire; **SF-36** = Short-Form 36.

Multidimensional Outcome Measures

HDYF = How Do You Feel Form; **MDS-UPDRS** = Movement Disorders Society Unified PD Rating Scale; **PDQ** = Parkinson's Disease Questionnaire; **UPDRS** = Unified Parkinson's Disease Rating Scale.

*Age = mean (SD); *N/D* **=** not defined in study.

Table 3
Description of Included Studies that used Yoga Therapy Interventions in Rehabilitation of Individuals with Multiple Sclerosis.

Reference	Details of Study	Patient Characteristics	Intervention Parameters	Description of Protocol	Outcome Measures	Principal Findings
Ahmadi et al. [59] **Year:** 2013	**Design:** RCT **Sample:** N = 31 (♂: 0 ♀: 31) Yoga (n = 11) Aerobic (n =10) Control (n = 10) **Objective:** Compare the effects of 8-weeks of aerobic and yoga training on balance, ambulatory function, fatigue and mood status in MS patients	**Dx:** MS **Stage:** EDSS Scale: 1-4 **Age:** 35.2 (9.01)	**Frequency:** 3 x per week **Session Duration:** 60-70 min **Intervention Period:** 8 weeks **Dose (total time):** 24-28 hrs	**Style of Yoga**: Hatha **Structure:** Classes incorporated postures, breath work, meditation, and relaxation techniques. Poses were held for 10-30 sec with 30-60 sec rest periods. Patients were supported for the majority of poses using props.	**Physical:** BBS, 10MWT, 2MWT, FSS **Psychosocial:** BDI, BAI **Multidimensional:** EDSS	**Results:** Significant improvements in balance score, walking endurance, FFS score, BDI score and BAI score observed in both treatment groups; greater improvement in BAI scores observed in the yoga group compared to aerobic group. **Conclusion:** Treadmill training and yoga practice can both improve ambulatory function, fatigue and mood status in individuals with mild to moderate MS.
Bhargav et al. [49] **Year:** 2016	**Design:** Crossover **Sample:** N = 18 (♂: 5 ♀: 13) **Objective:** Investigate the immediate effects of a cyclic meditation (CM) yoga session on the cognitive domains of psychomotor performance, selective attention, short-term memory, executive functions, and immediate and delayed recall in patients with relapse-remitting MS (RRMS)	**Dx:** Relapse-remitting and Progressive MS **Stage:** EDSS Scale: 0-6.5 **Age:** 51.5 (12.7)	**Frequency:** 2 sessions **Session Duration:** 30 min **Intervention Period:** 2 sessions **Dose (total time):** 1 hr	**Style of Yoga**: Cyclic meditation **Structure:** 3 yoga postures were interspersed with periods of 3 different types of relaxation. *Savasana* (supine rest; SR) was used as a control session for comparative analysis.	**Cognitive:** TMA/B, DSST, AVLT, WMS-R (Digit Span) .	**Results:** Both CR and SR sessions improved scores on DSTT, AVLT; significantly better performance on TMT-A and FDS after CM compared to SR; CM is better than SR in improving processing speed and working memory. **Conclusion:** Yogic relaxation techniques may have an immediate enhancing effect on processing speed, psychomotor performance, and recall of RRMS patients.
Cohen et al. [12] **Year:** 2017	**Design:** Pretest-post-test (pilot study) **Sample:** N = 14 (♂: 0 ♀: 14) **Objective:** Determine the safety and feasibility and effects on QoL, physical function and motor performance of a yoga program designed for people with MS-related disability	**Dx:** MS (any subtype) **Stage:** SR-MSDS Scale: 3-6 **Age:** 53.5 (8.3)	**Frequency:** 2x per week **Session Duration:** 90 min **Intervention Period:** 8 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha **Structure:** 10-min of yoga philosophy; 10 min of *pranayama*; 50 min of *asana* with chair or wall support if needed; 20 min of relaxation and meditation techniques including mindfulness and visualization.	**Cognitive:** PASAT-3 **Physical:** MSW-12, T25FW, 6MWT, 9HPT, 5STS, MDRT, MEP, SF-36 MCS **Multidimensional:** MSLQI	**Results:** Significant main effect found on SF-36 MCS, MFIS, BLCS, PDQ, MHI, MSW-12, T25FW, NHPT, PASAT-3, 6MWT, FTSTS and MDRT-Back. **Conclusion:** Yoga is a safe and effective intervention and has the potential to benefit several QoL and physical performance outcomes in individuals with moderate MS-related disability.
de Oliveira et al. [60] **Year:** 2016	**Design:** RCT (pilot study) **Sample:** N = 12 (♂: 1 ♀: 11) Yoga (n = 6) Control (n = 10) **Objective:** Evaluate the influence of a six-month yoga program on postural balance and subjective impact of postural balance impairment on activities of daily living (ADLs) in people with MS	**Dx:** MS (any subtype) **Stage:** EDSS Scale: 0-6 **Age:** Yoga ~ 46.0 (8.0) Control ~ 45.0 (9.0)	**Frequency:** 1x per week **Session Duration:** 60 min **Intervention Period:** 24 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha (Adapted) **Structure:** Postures addressed movements of the vertebral column and were carried out in seated, supine and upright positions held for 30 sec each; followed by breath work; concluded with relaxation in supine position *(Yoga Nidra*).	**Physical:** BBS, IPBDLSQ **Multidimensional:** EDSS	**Results:** Significant improvement in BBS score (especially in subjects with high EDSS score), increased self-reported postural balance, and decreased influence of postural balance impairment on ADLs from baseline to six months was observed in yoga group. **Conclusion:** Yoga training is beneficial for people with MS as it improves postural balance and decreases influence of postural balance impairment on ADLs.

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Doulatabad et al. [61] **Year:** 2012	**Design:** RCT **Sample:** N = 60 (♂: 0 ♀: 60) Yoga (n =30) Control (n = 30) **Objective:** Investigate how yoga techniques can modify physical pain and quality of life (QoL) in women with MS	**Dx:** MS (any subtype) **Stage:** *N/D* **Age:** 31.6 (8)	**Frequency:** 2x per week **Session Duration:** 60-90 min **Intervention Period:** 12 weeks **Dose (total time):** 24-36 hrs	**Style of Yoga**: Ashtanga inspired Hatha **Structure:** Incorporated (i) slow moving *asana*; (ii) *pranayama*; and (iii) mind focus and establishment of control through meditation, extension, and quiescence (R*aja*).	**Multidimensional:** MSQoL-54	**Results:** Yoga therapy resulted in a significant improvement in physical pain management and QoL compared to the control group. **Conclusion:** Yoga techniques can be used as a supplemental therapy to treat patients with MS as it strengthens physical power and improves mental status resulting in an improved QoL.
Ensari et al. [62] **Year:** 2016	**Design:** Pre-post quasi-experimental **Sample:** N = 14 (♂: 1 ♀: 23) Yoga (n = 8) Walking (n = 8) Control (n = 8) **Objective:** Examine the effects of single bouts of treadmill walking and yoga compared with a quiet and seated-rest control condition on acute mood symptoms in individuals with MS	**Dx:** Relapse-remitting MS **Stage:** EDSS Scale**:** 2 to 6 **Age:** 44.2 (8.2)	**Frequency:** 1 session **Session Duration:** 30 min **Intervention Period:** 1 session **Dose (total time):** 0.5 hrs (30 min)	**Style of Yoga**: Hatha **Structure:** 5 min of centering; 20 min of modified Hatha yoga for people with MS (nine postures including isometric exercises and muscle relaxation); 5 min of meditation and deep breathing.	**Psychosocial:** POMS	**Results:** Walking and yoga yielded comparable reductions in TMD scores and similar improvements in acute mood symptoms; walking (not yoga) resulted in an improvement in vigor. **Conclusion:** A single bout of exercise might be beneficial to induce mood-improving effects in people with MS and the modality of exercise might not matter if the goal is to improve overall acute mood symptoms.
Garrett et al. [63] **Year:** 2013a	**Design:** RCT **Sample:** N = 242 (♂:60 ♀: 182) Yoga (n = 77) PT (n =80) FI (n = 86) Control (n = 71) **Objective:** Evaluate the effectiveness of community-based exercise interventions for people with MS who have minimal gait impairment	**Dx:** Relapse-remitting, Primary progressive and Secondary progressive MS **Stage:** GNDS Score: 0 to 2 **Age:** Yoga ~ 49.6 (1.0) PT ~ 51.7 (10.0) FI ~ 50.0 (1.0) Control ~ 48.8 (11.0)	**Frequency:** 1x per week **Session Duration:** 60 min **Intervention Period:** 10 weeks **Dose (total time):** 10 hrs	**Style of Yoga**: Hatha **Structure:** Classes generally began with breath work, relaxation or 'body-centering,' followed by a series of range of motion or stretching exercises and dynamic weight-bearing poses held between 30 to 90 sec; concluded with relaxation, deep breathing or *Yoga Nidra.*	**Physical:** 6MWT **Multidimensional:** MSIS-29, MFIS	**Results:** All three exercise interventions led to significant improvement on the MSIS-29 psychological, MFIS total and physical subscale; Only PT-led and FI-led improved MSIS-29 physical and 6MWT **Conclusion:** Exercise has a positive effect on the physical impact of MS and fatigue. The group nature of the classes may contribute to the positive effects seen on the psychological impact of MS
Garrett et al. [64] **Year:** 2013a	**Design:** Secondary analysis of RCT **Sample:** N = 121(♂: 36♀: 84) Yoga (n = 38) PT Led (n = 41) FI Led (n = 42) **Objective:** Collect and compare follow-up data (week 24) to post-treatment (week 12) and baseline (week 1) data for participants in the intervention group	**Dx:** Relapse-remitting, Primary progressive and Secondary progressive MS **Stage:** GNDS Score: 0 to 2 **Age:** 51.5 (9.2)	**Frequency:** 1x per week **Session Duration:** 60 min **Intervention Period:** 10 weeks **Dose (total time):** 10 hrs	**Style of Yoga**: Hatha **Structure:** Classes generally began with breath work, relaxation or 'body-centering,' followed by a series of range of motion or stretching exercises and dynamic weight-bearing poses held between 30 to 90 sec; concluded with relaxation, deep breathing or *Yoga Nidra.*	**Physical:** 6MWT **Multidimensional:** MSIS-29, MFIS	**Results:** Positive effect of exercise on the physical impact of MS were not maintained 3-months post intervention; psychological well-being and impact of fatigue remained significantly improved from baseline **Conclusion:** Delivering health-promoting interventions over the lifetime of people with chronic neurological conditions is vital to maintaining sustained physical and mental health.

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Guner & Inanci. [65] **Year:** 2014	**Design:** Pretest-post-test **Sample:** N = 16 (♂: 2♀: 14) MS (n = 8) Control (n = 8) **Objective:** Determine the effects of 12 weeks of yoga therapy on fatigue, balance and gait parameters in people with MS	**Dx:** Relapse-remitting MS **Stage:** EDSS Scale: 0 to 6 **Age:** Yoga ~ 38.4(7) Control ~ 33.9(3.8)	**Frequency:** 2x per week **Session Duration:** 60 min **Intervention Period:** 12 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha (Adapted) **Structure:** Poses performed in sitting or supported by a chair/wall, and held for 10-30 sec with 30-60 sec rest periods in a room held at 16-17°C; concluded with 10-min deep relaxation (*savasana)*. Daily home practice was strongly encouraged.	**Physical:** FSS, BBS, Gait analysis using the Vicon 612 system with six cameras and two Bertec force plates	**Results:** Significant improvement observed in fatigue, balance, step length and walking speed after 12-week yoga intervention; visible but non-significant improvements in peak pelvic tilt, peak hip extension, and ankle power at push-off. **Conclusion:** Yoga therapy is safe and beneficial intervention for improving fatigue, balance and spatiotemporal gait paraments in patients with MS.
Hassanpour-Dehkordi & Jivad. [66] **Year:** 2014	**Design:** Quasi-experimental RCT **Sample:** N = 61 (♂: 1 ♀: 60) Yoga (n = 20) Aerobics (n = 20) Control (n = 21) **Objective:** Compare the effects of regular yoga and aerobic exercise on quality of life (QoL) of patients with MS	**Dx:** MS **Stage:** *N/D* **Age:** 31.9 (*N/D*)	**Frequency:** 3x per week **Session Duration:** 40 min **Intervention Period:** 12 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: *N/D* **Structure:** *N/D*	**Psychosocial:** SF-36	**Results:** The mean score on the QoL questionnaire was significantly higher than that of the aerobic group, and the aerobic group showed significantly higher mean scores compared with the control. **Conclusion:** Yoga and aerobic exercise can improve QoL in patients with MS.
Hasanpour-Dehkordi.[67] **Year:** 2016	**Design:** RCT **Sample:** N = 61 (♂: 1 ♀: 60) Yoga (n = 20) Aerobic (n =20) Control (n = 21) **Objective:** Investigate the influence of yoga and aerobic exercise on fatigue, pain and psychological status in patients with MS	**Dx:** MS **Stage:** *N/D* **Age:** 31.9 (*N/D*)	**Frequency:** 3x per week **Session Duration:** 60-70 min **Intervention Period:** 12 weeks **Dose (total time):** 36– 42 hrs	**Style of Yoga**: Hatha **Structure:** Stretching followed by standing, supine, prone-lying and sitting postures held for 10 to 30 sec with rest periods of 30 to 60 sec; breathing for concentration and relaxation; 10-min of deep relaxation. Home practice with pre-determined poses was strongly encouraged.	**Physical:** RFS **Psychosocial:** SF-36	**Results:** Significant reduction in fatigue severity, decreased pain with physical function, increased physical and emotional roles, increased social function, and improved mental status were observed in both the yoga and exercise groups. **Conclusion:** Scheduled yoga classes can significantly enhance the overall general health of patients with MS.
Hasanpour-Dehkordi et al. [68] **Year:** 2016	**Design:** RCT **Sample:** N = 60 (♂/♀: *N/D*) Yoga (n =30) Control (n = 30) **Objective:** Investigate the effects of yoga on physiological indices, anxiety, social functioning and quality of life (QoL) in MS patients	**Dx:** MS **Stage:** *N/D* **Age:** 30 (*N/D*)	**Frequency:** 3x per week **Session Duration:** 60-70 min **Intervention Period:** 12 weeks **Dose (total time):** 36– 42 hrs	**Style of Yoga**: Hatha **Structure:** Stretching followed by standing, supine, prone-lying and sitting postures held for 10 to 30 sec with rest periods of 30 to 60 sec; breathing for concentration and relaxation; 10-min of deep relaxation. Home practice with pre-determined poses was strongly encouraged.	**Physical:** VAS, FSS, Vital Signs **Psychosocial:** Spielberg Anxiety Inventory, SF-36	**Results:** Yoga significantly improved QoL and social functioning and significantly decreased fatigue intensity, pulse rate, blood pressure, anxiety and pain. **Conclusion:** Yoga should be considered a possible adjunctive therapy for decreasing stress and anxiety. Yoga appears to be safe and should be encouraged to increase self-efficacy, improve QoL and promote social functioning in patients with MS.

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Hogan et al. [69] **Year:** 2014	**Design:** RCT **Sample:** N =111 (♂:40 ♀: 71) Yoga (n = 13) Group PT (n = 48) 1-on-1 PT (n = 35) Control (n = 15) **Objective:** Evaluate the effectiveness of yoga and physiotherapy interventions delivered in community settings for people with MS who use bilateral aids for gait	**Dx:** MS **Stage:** GNDS Score: 3 to 4 **Age:** Yoga ~ 58 (N/D) Group PT ~ 57 (N/D) 1 on 1 PT ~ 52 (N/D) Control ~ 49 (N/D)	**Frequency:** 1x per week **Session Duration:** 60 min **Intervention Period:** 10 weeks **Dose (total time):** 10 hrs	**Style of Yoga**: *N/D* **Structure:** Static postures (e.g. mountain pose, cat pose, and tailor pose); self-massage, relaxation, meditation and breathing techniques.	**Physical:** BBS, 6MWT **Multidimensional:** MSIS-29, MFIS	**Results:** No significant improvements on MSIS-29 physical or psychological component scores and MFIS scores in the yoga group; significant decrease in 6MWT in yoga group. **Conclusion:** Physiotherapy interventions may be more effective for overall physical and psychological health than participating in yoga for people with MS who use bilateral support for gait.
Hosseini et al. [70] **Year:** 2018	**Design:** RCT **Sample:** N = 26 (♂: 12 ♀: 14) Yoga (n = 9) Resistance (n = 9) Control (n = 8) **Objective:** Compare the effects of home-based yoga training and resistance training (RT) on muscle strength, motor capacity and balance in patients with MS	**Dx:** MS **Stage:** EDSS Scale: 1 to 6 **Age:** 31.3 (9.07)	**Frequency:** 3x per week **Session Duration:** 60-70 min **Intervention Period:** 8 weeks **Dose (total time):** 24– 28 hrs	**Style of Yoga**: Hatha **Structure:** Stretching exercises with a progression to standing, prone-lying and sitting postures held for 8 to 30 sec (depending on tolerance) with 30 to 60 sec rest periods; new poses were added to the program every two weeks.	**Physical:** 1RM (leg press), 10MWT, 20-sec balance tests using computerized biodex (i.e. standing eyes open; standing eyes closed; single leg standing eyes open)	**Results:** Yoga had no significant effect on leg extensor muscle strength but RT increased it**;** functional capacity was not affected by either yoga or RT**;** single leg balance improved significantly in the yoga group. **Conclusion:** Both yoga and RT, when prescribed with regularity and controlled intensity and time, can have a positive impact on the lower limb strength and some degree of balance improvements in MS patients.
Najafi-Doulatabad et al. [71] **Year:** 2014	**Design:** RCT **Sample:** N = 60 (♂: 0♀: 60) Yoga (n = 30) Control (n = 30) **Objective:** Explore the effects of yoga techniques on physical activities and sexual function in women with MS	**Dx:** MS **Stage:** *N/D* **Age:** 31.6 (8.0)	**Frequency:** 2x per week **Session Duration:** 60-90 min **Intervention Period:** 8 weeks **Dose (total time):** 24– 36 hrs	**Style of Yoga**: Hatha **Structure:** Slow movements in supine, sitting and standing; postures with an emphasis on mindful breathing and focus on specific body parts; participants alternated between physical movement and mental activities interspersed with 10-15 min of rest in supine position.	**Multidimensional:** MSQoL-54	**Results:** Yoga caused significant improvements in physical activities requiring minimal to moderate exertion but did not minimize difficulty with more strenuous and heavy activities (i.e. stairs, walking through intersection); yoga improved sexual satisfaction. **Conclusion:** Yoga techniques may be beneficial in improving the physical and sexual function of women with MS.
Oken et al. [72] **Year:** 2004	**Design:** RCT **Sample:** N = 57 (♂: 4 ♀: 53) Yoga (n = 22) Exercise (n = 15) Control (n = 20) **Objective:** Determine the effect of yoga and aerobic exercise on cognitive function, fatigue, mood and quality of life in patients with MS	**Dx:** MS **Stage:** EDSS Scale: 0 to 6 **Age:** Yoga ~ 49.8 (7.4) Exercise ~ 48.8 (10.4) Control ~ 48.4 (9.8)	**Frequency:** 1x per week **Session Duration:** 90 min **Intervention Period:** 24 weeks **Dose (total time):** 36 hrs	**Style of Yoga**: Iyengar (Adapted) **Structure:** 19 modified supported poses held for 10 to 30 sec with rest periods of 30 to 60 sec; emphasis placed on breathing for concentration and relaxation; concluded with 10 min of deep relaxation, visualization or meditation techniques in supine. Daily home practice was strongly encouraged.	**Cognitive:** SCWT, Modified Useful FoV task, PASAT, WMS-III, WAIS **Physical:** MSFC, T25-FW, 9HPT, CSR, SL balance, MFI, Alertness (based on EEG) **Psychosocial:** POMS, CSED-10, SF-36, STAI	**Results:** No effect in either intervention on primary outcome measures of attention, alertness or mood; both active interventions showed significant improvement in secondary measures of fatigue. **Conclusion:** 6-months of yoga or exercise classes may have beneficial effect on levels of fatigue in patients with MS.

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Patil et al. [73] **Year:** 2012	**Design:** Pretest-post-test **Sample:** N = 16 (♂: 1♀: 10) **Objective:** Evaluate the effect of integrated yoga for neurogenic bladder dysfunction (NBD) in patients with MS	**Dx:** MS **Stage:** EDSS Scale 0 to 7.5 **Age:** 46.7 (11.2)	**Frequency:** 7x per week **Session Duration:** 120 min **Intervention Period:** 3 weeks **Dose (total time):** 42 hrs	**Style of Yoga**: Therapeutic **Structure:** Loosening and strengthening postures; guided relaxation techniques; breath cleansing technique; strong contractions of pelvic floor muscles; voluntary regulation of breath; counselling.	**Physical:** PVR (ultrasound), MCL **Psychosocial:** UDI-6 **Multidimensional:** IIQ-7	**Results:** Significant improvements in post void residual urine scores on micturition frequency checklist, incontinence impact questionnaire-7, and urogenital distress inventory-6. **Conclusion:** Integrated Yoga for bladder symptom is a safe and effective adjunctive therapy for patients with neurogenic bladder dysfunction in MS.
Powell et al. [74] **Year:** 2015	**Design:** Case Study **Sample:** N = 1 (♂: 0 ♀: 1) **Objective:** To report the case study results of an individualized yoga program for one participant with MS, in terms of her experience of yoga, how yoga affected her particular symptoms of MS, and to better understand the unique and changing needs of someone with MS in the context of yoga delivered on a one-on-one basis	**Dx:** Relapse-remitting MS **Stage:** *N/D* **Age:** 37 (*N/A*)	**Frequency:** 1x per week **Session Duration:** 60 min **Intervention Period:** 24 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha **Structure:** Sessions incorporated breath and body awareness practices; meditative and relaxation techniques; reappraisal of negative emotions with positive affirmations.	**Multidimensional:** Self-reported physical and psychological changes	**Results:** Participant experienced an increased awareness of negative thoughts and feelings about MS and how it affected her and her body; by the end of the program she reported experiencing improvements in muscle tone, strength, balance, psychological well-being and confidence. **Conclusion:** Yoga can provide physical benefits and may be a means to help cope and manage symptoms associated with MS.
Pritchard et al. [75] **Year:** 2010	**Design:** Pretest-Post-test (pilot study) **Sample:** N = 60 (♂/♀: *N/D*) MS (n = 12) Cancer (n = 10) **Objective:** Examine the effects of a 6-week *Yoga Nidra* meditation program on perceived stress in MS and cancer patients	**Dx:** MS **Stage:** *N/D* **Age:** *N/D*	**Frequency:** 1x per week **Session Duration:** 90 min **Intervention Period:** 6 weeks **Dose (total time):** 9 hrs	**Style of Yoga**: *Yoga Nidra* **Structure:** Included body scan meditation; breath work; exploration of sensations, emotions and thought patterns; moving back and forth between feeling and witnessing; and sitting in awareness; Daily home practice was encouraged guided by CDs.	**Psychosocial:** PSS	**Results:** Both MS and cancer patients reported significantly lower levels of perceived stress at the end of the 6-week program. **Conclusion:** *Yoga Nidra* is an effective stress-reduction technique for cancer and MS patients. It is easier to perform than MBSR for many chronically ill patients with restricted physical capabilities. Yoga postures are not necessary to obtain the stress-reduction benefits.
Razazian et al. [76] **Year:** 2015	**Design:** RCT **Sample:** N = 54 (♂: 0 ♀: 54) Yoga (n =18) Aquatic (n =18) Control (n =18) **Objective:** Investigate the influence of yoga and aquatic exercise on fatigue, depression, and paresthesia in patients with MS	**Dx:** Relapse-remitting, Progressive relapsing, Primary progressive and Secondary progressive MS **Stage:** EDSS Scale: 0 to 6 **Age:** 33.94 (6.9)	**Frequency:** 3x per week **Session Duration:** 60 min **Intervention Period:** 8 weeks **Dose (total time):** 24 hrs	**Style of Yoga**: Hatha **Structure:** Sessions consisted of breathing exercises, meditation, sun salutations, a variety of increasingly demanding standing postures, supported head and shoulder stands, different twists and bends, and concluded with corpse pose.	**Physical:** FSS **Psychosocial:** BDI	**Results:** Fatigue, depression and paresthesia decreased significantly in the yoga and aquatic exercise group. **Conclusion:** For females with MS and treated with standard immune regulatory meditation, exercise training such as yoga and aquatic exercises positively impact the core symptoms of MS, namely, fatigue, depression and paresthesia.

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Salgado et al. [77] **Year:** 2013	**Design:** Pretest-post-test **Sample:** N = 22 (♂: 6 ♀: 16) **Objective:** Examine the effects of a comprehensive, 4-month yoga program on strength, mobility, balance, respiratory function, and quality of life (QoL) in individuals with MS	**Dx:** MS **Stage:** EDSS Scale: 2.5 to 6.5 **Age:** 48.1 (10.5)	**Frequency:** *Group* ~ 5 day intensive *Home* ~ 3x per week **Session Duration:** *Group ~ N/D* *Home* ~72 min session **Intervention Period:** 18 weeks **Dose (total time):** 64.8 hrs	**Style of Yoga**: Ananda **Structure:** Included yoga postures, affirmations, energizing exercises, breath work, and meditation. Home practice ~ included 20 min of energizing exercises, 33 min of yoga postures, 9 min of deep relaxation, and 10 min of meditation and affirmation.	**Physical:** 30CST, BBS, 2MWT, PEF, 10MWT **Multidimensional:** EDSS, MSQLI	**Results:** Significant improvements in functional strength, balance, and peak expiratory flow and a trend toward improvement in mental health and QoL outcomes were detected following the intervention. **Conclusion:** Yoga can have a positive impact on physical functioning and QoL for person with mild to moderate MS.
Velikonja et al. [78] **Year:** 2010	**Design:** RCT **Sample:** N = 20 (♂/♀: *N/D*) Yoga (n = 10) Climbing (n =10) **Objective:** Investigate the effects of sports climbing and yoga on spasticity, cognitive impairment, mood change and fatigue in patients with MS	**Dx:** Relapse-remitting, Progressive relapsing, Primary progressive and Secondary Progressive MS **Stage:** EDSS Scale: 0 to 6 **Age:** *N/D* (*N/D*)	**Frequency:** 1x per week **Session Duration:** *N/D* **Intervention Period:** 10 weeks **Dose (total time):** *N/D*	**Style of Yoga**: Hatha **Structure:** Included stretching and strengthening exercises to build muscle strength and endurance; breathing exercises to relax musculature and centre the mind.	**Cognitive:** TOL, NAB (mazes subset), d2 tests **Physical:** MAS **Psychosocial:** CES-D **Multidimensional:** EDSS, MFIS	**Results:** Yoga did not reduce spasticity or effect executive functions, mood or fatigue; an increase in selective attention was observed in the yoga group. **Conclusion:** Yoga might improve some symptoms of MS and should be considered as a possible adjunctive therapy.
Young et al. [79] **Year:** 2018	**Design:** RCT **Sample:** N = 81(♂: 15♀: 66) Yoga (n = 26) M2M (n = 27) Control (n = 28) **Objective:** Examine the effects of 2 exercise interventions, a novel dance-based program termed movement-to-music (M2M), and an adapted yoga program, on the physical and psychosocial outcomes in people with MS	**Dx:** MS **Stage:** PDSS Score: 0 to 6 **Age:** Yoga ~ 48.4 (9.95) M2M ~ 49.7 (9.40) Control ~ 47.3 (10.3)	**Frequency:** 3x per week **Session Duration:** 60 min **Intervention Period:** 12 weeks **Dose (total time):** 36 hrs	**Style of Yoga**: Hatha **Structure:** Based on a 3-Mountain format, which included a warm-up phase, work phase, and cool-down phase. Classes included a series of stationary poses in sitting or standing (isometric contraction and relaxation techniques) that progressed in difficulty; concluded with relaxation.	**Physical:** TUG, 6MWT, FTSST **Multidimensional:** PROMIS Pain Interference Short Form 8a	**Results:** Yoga participants had improved mobility, but it was not statistically significant; no significant differences were observed in FTSST, fatigue, pain interference, and walking endurance in the yoga group compared to the controls **Conclusion:** No significant improvements were observed in participants undergoing a 12-week adapted yoga intervention.

Abbreviations:

Cognitive Outcome Measures:

AVLT = Auditory-Verbal Learning Test; **DSST** = Digit Symbol Substitution Test; **Modified Useful FoV task** = Modified Useful Field of View Task; **NAB** = Neuropsychological Assessment Battery; **PASAT-3** = Paced Auditory Serial Addition Test; **SCWT** = Stroop Color and Word Test; **TMA/B** = Trail Making A&B; **TOL** = Tower of London Test; **WMS-R** = Wechsler Memory Scales; **WAIS** = Wechsler Adult Intelligence Scale.

Physical Outcome Measures

BBS = Berg Balance Scale; **CSR** = Chair Sit and Reach; **FSS** = Fatigue Severity Scale; **FTSST** = Five Times Sit-To-Stand Test; **IPBDLSQ** = Influence of Postural Balance on Daily Living Structured Questionnaire; **PEF** = Peak expiratory flow; **MAS** = Modified Ashworth Scale; **MDRT** = Multidirectional Reach Test; **MEP** = Maximal expiratory pressure; **MFI** = Multidimensional Fatigue Inventory; **MSFC** = Multiple Sclerosis Functional Composite; **MSWS-12** = Multiple Sclerosis Walking Scale; **RFS** = Rhoten Fatigue Scale; **SSS** = Stanford Sleepiness Scale; **TUG** = Timed Up and Go; **T25FW** = Times 25-Foot Walk; **VAS** = Visual Analog Scale; **2MWT** = 2-minute Walk Test; **30CST** = 30-second Chair Stand Test; **5STS** = 5; **6MWT** = 6-minute Walk Test; **9HPT** = 9-Hole Peg Test; **10mWT** = 10-meter Walk Test.

Psychosocial Outcome Measures:

BAI = Beck Anxiety Inventory; **BDI** = Beck Depression Inventory; **CESD-10** = Center for Epidemiologic Studies Depression Scale; **POMS** = Profile of Mood States; **PSS** = Perceived Stress Scale; **STAI** = State-Trait Anxiety Inventory; **UDI-6** = Urogenital Distress Inventory Physiological: **MCL** = Micturition checklist; **PVR** = Post-void residual volume; **SF-36** = Short-Form 36; **SF-36 MCS** = Short-Form Health Status Survey Mental Component Summary.

Multidimensional Outcome Measures

EDSS = Expanded Disability Status Scale; **GNDS** = Guy's Neurological Disability Scale; **IIQ-7** = Incontinence Impact Questionnaire; **MFIS** = Modified Fatigue Impact Scale; **MSIS-29** = Multiple Sclerosis Impact Scale; **MSLQI** = Multiple Sclerosis Quality of Life Inventory; **MSQoL-54** = Multiple Sclerosis Quality of Life-54; **PDSS** = Patient Determine Disease Steps Scale; **PROMIS** = Patient-Reported Outcome Measurement Information System.

*Age = mean (SD); *N/D* **=** not defined in study; N/A = not applicable.

4. Discussion

4.1 The Question of Dose

The parameters and types of yoga varied across the included studies, and to the best of our knowledge, the effective treatment dose has yet to be investigated in literature. When prescribing yoga in a neurological population, there is a consensus that increased frequency leads to improved clinical outcomes. Patients will tend to notice physical improvements first, while positive cognitive and psychosocial changes are more likely to be elicited with continued adherence to a long-term yoga practice (i.e. 6 to 9 months).[80] The majority of yoga protocols described in this review implemented 60 to 75-minute yoga sessions at a frequency of one to three times per week for an intervention period of eight to twelve consecutive weeks. The average treatment dose across the three conditions were 26.5 hours, 17.4 hours, and 23 hours for stroke, PD and MS, respectively. The wide variety of interventional parameters employed highlights the necessity for the field to develop standardized yoga protocols in order to effectively investigate the optimal dose required to successfully manage neurological impairments.

It is important to recognize that not all therapeutic effects arising from YT occur in a simple linear dose-dependent manner. The holistic benefits that stem from YT are complex and emergent in nature. Aspects of patient recovery may not be able to be quantified by traditional outcomes measures separated into discrete categories of functional recovery. Many patients who have gone through a yoga intervention often report subjective experiences such as feeling a greater sense of overall wellness or being more mindful in everyday life.[80] The therapeutic environment, peer-to-peer social interaction, and culture of community and acceptance fostered within YT play a critical role in promoting patient recovery.[18,51] This complex interaction between patient and environment is greatly under-researched but is vital to establishing how best to integrate YT into neuro-rehabilitative care.

4.2 Yoga & Stroke

A large proportion of YT research in the post-stroke population has focused on improving balance, strength, and lower extremity range of motion. [36,41,42,80,81] One particular study centered its focus around the *pranayama* technique of alternate nostril breathing (ANB*)*, to evaluate its effect on physical as well as cognitive functioning. ANB is thought to activate both hemispheres of the brain and has been linked to improvements in verbal and communication abilities, spatial

orientation, cognition, and autonomic nervous system functioning. [39] While most of the included studies investigated the physical component of yoga, there has been less scientific inquiry into the psychosocial healing that yoga is capable of promoting. One of the first studies to describe the ability of yoga to help restore the mind-body connection in stroke survivors was carried out by Garrett, Immink, and Hiller (2011). Overall, the eleven studies included in this review support the notion that yoga is capable of impacting multiple body systems and functions and is an effective intervention that may positively influence the physical, cognitive, and psychosocial health of patients recovering from a stroke.

4.3 Yoga & Parkinson's Disease

There is considerable support for yoga as a promising nonpharmacologic therapy that positively influences the motor and non-motor symptoms that manifest in patients with PD.[45–47,50–55,57] Kwok and colleagues carried out one of the most rigorous clinical trials on yoga in PD to date and demonstrated that a mindfulness yoga intervention was as effective as a conventional exercise program in improving motor dysfunction and mobility.[51] Furthermore, patients who participated in the yoga intervention demonstrated significant reductions in anxiety and depressive symptoms, as well as greater improvements in psycho-spiritual health and health-related quality of life (HRQOL) when compared to the exercise control group. The success of this intervention emphasizes the need for healthcare professionals to adopt a more holistic approach in neurological rehabilitation. Integrating mindfulness-based activities into standard treatment may very well enhance the welfare of patients dealing with the physical challenges and psychological distress of living with a neurodegenerative condition.

4.4 Yoga & Multiple Sclerosis

Fatigue and chronic pain represent two of the most disabling symptoms that impact quality of life in individuals living with MS.[4,82] Results of the included studies were unable to clarify whether or not yoga is an effective management strategy for fatigue and pain in MS patients. While multiple RCTs reported a positive interventional effect on fatigue and pain,[59,61,63,64,68,72,76] there were a few studies that observed no significant change in the targeted outcomes measures.[69,78,79] After comparing the yoga intervention protocols among all the studies, the above discrepancies are likely due to differences in the type of exercises and techniques implemented in each intervention, rather than the treatment dose. Although most of the studies administered Hatha yoga, the physical postures and emphasis on the meditative and breathing components varied from

one study to the next, further emphasizing the need for the development of a standardized yoga intervention protocol to target specific symptoms of MS. Given that the successful management of chronic neurological symptoms require an integrated biopsychosocial approach, creating a yoga protocol that incorporates aspects of mindfulness, body awareness, thought monitoring and restructuring in order to equip patients with strategies to manage and cope with fatigue and pain may prove to be more effective compared to a general Hatha practice.

4.5 Implementing Yoga into the Neurological Rehabilitation Setting

Administering yoga in a rehabilitation setting can start to bridge the gap between physical and occupational therapy and help to holistically address the mind, body, and spirit of patients and caregivers. In general, the therapeutic focus of most of the yoga interventions described in this study involved increasing range of motion, improving balance, carrying out safe transitions and transfers, reducing psychological stress, fostering mindfulness, and cultivating self-compassion and acceptance towards one's personal situation. What makes yoga such an effective and readily accepted choice of activity in a rehab environment is that the practice can be adapted to accommodate almost any level of physical ability.[12] When working with individuals post-stroke, or with PD or MS, the extensive use of props (e.g. chairs, bolsters, blocks, straps, sandbags, blankets) can provide full stability and comfort for patients throughout the practice.[80] Positioning yoga mats next to the wall with a chair can ensure adequate support for standing and balance postures. Placing sandbags on affected extremities during relaxation poses can help ease a spastic limb or reduce resting tremors. Providing a rolled-up blanket for under the neck can provide comfort for a patient stuck in rigid kyphosis.

Analysis of the included studies also revealed clinical recommendations specific to each pathology. For example, developing yoga protocols for patients post-stroke should be carried out with the principles of stroke recovery in mind – i.e. providing simple and concise verbal cues, incorporating contralateral movements to activate both hemispheres of the brain and focusing on repetition to facilitate the brain's neuroplasticity.[80] When working with individuals with hemineglect or hemiparesis, therapists may need to provide hands-on or visual support for the participants' affected side to assist them in performing bilateral movements. Given that stiffness is one of the primary motor symptoms of PD, yoga postures that increase range of motion and flexibility, with a particular focus on the spine, hips, ankles, and shoulders should be incorporated into every class. Furthermore, while upright postures are still encouraged, standing extension

postures should be omitted from yoga sequences for patients with PD to avoid episodes of retropulsion.[18] YT for MS patients should be practiced in a setting that is at or below room temperature (21˚C) because yoga in hot-humid conditions may decrease nerve conduction and aggravate symptoms of MS.[59,65] In addition, frequent rest periods of 30 to 60 seconds in duration should be encouraged throughout the practice to avoid overexertion and fatigue.[65,70,72]

4.6 Study Limitations

In order to effectively verify the pertinence of articles to include in our study only articles written in English or French were screened and analyzed. As such, any relevant data published in other languages were omitted. Given the origins of yoga, it is likely that a plethora of research dating back thousands of years exists in Sanskrit, Hindi, Bengali, or other languages commonly used in India.

All relevant studies were included in our review regardless of their quality of evidence. Many of the studies reported in this paper are case studies, pilot studies, pre-test post-test design, and RCTs with underpowered sample sizes and/or lacking quality matched controls. No specific analysis of the effectiveness of YT in managing the pathology of stroke, PD or MS was conducted. As a result, the purpose of this scoping study was not to evaluate and compare the effectiveness of different clinical yoga protocols, but rather summarize how different YT interventions have been implemented into the rehabilitative care for the three neurological conditions of interest.

Excluding studies that used multi-modal interventions that combined YT with other therapeutic modalities may have omitted relevant clinical yoga protocols from analysis. This decision was made to ensure that any inference by the authors about implementing YT into neuro-rehabilitative care was based solely on the principles and techniques applied in YT and not influenced by concepts applied in other clinical interventions (e.g. cognitive behavioural therapy).

5. Conclusion

With psychiatric symptoms representing a common and often characteristic feature in a number of neurological disorders,[3,7,8] it has become apparent that the field of neurological rehabilitation urgently needs to establish readily-accessible and cost-effective programs that address both the functional and psychosocial needs of patients. The holistic nature of clinical yoga interventions, combined with its cost-effectiveness, accessibility, and adaptability makes YT a suitable modality to use with a neurological population. All studies described in this scoping review used different yoga protocols confirming the lack of specific clinical guidelines available

for implementing yoga into the rehabilitation of individuals affected by stroke, PD or MS. The clinical recommendations emanating from the present study can help guide the field toward developing a set of best practice guidelines to ensure the safe and effective administration of yogic interventions in a neuro-rehabilitative setting. Future researchers should keep in mind that the therapeutic benefits of yoga are complex and emergent in nature and may not arise solely through linear dose-dependent mechanisms. Understanding the personal experiences of patients who partake in clinical yoga interventions is integral to understanding the positive influence that YT has on the psychosocial well-being of neurological patients. Implementing YT in neuro-rehabilitative care can help health care professionals integrate a more holistic approach that addresses the fundamental physical and psychological challenges of living with a chronic and debilitating neurological disorder.

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Appendix A

Description of Different Yoga Types

Hatha Yoga: Hatha yoga is a combination of breath work, physical poses, and meditation. It focuses on controlled breathing and gentle static postures.

Yoga Nidra: Yoga Nidra focuses on deep relaxation through meditation that is guided verbally. This type of yoga is sometimes called "yogic sleep."

Kundalini Yoga: Kundalini yoga is a type of yoga that combines poses with breathing and chanting to reduce stress and increase energy. Classes focus on spiritual practice with physical poses.

Unilateral Nostril Breathing: Unilateral Nostril Breathing is a technique where inhalation and exhalation is done in one nostril, sometimes alternately. This breathing technique can be used as an exercise alone or can be combined with other yoga techniques.

Laughter Yoga: Laughter yoga involves voluntary forced laughter and is thought to provide the same benefits as spontaneous laughing in terms of increased mood.

Iyengar Yoga: Iyengar yoga practice focuses on posture awareness and often uses props to modify these postures. Poses are held and practiced in a precise manner.

Ananda Yoga: Ananda yoga is based on relaxation, which is achieved through physical postures and pranayama, or breathing exercises.