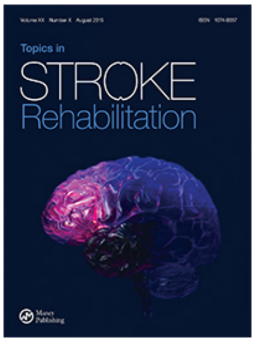

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ABSTRACT

Background: Survivors of stroke have long-term physical and psychological consequences that impact their quality of life. Few interventions are available in the community to address these problems. Yoga, a type of mindfulness-based intervention, is shown to be effective in people with other chronic illnesses and may have the potential to address many of the problems reported by survivors of stroke.
Objectives: To date only narrative reviews have been published. We sought to perform, the first systematic review with meta-analyses of randomized controlled trials (RCTs) that investigated yoga for its potential benefit for chronic survivors of stroke.
Methods: Ovid Medline, CINHAL plus, AMED, PubMed, PsychINFO, PeDro, Cochrane database, Sport Discuss, and Google Scholar were searched for papers published between January 1950 and August 2016. Reference lists of included papers, review articles and OpenGrey for Grey literature were also searched. We used a modified Cochrane tool to evaluate risk of bias. The methodological quality of RCTs was assessed using the GRADE approach, results were collated, and random effects meta-analyses performed where appropriate.
Results: The search yielded five eligible papers from four RCTs with small sample sizes (n = 17–47). Quality of RCTs was rated as low to moderate. Yoga is beneficial in reducing state anxiety symptoms and depression in the intervention group compared to the control group (mean differences for state anxiety 6.05, 95% CI:–0.02 to 12.12; p = 0.05 and standardized mean differences for depression: 0.50, 95% CI:–0.01 to 1.02; p = 0.05). Consistent but nonsignificant improvements were demonstrated for balance, trait anxiety, and overall quality of life.
Conclusions: Yoga may be effective for ameliorating some of the long-term consequences of stroke. Large well-designed RCTs are needed to confirm these findings.
Abbreviations: AMED: Allied and Complementary Medicine Database; GRADE: Grading of Recommendations, Assessment, Development, Evaluation; MD: mean difference; SMD: standardized mean difference; RCT: randomized controlled trial; ITT: intention to treat

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Introduction

Many survivors of stroke have long-term physical and psychological disabilities[1] that impact their quality of life. Difficulties experienced include physical function impairments, such as upper limb function, decreased gait speed, balance impairment, and fear of falling[2–7]that may lead to reduced willingness to participate in activities and sedentary lifestyle,[8] which further disrupt function and overall quality of life.[9] In addition, many survivors of stroke experience ongoing emotional health problems, including anxiety, fatigue, and depression.[1,10–12] It is estimated that 31% will develop depression within 5 years following stroke.[13] There are very few community-based therapy options available for long-term recovery and to reduce the incidence of further comorbidity.[14]

Yoga, as a program of health and well-being derived from Buddhist, Hindu, and other contemplative traditions,[2,15] might be a promising therapy to support the needs of survivors of stroke. The practices of yoga share characteristics with other practices derived from the Buddhist tradition such as those that cultivate mindfulness meditation including mindfulness-based stress reduction (MBSR).[16] Plausible mechanisms by which yoga has been proposed to provide benefits for the prevention and management of chronic conditions include exercise and promotion of mindfulness.[17–21] The exercise component of yoga involves movement and holding of postures (collectively known as asanas). The means of promoting mindfulness is when the low-impact exercise component of yoga is combined with focused attention to breathing (pranayama) and meditation (dharana).[22] Some of the benefits provided by yoga are common to other forms

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of physical activity and included building strength, as well as improving flexibility, balance and overall well-being in people with chronic illnesses.[23–26] Mindfulness is paying attention on purpose to the present moment with acceptance and nonjudgment.[16,27] This is quite similar to the principle of dharana in yoga, which is to sustain attention on the object of the yoga practice (e.g. holding posture or breathing). Yoga can improve mobility, mood, and quality of life in people who are older [6,28,29] who have chronic neurological conditions such as Parkinson,[30,31]or chronic conditions such as cancer[19] and coronary heart disease,[21] through a range of biopsychosocial benefits.[20] People with stroke also experience a complex range of problems like activity limitations, poor emotional well-being and lower quality of life in comparison with their age-matched peers.[8,32,33] Therefore, it is argued that yoga may improve well-being in chronic survivors of stroke by integrating the benefits of physical component and mindfulness into one process. Another advantage is that is applicable and accessible to people with different levels physical ability or health issues.[2,20,34,35]

Many survivors of stroke find it difficult to participate in regular physical activity and do not return to high-demand leisure activities that they were undertaking before their stroke. Many survivors prefer group-based training with an instructor.[36,37] Therefore, yoga may be a suitable physical activity for addressing a range of poststroke needs. However, to date, only narrative reviews on the benefits of yoga following stroke have been published.[35,38] Our *primary aim* was to conduct a systematic review of the existing evidence and perform meta-analyses of randomized controlled trial evidence to provide a robust critical appraisal of yoga and the potential effectiveness of yoga for survivors of stroke**.** Our *secondary aim* was to provide a comprehensive description of the feasibility of the yoga interventions investigated as well as the frequency and dosage, and outcomes that were measured to provide guidance for the field.

Methods

Search strategy, trial eligibility criteria, and data retrieval

We only included randomized controlled trials (RCTs) that had been conducted in adult populations (≥8 years of age); stroke diagnosis of any etiology or severity occurred at least within the 6 months prior to being recruited to the study, including transient ischemic attack, regardless of sex, ethnicity, language spoken, or number of events. We included trials with mixed populations, e.g., acquired brain injury, where stroke-only data could be extracted. Trial interventions could include either yoga postures (asanas); breathing (pranayama); or mindfulness meditation, or a combination of two or all three components of yoga. Trials were excluded if they included multimodal mindfulness interventions such as MBSR, mindfulness-based cognitive therapy, Tai Chi, or chanting where the effects of yoga could not be assessed separately. Comparators could include wait-list control, usual care, or an alternate "active therapy" to test against yoga as a stroke rehabilitation therapy irrespective of yoga style or dosage (frequency and intervention duration).

A systematic search strategy (online supplemental file) was formulated using subject headings and the combination of key terms (e.g. "yoga," "mindfulness," "stroke," "mood," and "quality of life") applied to each database. We searched using Ovid Medline, CINHAL plus, AMED, PubMed, PsychINFO, PeDro, Cochrane database, Sport Discuss, and Google Scholar for articles published between January 1950 and August 2016. We also searched the reference lists of included papers, review articles, and OpenGrey for Grey literature. Clinical trials platforms (e.g. the Australian and New Zealand Clinical Trial registry; ClinicalTrials.gov) were also searched for unpublished and ongoing trials. Key authors were contacted to establish whether any other important studies were missed or were being undertaken that warranted inclusion. Language filters were not applied.

The initial search and identification of trials were performed by the first author. Data extraction was conducted using an adapted Cochrane data extraction form.[39] For abstracts that appeared to meet the review criteria, full-text articles were retrieved and assessed. Final selection of eligible trials and uncertainty over eligibility was resolved by consensus with the second author, who also assessed the articles to ensure their conformity to the inclusion criteria.

Trials meeting the inclusion criteria were assessed for methodological quality and risk of bias using an appraisal framework adapted from the PeDro[40] and the Cochrane Risk of bias tool described in the Cochrane Handbook for Systematic Reviews of Interventions.[41] When the authors of the trials provided a satisfactory description for these quality assessment criteria, a positive value was assigned (+). If a criterion description was considered absent, unclear, or lacked the specified content, a negative value was assigned (−). To draw narrative conclusions across the included trials regarding the strength of evidence, the GRADE criterion was applied. Trials that scored 0–5 positive values were classified as low quality with a high risk of bias, 6–8 indicated a low to moderate quality with moderate risk of bias, 9–11 indicated a moderate quality with low to moderate risk of bias and 12 indicated high quality with a low risk of bias.[42]

TT independently extracted data from the included trials and entered into Review Managersoftware (Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) that can used to combine data from multiple trials for quantitative analyses. Data entry was checked by second author and disagreements were discussed with a third review author. Extracted information, including information regarding patient demographics, study design features, methods of allocation, and blinding methods, was tabulated. In cases where data important to the review were unpublished, the corresponding authors were contacted and additional data obtained. Outcomes were assessed across three broad categories: physical function; mood; and quality of life. Adverse events, including falls or death, were also summarized.

Statistical analysis

Where we considered trials to be sufficiently similar, i.e. comparators and outcomes measured were the same, we conducted a meta-analysis by pooling the appropriate data using Review Manager (Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) according to the PRISMA guidelines.[43] Means and standard deviation values were extracted for meta-analyses. Weighted effect sizes (standardized mean difference and 95% CIs) were calculated for depression and quality of life where different outcome measures were used.

A random-effects model was used to pool the data. Statistical heterogeneity between trials was assessed using the Chi-square test.[44] We considered a p-value ≤0.10 as indicating significant heterogeneity. I^2 statistics were also reported by estimating the amount of variance in a pooled effect size accounted for by heterogeneity in the sample of trials.[45] An I^2 value of 0% indicated no observed heterogeneity, while values of 25%, 50%, and 75% indicated low, moderate, and high heterogeneity, respectively. If between-group effect sizes were not reported, where possible the postintervention between-group analysis was calculated using postintervention scores. Overall effect sizes were calculated from the mean difference, where a p value of <0.05 indicated statistical significance. For outcomes where it was impossible to pool quantitatively, we narratively summarized the results.

Results

The articles selection process is illustrated using a PRISMA flow diagram[46] (Figure 1). The electronic search and manual screening of references returned 557 potential articles to be assessed for inclusion in our review. After strict screening, 21 full-text articles were read, where five met the inclusion criteria and were selected for data extraction.[2,5,24,47,48] Results for one trial were reported in two articles,[5,24] therefore only four trials were available for analysis, and all were pilot studies.

Characteristics of included trials

The characteristics of each RCT are summarized in Table 1. Two trials were conducted in Australia, one in Sweden and the other in the United States of America. Three trials had a wait-list control design, while one had an active control group. The total number of participants was 118 (control and intervention), and sample sizes varied from 17 to 47. Hatha yoga was the most common type of yoga used for the intervention. The frequency and dosage of the yoga interventions varied across the trials from 6 weeks to 10 weeks (Table 1). Two trials had home practice components as part of the intervention for approximately 45 min for 6 days per week.[2,47] Dosage was not specified (i.e. frequency or duration of the intervention) for home practice in one trial.[5,24] Compliance (a measure of class attendance) was reported in three trials. For face-to-face group classes, compliance varied between

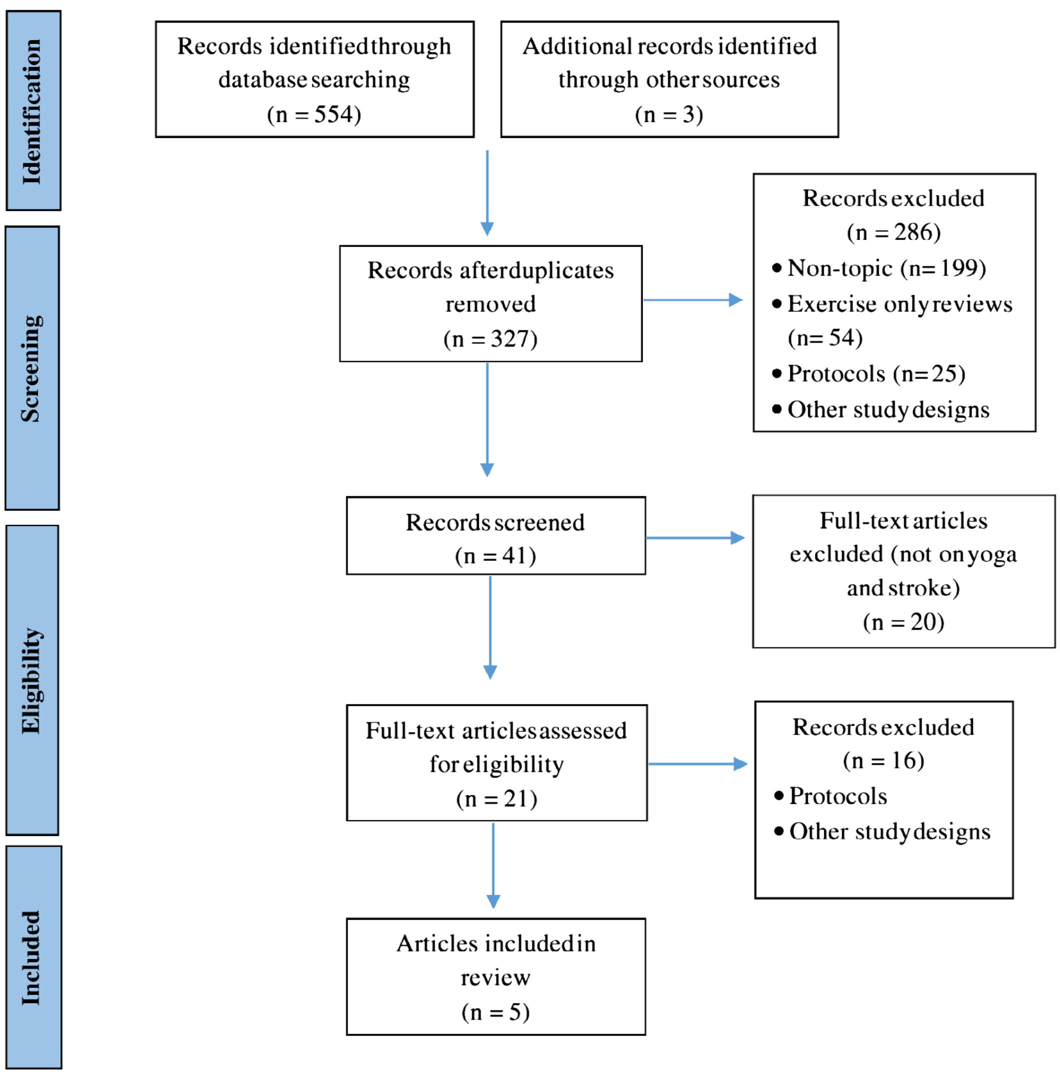

Figure 1. Flow diagram showing study selection for systematic review of trials on yoga and stroke care.

Table 1. Summary of characteristics of included randomized controlled trials.

Study/location	Design	Participants	Sample size	Yoga frequency and dosage	Type of yoga	Outcome measured and tools used for assessment	Adverse events	% drop-outs	Limitations
Immink, et al.[2] South Australia	Randomized controlled trial with wait-list control	Mean age: 60 chronic poststroke hemiparesis (>9 months)	25	90mins/week for 10 weeks + home practice	Hatha + meditation	Physical function • 9-Hole Peg test • Motor assessment scale • Berg Balance Scale • Comfortable gait Speed Mental health • Geriatric depression scale S25 • State-trait anxiety inventory Quality of life • Stroke impact scale	None	12	Use of motor imagery not monitored or recorded Study is underpowered – Small sample size Use of convenience sampling No intention-to-treat analysis No follow-ups Outcomes were only assessed at baseline and post-intervention (after 10 weeks) Did not include an active control group
Johansson, et al.[48] Sweden	Randomized controlled trial with wait-list control	Age:30–65 Stroke or traumatic brain injury (>12 months)	29	2.5 h/week for 8 weeks + home practice for 6x45 min /week for 8 weeks	Hatha	Mental health • Self-assessment scale for mental fatigue • Comprehensive psychopathological rating scale for depression & anxiety Cognitive • Process speed, attention & working memory using (Digital symbol-coding, verbal fluency test, Trail making test)	Not reported	10	No intention-to-treat analysis Study is underpowered – Small sample size
Schmid, et al.[5], Schmid, et al.[24] Indiana, USA	Randomized controlled trial with wait-list control	Mean age: 63 chronic stroke (>6 months)	47	2 × 60 min/week for 8 weeks + home practice	Not specified	Physical function • Range of motion • Upper extremity strength using arm curl test • Lower extremity strength using chair-to-stand test • Endurance using 6-min walk + 2-min step test • Berg Balance Scale Quality of life • Stroke-specific quality of life scale	Not reported	~16 ~16	Unblinded outcome assessment Relatively small sample size Low enrolment of women No intention-to-treat analysis
Chan, et al.[47] South Australia	Randomized controlled trial with active control	Mean age: 67 (intervention); 72 (control) Stroke type: chronic poststroke hemiparesis (>6 years)	17	Intervention: 90 min/week for 6 weeks + home practice + exercise weekly Active control: Exercise 50 min/week for 6 weeks	Hatha + meditation	Mental health • Geriatric depression scale • State trait anxiety inventory	None	18	Small sample size Unable to determine clinically relevant improvement was due to which treatment (yoga or exercise or combination of both) Length of interventions – 6 weeks is short Self-reporting of symptoms No intention-to-treat analysis

78% and 90%. However, home practice compliance was reported in one trial (82%).[2] Reasons for noncompliance included lack of transportation to attend group sessions, bad weather, illnesses not related to stroke, and work commitments.

Outcome measures used were inconsistent across the included RCTs (Table 1). Although most authors measured mood as an outcome, the assessment tools varied. Authors of three trials measured physical function outcomes.[2,5,24] Cognitive performance was assessed in one trial.[48] Longer-term postintervention follow-up to look for sustained effects were not reported by any of the authors.

Methodological quality of risk of bias

Table 2 shows the risk of bias assessment. In the two trials in which adverse events were recorded, no such events were reported.[2,47] In three trials, both between and within-group analyses were performed,[2,47,48] and none had an intention-to-treat (ITT) analysis. The lowest reported retention rate was 76%.[48] The risk of bias score varied between 5 and 8 (out of 12 points). Authors of two trials[2,47] described their method of randomization in detail and scored a maximum of 8 points therefore judged to have a moderate risk of bias. Authors of one trial-blinded participants to the nature of the intervention,[2] while the other blinded the outcome assessors.[47] Using the GRADE criteria, the overall quality of the trials was judged as low to moderate (Table 2).

Potential effects of yoga for stroke recovery

A summary of the main results from the included trials is presented in Table 3. Between group differences were not found for mobility and gait speed in one trial.[2] Pre–post improvements were significantly better in the intervention group than the control group for balance,[24] flexibility, strength and 6-min walking speed.[5]

In three trials mood outcomes were evaluated. A significant difference in postintervention mental fatigue scores was observed between the intervention and control group in one trial.[48] Between group differences were not found for depression,[2,48] overall anxiety[48] and state anxiety (participants perceived feeling of tension and anxiety at that moment of time)[2] – intervention. However, significant improvements postintervention was observed only in the intervention group for depression, anxiety, as well as cognitive scores.[48]

In one trial, with an active control group (general exercise), depression, state anxiety, and trait anxiety were not significantly different between intervention and at the 6-week follow-up assessment.[47]

Assessment for changes in quality of life was reported in two trials. Significant improvements were demonstrated between baseline and follow-up score in the intervention group only ($n = 37$) in one trial,[24] while significant improvements were only observed in the physical and memory domains of the stroke quality of life scale in the other trial.[2] No significant between group differences were observed between both groups at the end of the both trials.

Meta-analyses

No significant heterogeneity was detected in all meta-analyses. Only two trials were comparable for state and trait anxiety,[2,47]

Table 2. Results of the quality appraisal of the included yoga trials.

Citation	Eligibility criteria specified	Randomization procedure	Allocation concealed	Similarity of study groups	Blinding* of all subjects	Blinding of outcome assessors	Drop-outs	Compliance	Intention-to-treat analysis	Timing of outcome assessments	Between-group analysis used	Follow-up	Results
Randomized controlled trials													
Immink et al.[2]	+	+	–	+	+	–	+	+	–	+	+	–	8/12
Schmid et al.[5]	+	+	–	+	–	–	+	–	–	+	–	–	5/12
Johansson et al.[48]	+	+	–	+	–	–	+	–	–	+	+	–	6/12
Schmid et al.[24]	+	+	–	+	–	–	+	+	–	+	–	–	6/12
Chan et al.[47]	+	+	+	–	–	+	+	+	–	+	+	–	8/12

*For trials of interventions like yoga and mindfulness, it is not possible to blind those delivering interventions.

Table 3. Summary of study results from the included randomized controlled trials where common outcomes were reported.

First named author, year	Intervention group (postintervention period)			Control group (postintervention period)			Change or effect size (95% CI)
	Mean	*n*	SD	Mean	*n*	SD	
Mobility							
Immink[2]: Motor assessment scale	35.5	11	10.8	39.5	11	9.3	*4.00 (−4.42, 12.42)*
Immink[2]: 2-min walk distance (m)	90.2	11	51.9	104.0	11	49.1	*14.20 (−28.02, 56.42)*
Immink[2]: comfortable gait speed (m/s)	2.2	11	4.5	0.88	11	0.48	*−1.32 (−3.99, 1.35)*
Balance (Berg Balance Scale)							
Immink[2]	50.7	11	6.3	48.5	11	8	*2.20 (−3.82, 8.22)*
Schmid[24]	46.3	37	9.1	43.8	10	6.3	*2.50 (−2.38, 7.38)*
Depression (Geriatric Depression Scale and The Comprehensive Psychopathological Rating Scale)							
Immink[2]	2.7	11	2.9	4.8	11	3.3	*0.65 (−0.21, 1.51)*
Chan[47]	*3.56*	8	*4.12*	*3.17*	6	*1.9*	*−0.11 (−1.17, 0.95)*
Johansson[48]	*5.88*	12	*2.98*	*8.82*	14	*4.56*	*0.73 (−0.07, 1.53)*
State Anxiety (State Trait Anxiety Inventory)							
Immink[2]	33.4	11	7.1	41.8	11	12.2	*8.40 (0.06, 16.74)*
Chan[47]	*32.3*	8	*11.5*	*35.7*	*6*	*4.8*	*3.40 (−5.45, 12.25)*
Johansson[48]	NR	–	–	NR	–	–	
Trait Anxiety (State Trait Anxiety Inventory)							
Immink[2]	35.3	11	10.5	42	11	10.2	*6.70 (−1.95, 15.35)*
Chan[47]	*36.3*	8	*10.6*	*39.3*	*6*	*7*	*3.00 (−6.24, 12.24)*
Johansson[48]	NR	–	–	NR	–	–	
Quality of life (Stroke Impact Scale and Stroke Specific Quality of Life Scale)							
Immink[2]	*64.4*	11	*19.9*	*54.1*	11	*23.2*	*0.46 (−0.39, 1.31)*
Schmid[24]	*35.8*	37	*9.1*	*33*	10	*6.2*	*0.32 (−0.38, 1.02)*

Notes: Results presented in *italics* are author's own calculation or extrapolation from other data provided. SD: standard deviation, CI: confidence interval, NR: No comparable result.

three trials for depression,[2,47,48] and two trials for balance and overall quality of life scores.[2,24] Yoga appeared to be effective in reducing state anxiety symptoms, and depression in the intervention group compared to those in the control group, but this mean difference was borderline in being statistically different based on conventional criteria ($p = 0.05$; Figure 2(a) and Figure 3(a)). The mean difference in trait anxiety, balance and overall quality of life between intervention and control groups was not statistically significant (Figures 2(b), (c) and 3(b)).

Discussion

To our knowledge, this review is the first to include a meta-analytic approach following careful standardized quality assessment of the available RCTs to provide a summary of the current evidence on the benefits of practicing yoga for stroke recovery. Previous reviews were narrative appraisals that included a mix of observational and experimental study designs.[35,38] The majority of RCTs that met our inclusion criteria were small feasibility trials underpowered to detect differences in health outcomes. Our review, is consistent with the summation of others, that yoga is a feasible intervention and may promote well-being in survivors of stroke. Our meta-analyses provided the opportunity to have pooled the data from these small studies to assess for the likely impact on outcome in the areas of physical function, anxiety, depression, and overall quality of life.

Importantly, we found using meta-analytic techniques that yoga may ameliorate state anxiety symptoms, and depression in survivors of stroke. This finding is also supported by evidence from two observational before-after studies where the beneficial effect of yoga on state anxiety, and depression in survivors of stroke was reported.[49,50] These observational study designs make it difficult to determine whether the effects were specific to the yoga intervention or to other factors such as being part of a group with a shared experience.[51]

The physiological mechanisms of yoga on anxiety are not well understood. Practicing body postures and breathing, may act on the over active sympathetic nervous system and help reduce the objective indicators of anxiety (e.g. a racing heart, palpitations, increased blood pressure, signs of restlessness).[52] In addition, mindfulness helps raise awareness of body tension and may serve to increase self-confidence by promoting a personal sense of control and acceptance, thereby reducing perceived anxiety.[53,54]

Due to the limited number of trials on physical outcome, variations in outcome measures, measurement tools used and small sample sizes, there was insufficient evidence to draw firm conclusions on the evidence of yoga on physical effects poststroke. The lack of significant improvements on physical function may be related to the short intervention duration, with most trials lasting between 8 and 10 weeks. Buffart and colleagues suggested that 10 weeks may be too short to improve physical function and fitness and that longer intervention durations may be required in patients with chronic diseases.[19] Exercise training RCTs (non-yoga) aimed at improving fitness in people with chronic stroke included interventions lasting for a minimum of 12 weeks. These interventions provided significant improvements to physical function during this time period.[55,56] Therefore, a longer intervention duration may be required to achieve the full effectiveness potential of yoga as a therapy for chronic stroke recovery.

The potential benefits of yoga on stroke recovery beyond the benefits of general exercise interventions (strength training or aerobic exercise) is poorly researched. Chan's study[47] was the only study ($n = 17$) that used an active control (group exercise program). Lower effect sizes were shown in this trial, when compared to the results from the trials with different designs.[47] Although the American Heart Association recommends use of customized physical activity in survivors of stroke,[8] there is limited evidence regarding the effectiveness of exercise programs in stroke populations due to small sample sizes and methodological

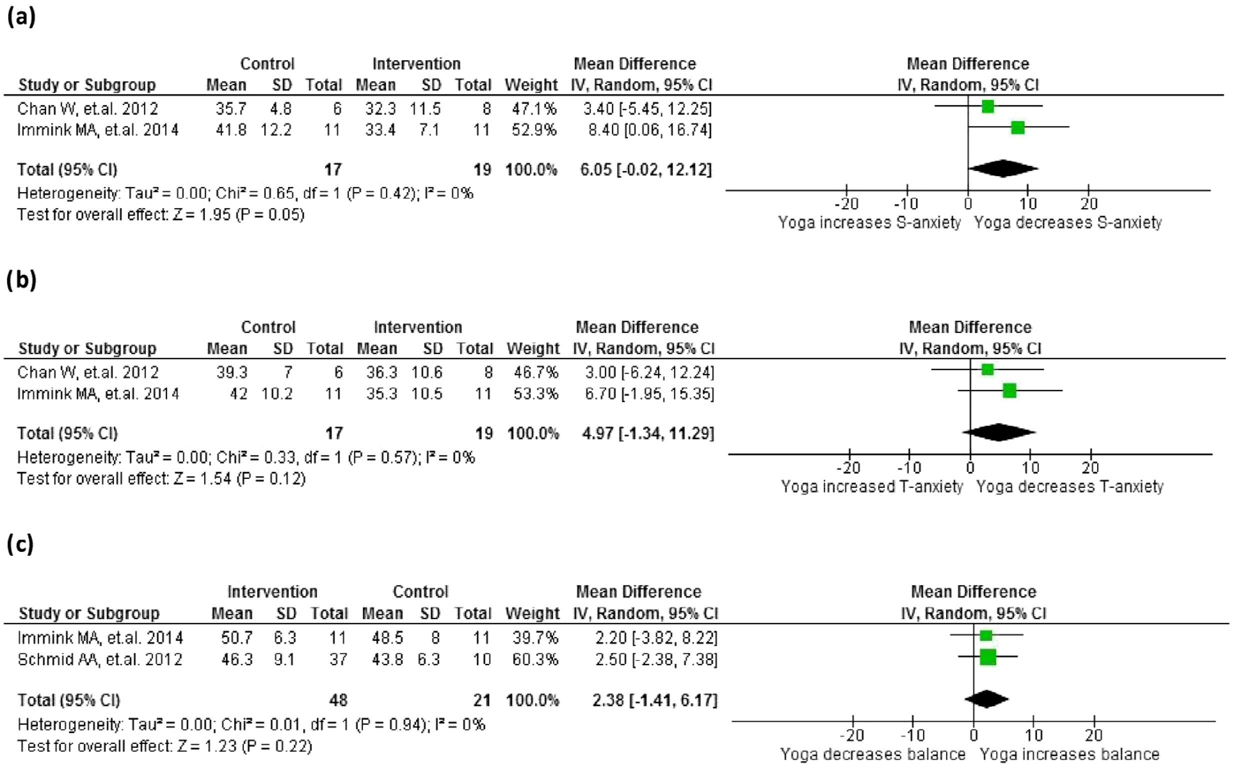

Figure 2. (a) Forest plot representing effect sizes of intervention and control groups in state anxiety (S-anxiety). (b) Forest plot representing effect sizes of intervention and control groups in trait anxiety (T-anxiety). (c) Forest plot representing effect sizes of intervention and control groups in balance outcome.

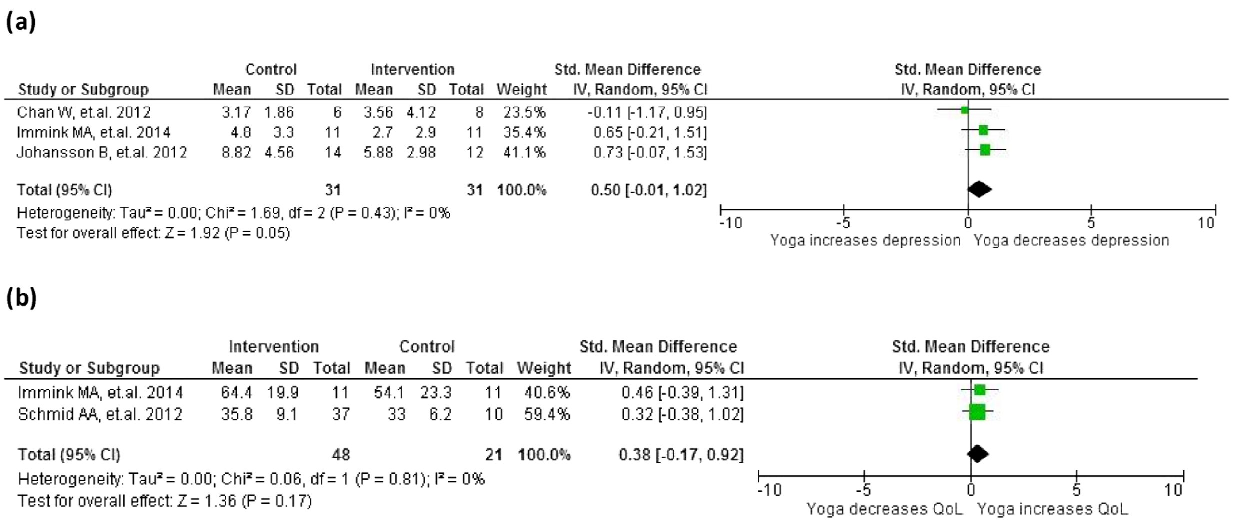

Figure 3. (a) Forest plot representing effect sizes of intervention and control groups in depression. (b) Forest plot representing effect sizes of intervention and control groups in quality of life (QoL) as an outcome.

variations. The evidence is also limited for strength training poststroke.[57] As reported by Erickson and colleagues, exercise training increases the size of the hippocampus and improves memory in older adults, reversing age-related loss in volume by 1–2 years.[58] Since stroke is often common in older adults this may offer some insights into potential mechanisms and may explain why an "active control" using an exercise intervention may equally reduce the observed effects of yoga. It is well understood that physical activity improves mood. In Chan's trial, participants observed smaller effects on mood. Whereas participants in wait-list control designed trials might be feeling good about being part of a group and engaging in social networking with other survivors, thereby providing a stronger signal for improving their mood.

For future trials in this area, the use of an active control is more appropriate for this type of multifaceted intervention over a wait-list control,[59] as it is difficult to differentiate the treatment effects specific to yoga. An active control with equivalent intervention duration and group session time is important to control for socialisation effects and the potential effects of general exercise.[59] Blinding the outcome assessors has not been rigorous in these trials and needs to be better considered in future trials. There is no definite answer to the ideal length or the "dosage" of a yoga intervention to bring about the best results but those who participated were physically able to complete all planned yoga activities, and no injuries or adverse events were reported. This supports the notion that once enrolled in the intervention, the majority of the participants completed the intervention in most trials. Future studies on comparison of intervention duration and dose, as well as powered to detect differences in recovery outcomes are needed. A future RCT could also include funding for travel, and variety of class times, to improve participant compliance in group classes. Incorporating an ITT analysis would be important for larger RCTs to minimise retention bias, if they experience large number of drop-outs or missing data.

Study limitations

Our review has some limitations. We acknowledge that there may be selection bias (because of the nominated inclusion criteria) and the potential for publication bias. Yoga has its roots in Hindu, Buddhist, Vedic and other contemplative traditions, and relevant research may have been missed if not published in the common medical or social sciences databases that we searched. We attempted to address publication bias through undertaking a manual search of complementary medicine journals to check for any research on yoga in stroke populations and by electronic searches of the web via Google to identify relevant grey literature. Coauthors working in the field MM and PS were also consulted, and we believe it is unlikely that we missed an RCT relevant to this review. We also acknowledge that one study did include patients with stroke or traumatic brain injury.

Conclusion

Despite the growing popularity of yoga in the general population and the potential benefits for survivors of chronic illnesses, there is limited evidence, in the form of large RCTs, on the effectiveness of yoga for long-term stroke recovery. However, evidence from these pilot trials assessed in this review highlights that yoga may be effective for improving some of the long-term consequences of stroke, particularly mood. It is strongly recommended that future research apply more stringent designs (e.g. randomization with active control and passive control groups as comparison, between-group analyses and ITT) to enable a robust evaluation of the effects of yoga among survivors of stroke.

Ethics approval and consent to participate

This systematic review of the literature did not involve human or animal research and did not require ethical approval. This systematic review was conducted as part of first author's PhD program.

Availability of data and materials

Data are presented in the main paper and additional supporting file.

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Disclosure statement

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