A systematic review of the benefits of mindfulness-based interventions following transient ischemic attack and stroke

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Background **Recent epidemiological studies have demonstrated an association between perceived psychological stress and ischemic stroke. A feature of stroke is recurrence; 30–40% within five-years following first transient ischemic attack/stroke. Equipping patients with skills and coping strategies to help reduce or manage perceived psychological stress may represent an important secondary prevention intervention. Mindfulness-based interventions are structured, group-based self-management programmes with potential to help people with long-term conditions cope better with physical, psychological, or emotional distress. Review evidence suggests significant benefits across a range of physical and mental health problems. However, we could find no evidence synthesis relating specifically to the benefits of mindfulness-based interventions following transient ischemic attack/stroke.**

Aim **The review aims to evaluate the benefits of mindfulness-based interventions following transient ischemic attack/stroke.**

Methods **Six major databases were searched using subject headings and key words. Papers were screened using review-specific criteria. Critical appraisal and data extraction were conducted independently by two reviewers. Statistical meta-analysis was not possible; therefore findings are presented in narrative form.**

Results **Four studies involving 160 participants were reviewed. Three papers reported mindfulness-based interventions delivered to groups; one paper reported a mindfulness-based intervention which was delivered one to one. The results demonstrate a positive trend in favor of the benefits of mindfulness-based interventions across a range of psychological, physiological, and psychosocial outcomes including anxiety, depression, mental fatigue, blood pressure, perceived health, and quality of life. No evidence of harm was found.**

Conclusion **Following transient ischemic attack/stroke, people may derive a range of benefits from mindfulness-based interventions; however, further methodologically robust trials are required.**

Key words: mindfulness-based stress reduction, prevention, perceived psychosocial stress, rehabilitation, stroke, transient ischemic attack

Introduction

Worldwide, stroke is the second most common cause of death (1) and a leading cause of long-term adult disability (2). In 2005, the global prevalence of living stroke survivors was estimated at 62 million; it is expected to rise to 77 million by 2030 (3). The absolute number of strokes is predicted to rise in response to demographic changes in the population and increased numbers of very old people. People experiencing first stroke or transient ischemic attack (TIA) are at significant risk of subsequent stroke; 30–40% of people will have a further event within five years (4), which highlights the potentially wide window of opportunity for secondary prevention. As with all vascular disease, a person's risk of stroke following TIA can be reduced using a range and variety of approaches, which include lifestyle interventions and behavioral changes (5,6). Traditionally acknowledged vascular risk factors only explain half of cerebrovascular disease risk (7) and there is a lack of attention paid to the potential role of psychosocial factors, including perceived stress, in the development of stroke disease (8). A growing body of scientific evidence confirms the association between psychological stress and the development of acute myocardial infarction (9–11); however, such research is minimal in the area of stroke and TIA. Yet public perception highlights psychological stress as a key risk factor for stroke (12,13). The few studies that relate to stroke have reported severe self-perceived stress, stressful life events, and poor adaptation to stress to be independently associated with increased risk of stroke (8,14–16), in particular fatal stroke (9,17).

Recent research in Scotland on multimorbidity using primary care data, has found that in a nationally representative sample of 1·8 million people only 6% of patients with stroke had no other long-term condition (18) and 64% had three or more other long-term conditions. Although one would expect comorbidity of stroke with other vascular conditions, 22% of stroke patients in the said study also had chronic pain, and 21% had depression. Following stroke, systematic review evidence indicates that 33% of stroke survivors experience depression (19); rates for anxiety are 20–25% (20). Both depression and anxiety remain common several years after the initial stroke event (19,20).

Mindfulness-based Interventions

Mindfulness-based interventions (MBIs), i.e., mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT), which derive from ancient, eastern philosophies, are increasingly being offered as therapeutic interventions in contemporary clinical psychotherapeutic settings (20). MBSR is a structured, group-based self-management program with potential to help people with long-term conditions to cope better

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Conflict of interest: None declared.

Sources of support: None.

DOI: 10.1111/ijs.12135

with physical and psychological or emotional distress. Reviews across a range of physical and mental health problems suggest significant benefits of MBSR (21–24). A meta-analysis of 39 studies (25) reported large effect sizes (0·97, 0·95) for anxiety and depression. A systematic review (26) of MBSR specifically for people with long-term conditions found benefits in all 15 included studies including: enhanced ability to cope with symptoms; improved well-being; quality of life; and better health outcomes. The review suggested that MBSR has the potential for much wider application in primary care. Although the precise mechanism of action of MBIs is not known, increased mindfulness appears to mediate improvement in functioning by reducing rumination and emotional avoidance and improving behavioral self-regulation (27). The standard format for MBSR is a sequence of eight weekly 2·5 h classes with a six-hour all-day class in week 6 (total of 26 h class time). However, there is no theoretical or empirical basis for this time-intensive format, and a recent review found effect size to be unrelated to number of in-class hours (28). MBCT is a form of psychological therapy which aims to aid the prevention of relapse of depression. It blends features of cognitive therapy with the mindfulness techniques described above (29). A study of recovered recurrently depressed patients found that relapse rates were reduced by 50% (29).

Recent economic trends mean that health providers are looking for innovative ways of delivering clinically effective services that are cost-effective or cost-neutral. MBIs, i.e., MBSR and MBCT, use minimal resources and therefore are inexpensive to deliver; they can be delivered in a range of settings, including community-based locations, and following the initial eight-week course, individuals can practice mindfulness independently, without support from rehabilitation services. Potential benefits are wide ranging. Physical and psychological health benefits include improved glycemic control in individuals with type 2 diabetes mellitus (30), alleviation of emotional distress in diabetes (31), alleviation of depression in individuals with cardiac disease (32) and diabetes (33), alleviation of anxiety and reduction in levels of perceived stress in a range of conditions including heart disease, cancer, anxiety, and depression (25,34). Thus, given the high prevalence of comorbidity, in particular depression and anxiety disorder (18–20), among stroke patients, MBIs are potentially relevant therapeutic interventions, offering a range of health benefits including alleviation of perceived psychosocial stress.

Why it was important to do this review

Emerging evidence demonstrates an association between self-perceived psychological stress and ischemic stroke (35). A recent large-scale epidemiological study found evidence of stress as an independent risk factor for stroke (36). As described above, a feature of stroke is recurrence, and people experiencing first stroke or TIA are at significant risk of subsequent stroke (4). Therefore, equipping patients with skills and coping strategies to help reduce or manage perceived psychological stress, may represent an important secondary prevention intervention. Scoping searches undertaken in Mindfulness Research Monthly (http://www.mindfulexperience.org), the Database of Abstracts of Reviews of Effectiveness (DARE), the Cochrane Database of Systematic reviews and the JBI (Joanna Briggs Institute) Library of Systematic Reviews failed to identify a relevant systematic review. Therefore we conducted a systematic review that aimed to evaluate the benefits of mindfulness-based interventions as therapeutic interventions following stroke/TIA.

Methods

Selection criteria

To enable the identification and selection of the best available evidence regarding the therapeutic benefits of MBIs following stroke/TIA, we determined inclusion criteria relating to Study design, Participants, Interventions and Outcomes (SPIO) (Box 1). SPIO is an adaptation of the Population, Interventions, Comparison, Outcomes framework which is commonly used to define the parameters of systematic reviews where designs other than randomized controlled trials (RCTs) are also considered (37).

A broad definition of stroke was adopted, to include ischemic stroke, hemorrhagic stroke, subarachnoid hemorrhage, and TIA (38). As with many other mind–body interventions, mindfulness as a therapeutic intervention is inherently varied and heterogeneous, therefore different forms, duration, and frequency of MBIs were included (28).

Search strategy

In April 2012 a systematic search for published and unpublished studies was conducted in six major electronic bibliographic databases: Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, CINAHL, Allied and Complementary Medicine Database, and PsycInfo. To identify any additional published and/or unpublished trials, we also searched ProQuest Dissertations & Theses Database and contacted stroke/mindfulness researchers. Selected medical subject headings were combined with key words

Box 1 Inclusion criteria: study design, participants, interventions, and outcomes

	Inclusion criteria
Study design	Randomized controlled trials
	Nonrandomized controlled trials
	Before and after studies
	Case control studies
	Cohort studies
Participants	Adults (aged ≥18 years)
	Minor stroke, transient ischemic attack or stroke
	Mixed populations where stroke data could be extracted
Interventions	Mindfulness
	Integrated interventions where mindfulness data could be extracted
Outcomes	*Primary outcome*
	Perceived stress
	Secondary outcomes
	Psychological outcome measures, e.g., anxiety, depression
	Physiological outcomes, e.g., blood pressure
	Psychosocial outcomes, e.g., social participation, perceived self health, quality of life

relating to stroke and mindfulness to create a search strategy which was finalized for use in MEDLINE (Appendix S1) and amended for use in the other databases, using appropriate controlled vocabulary, Boolean operators, and search symbols. Delimiters were: dates searched (1980–2012); research subjects (human); and language (English). RefWorks was used to store and manage the results of the database searches.

Selection of papers for inclusion

The bibliographic records identified by the searches were screened for relevance using broad inclusion criteria, i.e., 'stroke' and 'mindfulness'. All relevant papers were then screened, using the SPIO inclusion criteria (Box 1), to select eligible papers. All selected papers were subject to methodological appraisal. To reflect the range of study designs permissible within the inclusion criteria, a range of standardized critical appraisal checklists were selected for use in this review. The Scottish Intercollegiate Guidelines Network checklist for RCTs grades evidence as: ++ *where All or most of the criteria have been fulfilled. Where they have not been fulfilled the conclusions of the study or review are thought very unlikely to alter; + Some of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions; and – Few or no criteria fulfilled. The conclusions of the study are thought likely or very likely to alter* (39). The Joanna Briggs Institute's (JBI) comparable cohort/case control studies checklist (40) scores studies using nine methodological criteria; the Newcastle-Ottawa Quality Assessment scale uses 10 methodological criteria to assess cohort studies (41).

Due to the paucity of available evidence, no papers were excluded on the grounds of quality. However, methodological issues are discussed below and reported in the evidence table.

Data extraction

Data, including details of study design and methods, interventions (delivery and content), populations, and primary and secondary outcomes, were extracted from papers using a data extraction tool developed by the authors. All screening and assessment processes were conducted by two reviewers (M. L. and J. B.) who worked independently and then met to discuss and agree the outcomes; any disagreements were resolved consensually.

Data synthesis

Due the heterogonous nature of the papers included in the review, meta-analyses were not possible; therefore, the review findings are presented in narrative form.

Results

The database searches retrieved 1509 unique bibliographic records. Using the screening methods described above, three papers were found to be eligible for inclusion in the review (see Fig. 1). One additional paper (42), which reported an MBSR intervention evaluated with a mixed population, i.e., stroke and traumatic brain injury, was identified from a subsequent electronic table of contents alert. We contacted the author who conducted additional analyses and provided us with 'stroke only' data; therefore four papers were included in the final stage of the review: Johansson *et al.* (43), Magnusson *et al.* (44), Joo *et al.* (45) and Moustgaard *et al.* (46). To enable comprehensive completion of data extraction forms, we requested additional information from the authors. No response was received from two authors; however, we were provided with a full-text copy of Moustgaard's thesis (47) which enabled us to complete the data extraction for the associated paper, and Johansson provided us with stroke only data.

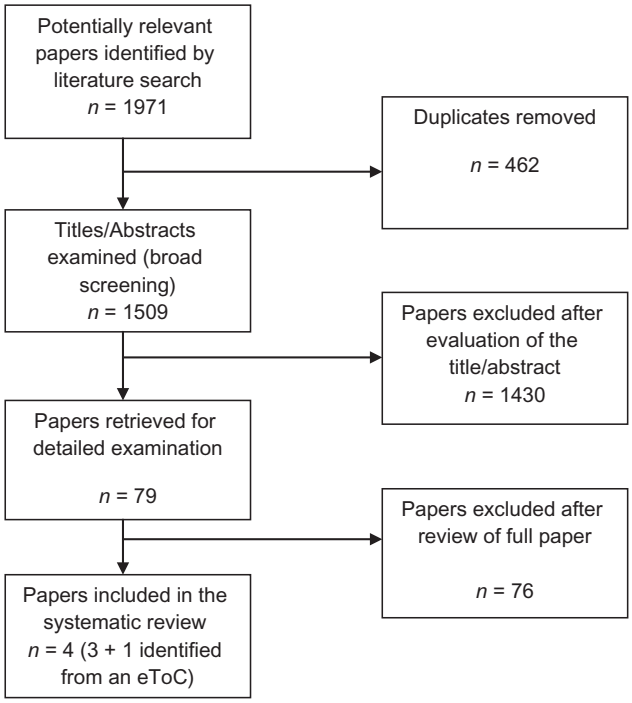

Fig. 1 Flowchart of study selection. eTOC, electronic table of contents.

Study characteristics

Johansson *et al.* (43) reported a wait-list RCT, Magnusson *et al.* (44) reported a case-control study, and Joo *et al.* (45) and Moustgaard *et al.* (46) reported case series. The key characteristics of the studies, including study design, aim, setting, population, intervention design and delivery, and primary and secondary outcomes, are presented in the evidence table (Table 1). The studies were conducted in four different countries, i.e., Sweden (43), Korea (45), Denmark (44), and Canada (46). Johansson *et al.* (43) and Moustgaard *et al.* (46) recruited participants who had had a stroke from the general population. Joo *et al.* (45) recruited participants who were more than six-months postsurgery for cerebral aneurysm rupture; it is not clear where they were recruited from, but it is likely that they were recruited from a clinical setting. Magnusson *et al.* (44) recruited participants who had had a stroke; it is not clear where they were recruited from, but it is likely that they were identified from a clinical database.

Methodological quality of included papers

In terms of methodological quality, the study by Johansson *et al.* (43) was graded as being of mid-level (+) quality, i.e., some of the

Table 1 Study characteristics and key findings

Author; country; design; quality	Participant details	Outcomes measures	Mindfulness-based intervention	Key findings
Johansson *et al.* (43) Sweden Wait-list RCT +	Sample size: 12 stroke N.B: 22 in sample; 10 traumatic brain injury **Intervention group** Gender: 6 female, 6 male Mean age: 54·1 (SD 6·7) years Spouse: Not reported (NR) Living alone: NR Employment: 3 Education: 15·5 (SD 2·3) years **Waitlist group** Gender: 6 female, 3 male Mean age: 56·9 (SD 8·3) years Spouse: NR Living alone: NR Employment: 2 Education: 14·4 (SD 3·4) years	*Psychological outcomes* Mental Fatigue Scale (MFS) The Comprehensive Psychopathological Rating Scale (CPRS) (depression and anxiety)	Range of formal and informal practices, based on Kabat Zinn's mindfulness-based stress reduction (MBSR) program. Formal practices included gentle Hatha yoga, body scan and sitting meditation. Materials: guided instructions and CDs for home practice Duration and frequency: weekly for eight-weeks; 2½ hours per week, with 1, day-long silent retreat between sessions 6 and 7 and home practice for 45 min, six-days a week Format: Group work	*Psychological outcomes* MFS: nonsignificant difference between the groups after eight weeks. Group 1 showed a decline in MFS ($P = 0{\cdot}095$), while the control group was unchanged ($P = 0{\cdot}113$). The control group completed the program later and showed a similar but significant decline ($P = 0{\cdot}015$). CPRS (depression and anxiety): no differences when comparing MBSR and control group on pre- and posttest. Repeated measure (paired *t*-test) detected decreased scores over time for both groups for depression (group 1 $P = 0{\cdot}096$, group 2 $P = 0{\cdot}089$) and anxiety (group 1 $P = 0{\cdot}094$, group 2 $P = 0{\cdot}120$). No such changes found for waitlist control group (depression $P = 0{\cdot}947$, anxiety $P = 0{\cdot}896$)
Moustgaard *et al.* (46) Canada Case series 3/9	Sample size: 23 (completers); 30 (baseline) Gender: 17 male, 6 female Mean age:63·3 (SD 11·8) years Spouse: 17 Living alone: 22 Employment (including voluntary work): 3 Education: Graduate 10	*Psychological outcomes* Beck Anxiety Inventory (BAI) Beck Depression Inventory Revised (BDI-II) Hospital Anxiety and Depression Scale (HADS) 36-Item Short-Form General Health Survey (SF-36) Stroke Specific Quality of Life Scale (SS-QOL)	Mindfulness-based stress reduction (MBCT) program adapted to meet needs of people following stroke, e.g., aspects of the yoga sessions modified, psycho-education specific to stroke included; language was pertinent. Focus on treatment and prevention of depression but extended to include other aspects of emotional and physical coping. Core content and approach of MBCT was unaltered. Group leaders met participants individually to review at-home assignments and logbook entries. Materials: logbook Duration and frequency: Weekly for nine-weeks; 1¾ hours per week Format: Group work	Significant positive effects with large effect sizes, between baseline (T1) and outcome (T2) and baseline (T1) and three-month follow-up (T3) for: ➢ BAI – total score, neurophysiological scale, subjective scale. ➢ BDI-II All scales ➢ HADS Anxiety ➢ HADS Depression ➢ SF-36 physical component score subscale ➢ SF-36 mental component score subscale ➢ SS-QoL – total, energy, family role, mobility, personality, self-care, social roles, thinking, upper extremity, vision, work. Cognitive and somatic manifestations of anxiety and depression decreased over nine-week intervention period. Improvements maintained at three months

Table 1 Continued

Author; country; design; quality	Participant details	Outcomes measures	Mindfulness-based intervention	Key findings
Joo *et al*. (45) Korea Case series 3/9	Sample size: 11 (completers); 28 (baseline) Gender: 6 female, 5 male Age: Mean age 52·5 (range 38–65) years Spouse: NR Living alone: NR Employment: NR Education: NR	*Psychological outcomes* Beck Depression Inventory (BDI) Korean version State-Trait Anxiety Inventory (SAI) Trait Anxiety Inventory (TAI) *Physiological outcomes* Diastolic blood pressure (DBP) Systolic blood pressure (SBP) Heart Rate Variability (HRV)	MBSR program included body scanning, sitting meditation, and Hatha yoga. In addition, 'loving-kindness meditation' was practiced, and through group discussions, participants had time to share their experiences. Participants also performed body scanning, sitting meditation, yoga, and mindfulness in routine life Materials: CD on mindfulness of routine life Duration and frequency: Weekly for eight weeks; 2½ hours each session Format: Group work	*Psychological outcomes* Depression and Anxiety BDI: reduced ($P = 0{\cdot}013$) SAI: decreased ($P = 0{\cdot}091$) TAI: decreased ($P = 0{\cdot}056$) *Physiological outcomes* DBP: decreased ($P = 0{\cdot}062$) SBP: decreased ($P = 0{\cdot}059$) HRV: Improvement in the homeostasis control mechanism of the autonomic nervous system was shown by improvements in range of HRV parameters including: Physical Stress Index: decreased ($P = 0{\cdot}037$) Total Power: increased ($P = 0{\cdot}026$)
Magnusson *et al*. (44) Denmark Case control 2*	Sample size: 73 (intervention group) Gender: 53 male, 20 female Mean age: 64·8 years Spouses NR Living alone: NR Employment: NR Education: NR	Accumulated risk of death with associated cardiovascular disease	MBSR program included meditation, relaxation and awareness exercises, expressive writing, blessings counting and life attitude exercises, music listening, leadership and time management Materials: 330-page 'booklet' Duration and frequency: 15 (average) consultations as part of integrated rehabilitation; aimed to have first 10 consultations within the first month Format: Unclear, likely one-to-one	*Mortality* IR was associated with a minimum of 50% reduction in death rate, when compared with similar patients with cardiovascular disease receiving conventional treatments ($P < 0{\cdot}005$).

+ denotes some of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions.
2* denotes that this paper was awarded 2 stars out of a possible 10.

criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions (39). However, the quality of the other three studies was poor. Moustgaard *et al.* (46) and Joo *et al.* (45) both scored 3 out of a possible 9 on the JBI comparable cohort/case control studies checklist. Magnusson *et al.* (44) scored only 2 stars (out of a possible 10) on the Newcastle–Ottawa assessment scale. Particular methodological issues were small sample sizes, attrition rates, and issues of generalizability. Attrition rates were 24% ($n = 7$) in the study by Johansson *et al.* (43), 23% ($n = 7$) in Moustgaard *et al.*'s study (46), and 61% ($n = 17$) in the study by Joo *et al.* (45). However, intention-to-treat analysis was not conducted in these three studies. In terms of generalizability, Joo *et al.*'s (45) intervention was delivered only to participants who had had an aneurysmal subarachnoid hemorrhage (SAH); SAH accounts for <5% of all strokes (47).

Outcomes

None of the studies reported perceived stress, our primary outcome of interest. In one study (Johansson *et al.* (43)), sensitivity to stress was a single item in the 13-item Mental Fatigue Scale and no change in individual scores was reported. However, all studies did report secondary outcomes of interest, including other psychological outcomes, i.e., anxiety, depression and mental fatigue, as well as physiological outcomes, i.e., blood pressure, and psychosocial outcomes, i.e., perceived general health and quality of life.

Intervention characteristics

Johansson *et al.* (43), Joo *et al.* (45), and Moustgaard *et al.* (46) delivered 'typical' MBSR interventions (as described above). Moustgaard *et al.* (46), who used a cognitive behavioral therapy approach (MBCT), described their intervention as being adapted

Table 2 Participants by number age and gender

	Intervention			Control		
Study	Number	Mean age (SD)	% Male	Number	Mean age (SD)	% Male
Johansson *et al.* (43)	7	54·1 (6·74)	57	5	60·8 ± 7·01	40
Joo *et al.* (45)	11	38–65 years (range)	46	Not applicable (N/A)	N/A	N/A
Magnusson *et al.* (44)	73	64·8 [not reported (NR)]	73	NR	NR	NR
Moustgaard *et al.* (46)	16	63·3 (11·8)	74	N/A	N/A	N/A

Table 3 Depression: BDI-II; HADS

Study	Measure	Pretest mean (SD)	Posttest mean (SD)	Follow-up mean (SD)	*P* value
Moustgaard *et al.* (46)	BDI-II	12·10 (7·14)	3·48 (3·63)	4·33 (3·67)	0·001
	HADS	5·62 (4·00)	2·52 (2·42)	2·86 (2·22)	0·001

BDI-II, Beck Depression Inventory Revised; HADS, Hospital Anxiety and Depression Scale.

to suit the 'physical and emotional' needs of people who have had stroke. Magnusson *et al.* (44) delivered an integrated rehabilitation program, which incorporated key elements of MBSR, e.g., meditation, relaxation, and awareness exercises; it is not clear how this was delivered, but it is likely that this was delivered on a one-to-one basis. All four interventions were of short duration. Both Johansson *et al.* (43) and Joo *et al.* (45) delivered their interventions weekly for eight-weeks in 2½-hour sessions, and collected follow-up data directly after the intervention. Moustgaard *et al.* (46) delivered their intervention weekly over nine-weeks, in 1¾-hour sessions; follow-up data were collected at 10 days postintervention and again three-months postintervention. Magnusson *et al.* (44) delivered their intervention in 15 sessions (mean). They aimed to deliver the first 10 sessions within the first month of the intervention and collected observational data at a single but unspecified time point.

Participant characteristics

Review data were extracted from four papers, which included four completed studies with 160 participants (baseline). Johansson *et al.* (43), Joo *et al.* (45), and Moustgaard *et al.* (46) reported participant characteristics for completers only (Table 1). The age and gender of participants are presented in Table 2. Notably, participants were young if compared with the general stroke population; the mean age for acute stroke in Western countries is approximately 75 years (48).

Psychological outcomes

Depression

Moustgaard *et al.* (46) measured depression using the Beck Depression Inventory, Revised (BDI-II) and Hospital Anxiety and Depression Scale (HADS), and Johansson *et al.* (43) used the Comprehensive Psychopathological Rating Scale (CPRS). Moustgaard *et al.* (46) reported that all BDI-II scales demonstrated a reduction in the number of depressive symptoms endorsed at posttest and follow up, than at pretest. The HADS depression score demonstrated an overall improvement between pretest and posttest, which was maintained at three-month follow-up and was statistically significant (Table 3). Johansson *et al.* (43) reported no significant differences in CPRS for depression outcomes between the MBSR groups and control, or on repeated measures testing in the intervention group (Table 4); however, as was the case for anxiety, the sample size was very small and the study underpowered, which the authors felt explained the results.

Table 4 Paired *t*-test *P* values for change in depression using CPRS

Study	Group	*P* value
Johansson *et al.* (43)	Intervention group 1	0·096
	Intervention group 2	0·089
	Control	0·947

CPRS, Comprehensive Psychopathological Rating Scale.

Anxiety

Joo *et al.* (45) measured anxiety using the State-Trait Anxiety Inventory and the Trait Anxiety Inventory; Moustgaard *et al.* (46) measured anxiety using the HADS and the Beck Anxiety Inventory (BAI). Johansson *et al.* (43) measured anxiety using the CPRS.

Joo *et al.* (45) reported a reduction in state anxiety and trait anxiety, the latter having borderline significance, thus demonstrating a trend toward a reduction in anxiety following the eight-week MBSR course (Table 5). Moustgaard *et al.* (46) reported a significant reduction in the BAI total score between pretest and three-month follow-up, but not between posttest and three-month follow-up. The HADS anxiety score demonstrated an overall improvement between pretest and posttest, which was maintained at three-month follow-up and was statistically significant. Johansson *et al.* (43) reported no significant differences in CPRS for anxiety outcomes between the MBSR groups ($n = 2$) and (waitlist) control, or on repeated measures testing in the intervention groups (Table 6); however, the sample size was small and the authors felt the results were due to a type II error.

Mental fatigue

Johansson *et al.* (43) measured mental fatigue using the Self-assessment of Mental Fatigue. They reported reduced self-

Table 5 Anxiety: SAI; TAI; HADS

Study	Measure	Pretest mean (SD)	Posttest mean (SD)	Follow-up mean (SD)	*P* value
Joo *et al*. (45)	SAI	51·3 (13·9)	42·3 (15·2)	n/a	0·091
	TAI	50·9 (12·3)	41·3 (12·8)	n/a	0·056
Moustgaard *et al*. (46)	HADS	5·81 (3·39)	1·67 (1·91)	2·33 (2·01)	0·001
	BAI	9·67 (7·15)	4·38 (2·48)	3·75 (2·83)	0·001

BAI, Beck Anxiety Inventory; HADS, Hospital Anxiety and Depression Scale; SAI, State-Trait Anxiety Inventory; TAI, Trait Anxiety Inventory.

Table 6 Paired *t*-test *P*-values for change in anxiety using CPRS

Study	Group	Paired *t*-test *P* values
Johansson *et al*. (43)	Intervention group 1	0·094
	Intervention group 2	0·120
	Control	0·896

CPRS, Comprehensive Psychopathological Rating Scale.

Table 7 Paired *t*-test *P* values for change in mental fatigue using SMF

Study	Group	*P*-value
Johansson *et al*. (43)	Intervention group 1	0·095
	Intervention group 2	0·015
	Control	0·113

SMF, Self-assessment of Mental Fatigue.

Table 8 Systolic blood pressure

Study	Time point	Mm Hg mean (SD)	*P* value
Joo *et al*. (45)	Systolic blood pressure		
	Pretest	127·9 (16·9)	
	Posttest (eight-weeks later)	114·2 (13·7)	0·062
	Diastolic blood pressure		
	Pretest	76·8 (9·5)	
	Posttest (eight-weeks later)	72·5 (9·3)	0·059

reported mental fatigue in both intervention groups following the MBI, one of which was significant (Table 7).

Physiological outcomes

Blood pressure

Only Joo *et al.* (45) measured change in blood pressure. They reported a reduction in systolic and diastolic blood pressure following the eight-week intervention; neither result was statistically significant (Table 8).

Psychosocial outcomes

Perceived general health and quality of life

Only Moustgaard *et al.* (46) measured perceived general health, using the Short-Form General Health Survey (SF-36) and quality of life, using the Stroke Specific Quality of Life Scale (SS-QoL). In general, the authors reported improvements in perceived general health and in quality of life which were maintained (Table 9); however, there were some exceptions. Both subscales (physical component score and mental component score) of the SF-36 revealed improvement between pretest and posttest which was maintained at three-month follow-up. In addition, the SSQoL total score, and most subscales, showed improvement at follow-up. Unexpectedly, the mobility scale and upper extremity scale scores revealed improvement between pretest and three-month follow-up.

Discussion

To our knowledge, this is the first systematic review of MBIs for TIA/stroke. A comprehensive search and subsequent screening identified only four eligible papers. Study designs were varied and participant numbers were small. Interventions tested included MBSR, MBCT, and an integrated rehabilitation program which incorporated elements of MBSR. The structured interventions were delivered to groups or in one-to-one sessions. None of the studies evaluated the effectiveness of MBIs on perceived psychosocial stress, although one underpowered study found no change in sensitivity to stress on a single-item score in a composite Mental Fatigue Scale. However, a range of psychological, physiological, and psychosocial outcomes including anxiety, depression, mental fatigue, blood pressure, perceived health, and quality of life were measured and, overall, the results demonstrate a positive trend in favor of the therapeutic benefits of MBIs. And, in addition to the psychosocial benefits of MBIs, perceived physical improvement, sustained over three-months, was also noted in one, small study (45). Importantly, no evidence of harm was found, and no adverse events were reported.

As described above, there is a growing body of evidence which suggests an association between perceived psychological stress and TIA/ischemic stroke, although the explanatory mechanisms have yet to be fully identified. 'Stress' is widely perceived by members of the public to be a precursor to the onset of TIA/stroke (12,13) and furthermore is seen as a risk factor which is modifiable by the individual experiencing it (49). Therefore, incorporating education and training about how to cope with and manage psychosocial stress into multimodal interventions for the secondary prevention of stroke is likely to be of benefit and will do no harm.

Increasingly, the imperative to address psychological care needs of stroke survivors and their families is accepted as an essential aspect of acute stroke care and longer-term rehabilitation (50). And while clinical guidelines recommend implementation of assessment processes and interventions designed to help people cope with and manage psychological problems following TIA/

Table 9 Perceived general health and quality of life

Study	Measure	Pretest mean (SD)	Posttest mean (SD)	Follow-up mean (SD)	*P* value
Moustgaard *et al.* (46)	SF-36 PCS	39·19 (6·21)	46·78 (7·73)	45·73 (8·74)	0·001
	SF-36 MCS	48·55 (10·14)	56·10 (6·40)	53·95 (10·60)	0·002
	SS-QoL (total)	285·95 (37·05)	321·81 (38·31)	326·19 (38·94)	0·001
	SS-QoL Energy	12·24 (4·13)	15·24 (3·83)	15·86 (3·93)	0·001
	SS-QoL Family role	27·57 (8·75)	31·0 (7·74)	31·48 (7·35)	0·001
	SS-QoL Mobility	45·38 (12·10)	49·71 (10·28)	50·48 (10·13)	0·004
	SS-QoL Mood	29·91(6·95)	33·62 (5·60)	33·57 (5·15)	0·013
	SS-QoL Personality	11·48 (5·14)	16·38 (3·57)	16·81 (3·40)	0·001
	SS-QoL Self-care	34·67 (4·31)	36·57 (3·76)	36·57 (3·92)	0·001
	SS-QoL Social roles	19·76 (7·85)	25·29 (6·07)	26·10 (5·82)	0·001
	SS-QoL Thinking	11·29 (3·12)	14·43 (2·25)	14·81 (2·11)	0·001
	SS-QoL Upper extremity	36·33 (8·57)	38·57 (7·93)	38·86 (7·95)	0·007
	SS-QoL Vision	16·76 (4·56)	17·71 (3·81)	17·95 (3·32)	0·017
	SS-QoL Work	8·91 (3·46)	10·76 (3·25)	10·95 (3·19)	0·001

MCS, mental component score; PCS, physical component score; SF-36, 36-Item Short-Form General Health Survey; SS-QoL, Stroke Specific Quality of Life Scale.

stroke [e.g., Gillham & Clark; Intercollegiate Stroke Working Party; Miller *et al.* (51–53)], the widespread lack of adequate resourcing of contemporary psychological care after stroke has been highlighted (54). Resourcing issues and sustainability are increasingly important considerations, particularly in light of current economic austerity measures in the developed world and ongoing financial constraints in the developing world. MBIs are inexpensive to deliver, require little equipment or other resources, and are flexible in terms of delivery location (a space large enough to accommodate a group of 10 people is all that is required). Following completion of the eight-week course, groups may become self-sustaining, thus enabling participants to gain psychosocial benefits associated with peer support, and /or to continue to practice on their own.

Strengths of this review

To ensure that we had indentified all potentially relevant studies, our search strategy was broad and comprehensive, and included gray literature resources. And, acknowledging the paucity of evidence in the field, we extended our review inclusion criteria to include a range of experimental and nonexperimental study designs, thus enabling us to draw on a wider evidence base.

Limitations of this review

In terms of the search strategy, there is no subject heading for mindfulness; however, we were able to compensate for this by using associated subject headings and appropriate key words. Also, due to resource constraints, we limited our review to studies published in the English language and therefore may have excluded other potentially relevant studies. In terms of the quality of the evidence generated by our review, we included all relevant studies, irrespective of methodological quality; however, this is common practice in reviews such as this, in which the included papers used a range of research designs, and measuring quality across heterogeneous study designs remains an unresolved and contentious issue for reviewers and the subject of continuing debate.

Limitations of the included papers

The studies included in the review were small and of poor methodological quality. We found only one trial and that had small numbers and a mixed neurological population. There was no evidence of sample size calculation, and the study was underpowered for stroke. Across the four studies, there was considerable heterogeneity relating to characteristics of the populations studied, outcomes measured, outcome measures, and intervention design and delivery, and therefore meta-analysis was not possible. Three studies used MBSR and one used MBCT, therefore we are unable to make distinction between these two forms of MBIs in relation to stress management following TIA/stroke. None of the studies had a longitudinal perspective so we are unable to determine the effectiveness of MBIs in the long term. In light of these methodological limitations, the review findings should be viewed with caution.

Implications for practice

This systematic review demonstrates that MBIs may be beneficial in practice across a range of psychological, psychosocial, and physical limitations induced by TIA/stroke and are unlikely to cause any harm. However, the paucity of evidence prevents an overt recommendation to incorporate MBIs into current practice.

Implications for research

MBIs are amenable to standardization. Large-scale, methodologically robust, longitudinal trials of standardized interventions are required to determine the effectiveness of MBIs in relation to coping with and managing perceived psychosocial stress following TIA/stroke. To gain understanding of participants' perceptions of the acceptability and relevance of MBIs, qualitative explorations are required. However, generating good evidence of the efficacy and acceptability of MBIs will only be the first step toward implementation, and issues regarding practitioner training and governance need to be resolved.

Conclusions

The evidence generated by this review suggests that there may be therapeutic benefit to be derived from MBIs following TIA/stroke. The review paves the way for further longitudinal investigation of feasibility, effectiveness, and acceptability of MBIs among diverse stroke populations.

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