Psychological interventions for post stroke pain: A systematic review

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Abstract

Chronic pain is prevalent after stroke and has significant impact on quality of life. Research demonstrates the efficacy of psychological interventions for mixed chronic pain conditions. This review aimed to assess evidence on the effectiveness of psychological interventions for chronic pain in people with stroke. PubMed, PsychINFO, Embase, and CINAHL were searched from inception to 31 January 2021 at all levels of evidence. Psychological interventions assessing chronic pain in adults following stroke as a primary outcome were included. All outcomes related to pain quality were included (e.g. intensity, frequency, duration). Study quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Reports and Risk of Bias in N-of-1 Trials (RoBiNT) Scale. Three single *n* case reports were included. A narrative synthesis was performed, indicating that psychological interventions may reduce chronic post-stroke pain, however overall quality appraisal of the included studies was poor, due to low internal validity found in the single *n* case report designs. The limited evidence suggests that psychological interventions may have clinical utility in reducing chronic post-stroke pain. However, due to the paucity and quality of studies found, results must be treated with caution. More rigorous research is needed.

Keywords: Stroke, chronic pain, post-stroke pain, psychological interventions

Introduction

Persistent pain following stroke is a common and often debilitating experience for many patients after stroke. The International Classification of Diseases (ICD-11) defines chronic pain as persistent or recurring pain lasting longer than three months (World Health Organization, 2021). Central post stroke pain, nociceptive pain and tension headache are the most common chronic pain conditions reported after stroke (Widar et al., 2002). Lesions in the spinothalamic pathways are thought responsible for most central post stroke pain, whereas spasticity, shoulder tendinopathies and capsulitis, and complex regional pain syndrome contribute to the nociceptive category (Harrison & Field, 2015). Headache aetiology is less clear; but muscle tension or stimulation of the trigeminovascular system is thought to characterise most post-stroke headache (Harrison & Field, 2015).

In terms of prevalence, Jönsson et al. (2006) found 32% of stroke patients reported moderate to severe pain four months after their stroke. Prevalence reduced to 21% one year later, although pain intensity at that time was described as more severe. In contrast, Widar et al. (2002) found that 35% of 43 stroke patients reported central post stroke pain, 35% nociceptive pain, and 23% tension type headache at two years post-event. An integrative review of 14 studies identified five primary factors influencing the experience of post-stroke pain and associated patient quality of life: depression, anxiety, fatigue, cognitive function, and physical function (Payton & Soundy, 2020). In line with the biopsychosocial model of pain (Gatchel et al., 2007), the link between pain and mood after stroke is bidirectional, with pain being both a precursor and result of depression (Payton & Soundy, 2020). The Australian and New Zealand Clinical Guidelines for Stroke Management include a strong recommendation that stroke patients be treated in a unit with an interdisciplinary team,

comprising of psychologists in addition to medical personnel (Stroke Foundation, 2021). The UK clinical guidelines for stroke (Rudd et al., In press) emphasise the need for a multi-disciplinary approach to services for people who have experienced a stroke which include psychological care. These guidelines also state the need for people with post-stroke pain to be reviewed regularly not only in terms of pharmacotherapy, but also incorporating psychological care to address anxiety, depression, and psychological distress (Rudd et al., In press, p. 80). What interventions are most effective in the treatment and management of pain has been identified as a priority in stroke rehabilitation and long-term care (Stroke Association, 2021).

Because of its chronicity and the lack of effective pharmacological options for many patients (Foster et al., 2018), a wide range of psychological treatments have been developed for chronic pain. In particular, behaviour therapy and cognitive behavioural therapy (CBT) have evidence for their effectiveness in the treatment of the majority of chronic pain disorders (Gandy et al., 2022; Williams et al., 2020), including headache (Andrasik, 2007). Additionally, Acceptance and Commitment Therapy (ACT) has been demonstrated to be more effective than controls and inactive treatments for chronic pain (Hann & McCracken, 2014; Hughes et al., 2017). Systematic reviews have demonstrated that psychological interventions are efficacious in treating chronic pain disorders such as fibromyalgia (Bernardy et al., 2018) and chronic headache (Perlini et al., 2020). However, stroke can affect physical, cognitive, and communication abilities and these can all impact the potential to benefit from psychological treatment. This means the efficacy of psychological treatments for chronic pain cannot be assumed when applied to pain after stroke. The most recent review of psychological treatments for neuropathic pain (Eccleston et al., 2015) did not include studies of stroke-related pain.

This review aims to systematically assess the efficacy of psychological interventions for chronic pain in people with stroke. Specifically, the review asks, "How many studies have examined the effectiveness of psychological therapies for chronic pain in persons with stroke, what were the interventions, and what were the outcomes achieved?"

Method

Literature Searches

Following protocol registration with the International Prospective Register of Systematic Reviews (PROSPERO: CRD42020186891), the following databases were searched from inception to 31 January 2021: PubMed, PsycINFO, Embase, and CINAHL. MeSH terms and subject headings were selected by the authors, experts in pain and stroke, based on their familiarity with the literature including other reviews. These were tailored to each database in consultation with a specialist librarian (see example search strategy in Appendix). ProQuest Dissertations and Theses Global was also searched to capture unpublished literature and conference proceedings. After screening was completed, the reference lists of included studies were searched to identify any relevant work that may have been missed in previous searches.

Eligibility Criteria

Study participants were required to be adults (≥18 years) reporting chronic pain (pain persisting for at least three months) in any body site following stroke. Non-human studies and paediatric studies were excluded, as were studies published in languages other than English (due to limitations regarding resources for accurate translation of papers). All psychological interventions following stroke that assessed pain as a primary outcome were included.

Psychological interventions were defined using Eccleston and colleagues' previous Cochrane review definition, that is:

> "…using psychotherapeutic methods specifically designed to alter psychological processes believed to contribute to pain, distress, or disability… methods underpinned by specific theories of the aetiology of human behaviour for which there is some evidence of efficacy in the broader field of clinical psychology." (Eccleston et al., 2015 (p. 4))

Due to the low number of studies known to the reviewers in the area, all study designs including single case design studies, qualitative interview and focus group studies, quasi experimental designs, and randomised controlled trials (RCTs) were included. Both quantitative outcomes and qualitative data regarding the experience of participation in interventions were considered. In addition to measuring pain outcomes, associated changes in psychological functioning (e.g., depression, anxiety, quality of life and impact of pain on activities of daily living) were extracted.

Screening

After the removal of duplicates, titles and abstracts were independently screened using Covidence systematic review software (Veritas Health Innovation, n.d) by two researchers (BVZ and IM) against the eligibility criteria. At this stage, studies were excluded if they did not meet the eligibility criteria above. Reasons for exclusion were primarily that the studies did not target pain as their primary outcome, did not feature a psychological intervention, or that the sample was not those experiencing chronic pain following stroke. Full reports were obtained for all titles that appeared to meet the inclusion criteria or where there was any uncertainty on their meeting of criteria. If the full-text of a study that might meet inclusion

criteria was not available, three attempts were made to contact the authors via email. Disagreement about inclusion in the review was resolved through consultation with senior researchers (IK, TNJ & ST). Reasons for excluding full-text studies were recorded. Authors of three studies that featured incomplete results/methods were contacted; however, one author responded to email requests. The author provided further study details included in the current review (e.g., conference poster with more data in addition to conference abstract).

Data extraction and analysis

Data extraction was also completed using Covidence software. As recommended by Higgins et al. (2019), data relating to key sample characteristics (e.g., age, ethnicity, gender, stroke type, chronic pain severity and type, duration of chronic pain, time since stroke, cognitive and communication impairments), study design and comparison groups were extracted where applicable. A narrative synthesis was conducted considering study design and quality, intervention characteristics and delivery, participants, and outcome measures. Similarities and differences between study findings were appraised. Two researchers (BVZ, IM) independently extracted the data for each study, and cross-checked their results to ensure accuracy.

Assessment of study quality

The quality of case studies/reports included in the review was measured using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Reports (Moola et al., 2017). JBI critical appraisal tools were designed for use in systematic reviews and this checklist is a well-regarded method to assess the methodological quality of case reports (Munn et al., 2020; Zeng et al., 2015). Internal and external validity of these single case studies were measured by the Risk of Bias in N-of-1 Trials (RoBiNT) Scale (Tate et al., 2013). This scale has

demonstrated excellent inter-rater reliability and evidence of sound construct validity (Tate et al., 2013). Ratings for each instrument were cross-checked, with discrepancies resolved through consultation with the first author.

Results

After an initial identification of 1,660 studies, 219 duplicates were removed. 1,369 studies were excluded at title and abstract screening, whilst another 69 were excluded after full text eligibility assessment. This resulted in 3 studies included in the review. Results are reported in line with PRISMA guidelines (Moher et al., 2015), see Figure 1.

[insert Figure 1 about here]

Data Synthesis

Three studies met review inclusion criteria, with all identified from database searches and none sourced through hand searching of reference lists. Table 1 provides a summary of descriptive characteristics for each included study. All three studies were single *n* case studies/reports. No randomised control trials, quasi-experimental designs or qualitative studies met the eligibility criteria. Quantitative synthesis of studies was not possible due to the low number of included studies and the nature of study design and outcome variables extracted. Instead, a narrative synthesis was conducted to describe and interpret study characteristics and findings.

Table 1. Study characteristics

Study	Design	Country	n	Participant Age Gender, and Ethnicity	Time Since Stroke	Stroke Type	Pain Type and Duration of Pain Prior to Intervention	Co-Morbidities	Symptoms associated with stroke	Inclusion of people with aphasia	Inclusion of people with significant cognitive change	Modification for cognitive or communication difficulties
Brown and Becerra (2017)	Case Study	Australia	1	62 year old woman Ethnicity not reported	18 years	Intracerebral haemorrhage from an arterio venous malformation in right parietal temporal region	Neuropathic post-stroke pain 18 years	Depression, Anxiety, and Stress Scale scores indicated severe levels of depression at baseline	Chronic neuropathic pain in left leg; hemiparesis in left arm and hand; depression; some impairments to visuo-spatial cognitive functioning	No	Some impairments to visuo-spatial cognitive functioning	Unreported
Edwards et al. (2000)	Case Study	USA	1	70 year old woman Caucasian	7 years	Left posterior cerebral artery infarction involving left mesiotemporal and thalamic regions	Central post-stroke pain 7 years	Hypertension	Pain, ataxia, mild aphasia, right-side parietal headaches, depressive symptoms, sleep/appetite disturbances	Yes	No	Yes
Groet (2012)	Case Study	The Netherlands	1	39 year old woman Ethnicity not reported	States 1 year after stroke was still on medication; then EMDR was trialled	Stroke type not specified	Trigeminal neuralgia pain (facial pain) Pain persisted following 1 year on medication	Emotional disorder, fatigue	Emotional disorder, fatigue, extreme facial pain (trigeminal neuralgia pain)	Unreported	Yes	Unreported

Table 1 continued

Study	Intervention	Frequency and Duration	Delivery and Provider of Intervention	Co-Occurring Interventions	Outcome Measures	Fidelity or Compliance Measures	Treatment Manual Provided
Brown and Becerra (2017)	Mindfulness 25min daily mindfulness meditation activity on breath-focussed attention via CD. No comparison.	12 weeks; 25 min. mindfulness practice per day. Weekly 30 min-1 hour meetings to discuss practice difficulties and support scheduling of daily practice.	Mindfulness practised with CD; primary author of study completed assessments and assisted in supporting practice difficulties	25mg Lyrica Panamax and Norspan as required. Hydrotherapy Brahma Kumaris Meditation	*Cognitive Measures* - Woodcock Johnson - 3rd Edition (WJ-III-BIA) - Trail Making Test (TMT) - Controlled Oral Word Association Test (COWAT) *Pain Measures* - Short-Form McGill Pain Questionnaire 2 (SF-MPQ-2) - Pain Intensity (0-10 numerical rating scale; NRS) *Psychological and Well-being Measures* - Difficulties in Emotion Regulation Scale (DERS) - Perth Emotional Reactivity Scale (PERS) - SF-36 Health Survey - Depression Anxiety Stress Scale (DASS-21)	Assessor assisted with discussing mindfulness practice difficulties and supported scheduling of daily practice. No formal measures of fidelity/compliance.	No
Edwards et al. (2000)	EMG Biofeedback with psychotherapy (PMR, Behavioural Pain Coping Skills Training, Forced Used Therapy, CBT) No comparison	16 weeks (one 50 min. session weekly) 6 sessions biofeedback with PMR + 10 sessions of CBT and Forced Used Therapy	Face-to-face sessions; provider unclear	Some pain medication usage (switching from reactive to prophylactic through intervention)	*Psychological Measures* - Beck Depression Inventory (Depression) *Pain Measures* - Pain Intensity (0-10 NRS) - No. of days without pain - Duration of typical pain episode Other outcomes included the following but measurements or methods used to assess these were not provided: medication usage, perceived efficacy to manage pain, headache frequency/intensity, sleep efficiency, insight into pain and dysfunction, ataxia and neglect/dysfunction, limp/stability, kinesiophobia, exercise, social functioning, and activities away from home	None reported	No
Groet (2012)	EMDR	7 weekly EMDR sessions (3 with regular beeps, 4 with irregular beeps), duration not stated.	Unclear	Carbamazepine (200 3dd) received first year following stroke without any effect. Unclear if medication was continued for the duration of the intervention. Cognitive rehabilitation.	Pain level (0-10 NRS)	None reported	No

Table 1 continued

Study	Summary of Results for Pain	Summary of Results (Other Outcomes)	Qualitative Feedback
Brown and Becerra (2017)	Immediate effect of pain reduction following Mindfulness practice, consistent across daily practice. Short-term reduction in pain ratings on the sub scales of Continuous, Neuropathic, and Affective pain on the SF-MPQ-e. However, long-term pain intensity reduction was not evident at follow up.	Reduction in emotional reactivity, but this was not maintained at follow up. A small reduction in difficulty in emotion regulation at post intervention, which improved again at follow up. Improvements in depression and stress levels, however an increase in anxiety was noted post intervention. At follow up, depression and stress scores increased, whilst anxiety reduced (however this level was still higher than initial baseline level). Improvement in emotional quality of life at short term only.	Not provided, although it is reported participant ceased the Mindfulness practice post intervention and "at times reported difficulties in maintaining Mindfulness during practice."
Edwards et al. (2000)	Highest pain intensity rating remained unchanged, but average pain intensity decreased, and range of pain ratings expanded. The number of days without pain per month increased and duration of a typical pain episode decreased.	Increased medication adherence and pain management self-efficacy. Reduced headaches, better sleep, increased insight into pain and dysfunction, improvements in ataxia/neglect/dysfunction, improvements in stability/limp, reduction in kinesiophobia, increased exercise levels (0 = walking 20min 3x a week), increased social functioning (groceries, church, intimacy). Reduction in depression as measured by BDI.	Patient queried at the end of treatment about her satisfaction with the comprehensive intervention and her current pain disposition. "Quite satisfied" with treatment, especially current perceived ability to control and cope with her pain. Patient reported treatment had exceeded her expectations by having pain less frequently and of shorter duration.
Groet (2012)	Abstract results: EMDR-treatment associated with a reduction in self-reported pain level from an average of 6/10 at pre-treatment to 0.5/10 post treatment. Conference poster provided by author differs and reports 5.8 reducing to 0.6. Poster also incorporates a follow up measure at 9 months which was 1.2. Pain reduction was only observed following irregular beep EMDR treatment.	n/a	Not reported

A total of *n=3* participants were included in the review, all of whom were women. Ethnicity of participants was mostly unreported, with one participant identified as Caucasian. Participant ages were 39, 62, and 70. Pain type included neuropathic post-stroke pain, central post-stroke pain, and trigeminal neuralgia pain. Time since stroke and duration of pain ranged from between approximately 1 year to 18 years. Participants commonly reported experiencing a wide range of stroke related symptoms and co-morbidities in addition to pain (e.g., hemiparesis, depressive symptoms, ataxia, and sleep and appetite disturbances). There was limited description of whether participants experienced cognitive or communication impairments as a result of their stroke. One case study featured a participant with mild aphasia, and another case study included a participant with some impairments to visuo-spatial cognitive functioning. There was limited information as to whether psychological interventions were modified for communication or cognitive impairments, with the exception of Edwards et al. (2000) which described some modifications due to the participant having aphasia.

There were a range of psychological interventions represented in the review, including mindfulness meditation (Brown & Becerra, 2017), Eye Movement Desensitization and Reprogramming (EMDR) (Groet, 2012), as well as one study (Edwards et al., 2000) which included a multi-modal intervention incorporating biofeedback with progressive muscle relaxation (PMR), behavioural pain coping skills, forced used therapy, and CBT. Interventions were generally brief, ranging from 7 to 16 weeks in duration. Session length ranged from 25 minutes to 50 minutes. Number of total sessions with the health professional ranged from 7 to 16. There was a lack of clear reporting regarding who provided the intervention, with the exception of the mindfulness intervention, which was delivered by a clinical psychology student (Brown & Becerra, 2017). Psychological interventions targeting

pain commonly co-occurred with other conventional treatments (e.g., pain or anti-inflammatory medication, cognitive rehabilitation, and hydrotherapy). No drop-out or cessation of treatment was reported by any case studies between baseline and post-intervention periods. Studies did not include analyses of cost-effectiveness.

Study Quality Assessment

Tables 2 and 3 provide an overview of study quality utilising the JBI Study Quality Checklist and the RoBiNT Scale. The two case studies that were peer-reviewed (Brown & Becerra, 2017; Edwards et al., 2000) were rated favourably using the JBI Study Quality Checklist due to the level of detail provided regarding participant demographics, history, clinical condition, intervention procedures, adverse events reported, and communication of practical implications. The study drawn from grey literature, a conference abstract, provided less description of key participant characteristics, interventions, and outcomes.

Table 2. Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Reports

Study	Were patient's demographic characteristics clearly described?	*Notes*	Was the patient's history clearly described and presented as a timeline?	*Notes*	Was the current clinical condition of the patient on presentation clearly described?	*Notes*	Were diagnostic tests or assessment methods and the results clearly described?	*Notes*
Brown and Becerra (2017)	Yes	Most demographics described, with the exception of ethnicity/race. Prognosis not specifically referred to.	Yes	Detailed history with a few exceptions such as family history.	Yes	Differential diagnosis not discussed, but otherwise detailed.	Yes	Assessments were clearly described/validated tools were used.
Edwards et al. (2000)	Yes	Most demographics described; with exception of current medications, setting and context.	Yes	Detailed history with a few exceptions such as family history.	Yes	Differential diagnosis not discussed, but otherwise detailed.	No	Some assessments and results were unclear/ambiguous.
Groet (2012)	No	Limited information provided re: race, medical history, diagnosis, prognosis, past test results, and current medications.	No	No family or psychosocial history provided. Limited amounts of detail.	No	Limited or no information re: severity of cognitive impairment, mental, stroke type or differential diagnosis.	No	Noted some discrepancies between the abstract and poster results.

Table 2 continued

Study	Was the intervention(s) or treatment procedure(s) clearly described?	*Notes*	Was the post-intervention clinical condition clearly described?	*Notes*	Were adverse events (harms) or unanticipated events identified and described?	*Notes*	Does the case report provide takeaway lessons?	*Notes*
Brown and Becerra (2017)	Yes	Frequency and type of intervention described; however, specific treatment protocol not provided.	Yes	Post intervention results described clearly in tables, figures, and text.	Yes	Unanticipated increase of anxiety post intervention reported. No other adverse effects occurred.	Yes	Summarises lessons re mindfulness intervention, e.g. short lived benefit.
Edwards et al. (2000)	Yes	Treatment was described well; although no protocol/manual provided.	Yes	Lengthy written description of results outcomes.	Yes	Initial increase of pain before improvement discussed.	Yes	Summarises results, provides suggestions/ observations about intervention that can be applied.
Groet (2012)	No	There was limited information provided re: the EMDR intervention.	Yes	Post treatment pain levels reported.	No	No explicit mention of harms or adverse events; although does state no improvements following regular beep version of EMDR.	Yes	Summarises lessons re mindfulness intervention, e.g. EMDR might reduce trigeminal neuralgia pain.

Table 3 Risk of Bias in N-of-1 Trials (RoBiNT) Scale

Internal Validity							
Study	**Design with control**	**Randomisation**	**Sampling of behaviour**	**Blinding of people involved in the intervention**	**Blinding of assessor(s)**	**Inter-rater agreement**	**Treatment adherence**
Brown and Becerra (2017)	0 points - Case Report; no design with control	0 points - Case Report; no randomisation	0 points - <3 data points in all phases.	0 points - No blinding.	0 points - No blinding.	0 points - Self report measures (subjective).	0 points - No evaluation of treatment adherence.
Edwards et al. (2000)	0 points - Case Report; no design with control	0 points - Case Report; no randomisation	0 points - <3 data points in all phases.	0 points - No blinding.	0 points - No blinding.	0 points - Self report measures (subjective).	0 points - No evaluation of treatment adherence.
Groet (2012)	0 points - Case Report; no design with control	0 points - Case Report; no randomisation	0 points - <3 data points in all phases.	0 points - No blinding.	0 points - No blinding.	0 points - Self report measures (subjective).	0 points - No evaluation of treatment adherence.

Table 3 continued

External Validity								
Lead author (date)	**Baseline characteristics**	**Setting**	**Dependent variable (target behaviour)**	**Independent variable (e.g., therapy/intervention)**	**Raw data record**	**Data analysis**	**Replication**	**Generalisation**
Brown (2017)	1 point: Descriptive factors of baseline characteristics described; but limited analysis (e.g., no functional analysis) - formulation general not specific	2 points: Quiet room in participants home.	2 points - Target (pain) operationalised and instruments described	2 points - Mindfulness intervention, no. of sessions, duration, and frequency described	2 points- Figure 1 has raw data for each day of mindfulness practice. Raw data for all measures reported as this is a case study.	1 points - No rationale for analysis provided	0 points - No replication	0 points - No generalisation measures
Edwards (2000)	2 points - Analysis of reported baseline characteristics in the form of biopsychosocial model/interview data. Fucnctional analysis provided using CBT model)	0 points - Very little information about setting described	2 points - Pain defined on a 0-10 scale. Noted; however, other non-pain variables were not operationally defined/measurement method not described (e.g. efficacy, sleep, kinesiophobia).	2 points - Detailed description of content of intervention provided (no manuals) but describes all procedural details	1 point- Raw data recorded for most pre/post info; however, not for all pain outcomes (aggregated data for pre/post and lack of raw data across sessions)	0 poinits - No statistical or visual analysis of data	0 points - No replication	0 points - No generalisation measures
Groet (2012)	0 points - Limited biographic information for participant characteristics	0 points - Measurements done at home but no info about the setting of treatment	1 point - Target outcome defined (self-reported level of pain out of 10), however, could be more specific (e.g., providing clarification that this is indeed measuring intensity of pain)	0 points - Simply defined as EMDR treatment	0 poinits - Raw data only provided for selected phases in graphs	0 poinits - Visual inspection without statistical analysis	0 points - No replication	0 points - No generalisation measures

Internal validity, as measured by the RoBiNT Scale, was uniformly rated as poor, with each case study scoring 0 points across each internal validity domain. This was due in part to each *n* of 1 study using a case report design which lacks the core features of a single case experiment, e.g. ABAB design, sequential introduction of an intervention, and specific data analysis (Krasny-Pacini & Evans, 2018). Scores for external validity as measured by the RoBiNT Scale were varied. Again, the lack of information provided in the grey literature study about baseline characteristics, study setting, outcome measures, and interventions limited its study quality ratings. In particular, there was limited consideration of replicability and generalisation of effects observed during intervention, and data-analysis was reported in a limited fashion.

Effectiveness of psychological interventions for pain

Pain was measured using a wide array of instruments (see Table 1 for list of outcome measures). Using mindfulness meditation to treat neuropathic post-stroke pain, Brown and Becerra (2017) reported immediate pain reduction following the mindfulness intervention which was consistent across daily practice, and demonstrated evidence of short-term reductions in continuous, neuropathic and affective pain subscales of the Short-Form McGill Pain Questionnare-2. There was less evidence for pain reduction at follow-up, which occurred approximately 26 weeks after the initial baseline assessment. Unfortunately, further long-term data was not collected due to the participant developing cancer and further health complications.

Edwards et al. (2000) tested the effectiveness of 6 weeks EMG biofeedback with progressive muscle relaxation followed by 10 weeks of CBT and found that although the highest pain intensity rating remained unchanged following the intervention, average pain intensity ratings

decreased, from a mean average of 9/10, to 5/10 (where 0=no pain and 10=the most severe pain the patient had ever experienced). Furthermore, the number of days without pain per month increased, and the duration of a typical pain episode decreased as measured at posttreatment.

Groet (2012) reported that EMDR for post-stroke pain administered once a week for 7 weeks was associated with a reduction in pain level from 5.8/6 to 0.5/6 (both abstract and conference poster results presented) between baseline and post-intervention. However, it was noted that pain reduction was only present in the irregular beep version of EMDR and not the regular beep version. In this version, the auditory tone utilised for EMDR did not occur at regular time intervals.

Effectiveness of psychological interventions for indicators of psychological distress

There was mixed evidence to support the use of psychological interventions in reducing psychological distress, in particular maintenance of gains at follow-up was inconsistent. Edwards et al. (2000) found improvements in depression and social functioning by end of treatment. Brown and Becerra (2017) using a mindfulness intervention found a small improvement in emotional regulation skills post-intervention, which further improved at follow-up. There were some improvements in depression and anxiety noted initially; however, depression and stress scores increased at follow-up, and anxiety (although decreased from post-intervention) remained higher than initial baseline level. Similarly, a reduction in emotional reactivity was noted initially, however this was not maintained at follow-up.

Effectiveness of psychological interventions for other outcomes

Edwards et al. (2000) observed medication adherence and pain management self-efficacy to increase following biofeedback and psychotherapy. This case study also reported better sleep (faster onset with fewer awakenings), increased insight into pain and dysfunction, improvements in ataxia, stability/limp, increased exercise and social functioning, and a reduction in kinesiophobia.

Discussion

Considering the prevalence of chronic pain following a stroke, and the fact that psychological interventions are established treatments for chronic pain, it was surprising that so few studies exploring psychological pain management for post-stroke pain were found.

From the small number of studies identified, there is some limited evidence that psychological interventions can result in reductions in pain intensity. However, due to the wide range of co-occurring interventions and lack of control or comparison groups, conclusions regarding the effectiveness of psychological interventions need to be treated with caution. It is not possible to recommend which psychological intervention(s) for chronic pain after stroke should in particular be subject to further investigation.

There is some evidence that other outcomes (in addition to pain) may improve as a result of psychological interventions, however as this evidence derives from a single study, results should be interpreted with caution. Somewhat surprisingly there was mixed evidence demonstrating the effectiveness of psychological interventions in reducing psychological distress for people experiencing post-stroke pain. Reductions in distress were noted in the most recent Cochrane review of psychological therapies for general (non-neuropathic)

chronic pain (Williams et al., 2020), so it is unclear why similar outcomes were not observed here.

Overall, the quality of evidence supporting the use of psychological interventions for post-stroke chronic pain is poor. All three studies identified relied on case report data, one of which was limited in their description of participant characteristics, intervention procedures and outcomes. The external validity of case studies could be improved by providing functional analyses or formulations of participant concerns, improving the descriptions of study setting, providing greater detail regarding outcome measurements and interventions, and providing raw data at multiple points throughout the duration of the intervention.

Controlled trials would allow for researchers to test the effectiveness of interventions against comparators, and to increase confidence in the internal validity and generalisability of findings. This review did not find any RCTs which met the inclusion criteria. Future studies should not only aim to utilise RCT designs, but should also pay attention to reporting guidelines (Hoffmann et al., 2014) regarding the transparency of procedures (e.g., allocation, participant drop out), the pre-registration of trial protocols, and pre-reporting of data analysis plans. Including measures of participant expectancies/credibility ratings for self-report outcomes may also assist studies incorporating self-report data.

This review has several limitations. The small number of studies and small samples makes it difficult to establish any significant trends emerging in the literature, or to provide quantitative analysis of data. Researchers might consider future studies that build on existing studies or compiling a core set of outcome measures for people with stroke to allow for

comparison across future research. Future studies should adopt the existing criteria for chronic pain.

For logistical reasons only English language papers were included. Moreover, due to the fact that all studies were single *n* case reports, it is unlikely the conclusions of this review reflect a diverse or representative sample of people experiencing post-stroke pain. Future research into psychological treatments for chronic pain after stroke should utilise large sample sizes and ensure full descriptions of participants including ethnicity and socio-economic status are recorded. Study recruitment should attempt to obtain participants from wide range of backgrounds and disability severities so results are generalizable. Further, given post-stroke pain conditions have a variety of presentations and likely aetiologies, it should be considered psychological interventions may not be as efficacious for all.

Pain is a challenging outcome of stroke for many patients and can greatly impact quality of life. Whilst the limited evidence appears to demonstrate that psychological interventions may have clinical utility in reducing chronic post-stroke pain, the paucity of studies found, in conjunction with their overall poor quality and high risk of bias makes it impossible to recommend any specific intervention. This review summarises the scant evidence but indicates the chasm of opportunity to contribute in this area. Research with high internal and external validity is sorely needed, in particular replicable RCTs.

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