

# Overview of Systematic Reviews and Meta-Analyses of Acupuncture for Stroke

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## Key Words

Overview · Systematic review · Meta-analysis · Complementary therapy · Acupuncture · Stroke

## Abstract

**Background:** We aimed to systematically overview published systematic reviews and meta-analyses in order to identify whether and when acupuncture is an effective treatment for stroke and stroke-related disorders. We also hoped to identify the best directions for future research in this area.

**Methods:** Systematic reviews and meta-analyses of randomized controlled trials (RCTs) and quasi-RCTs evaluating the efficacy of acupuncture to treat stroke or stroke-related conditions were included. Electronic searches were conducted in the Cochrane Database of Systematic Reviews, Ovid MEDLINE, CINAHL, Ovid EMBASE, EBSCO Allied and Complementary Medicine (AMED) database, Chinese Biological Medicine Database, and Chinese National Knowledge Infrastructure Database. Two authors independently assessed the compliance of studies with eligibility criteria, and extracted data from included studies. The quality of systematic reviews was assessed according to the Overview Quality Assessment Questionnaire. **Results:** A total of 24 systematic reviews were included, of which 4 (16.7%) were Cochrane systematic reviews and 20 (83.3%) were non-Cochrane reviews. Acupuncture was analyzed as an acute stroke intervention in 3 re-

views (12.5%), as an approach to stroke rehabilitation in 6 (25%), and as an intervention to treat various stroke-related disorders in the remaining 15 (62.5%). Reviews analyzing death or dependency/disability as the primary outcome reported no statistically significant difference between acupuncture and nonacupuncture control treatments. In contrast, reviews in which the outcome was improvement in global neurological deficit scores or performance on the video-fluoroscopic swallowing study test or water-swallowing test often reported that acupuncture was superior to control treatment. The quality of 10 reviews was 'poor', 6 reviews were 'moderate' and 8 were 'good'. **Conclusions:** The available evidence suggests that acupuncture may be effective for treating poststroke neurological impairment and dysfunction such as dysphagia, although these reported benefits should be verified in large, well-controlled studies. On the other hand, the available evidence does not clearly indicate that acupuncture can help prevent poststroke death or disability, or ameliorate other aspects of stroke recovery, such as poststroke motor dysfunction. These findings suggest that researchers should focus on the potential application of acupuncture to treat poststroke neurological impairment and dysfunction and on the development of more precise tools to assess these improvements after stroke.

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## Introduction

Stroke is the second most common cause of death worldwide, as well as the leading cause of adult disability [1, 2]. Nevertheless, medicine has developed few effective interventions against stroke and stroke-related disorders such as poststroke motor dysfunction and poststroke dysphagia. In China and elsewhere in East Asia, acupuncture has been a primary medical intervention for stroke and stroke-related disorders over the past 1,000 years [3], and in that part of the world, it continues to be used as a standard complementary therapy after stroke. In fact, a nationwide survey of 1,095 physicians from 247 Chinese hospitals between 1993 and 1994 found that 66% of Chinese doctors routinely used acupuncture to treat stroke patients, and 63% believed it to be effective [4]. Another more recent survey in 2007 among 202 Chinese acute stroke patients showed that 63.14% would choose acupuncture as part of medical intervention [5]. In South Korea an investigation of 304 stroke-patient respondents between 2004 and 2005 found that 54% had used complementary and alternative therapies, of which 92% had used traditional Korean medicine, primarily acupuncture [6]. Physicians and patients in Western countries and emerging economies [7–12] have also begun to accept acupuncture as an alternative therapy for a variety of neurological disorders.

Traditional Chinese medicine theory believes that the very core of disease onset is disruption of qi, the body's 'vital energies'. Qi flows through a network of channels, called 'meridians', running along the surface of the human body. Inserting needles at certain acupoints located along the meridians restores qi flow, thereby influencing progression of the disease [3]. In classical manual acupuncture, needles are inserted into acupoints to achieve a 'de qi' reaction, in which the patient perceives an ache or heaviness in the area surrounding the needle, while the acupuncturist performs a biomechanical movement (grasping the needle) that restores the qi flow at the site of insertion [13]. In addition to classical manual acupuncture, various modified acupuncture therapies have entered into widespread use, including scalp acupuncture [14], warm acupuncture, electro-acupuncture, auricular acupuncture [15] and 'xinnaokaiqiao' acupuncture [16].

The technical simplicity, noninvasiveness and lack of adverse effects of acupuncture compared to Western pharmacological and surgical approaches have made it an attractive treatment option in the West and East alike. Since the 1970s, hundreds of trials have been carried out to test the efficacy of acupuncture to treat stroke. These trials have been performed using widely differing methodologies and

clinically diverse populations. To help identify real effects amid noise due to confounders, numerous systematic reviews and meta-analyses have been carried out to examine the effects of acupuncture to treat different types of stroke and stroke-related disorders at different stages of disease. These systematic reviews and meta-analyses have reported sometimes confusing and even conflicting results, which may help explain why acupuncture is still widely regarded as an 'alternative' therapy. In an effort to definitively identify under what conditions acupuncture can be an effective stroke treatment, we performed a systematic overview of systematic reviews and meta-analyses in the literature. Our secondary goal was to identify gaps and ambiguities in the literature as a guide for future research.

## Methods

We included systematic reviews and meta-analyses of randomized controlled trials (RCTs) and quasi-RCTs that evaluated the efficacy of acupuncture to treat any type of stroke or stroke-related disorders, including poststroke dysphagia, depression, hiccups, urinary incontinence, hand-shoulder syndrome and shoulder pain. Systematic reviews and meta-analyses involving any acupuncture modality were included. Systematic reviews in which studies involved other alternative therapies or drug therapy were included if these same nonacupuncture therapies were given to both the intervention (acupuncture) arm and the control arm (no acupuncture). Reviews were excluded if they: (1) included controlled clinical trials; (2) compared the efficacy of different acupuncture therapies, such that there was no nonacupuncture control group, or (3) were nonsystematic narrative reviews or overviews.

Using our prespecified inclusion criteria, we comprehensively searched the following databases with no language restrictions: the Cochrane Library (Issue 5, 2013), Ovid MEDLINE (1966 to June 2013), Cumulative Index to Nursing and Allied Health Literature (CINAHL, 1982 to June 2013), Ovid EMBASE (1980 to June 2013), Allied and Complementary Medicine (AMED, 1985 to June 2013), Chinese Biological Medicine Database (CBM, 1981 to June 2013), and China National Knowledge Infrastructure (CNKI, 1996 to June 2013). The following search terms were used: 'stroke', 'cerebrovascular accident', 'isch(a)emic stroke', 'infarction', 'apoplexy', 'h(a)emorrhage', 'acupuncture', 'acupressure', 'auricular', 'systematic review' and 'meta-analysis'.

In addition to these automated searches in databases, we manually searched four Chinese journals relevant to acupuncture (from 1980 to June 2013): *Acupuncture Research*, *Chinese Acupuncture and Moxibustion*, *Journal of Clinical Acupuncture and Moxibustion*, and *Shanghai Journal of Acupuncture and Moxibustion*.

We identified eligible reviews using a two-step selection process. First, two investigators (J.Z. and D.W.) independently screened the titles and abstracts to exclude reviews that obviously did not meet the prespecified criteria. Second, the same investigators read the full text of the potentially eligible reviews and discarded those failing to meet the inclusion criteria. Disagreements were resolved by discussion and consensus.

The same two authors extracted the following data from included reviews: countries of the included trials, number of trials included, patient demographic and clinical data, main outcomes and conclusions. The quality of the included reviews was assessed using the Overview Quality Assessment Questionnaires (OQAQ). This instrument evaluates the scientific quality of a systematic review based on the answers to nine questions, generating an overall quality score ranging from 1 to 7 [17]. A score of 6–7 indicates a review of ‘good’ quality, 3–5 indicates a review of ‘moderate’ quality, and 0–3 a review of ‘poor’ quality.

Data from reviews were quoted in the form of standardized mean difference (SMD), weighted mean difference (WMD), odds ratio (OR) or relative risk (RR), depending on what the review authors reported. Whenever possible, meta-analysis results were also reported with 95% confidence intervals (CI).

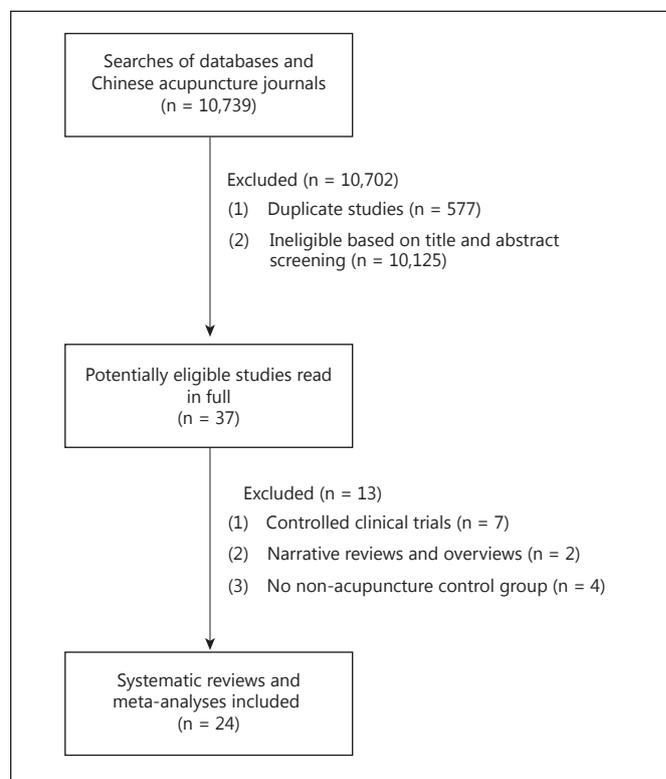
## Results

Initially, 10,739 potentially relevant records were identified through electronic and manual searches. After screening titles and abstracts, 10,702 records were excluded and the remaining 37 reviews were read in full. Finally, 24 systematic reviews were included in this overview: 4 (16.7%) Cochrane systematic reviews and 20 (83.3%) non-Cochrane systematic reviews (fig. 1).

Table 1 summarizes the key findings of all systematic reviews. Among the 24 reviews, 18 (75%) were conducted in China, 4 (16.7%) in Korea, 2 (8.3%) in the UK, 1 (4.2%) in Canada and 1 (4.2%) in Sri Lanka. The 24 reviews included 366 RCTs and quasi-RCTs, with each systematic review comprising 3–72 RCTs. Three reviews (12.5%) analyzed acupuncture as an acute stroke intervention [18–20], 6 (25%) analyzed it as an approach to stroke rehabilitation [21–26], and the remaining 15 (62.5%) analyzed it as an intervention to treat various stroke-related disorders. Of these 15 reviews, 4 focused on poststroke motor dysfunction [27–30], 4 on poststroke dysphagia [31–34], 2 on poststroke depression [35, 36], and 1 review on each of poststroke hiccup [37], poststroke urinary incontinence [38], shoulder-hand syndrome [29], shoulder pain [39] and apoplectic aphasia [40]. The OQAQ quality of 10 reviews was rated as ‘good’, 6 were rated as ‘moderate’ and 8 as ‘poor’.

### *Acupuncture as an Intervention to Treat Acute Stroke*

Three reviews [18–20], comprising 27 RCTs and quasi-RCTs, examined the efficacy of acupuncture therapy as an intervention for acute stroke. All 3 reviews conducted meta-analyses. The Cochrane systematic review by Zhang et al. [20] investigated both acute ischemic and hemorrhagic stroke, while the two non-Cochrane systematic reviews focused on acute ischemic stroke.



**Fig. 1.** Flowchart of the review selection process.

Two reviews assessed the efficacy of manual and electronic acupuncture against conventional care as the control [19], or against sham acupuncture or no treatment as the control [20]. The primary outcome in both reviews was death or dependency/disability at the end of treatment/follow-up, and in both cases there was no significant difference between the acupuncture and control arms. Nevertheless, Zhang et al. [20] discovered a borderline significant trend favoring acupuncture, with slightly lower rates of mortality and dependency at the end of long-term follow-up (15–22 months). The secondary outcome in both reviews was an improvement in neurological deficit scores. Both studies found acupuncture to be associated with significantly greater improvements than the control treatment: SMD 1.17, 95% CI 0.30–2.04 [20] and WMD 3.49, 95% CI 2.00–4.99 [19].

In the third review, Wang et al. [18] meta-analyzed 8 RCTs and compared the efficacy of scalp acupuncture with conventional medication. Acupuncture was associated with significantly greater improvement in neurological deficit scores (WMD 3.89, 95% CI 2.43–5.36) as well as significantly higher rates of clinical efficacy (RR 1.23, 95% CI 1.11–1.37).

**Table 1.** Summary of key findings from all systematic reviews included in this overview

Review	Cochrane	Country	Treatment context	Studies and patients included	Main results	OQAQ quality	Key conclusion
Zhang [20], 2005	Yes	China	Acute stroke	9 RCTs, 5 quasi-RCTs, 1,208 patients	Acupuncture (EA, MA) vs. Sham acupuncture or no treatment. Borderline dead or dependent (4 RCTs). OR 0.66 (95% CI 0.43–0.99). Dead or needing institutional care after 3 months or more (3 RCTs). OR 0.58 (95% CI 0.35–0.96). Neurological deficit score change by SSS, MESSS and BI (6 RCTs). SMD 1.17 (95% CI 0.30–2.04). Acupuncture (EA, MA) vs. Sham acupuncture only. Death or requiring institutional care at the end of follow-up (2 RCTs). OR 0.49 (95% CI 0.25–0.96).	Good	Acupuncture appeared to be safe but without clear evidence of benefit.
Zhang [19], 2009	No	China	Acute stroke (ischemic)	5 RCTs, 429 patients	Acupuncture (EA, MA) + medication vs. medication. Neurological deficit score change by SSS (3 RCTs). WMD 3.49 (95% CI 2.00–4.99).	Poor	No clear evidence for or against therapeutic benefit of acupuncture.
Wang [18], 2012	No	China	Acute stroke (ischemic)	8 RCTs, 538 patients	Acupuncture (SA) vs. medication. Neurological deficit scores by BI, FIM and SIAS (6 RCTs). WMD 3.89 (95% CI 2.43–5.36). Rate of clinical efficacy (4 RCTs). RR 1.23 (95% CI 1.11–1.37).	Moderate	SA is significantly effective at improving neurological deficit score and clinical efficacy rate.
Park [26], 2001	No	UK	Poststroke rehabilitation	9 RCTs, 538 patients	No meta-analysis. Qualitative description only.	Good	No compelling evidence for therapeutic benefit of acupuncture.
Kim [25], 2005	No	Korea	Poststroke rehabilitation	9 RCTs, 748 patients	No meta-analysis. Qualitative description only.	Poor	None indicated.
Wu [24], 2006	Yes	China	Poststroke rehabilitation (subacute and chronic)	5 RCTs, 368 Patients	Acupuncture (MA) + rehabilitation vs. rehabilitation. Neurological deficit score improvement by CSRS (4 RCTs). OR 6.55 (95% CI 1.89–22.76).	Good	No clear evidence for or against therapeutic benefit of acupuncture.
Wu [22], 2010	No	Canada	Poststroke rehabilitation	56 RCTs, 5,650 patients	Acupuncture (SA, MA, EA) vs. various controls (Sham acupuncture, rehabilitation, medication or Chinese herbs). Various outcome measurements transformed into rate of clinical efficacy (38 RCTs). OR 4.33 (95% CI 3.09–6.08).	Moderate	Acupuncture is likely effective for improving poststroke rehabilitation.
Kong [23], 2010	No	Korea	Poststroke rehabilitation	10 RCTs, 711 patient	No meta-analysis. Qualitative description only.	Good	No clear evidence for or against therapeutic benefit of acupuncture.
Lee [21], 2013	No	Korea	Poststroke rehabilitation	21 RCTs, 2,172 patients	Acupuncture (SA) vs. medication. Rate of clinical efficacy (3 RCTs). RR 1.30 (95% CI 1.19–1.42). Acupuncture (SA) + medication vs. medication. Rate of clinical efficacy (2 RCTs). RR 1.19 (95% CI 1.05–1.36). ADL by BI (2 RCTs). SMD 0.78 (95% CI 0.40–1.17). Neurological deficit score by CSRS (6 RCTs). SMD 0.61 (95% CI 0.40–0.81). Acupuncture (SA) + rehabilitation vs. rehabilitation. Rate of clinical efficacy (2 RCTs). RR 1.12 (95% CI 1.01–1.23). ADL by BI (2 RCTs). WMD 13.41 (95% CI 11.05–15.76).	Moderate	Weak but positive evidence for the effectiveness of scalp acupuncture as adjunct to conventional care.
Size [29], 2002	No	China	Stroke-related disorders (motor dysfunction)	14 RCTs, 1,213 patients	Acupuncture (MA, EA) + rehabilitation vs. rehabilitation. Disability over 6 months by effect size calculated with BI, SADLI and FIM (6 RCTs). Effect size, estimate of change 0.49 (95% CI 0.03–0.96). Acupuncture (MA/EA) vs. rehabilitation. Motor recovery by effect size calculated with SSS, mobility score and BS (6 RCTs). Effect size, estimate of change 1.01 (95% CI 0.79–1.22). Disability over 6 months by BI, SADLI and FIM (4 RCTs). OR 12.5 (95% CI 4.3–36.2).	Moderate	Results unclear.

**Table 1** (continued)

Review	Cochrane	Country	Treatment context	Studies and patients included	Main results	OQAQ quality	Key conclusion
Li [30], 2002	No	China	Stroke-related disorders (motor dysfunction)	9 RCTs, 1,253 patients	Acupuncture (MA, EA) vs. medication. Rate of clinical efficacy based on recovery of limb strength by end of treatment (5 RCTs). OR 2.45 (95% CI 1.62–3.72). Rate of clinical efficacy based on neurological deficit score at end of treatment (3 RCTs). OR 2.90 (95% CI 1.98–4.26).	Poor	Evidence does not indicate that acupuncture is effective for treating poststroke hemiplegia.
Liu [28], 2008	No	China	Stroke-related disorders (motor dysfunction)	23 RCTs, 2,462 patients	Acupuncture (MA, SA, EA, AA + MA) with massage vs. various controls. Motor recovery assessed by traditional Chinese medicine efficacy evaluation (5 RCTs). OR 2.44 (95% CI 1.42–4.19). Motor recovery by FMA (12 RCTs). OR 12.38 (95% CI 7.18–17.58). Motor recovery by BI (8 RCTs). OR 17.30 (95% CI 16.05–18.05).	Poor	No clear evidence for or against therapeutic benefit of acupuncture.
Qi [27], 2009	No	China	Stroke-related disorders (motor dysfunction)	11 RCT and 3 quasi-RCTs, 978 patients	Acupuncture (MA) vs. moxibustion: tone assessment by FMA (1 RCT). WMD for upper limbs 15.10 (95% CI 11.95–18.25). WMD for lower limbs 7.30 (95% CI 3.87–10.73). Acupuncture (MA) + electro-stimulation + medication + rehabilitation vs. electro-stimulation + medication + rehabilitation. Motor recovery by BI (4 RCTs). WMD 8.70 (95% CI 5.43–11.97). Acupuncture (MA) + massage vs. medication + massage. Motor recovery by adductor tone rating (1 RCT). WMD 0.70 (95% CI 0.35–1.05).	Poor	No reliable conclusions possible.
Wang [34], 2006	No	China	Stroke-related disorders (dysphagia)	4 RCTs and 2 quasi-RCTs, 436 patients	Rate of clinical efficacy (6 RCTs). RR 1.17 (95% CI 1.08–1.27). Reduction in time for thick barium to pass through pharynx by VFSS (1 RCT). WMD 7.23 (95% CI 1.28–13.18).	Moderate	No reliable conclusions possible.
Wong [31], 2012	No	China	Stroke-related disorders (dysphagia)	9 RCTs, 783 patients	No meta-analysis. Qualitative description only.	Good	Acupuncture together with conventional rehabilitation appears to have positive effect on dysphagia after stroke.
Geeganage [33], 2012	Yes	Sri Lanka	Stroke-related disorders (dysphagia)	4 RCTs, 256 patients	Acupuncture (EA/MA) vs. rehabilitation/medication. Clinical efficacy based on reduction of dysphagia severity at the end of the trial based on water-swallowing test, swallowing function or bulbar function (3 RCTs). OR 0.24 (95% CI 0.13–0.46).	Good	Acupuncture may reduce dysphagia severity.
Long [32], 2012	No	China	Stroke-related disorders (dysphagia)	72 RCTs, 6,134 patients	Acupuncture (various) vs. controls (various). Clinical efficacy evaluated by VFSS test, water-swallowing test or other tests (72 RCTs). OR 5.17 (95% CI 4.18–6.38). Bespoke clinical efficacy evaluated by water-swallowing test only (47 RCTs). OR 5.57 (95% CI 4.21–7.38). Acupuncture (various) vs. no treatment. Subset of higher-quality studies (4 RCTs). OR 2.34 (95% CI 1.34–4.07).	Good	Acupuncture may be beneficial to treat poststroke dysphagia.
Zhang [36], 2009	No	China	Stroke-related disorders (depression)	9 RCTs and 8 quasi-RCTs, 1,507 patients	Acupuncture (EA, MA, Xinnaokaicao) vs. antidepressant medication. Depression relief based on traditional Chinese medicine efficacy evaluation (16 RCTs). OR 2.54 (95% CI 1.91–3.38). Depression relief based on HAMD score (12 RCTs, random effect). WMD 2.68 (95% CI 1.21–4.41).	Poor	Acupuncture shows greater therapeutic effect than commonly used antidepressant medications, with similar safety.

**Table 1** (continued)

Review	Cochrane	Country	Treatment context	Studies and patients included	Main results	OQAQ quality	Key conclusion
Xiong [35], 2010	No	China	Stroke-related disorders (depression)	20 RCTs, 2,031 patients	Acupuncture (EA, MA) vs. antidepressant medication (fluoxetine). Improvement in HAMD-24 score after 1st week of treatment (1 RCT). WMD 3.80 (95% CI 0.04–7.64). Improvement in HAMD-24 score after 4th week of treatment (7 RCTs). WMD 1.34 (95% CI 0.02–2.67). Reduction rate of HAMD-24 score (5 RCTs). RR 1.15 (95% CI 1.07–1.24). Improvement in HAMD-17 score after 4th week of treatment (2 RCTs). WMD 1.15 (95% CI 0.30–2.10). Improvement in SDS score after 4th and 8th week of treatment (3 RCTs). WMD 6.02 (95% CI 3.30–8.73). WMD 9.37 (95% CI 7.66–11.08). Acupuncture (MA) vs. antidepressant (amitriptyline). Reduction rate of HAMD-24 score (1 RCT). WMD 3.29 (95% CI 2.97–4.01). Improvement in SDS score after 4th week of treatment (1 RCT). WMD 6.18 (95% CI 3.96–8.40).	Moderate	Acupuncture is safe for treating poststroke depression, but whether it is more effective than Western medication remains uncertain.
Zhu [37], 2011	No	China	Stroke-related disorders (hiccups)	3 RCTs, 143 patients	Acupuncture (MA) vs. medication. Hiccup relief after treatment, based on traditional Chinese medicine efficacy evaluation (3 RCTs). OR 9.05 (95% CI 3.17–25.82). No meta-analysis. Qualitative description only.	Poor	No clear evidence for or against therapeutic benefit of acupuncture.
Thomas [38], 2008	Yes	UK	Stroke-related disorders (urinary incontinence)	3 RCTs, 224 patients	No meta-analysis. Qualitative description only.	Good	None indicated due to insufficient data.
Lu [41], 2009	No	China	Stroke-related disorders (shoulder-hand syndrome)	3 RCTs, 252 patients	No meta-analysis. Qualitative description only.	Poor	No clear evidence for or against therapeutic benefit of acupuncture.
Lee [39], 2012	No	Korea	Stroke-related disorders (shoulder pain)	7 RCTs	No meta-analysis. Qualitative description only.	Poor	Acupuncture is an effective treatment for shoulder pain after stroke.
Pang [40], 2010	No	China	Stroke-related disorders (aphasia)	10 RCTs and 1 quasi-RCT, 756 patients	Acupuncture (MA) vs. speech rehabilitation. Speech recovery based on traditional Chinese medicine efficacy evaluation (4 RCTs). RR 1.72 (95% CI 1.09–2.71). Acupuncture (MA) + speech rehabilitation vs. speech rehabilitation. Speech recovery based on traditional Chinese medicine efficacy evaluation 'Cure' level (5 RCTs). RR 2.93 (95% CI 1.76–4.88). Speech function score (4 RCTs). WMD 10.54 (95% CI 7.86–13.21). Oral expression score (3 RCTs). WMD 8.86 (95% CI 7.38–10.35).	Poor	No clear evidence for or against therapeutic benefit of acupuncture.

AA = Auricular acupuncture; BI = Barthel ADL index; CSRS = Chinese stroke recovery score; EA = electro-acupuncture; FIM = functional independence measure; FMA = Fugl-Meyer assessment; HAMD = Hamilton Depression Rating Scale; MA = classical manual acupuncture; MESSS = modified Edinburgh-Scandinavian stroke scale; SA = scalp acupuncture; SADLI = Sun-naas ADL index; SDS = self-rating depression scale; SIAS = stroke impairment assessment set; SSS = Scandinavian stroke scale.

### *Acupuncture for Poststroke Rehabilitation*

One Cochrane systematic review [24] and 5 non-Cochrane systematic reviews [21–23, 25, 26] assessed the efficacy of acupuncture for poststroke rehabilitation. All reviews focused on ischemic and hemorrhagic stroke, and the authors placed no restrictions on the disease stage. Five of these reviews assessed the efficacy of manual or electronic acupuncture against various control treatments including sham acupuncture, conventional rehabilitation, medication or Chinese herbs. Quantitative analyses were impossible because the included studies reported different outcomes, which spanned physical assessment, disability and motor assessments, and other validated stroke assessment scales. Nevertheless, three reviews tried to perform meta-analysis on subgroups to reduce the bias caused by heterogeneity [22–24]. The Cochrane review of Wu et al. [24] included subacute and chronic stroke patients and meta-analyzed changes in neurological deficit scores on the Chinese Stroke Recovery Scale. They found that acupuncture was associated with a much higher probability of a deficit reduction (OR 6.55, 95% CI 1.89–22.76,  $p = 0.04$ ), but the heterogeneity was high ( $I^2 = 68\%$ ). Kong et al. [23] meta-analyzed subgroups who received acupuncture or sham acupuncture, and found no significant difference in either functionality during activities of daily living (ADL) or in changes in neurological deficit scores. Wu et al. [22] transformed the diverse outcome measurements of 38 trials into binary variable outcomes and pooled the data. They found acupuncture to be associated with significantly better outcomes than sham or no acupuncture (OR 4.33, 95% CI 3.09–6.08), leading them to conclude that acupuncture is likely to be effective for improving poststroke rehabilitation.

Among the 6 reviews assessing the efficacy of acupuncture for poststroke rehabilitation, only the review by Lee et al. [21] assessed the efficacy of scalp acupuncture. Those authors found that scalp acupuncture, when used as an adjunct to conventional treatment, was associated with higher rates of clinical efficacy and higher ADL functionality. Those authors concluded that the evidence for acupuncture as a useful part of poststroke rehabilitation was weak but positive.

### *Acupuncture to Treat Stroke-Related Disorders*

Four reviews focused on poststroke motor dysfunction, and all of them performed meta-analyses. These reviews included studies on both hemorrhagic and ischemic stroke patients at different stages of disease [27–30]. Sze et al. [29] analyzed 14 RCTs that compared motor impairment and disability in patients treated with manu-

al acupuncture alone, manual acupuncture with rehabilitation, or rehabilitation alone. A significant clinical benefit due to acupuncture was found only for severity of disability after treatment (OR 12.5, 95% CI 4.3–36.2). Liu et al. [28] analyzed 23 RCTs comparing various acupuncture modalities (manual, electro, scalp, auricular) with various control treatments, which the review did not describe clearly. Acupuncture proved superior to control treatments for motor recovery, assessed using the Traditional Chinese Medicine Efficacy Evaluation (OR 2.44, 95% CI 1.42–4.19) or the Fugl-Meyer Assessment (OR 12.38, 95% CI 7.18–17.58), as well as for ADL functionality, measured using the Barthel Index (OR 17.30, 95% CI 16.05–18.05). Li et al. [30] analyzed 9 RCTs that compared three acupuncture modalities (electro, scalp, manual) with conventional medication in terms of muscle tone improvement of hemiplegic limbs and neurological deficit scores at the end of treatment. Acupuncture was associated with significantly better muscle tone (OR 2.45, 95% CI 1.62–3.72) and improvement in neurological deficit score (OR 2.90, 95% CI 1.98–4.26). The fourth review, by Qi et al. [27], also found acupuncture to be associated with significantly greater improvement in ADL functionality, as measured by the Barthel Index (WMD 8.70, 95% CI 5.43–11.97). However, none of the 4 reviews made firm conclusions about the efficacy of acupuncture due to the low quality of included trials or the small number of study participants.

One Cochrane review [33] and 3 non-Cochrane systematic reviews [31, 32, 34] examined poststroke dysphagia. The Cochrane review by Geeganage et al. [33] compared the efficacy of deep-swallowing manual or electroacupuncture therapy with that of routine medication and rehabilitation for treating patients with acute or subacute stroke. Although the treatments did not differ significantly for the primary outcome of death or dependency/disability, acupuncture was associated with significantly less severe dysphagia (OR 0.24, 95% CI 0.13–0.46) based on a post-treatment water-swallowing test and bulbar function. Long and Wu [32] analyzed 72 RCTs involving 6,134 patients with various types of stroke in which medicine and/or rehabilitation training plus acupuncture was compared with medicine and/or rehabilitation only using the video-fluoroscopic swallowing study (VFSS) test and the water-swallowing test as outcomes. Data for these outcomes were converted into clinical efficacy rates in order to allow quantitative synthesis of data from all trials. Meta-analysis showed that acupuncture was associated with significant improvement in the severity of dysphagia (OR 5.17, 95% CI 4.18–6.38) when VFSS and water-swallow-

ing test results were combined. This clinical benefit was even greater when only water-swallowing test results were meta-analyzed (OR 5.57, 95% CI 4.21–7.38). Long and Wu [32] verified this result in a subgroup analysis of 4 higher-quality RCTs (OR 2.34, 95% CI 1.34–4.07). An earlier systematic review similarly reported that acupuncture was associated with significantly better VFSS and water-swallowing test results than were medication, rehabilitation training or Chinese herbs [34]. Wong et al. [31] made only qualitative comparisons in their review comparing the combination of acupuncture with swallowing training against either medication with training or medicine alone. Those authors concluded that acupuncture together with conventional rehabilitation might have a positive effect on dysphagia after stroke.

The remaining reviews included in our overview focused on other stroke-related disorders: 2 examined poststroke depression [35, 36] and single reviews examined poststroke hiccup [37], poststroke urinary incontinence [38], shoulder-hand syndrome [41], shoulder pain [39] and apoplectic aphasia [40]. Data in only one review on poststroke depression [36] and one on poststroke hiccup [37] suggested that acupuncture was superior to control treatments, but the authors in those studies did not draw any firm conclusions about the therapeutic efficacy of acupuncture due to the low quality of included trials or the small number of study participants.

## Discussion

This overview identified a considerable number of systematic reviews, giving us a comprehensive picture of controlled assessments of acupuncture as a possible treatment for stroke and related disorders. Most studies focused on acupuncture as an intervention for stroke rehabilitation. Although most of the reviews we included did not wish to draw firm conclusions due to the small size of the included trials or their low methodological quality, our overview identified relatively convincing evidence for acupuncture as a treatment for stroke-related dysphagia.

Based on the ability of acupuncture to increase the flow of qi at points of needle insertion, practitioners of traditional Chinese medicine have historically held it to be particularly effective for ameliorating poststroke neurological impairment and dysfunction. Our overview supports this belief by providing evidence that acupuncture can be effective for stroke rehabilitation and stroke-related dysfunction based on assessments of neurological impairment, global neurological deficit, ADL functional-

ity or water-swallowing ability. On the other hand, acupuncture was not associated with significantly better rates of death or dependency/disability than control treatments in any of the reviews we included.

It is worth noting that death or dependency/disability remain the primary outcomes accepted by most researchers and clinicians for assessing the efficacy of acupuncture. Other outcomes are less widely accepted because of potential measurement bias. For example, the clinical benefit of acupuncture for treating poststroke dysphagia may be partly attributable to the fact that the VFSS test and water-swallowing test are more subjective than measures of death and disability. Therefore, it would be valuable to develop more precise and objective tools that can be widely recognized for assessing the efficacy of acupuncture to treat stroke.

Our overview is constrained by limitations in the included systematic reviews. These limitations occur at the level of individual studies: only 13.5% of acupuncture trials included in Cochrane systematic reviews show acceptable quality in terms of randomization, allocation concealment, blinding and low rate of loss to follow-up [42]. In fact, many of the systematic reviews in our overview did not draw any firm conclusions because of methodological flaws in the included trials. In addition, many of the systematic reviews themselves failed to prespecify their inclusion and exclusion criteria according to the 'PICO' acronym. This may have led the authors to include inappropriate studies, causing significant heterogeneity in the dataset and increasing the risk of misleading conclusions according to the 'garbage in, garbage out' principle. One aspect of this heterogeneity is that many systematic reviews included different types of stroke (ischemic and hemorrhagic) at different stages.

In conclusion, the current evidence suggests that acupuncture is not effective for death or dependency/disability. However, acupuncture may be effective for treating poststroke neurological impairment and dysfunction, particularly poststroke dysphagia, although these findings require verification in rigorous RCTs. Future studies should place more emphasis on the efficacy of acupuncture for treating poststroke neurological impairment and dysfunction and on the development of more precise tools for assessing these outcomes.

## Disclosure Statement

The authors have nothing to disclose.

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