



Systematic Review of Acupuncture for Low Back Pain: Efficacy and Clinically-Meaningful Change

Abstract

Low back pain has a substantial effect on the quality of life for those affected and places a significant economic burden on healthcare systems. The purpose of this study is to identify, document, and appraise reports of randomized controlled trials on the treatment of low back pain with acupuncture. Relevant studies were identified through systematic searches in scientific databases. Eighteen of 948 papers retrieved met all inclusion criteria and were reviewed. Acupuncture significantly outperformed usual care in 10 of 11 trials. Sham acupuncture outperformed waitlist in 1 trial and conventional care in 2 trials. Needleless placebo acupuncture outperformed conventional care in 1 of 3 trials reviewed. No moderate or severe adverse events related to the intervention were reported. Concerns of cost and missed work were studied in some trials. Acupuncture was associated with fewer days absent from work in 1 reviewed trial. The identified evidence suggests that 1) acupuncture is a safe, effective, and possibly cost-effective treatment for low back pain; and 2) sham and needleless placebo acupuncture do not appear to be inert. Further trials investigating the cost and potential cost-saving strategies of acupuncture are merited.

Perspective

This article presents a systematic review of trials of acupuncture in the treatment of low back pain. The evidence suggests that acupuncture is a safe, effective, and possibly cost-effective treatment for low back pain and that sham and needleless placebo acupuncture do not appear to be inert.

Keywords: acupuncture, low back pain, efficacy, clinically meaningful change

Introduction

Low back pain (LBP) has a substantial effect on the quality of life of those affected by it. As well as a major health problem for these individuals, LBP also places a significant economic burden on healthcare systems. Approximately 1 in 4 people affected by LBP seek medical attention within a 6-month period.¹ Workers with acute lumbar sprain account for 42% of all occupational injuries (www.bls.gov/iif).

Authors: All authors are listed and all have contributed substantially to the manuscript. There are no other manuscripts in publication or in submission from this project.

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The magnitude of the burden from low back pain has increased in recent years. In 1990, a study ranking the most burdensome conditions in the U.S. in terms of mortality or poor health as a result of disease ranked low back pain in sixth place; in 2010, low back pain jumped to third place, with only ischemic heart disease and chronic obstructive pulmonary disease ranking higher. (http://www.ninds.nih.gov/disorders/backpain/detail_backpain.htm)

Significance

Even though low back pain has such an important impact on general health, this condition is often treated insufficiently. Poor efficiency in treatment has led to the necessary creation of guidelines that address evidence-based strategies for treatment of LBP.² The effectiveness of acupuncture for the management of LBP has been reviewed systematically in 1999,³ in 2005,⁴ in 2008,⁵ in 2012,⁶ and again in 2013.^{7,8}

The largest study previously reviewed was the highly publicized German acupuncture trial including 1,162 patients from 340 practices. The results of the study revealed that the effectiveness of acupuncture, either verum or sham, was almost twice that of conventional therapy.⁹ However, many of the trials reviewed in the systematic reviews, particularly by van Tulder and Furlan, were conducted 10-30 years ago and were of poor methodologic quality. Several of the systematic reviews³ and meta-analyses¹⁰ had inconclusive results. The present study was undertaken to summarize more recent trials of acupuncture for LBP and to analyze the findings in light of recent evidence indicating that sham acupuncture is not an inert control.

The aim of the present study is to identify and summarize findings from relevant recent trials of acupuncture for the treatment of low back pain. The identified trials were reviewed and findings were summarized regarding statistical significance, clinical relevance, as well as quality, as many older trials have been deemed to be of poor methodologic quality. Lastly, findings were analyzed with respect to type of sham comparison employed.

Methods

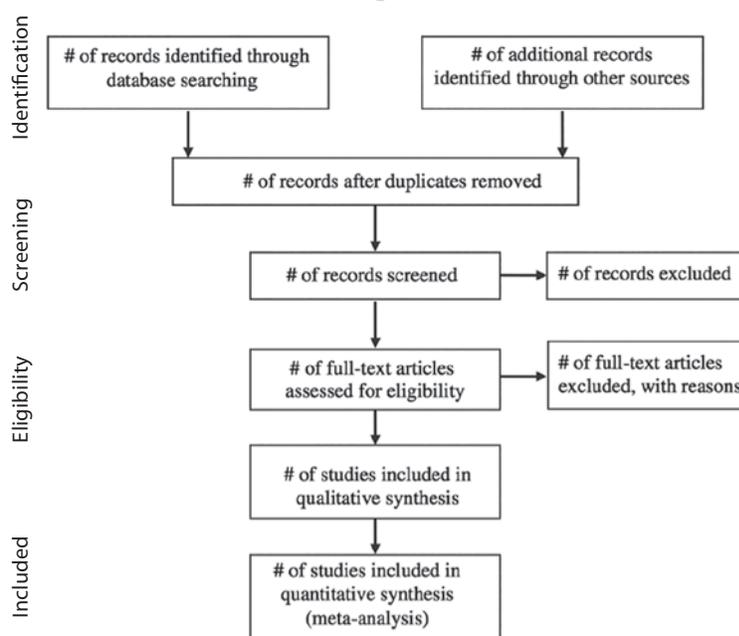
Relevant studies were identified through systematic searches in scientific databases (MEDLINE, Cochrane Library, CINAHL), "similar article" searches, and reference list scanning. Inclusion criteria were randomized controlled trial (RCT), acupuncture, electro-acupuncture, dry needling, low back pain (LBP), ages 18-65, published 2004-2014, and full text available in English. Exclusion criteria included pregnancy, pediatric, not acupuncture, not randomized controlled trial, animal studies, systematic analyses, meta-analyses, and feasibility studies. The date range of 2004-2014 was selected to capture the most recent literature because many older trials have been deemed to be of poor methodologic quality.⁴ The age

range of 18-65 was used to capture studies with adult working-age individuals as relevant to Labor and Industries. PRISMA guidelines were followed to design and execute the study.¹¹

Search terms of "low back pain" or "lower back pain" and "acupuncture," "acupuncture therapy," "electro-acupuncture," "electro-acupuncture therapy," "electro-acupuncture" or "electro-acupuncture therapy," in [ti] title or [majr] major topic of an article and English in [language] resulted in a retrieval of 948 articles dated 2004-2014. All abstracts were independently reviewed by two assessors, and 18 papers met all inclusion criteria and none of the exclusion criteria.

Study quality was assessed using the Standards for Reporting Interventions in Controlled Trials of Acupuncture (STRICTA) Criteria checklist. STRICTA was developed with the Consolidated Standards of Reporting Trials (CONSORT) Group and is an official extension of the CONSORT statement. The CONSORT guideline is the most well-known reporting guideline and has been listed among the top health research milestones of the twentieth century, according to the Patient-Centered Outcomes Research Institute (PCORI) (Gabriel & Normand, 2012). There are six key acupuncture-related items highlighted to ensure clear and transparent reporting of trials: 1) acupuncture rationale, 2) details of needling, 3) treatment regimen, 4) other components of treatment, 5) practitioner background, and 6) control or comparator interventions (MacPherson, et al., 2010). This project gathered data on all 25 CONSORT items and all 6 acupuncture-related items. Reviews were independently carried out by six reviewers, and data were input into customized extraction forms. Data were compiled and summarized by the two Primary Investigators (LJTS & JAS).

Fig. 1. Flow of information through the different phases of systematic review



“The CONSORT guideline is the most well-known reporting guideline and has been listed among the top health research milestones of the twentieth century...”

Results

Database searches identified 986 papers, and an additional 12 papers were identified through reviewing references. After duplicates were identified and 286 records were removed, the remaining 712 records were screened. Records were excluded if they were not published in English, not relevant to the project, or if the full text was unavailable; in all, 694 records were assessed for eligibility and were excluded as they did not meet eligibility criteria. Eighteen (18) papers were identified as eligible and subsequently reviewed using the criteria set forth in the CONSORT and STRICTA checklists. A total of 7,161 subjects were randomized in the studies analyzed for this review. Studies randomized a range of 26-3,093 subjects.

Study interventions included:

(1) traditional acupuncture according to traditional Chinese medicine (TCM) differential diagnosis, Korean acupuncture, medical acupuncture;

- (2) acupuncture with electric stimulation—electrical stimulation leads connected to acupuncture needles after insertion and the unit turned on to the level of patient comfort;
- (3) modified acupuncture—superficial sparrow pecking method, single insertion at most tender point.

Control or comparators included:

- (1) usual care consisting of physiotherapy, manipulation, and/or medication,
- (2) sham needling, e.g., sham superficial needling, not in the area of the lower back,¹²
- (3) needleless placebo, e.g., contact was made with the skin by touching with a toothpick.¹³

Interventions assessed within each category varied in terms of their components and delivery. (See Table 1)

Table 1. Study Characteristics

Year	First Author	Acupuncture Intervention	Control / Comparison	# Subjects Randomized
2014	Bahrami-Taghanaki	TCM	Chrono-acupuncture	60
2006	Brinkhaus	Medical Acupuncture	Sham: superficial needling not in the lower back	301
2009	Cherkin	TCM	Simulated acupuncture: toothpick + guide tube Usual care	641
2013	Cho	Korean	Non-penetrating sham needles	130
2007	Haake	TCM	Sham acupuncture, usual care	1,162
2006	Inoue	Acupuncture sparrow pecking method	Injection of 5 mg of dibucaine hydrochloride /5 ml	31
2009	Inoue	Single insertion at most tender point	Needleless placebo using guidetube	26
2010	Miao	TCM	Electro-Acupuncture	80
2013	Pach	TCM	Standardized vs. individualized treatment	150
2006	Thomas	TCM	Usual care	241
2004	Tsui	TCM	Acupuncture + electrical heat; control group	42
2012	Vas	TCM	Sham acupuncture using non-specific acu-points	275
2013	Weiss	TCM	Usual care	160
2006	Witt	NR	Waitlist 3 mos.	3,093
2011	Yeh	EA	Sham, usual care	90
2013	Yuan	TCM	Usual care	408
2012	Zaringhalam	TCM	Usual care: massage, PT, and medication	187
			Total randomized: 7,161	

Acupuncture vs. Usual Care

Of the 18 trials reviewed, 11 trials compared acupuncture to usual or conventional care; acupuncture outperformed usual care in all 11 reports (statistically significant in 10 trials). Acupuncture was compared to other types of acupuncture (sham acupuncture, placebo acupuncture, acupuncture with heat) or to other types of control groups in 15 of 19 papers; acupuncture outperformed the comparator in 10 of those 15 reports. For example, Cherkin et al.¹³ found that individualized, standardized, and simulated (toothpick contact) acupuncture all outperformed usual care (all three groups $p < .001$). Three studies reported findings of both verum and sham acupuncture outperforming usual care.^{9,13,14} Six studies found that acupuncture outperformed usual care without sham arms⁵⁻²⁰ and with sham arms.²¹

Clinically Meaningful Change

Clinically meaningful change is defined here as change of 30% or more in reported scale scores after study intervention.²² Refer to these findings in Table 2. Of the 18 papers reviewed, 13 studies reported acupuncture (including true/verum, sham, and/or placebo) resulting in clinically meaningful change in scale scores.

Looking specifically at scales: a clinically meaningful change was reported in Visual Analogue Scale scores (7 studies), Short Form-36 scores (1 paper), and Numeric Pain Rating Scale (NPRS) (1 paper). Disability was reported with the Rowland Morris Disability Questionnaire (5 studies), the Oswestry Disability Index (2 studies), and the Hanover Functional Ability Questionnaire (2 studies). One study reported that acupuncture did not result in a clinically meaningful change in scale scores. In 4 of 18 papers, clinically meaningful change could not be determined from the data provided in the published paper.

Acupuncture vs. Sham

Four of the studies reviewed used sham needling as a comparator.^{9,12,14,21} Of those, 2 had an additional usual care arm.^{9,21} Acupuncture outperformed usual care ($p < .001$) but there were no significant differences between acupuncture and sham except in the study by Yeh et al.,²¹ which found that sham and verum acupuncture were both associated with decreased VAS-reported pain scores as reported.

Table 2. Results

Year	First Author	Did Acupuncture Outperform Usual Care?	Did It Reach Statistical Significance?	Did Acupuncture Out-Perform Comparator?	Did It Reach Statistical Significance?	Did acu group(s) meet 30% change criteria? Y/N?
2014	Bahrami-Taghanaki	NA	NA	Yes	Yes	Yes: both acu+ time points and acu
2006	Brinkhaus	NA	NA	Yes	Yes	?*
2009	Cherkin	Yes	Yes	No	No	Yes: all 3 acu groups
2013	Cho	NA	NA	Yes	Yes	Yes: real and sham acu
2007	Haake	Yes	Yes	No	No	Yes: verum acu and sham acu
2006	Inoue	NA	NA	Yes	Yes	No
2009	Inoue	NA	NA	Yes	Yes	Yes
2010	Miao	NA	NA	Yes	Yes	?*
2013	Pach	NA	NA	No	No	Yes*: both acu groups
2006	Thomas	Yes	Yes	NA	NA	Yes
2004	Tsui	Yes	Yes	Yes	Yes	Yes**: electro acu & electro heat acu
2012	Vas	Yes	Yes	No	No	Yes: true acu, sham acu, placebo acu
2013	Weiss	Yes	Yes	NA	NA	?
2006	Witt	Yes	Yes	NA	NA	Yes
2011	Yeh	Yes	Yes	Yes	Yes	?*
2013	Yuan	Yes	Yes	NA	NA	Yes
2012	Yun	Yes	Yes	Yes	Yes	Yes: Both Hegu acu & standard acu
2010	Zaringhalam	Yes	NR	Yes	Yes	Yes: acu, acu + Baclofen

NOTES:

NA Not applicable

NR Not reported

?* Insufficient data reported to determine clinically significant change

SCALES:

HVAC Hannover Functional Ability Questionnaire

ODQ Oswestry Low Back Pain Disability Questionnaire

SF-36 Short Form 36

SF - MPQ McGill Pain Questionnaire Short Form

VAS Visual Analogue Scale

VRS Verbal Rating Scale

Acupuncture vs. Needleless Placebo

Three of the studies reviewed used a needleless placebo as a comparator.^{13,23-25} Cherkin et al.¹³ found that individualized, standardized, and simulated (with toothpicks) acupuncture all performed better than usual care ($p < .001$). However, individualized and standardized acupuncture did not perform better than simulated (toothpick) sham acupuncture. This is possibly due to minimal tissue damage initiating a local inflammatory response like true acupuncture.²⁶ Cho et al.²⁴ and Inoue et al.²⁵ found that real acupuncture outperformed needleless placebo acupuncture.

Acupuncture vs. Modified Acupuncture Only (No Usual Care Arm)

Three trials reviewed in this study examined two different forms of acupuncture. Bahrami-Taghanaki et al.²⁷ found that chrono-acupuncture (standardized acupuncture plus acupoints added that relate to time of day) outperformed acupuncture. Neither group was compared to usual care. Miao²⁸ found that electro-acupuncture outperformed classical acupuncture and Pach et al.²⁹ found that both individualized and standardized acupuncture showed clinically meaningful pain reduction after eight weeks; however, statistical significance was not demonstrated.

Acupuncture vs. Medication

Two trials investigated acupuncture compared to the medications Hydrochloride injection²³ and Baclofen.³⁰ Acupuncture outperformed local anesthetic injection²³ and outperformed Baclofen at the end of study and at a 10-week follow-up.³⁰

Methodologic Quality of Trials

Overall, the 18 trials reviewed met many of the CONSORT methodologic quality standards listed in Table 3, with a few exceptions as noted. These instances of missing data are indicated as "NR," not reported. All 18 papers were indeed randomized controlled trials (RCTs), as indicated in the title (#1a); eligibility was specified in all 18 papers (#4a); all papers indicated primary and secondary outcomes (#6a); the rationale for the type of comparator was discussed in 16 of 18 papers (#6b); randomization method was described in 16 of 18 papers (#8a); statistical methods were discussed in all papers (#12a); baseline demographics were provided in all but one paper (#15); adverse events were reported in 11 of 18 papers (#19); and the study findings were interpreted in a way that was consistent in all papers (#22).

Table 3. Methodologic Quality

Year	First Author	RCT	Eligibility	Outcomes Defined; Primary Outcome	Randomization Method	Baseline Demographics	Adverse Events
2014	Bahrami- Taghanaki	Yes	Yes	Yes; VAS	Yes	Yes	NR
2006	Brinkhaus	Yes	Yes	Yes; VAS	Yes	Yes	Yes; mild: bleeding, hematoma
2009	Cherkin	Yes	Yes	Yes; RMDQ & sx bothersomeness	Yes	Yes	Yes. Mild: dizziness, back spasms, short-term pain, pain lasting 1 month
2013	Cho	Yes	Yes	Yes; VAS	Yes	Yes	Yes; mild: increased pain, bruising
2007	Haake	Yes	Yes	Yes; Von Korff Chronic Pain Grade Scale & HFAQ	Yes	Yes	Yes; no AEs
2006	Inoue	Yes	Yes	Yes; VAS	Yes	Yes	NR
2009	Inoue	Yes	Yes	Yes; VAS & Schober test	Yes	Yes	NR
2010	Miao	Yes	Yes	Yes; pressure point pain intensity test	Yes	No; Only age	NR
2013	Pach	Yes	Yes	Yes; VAS	Yes	Yes	Yes; no AEs
2006	Thomas	Yes	Yes	Yes; SF-36 bodily pain subscale	Yes	Yes	Yes; mild transient pain at the site of needling, temporary worsening of back pain
2004	Tsui	Yes	Yes	Yes; NPRS, SLR, RMDQ	NR	Yes	NR
2012	Vas	Yes	Yes	Yes; RMDQ	Yes	Yes	Yes; mild epigastritis, nausea, increased pain after the treatment session
2013	Weiss	Yes	Yes	Yes; all items on the SF-36	NR	Yes	Yes; mild nausea, dizziness, urgency, pain at puncture site
2006	Witt	Yes	Yes	Yes; HFAQ & Back Function Loss	Yes	Yes	Yes; mild bleeding, bruising, needle pain
2011	Yeh	Yes	Yes	Yes; BPI pain intensity subscale	Yes	Yes	Yes; mild fainting, increased pain
2013	Yuan	Yes	Yes	Yes; VAS & C-SFODI	Yes	Yes	Yes; mild worsening pain
2012	Yun	Yes	Yes	Yes; RMQ & VAS	Yes	Yes	NR
2010	Zaringhalam	Yes	Yes	Yes; VAS & RMQ	Yes	Yes	NR

Risk of Bias

Details regarding risk of bias are reported in Table 4. All but two papers provided details regarding randomization. All but two papers provided treatment allocation concealment detail, such as discussion of who generated the allocation sequence, who enrolled participants, and/or who assigned participants to interventions. Fourteen papers reported on blinding after assignment, 11 of which blinded or masked participants. Trial limitations were discussed in 15 papers and generalizability was discussed in 16 of 18 papers.

“Many studies of acupuncture conducted in 1980s-2000 were of low methodologic quality, and the field has worked to improve study quality. For this reason, the current study only reviewed trials published in 2004-2014.”

Table 4. Risk of Bias

Year	Author	Randomization Method Discussed?	Treatment Allocation Concealed: Discussion of who generated the allocation sequence, who enrolled participants, and who assigned participants to interventions	Blinding After Assignment: Participants, healthcare providers, data collectors, and outcome adjudicators	Trial Limitations Discussed?	Generalizability/ Applicability Discussed?
2014	Bahrami-Taghanaki	Yes	Yes	Yes; participants, statistician	Yes	NR
2006	Brinkhaus	Yes	Yes	Yes; participants~	Yes	Yes
2009	Cherkin	Yes	Yes	Yes; outcome assessors, diagnostic acupuncturists~	Yes	Yes
2013	Cho	Yes	Yes	Yes; participants~	Yes	Yes
2007	Haake	Yes	Yes~	Yes; participants~	Yes	Yes
2006	Inoue	Yes	Yes	Yes; evaluation acupuncturists, participants	Yes	Yes
2009	Inoue	Yes	Yes	NR	Yes	Yes
2010	Miao	Yes	Yes	Yes; participants	Yes	NR
2013	Pach	Yes	Yes	Yes; participants	Yes	Yes
2006	Thomas	Yes	Yes	Yes; second statistician	Yes	Yes
2004	Tsui	NR	NR	Yes; evaluation acupuncturists, participants	NR	Yes
2012	Vas	Yes	Yes	Yes; participants	NR	Yes
2013	Weiss	NR	Yes	NR	Yes	Yes
2006	Witt	Yes	Yes	NR	Yes	Yes
2011	Yeh	Yes	Yes	Yes; participants, medical staff	Yes	Yes
2013	Yuan	Yes	Yes	NR	Yes	Yes
2012	Yun	Yes	NR	Yes; participants, outcome assessor, statistician	Yes	Yes
2010	Zaringhalam	Yes	Yes	Yes; outcome assessor	NR	Yes

KEY:

~ Details of trial published elsewhere

NR Not reported

Adverse Events

Adverse events were reported in 11 of 18 papers (see Table 3). No moderate or severe adverse events related to the intervention were reported in the papers reviewed. Minimal adverse events included minor bleeding, bruising, nausea, and temporary worsening of symptoms.

Discussion

The trials of acupuncture for LBP reviewed here indicate acupuncture is likely a safe modality of care because no severe or adverse events were reported in any of the papers reporting adverse events (11 of 18 papers). Acupuncture also appears to be an effective intervention: acupuncture significantly outperformed standard or conventional care in 10 of 11 studies and demonstrated clinically significant change in scale scores of 13 of 18 studies reported here.

This finding is in line with the American College of Physicians & Pain Society,³¹ the American Family Physician,³² and the NIH positions that all now recommend acupuncture for low back pain (https://nccih.nih.gov/news/press/pain_review). Furthermore, The Joint Commission clarified in January 2015 that acupuncture therapy is one evidence-informed, non-pharmacologic option that should be included in pain management strategies (www.jointcommission.org).

Results in Context of Current Literature

Although all 18 studies meet the methodological criteria for RCTs, many studies lack adequate blinding of subjects, study personnel, and outcome assessors. Some studies also lack adequate concealment of treatment allocation to various study staff. These are important safeguards necessary to reduce bias. Many studies of acupuncture conducted in 1980s-2000 were of low methodologic quality, and the field has worked to improve study quality. For this reason, the current study only reviewed trials published in 2004-2014.

Some prior systematic reviews of acupuncture for LBP have reached different conclusions than the present review; this is for several reasons. First, two trials reviewed much older evidence, none of which met the present study inclusion criteria. They also concluded, based only on statistical significance, that acupuncture is not effective in the management of pain³ and not effective in the management of acute low back pain but may be effective for chronic low back pain.⁴ More recent trials have reached similar conclusions, including Yuan et al.,³³ which found “there is moderate evidence that acupuncture is more effective than no treatment, and strong evidence of no significant difference between acupuncture and sham acupuncture, for short-term pain

relief. There is strong evidence that acupuncture can be a useful supplement to other forms of conventional therapy for nonspecific LBP...” (p.E887). Lam, Galvin & Curry⁷ state that “acupuncture had a clinically meaningful reduction in levels of self-reported pain...when compared with sham, and improved function...when compared with no treatment immediately post intervention. Levels of function also clinically improved when acupuncture in addition to usual care, or electro-acupuncture was compared with usual care alone.” (p. 2124).

A second reason for differing conclusions concerns the topic of sham acupuncture. Prior trials interpreted findings of verum acupuncture not outperforming sham acupuncture as indicative of: 1) non-significance of between-group findings, and 2) that acupuncture is not an effective intervention. However, these trials are in effect comparing a full dose (complete treatment) of acupuncture (verum) to a diluted or decreased dose of acupuncture (sham). There are long-standing traditions of providing acupuncture on non-acupoints thought to be active in an individual patient—this is what has been used in clinical trials as one type of sham acupuncture. There is also a longstanding tradition of using contact needling in Japanese meridian therapy—this is used as needleless placebo acupuncture in three trials reviewed here. Both sham and needleless placebo acupuncture are therefore, in fact, types of acupuncture. It is not appropriate to compare sham and verum acupuncture and conclude that acupuncture is no better than “sham” when these trials are actually comparing various types of physiologically active and historically utilized types of acupuncture.

Sham as a Comparator

The fact that sham acupuncture is not inert must be taken into account when interpreting findings of studies comparing verum to sham acupuncture. Sham acupuncture might be thought of as a diluted or decreased dose of acupuncture, but this “diluted or decreased dose” of acupuncture is still physiologically active. Four of the studies examined used sham needling as a comparator revealed that sham acupuncture produced analgesic effects similar to verum.

Though imaging studies reveal that true acupuncture points modulate central processing mechanisms where other points do not,^{34,35} the impact of needling so-called sham points stimulate additional peripheral mechanisms such as adenosine,³⁶ opioid peptides,³⁷ fibroblast cells,³⁸ and cytokines³⁹ regardless of the point location. It is for this reason that sham acupuncture does not make a worthy comparator. Given these findings, NIH's division for Integrative Health, the NCCIH, specifically states that sham-controlled studies are a low programmatic funding priority (<https://nccih.nih.gov/grants/acupuncture/priorities>).

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Cost-Effectiveness

In addition to effectiveness and safety, concerns regarding cost and missed work were studied in some of the reviewed trials. Several studies reported on costs associated with acupuncture care. Acupuncture was found to be cost-effective at 24-months follow-up in a large study conducted in the UK, compared to usual care.⁴⁰ Another large trial conducted in Germany found acupuncture to be cost-effective.¹⁸ Furthermore, a systematic review of various non-pharmacological interventions reported that acupuncture is likely to be a cost-effective option for LBP.⁴¹ Acupuncture was associated with fewer days absent from work in one reviewed trial.²⁷

Limitations

Due to the heterogeneity of the studies, a systematic review of the best evidence available was undertaken. Areas of heterogeneity included studies of various types of low back pain and various types of measures used. Interventions included different styles of acupuncture (both standardized treatments and individualized point combinations tailored for each subject). Many different comparators were used, and usual care differed in the different countries where the trials were conducted. All these levels of heterogeneity must be taken into account when interpreting findings in the present study.

Furthermore, 7 of the studies included fewer than 100 participants. Trials included 2 to 4 arms or groups and as few as 20 people per arm. Trials having such small sample sizes call to question the validity of extending generalizability beyond the trial sample.

Although all 18 studies met the methodological criteria for RCTs under Cochrane collaboration group recommendations, some studies lacked adequate blinding of subjects, study personnel, and outcome assessors, which weakens the interpretations of the findings (Table 4). The subjective nature of reporting outcomes is especially problematic in LBP studies, as many variables can influence subjective perception of pain, anxiety, depression, and fear of returning to work. Future studies including objective measures such as quantitative sensory testing are needed to confirm these results.

Suggestions for future work are: 1) that trials of acupuncture be conducted specifically for injured workers with acute LBP; and 2) ideally, a Patient Centered Outcomes Research Institute (PCORI)-funded trial allowing the collection of data relevant to how acupuncture delivered by licensed East Asian medicine practitioners performs for the treatment of injured workers. This would provide specific and relevant evidence to inform policy and coverage of care for injured workers in the USA.

“Several studies reported on costs associated with acupuncture care. Acupuncture was found to be cost-effective at 24-months follow-up in a large study conducted in the UK, compared to usual care.”

Conclusion

The evidence analyzed by previous investigators who have systematically reviewed acupuncture for low back pain, as well as the current evidence collected in the 18 studies analyzed for this review, supports the use of acupuncture as a safe and potentially effective option in the treatment of low back pain. Additional studies are needed to further validate these findings and to examine the mechanisms behind the positive effects of acupuncture for low back pain.

References

1. Kent PM, Keating JL. The epidemiology of low back pain in primary care. *Chiropr Osteopat*. 2005;13:13.
2. Hooten WM, Cohen SP. Evaluation and Treatment of Low Back Pain: A Clinically Focused Review for Primary Care Specialists. *Mayo Clin Proc*. 2015;90(12):1699-1718.
3. van Tulder MW, Cherkin DC, Berman B, Lao L, Koes BW. The effectiveness of acupuncture in the management of acute and chronic low back pain. A systematic review within the framework of the Cochrane Collaboration Back Review Group. *Spine (Phila Pa 1976)*. 1999;24(11):1113-1123.
4. Furlan AD, van Tulder M, Cherkin D, et al. Acupuncture and dry-needling for low back pain: an updated systematic review within the framework of the cochrane collaboration. *Spine (Phila Pa 1976)*. 2005;30(8):944-963.
5. Yuan J, Kerr D, Park J, Liu XH, McDonough S. Treatment regimens of acupuncture for low back pain--a systematic review. *Complement Ther Med*. 2008;16(5):295-304.
6. Hutchinson AJ, Ball S, Andrews JC, Jones GG. The effectiveness of acupuncture in treating chronic non-specific low back pain: a systematic review of the literature. *J Orthop Surg Res*. 2012;7:36.
7. Lam M, Galvin R, Curry P. Effectiveness of acupuncture for nonspecific chronic low back pain: A systematic review and meta-analysis. *Spine (Phila Pa 1976)*. 2013;38(24):2124-2138.
8. Lee JH, Choi TY, Lee MS, Lee H, Shin BC. Acupuncture for acute low back pain: a systematic review. *Clin J Pain*. 2013;29(2):172-185.
9. Haake M, Müller HH, Schade-Britttinger C, et al. German Acupuncture Trials (GERAC) for chronic low back pain: randomized, multicenter, blinded, parallel-group trial with 3 groups. *Arch Intern Med*. 2007;167(17):1892-1898.
10. Ernst E, White AR. Acupuncture for back pain: a meta-analysis of randomized controlled trials. *Arch Intern Med*. 1998;158(20):2235-2241.
11. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol*. 2009;62(10):e1-34.
12. Brinkhaus B, Witt CM, Jena S, et al. Acupuncture in patients with chronic low back pain: a randomized controlled trial. *Arch Intern Med*. 2006;166(4):450-457.
13. Cherkin DC, Sherman KJ, Avins AL, et al. A randomized trial comparing acupuncture, simulated acupuncture, and usual care for chronic low back pain. *Arch Intern Med*. 2009;169(9):858-866.
14. Vas J, Aranda JM, Modesto M, et al. Acupuncture in patients with acute low back pain: a multicentre randomised controlled clinical trial. *Pain*. 2012;153(9):1883-1889.
15. Thomas KJ, MacPherson H, Thorpe L, et al. Randomised controlled trial of a short course of traditional acupuncture compared with usual care for persistent non-specific low back pain. *BMJ*. 2006;333(7569):623.
16. Tsui ML, Cheing GL. The effectiveness of electroacupuncture versus electrical heat acupuncture in the management of chronic low-back pain. *J Altern Complement Med*. 2004;10(5):803-809.

17. Weiss J, Quante S, Xue F, Muche R, Reuss-Borst M. Effectiveness and acceptance of acupuncture in patients with chronic low back pain: results of a prospective, randomized, controlled trial. *J Altern Complement Med.* 2013;19(12):935-941.
18. Witt CM, Jena S, Selim D, et al. Pragmatic randomized trial evaluating the clinical and economic effectiveness of acupuncture for chronic low back pain. *Am J Epidemiol.* 2006;164(5):487-496.
19. Yuan WA, Huang SR, Guo K, et al. Integrative TCM conservative therapy for low back pain due to lumbar disc herniation: A randomized controlled clinical trial. *Evid Based Complement Alternat Med.* 2013;2013.
20. Yun M, Shao Y, Zhang Y, et al. Hegu acupuncture for chronic low-back pain: a randomized controlled trial. *J Altern Complement Med.* 2012;18(2):130-136.
21. Yeh ML, Chung YC, Chen KM, Chen HH. Pain reduction of acupoint electrical stimulation for patients with spinal surgery: a placebo-controlled study. *Int J Nurs Stud.* 2011;48(6):703-709.
22. Laupacis A, Sackett D, Roberts R. An assessment of clinically useful measures of the consequences of treatment. *N Engl J Med.* 1988; 318(26):1728-1733.
23. Inoue M, Hojo T, Nakajima M, Kitakoji H, Itoi M. Comparison of the effectiveness of acupuncture treatment and local anaesthetic injection for low back pain: a randomised controlled clinical trial. *Acupunct Med.* 2009;27(4):174-177.
24. Cho YJ, Song YK, Cha YY, et al. Acupuncture for chronic low back pain: a multicenter, randomized, patient-assessor blind, sham-controlled clinical trial. *Spine (Phila Pa 1976).* 2013;38(7):549-557.
25. Inoue M, Kitakoji H, Ishizaki N, et al. Relief of low back pain immediately after acupuncture treatment—a randomised, placebo controlled trial. *Acupunct Med.* 2006;24(3):103-108.
26. Reece JBC, N. A. *Campbell biology.* Boston: Benjamin Cummings / Pearson; 2011.
27. Bahrami-Taghanaki H, Liu Y, Azizi H, et al. A randomized, controlled trial of acupuncture for chronic low-back pain. *Altern Ther Health Med.* 2014;20(3):13-19.
28. Miao EY & Miao MY. Effect of electroacupuncture on the third lumbar transverse process syndrome: A randomized controlled trial. *Medical Acupuncture.* 2010;22(4):249-55.
29. Pach D, Yang-Strobel X, Lüdtker R, et al. Standardized versus Individualized Acupuncture for Chronic Low Back Pain: A Randomized Controlled Trial. *Evid Based Complement Alternat Med.* 2013;2013:125937.
30. Zaringhalam J, Manaheji H, Rastqar A, Zaringhalam M. Reduction of chronic non-specific low back pain: a randomised controlled clinical trial on acupuncture and baclofen. *Chin Med.* 2010;5:15.
31. Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med.* 2007;147(7):478-491.
32. Last AR, Hulbert K. Chronic low back pain: evaluation and management. *Am Fam Physician.* 2009;79(12):1067-1074.
33. Yuan J, Purepong N, Kerr DP, Park J, Bradbury I, McDonough S. Effectiveness of acupuncture for low back pain: a systematic review. *Spine (Phila Pa 1976).* 2008;33(23):E887-900.
34. Zeng F, Song WZ, Liu XG, et al. Brain areas involved in acupuncture treatment on functional dyspepsia patients: a PET-CT study. *Neurosci Lett.* 2009;456(1):6-10.
35. Theysohn N, Choi KE, Gizewski ER, et al. Acupuncture-related modulation of pain-associated brain networks during electrical pain stimulation: a functional magnetic resonance imaging study. *J Altern Complement Med.* 2014;20(12):893-900.
36. Goldman N, Chen M, Fujita T, et al. Adenosine A1 receptors mediate local anti-nociceptive effects of acupuncture. *Nat Neurosci.* 2010;13(7):883-888.
37. Wang Y, Gehring R, Mousa SA, Hackel D, Brack A, Rittner HL. CXCL10 controls inflammatory pain via opioid peptide-containing macrophages in electroacupuncture. *PLoS One.* 2014;9(4):e94696.
38. Langevin HM, Bouffard NA, Badger GJ, Churchill DL, Howe AK. Subcutaneous tissue fibroblast cytoskeletal remodeling induced by acupuncture: evidence for a mechanotransduction-based mechanism. *J Cell Physiol.* 2006;207(3):767-774.
39. da Silva MD, Bobinski F, Sato KL, Kolker SJ, Sluka KA, Santos AR. IL-10 cytokine released from M2 macrophages is crucial for analgesic and anti-inflammatory effects of acupuncture in a model of inflammatory muscle pain. *Mol Neurobiol.* 2015;51(1):19-31.
40. Thomas KJ, MacPherson H, Ratcliffe J, et al. Longer term clinical and economic benefits of offering acupuncture care to patients with chronic low back pain. *Health Technol Assess.* 2005;9(32):iii-iv, ix-x, 1-109.
41. Andronis L, Kinghorn P, Qiao S, Whitehurst DG, Durrell S, McLeod H. Cost-Effectiveness of Non-Invasive and Non-Pharmacological Interventions for Low Back Pain: a Systematic Literature Review. *Appl Health Econ Health Policy.* 2016.

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