Acupuncture and Herbal Medicine

Efficacy and safety of acupuncture in treating low back and pelvic girdle pain during pregnancy: a systematic review and meta-analysis of randomized controlled trials

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Abstract

Objectives: Low back and pelvic girdle pain (LBPGP) is common during pregnancy. Acupuncture is an effective and safe therapy for pain relief. However, further evidence is required to confirm the efficacy and safety of acupuncture in treating LBPGP during pregnancy. This study aimed to systematically review and investigate the clinical efficacy and safety of acupuncture for the treatment of pregnancy-related LBPGP.

Methods: The PubMed, EMBASE, Cochrane Library, CNKI, VIP, and WanFang databases were searched from January 2000 to August 2023. Only the randomized controlled trials (RCTs) involving pregnant women between 16 and 34 weeks of gestation diagnosed with LBPGP were included in the study. A meta-analysis was conducted and pooled risk ratios (RRs) or mean differences (MDs) with 95% confidence intervals (CIs) were compared.

Results: Meta-analysis included 12 RCTs involving 1,641 participants. Eleven trials compared acupuncture alone or acupuncture combined with standard care (SC), of which three trials also used non-penetrating or placebo acupuncture as the control group. One trial compared acupuncture alone with non-penetrating acupuncture. Compared with SC, acupuncture combined with SC group significantly decreased visual analog scale score (mean difference (MD) = –2.83, 95% CI = –3.41 to –2.26, $P < 0.00001$), cesarean section rate (RR = 0.69, 95% CI = 0.49–0.97, $P = 0.03$), preterm birth rate (RR = 0.42, 95% CI = 0.27–0.65, $P < 0.0001$), labor duration (MD = –1.97, 95% CI = –2.73 to –1.20, $P < 0.0001$), and Oswestry disability index score (MD = –9.14, 95% CI = –15.68 to –2.42, $P = 0.008$). In addition, acupuncture combined with SC significantly improved 12-Items Short Form Health Survey of physical component summaries (SF12-PCS). No significant differences were observed in the spontaneous delivery rate, newborn weight, drowsiness, and 12-Items Short Form Health Survey of mental component summaries (SF12-MCS) between the two groups. Adverse events such as needle pain and needle bleeding were aggravated in both the SC and acupuncture treatment groups but none were associated with acupuncture during or after the treatment period.

Conclusions: Meta-analysis showed that acupuncture combined with SC had better efficacy than SC alone and could be a potential therapy for LBPGP during pregnancy. The safety results imply that acupuncture caused few adverse reactions; however, more evidence is required for further confirmation.

Keywords: Acupuncture, Low back and pelvic girdle pain, Meta-analysis, Pregnancy

Graphical abstract: http://links.lww.com/AHM/A89.

Introduction

The musculoskeletal system is affected by anatomical and physiological changes during pregnancy[1], leading to a prevalence of nearly 50% low back and pelvic girdle pain (LBPGP) in pregnant women worldwide[2]. LBPGP usually begins at approximately 18 weeks of gestation,

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and the pain gradually increases to a maximum at 24 to 36 weeks of gestation[3], affecting the self-care ability and quality of life of pregnant women[4]. Studies have revealed that advanced maternal age, high blood pressure, working status, smoking, and high physical activity levels are potential risk factors for pregnancy-related LBPGP[5–9]. Analgesics are mainly used to treat LBPGP and relieve the clinical symptoms of patients[10]. However, the long-term use of drugs may cause potential harm to pregnant women and fetuses, such as maternal nausea, drowsiness[11], fetal growth restriction[12], fetal malformations[13], and early abortion[14].

Acupuncture has an extensive history of use for pain therapy in China and other Asian countries[15]. According to the theory of Chinese medicine, pain and its related disorders are due to the imbalance of *yin* and *yang* and excess or deficiency of *qi*, blood, or body fluids[16]. The mechanism of acupuncture involves adjusting the balance of *yin* and *yang* and restoring *qi*, blood, and body fluids to normal levels by stimulating specific acupuncture points on different meridians that govern different organs and their interactions[17]. Western medicine suggests that acupuncture has an excellent analgesic effect by stimulating the afferent nerve, adjusting the signal transmission of pain in the spinal cord, and reducing brain perception[18].

Although acupuncture is widely applied even during pregnancy, the National Institute for Health and Care Excellence has not recommended its use for managing low back pain owing to a lack of convincing and systematic evidence on its effectiveness and safety for pregnant women[19].

We conducted a systematic review and meta-analysis of acupuncture treatment for pregnancy-related LBPGP to assess its effectiveness and safety in pregnant women with LBPGP.

Methods

Literature search

Databases including PubMed, EMBASE, Cochrane Library, CNKI, VIP, and WanFang were searched from January 1, 2000, to August 31, 2023, for all published randomized controlled trials (RCTs). The search strategies were designed using terms related to acupuncture, acupuncture therapy, pregnancy, low back pain, and pelvic girdle pain (Supplementary Appendix S1, http://links.lww.com/AHM/A88). There were no limitations on the language of the publications. The full texts of all relevant trials identified from the search strategy were screened and verified independently by two authors. Disagreements were resolved through discussion or consultation with a third assessor. The study was registered with INPLASY (INPLASY2022110104).

Inclusion criteria

Types of studies

Only the RCTs were eligible for inclusion.

Types of participants

All pregnant women diagnosed with LBPGP between 16 and 34 weeks of gestation were included regardless of their race, nationality, age, and duration of pain.

Types of interventions

Treatments such as acupuncture, nonsteroidal anti-inflammatory drugs (NSAIDs), and other conventional therapies (such as using maternity belts or clastic stockings), either alone or in combination, were included. Placebo, no-treatment, non-penetrating acupuncture (NPA), and standard care (SC) groups were included as controls.

Types of outcome measures

All efficacy- and safety-related outcomes reported in the included RCTs were summarized. The primary outcome was the visual analog scale (VAS) score. Secondary outcomes included safety-relevant indices, such as spontaneous delivery rate, cesarean section rate, labor duration, newborn weight, newborn height, preterm birth rate, total adverse outcome rate, 12-Items Short Form Health Survey (SF12), and Oswestry disability index (ODI). The data were extracted for further meta-analysis. These are introduced as follows:

1. VAS: A psychometric response scale that can be used in questionnaires. It is a measure of subjective characteristics or attitudes that cannot be measured directly. (Specific methods: On a 0–10 scale, 0 = no pain; 1–3 = mild pain, 4–7 = moderate pain, and 8–10 = severe pain.)
2. Spontaneous delivery rate = Spontaneous delivery cases/number of patients × 100%.
3. Spontaneous delivery: Full-term delivery without instrument assistance.
4. Cesarean section rate = Cesarean section cases/number of patients × 100%.
5. Preterm birth rate = Preterm birth cases/number of patients × 100%.
6. Preterm birth: Delivery before 37 gestational weeks.
7. Total adverse outcome rate = Total adverse outcome cases/number of patients × 100%.
8. ODI: This index was derived from the Oswestry low back pain questionnaire used by clinicians and researchers to quantify disability due to low back pain.
9. SF12: This is a commonly used measure of the health status of patients of various ages. The results included physical and mental component summaries.

Exclusion criteria

The exclusion criteria were as follows: 1) studies on transcutaneous electrical nerve stimulation, music therapy, psychotherapy, and massage therapy for LBPGP; 2) studies without original data; and 3) reviews, case series, case reports, proposals, basic research, expert experience, and retrospective studies.

Data collection and extraction

Selection of studies

Two authors independently assessed all potential studies identified using the search strategy. Disagreements were resolved through discussions and consultations with a third author. We created a flow diagram for study identification, inclusion, and exclusion.

Data extraction and management

We designed a data extraction form that included baseline information, trial dates, study methodologies and outcomes,

sources of trial funding, and declarations of interest by trial authors. For eligible studies, two authors independently completed the data extraction form. Discrepancies were resolved through discussions or consultations with a third author.

We entered the data into Review Manager software (RevMan5.4) and checked for accuracy. When information regarding any of the above was unclear, the authors of the original studies were contacted to provide or confirm additional details.

Quality assessment

Two review authors independently assessed the risk of bias for each study using the Risk of Bias 2 (RoB-2)[20]. It includes five domains: 1) bias arising from the randomization process, 2) bias due to deviations from intended interventions, 3) bias due to missing outcome data, 4) bias in the measurement of the outcome, and 5) bias in the selection of reported results. Each domain was assessed as low or high risk of bias or could be expressed as "some concerns."

Data synthesis and analysis

Measures of treatment effect

For dichotomous data, we presented the results as risk ratios (RRs) with 95% confidence intervals (CIs). For continuous data, we used the MD if the outcomes were measured in the same manner between trials.

Assessment of heterogeneity

We assessed the statistical heterogeneity in each meta-analysis using T^2, I^2, and χ^2 statistics. We regarded heterogeneity as not important if I^2 was between 0% and 40%, moderately important if I^2 was between 30% and 60%, and substantial if I^2 was between 50% and 90%[21]. When $I^2 > 50\%$, a random-effects model was selected for the meta-analysis, and when $I^2 < 50\%$, a fixed-effects model was applied.

Results

Literature screening

A total of 719 clinical studies were identified through the literature search. In total, 359 trials were excluded after dereplication. After screening titles and abstracts, 340 trials were excluded. The full texts of 20 studies were further reviewed and seven studies were excluded. Among them, four studies used the wrong intervention (two studies compared transcutaneous electric stimulation (TENS) with exercise and acetaminophen[22,23]; two studies compared acupuncture with physiotherapy[24,25]); three studies used the wrong randomization (two studies were quasi-randomized without specific methods[26,27] and one study divided groups by gestational weeks and not by treatment[28]); and one study had a high risk of bias due to a large volume of missing outcomes[29]. In total, 12 RCTs[30–41] involving 1,641 participants comparing acupuncture combined with SC with SC alone (main comparison) or SC combined with NPA were included in the meta-analysis. One trial alone used placebo acupuncture[35] and four trials used NPA[30,31,35,40]. The study selection process is summarized in Figure 1. A summary of the characteristics of the 12 RCTs is presented in Table 1.

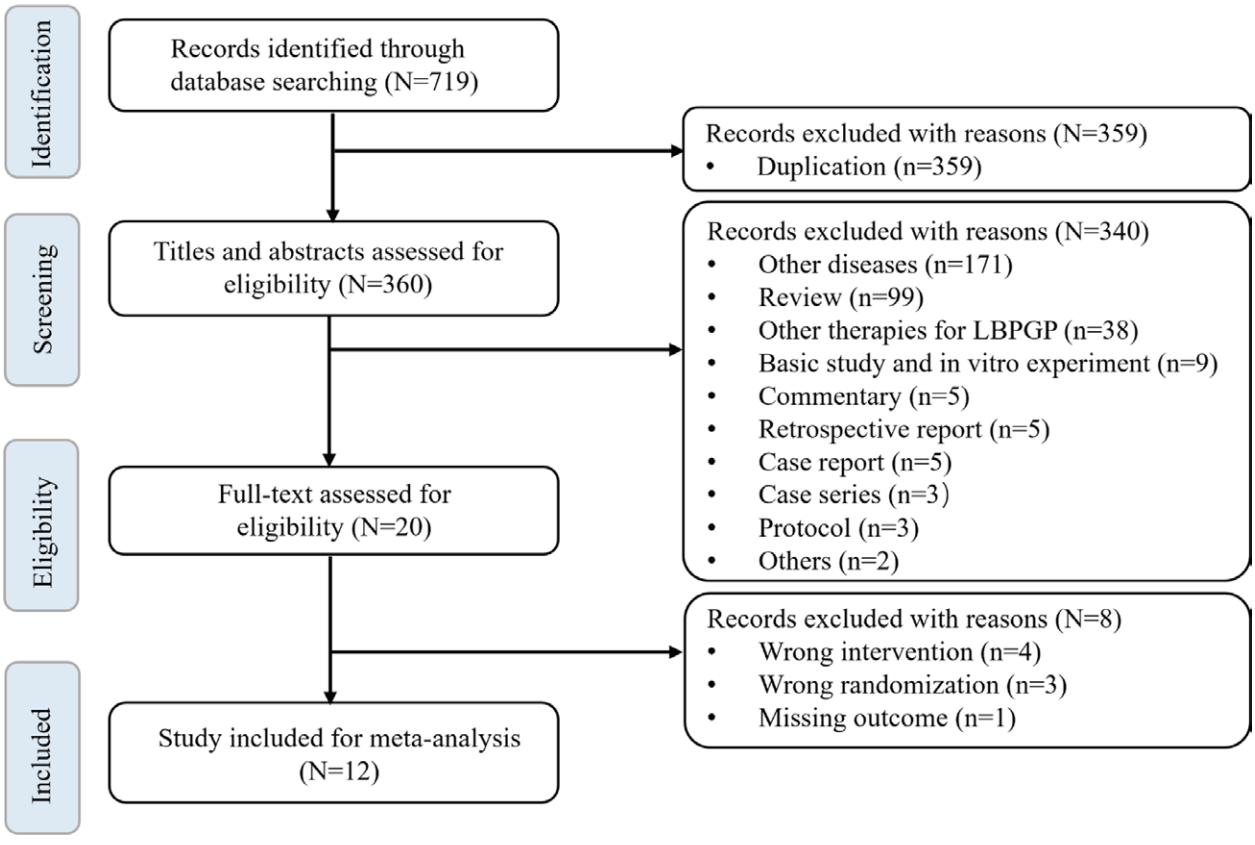

Figure 1. Flow diagram of the study selection.

Table 1

Summary of the characteristics of the included studies

Study ID	A/C (*n*)	Interventions		Control	Follow-up	Baseline similarity	Randomization	Blinding	Drop-off (%)	Acupuncture points	Outcome measurement
Bishop et al. 2016[30]	42/41/42	A + C	C	C + NPA	8 weeks	Comparable	Randomized	NR	12.50	1. Local points: BL23-28, BL54, BL31-33, GB30, HJJL4, HJJL5 2. Distal points: GB34, ST36, LR3, LI4, BL60, BL62	↑: SF12-PCS and SF12-MCS at 8 weeks follow-up; ↓: ODI score, PGQ score, pain intensity, wake-up frequency (woken up most/ every night by LBP) at 8 weeks follow-up
Elden et al. 2008[31]	58/57	A + C	/	C + NPA	1 week	Comparable	Randomized number table	Double-blind	7.80	1. unilateral: GV20, 2. bilateral: LI4, BL 26, BL 32, BL 33, BL 54, KI 11, BL 60, EX 21, GB 30	NS: VAS score, ODI score, EQ-5D, pain provocation test and functional test at 1 week follow-up, ↑: DRI, Number of women in regular work
Elden et al. 2005[32]	125/130/131	A + C	C	C + exercise	1 week	Comparable	Randomized number table	Single-blind	9.06	1. unilateral: GV20, 2. bilateral: LI4, BL 26, BL 32, BL 33, BL 54, KI 11, BL 60, EX 21, GB 30	↓: Serious and minor adverse events; NS: maternal blood pressure; maternal and neonatal heart rate
Elden et al. 2008[33]	125/130/131	A + C	C	C + exercise	1 week	Comparable	Randomized number table	Single-blind	9.06	1. unilateral: GV20, 2. bilateral: LI4, BL 26, BL 32, BL 33, BL 54, KI 11, BL 60, EX 21, GB 30, SP 12, ST 36	↑: Patrick's fabere test; ↓: VAS score 1 week after treatment, Posterior pelvic pain provocation test and subgroups of pelvic girdle pain; NS: Trendelenburg's test
Jia 2015[34]	47/47	A	C	/	NR	Comparable	Randomized	NR	0	Bilateral Shenshu, Dachangyu and Ashi	↓: VAS score after 1, 2,4 weeks of treatment, preterm birth rate, cesarean section rate; NS: gestational weight gain, newborn height, newborn weight
Vas et al. 2019[35]	55/55/55	A + C	C	SC + NPA	1 year	Comparable	Randomized	Double-blind	5.40	1.Verum ear acupuncture: Shenmen, Kidney, Low back, and pelvic gridle reflex zone 2. placebo ear acupuncture/ nonspecific ear acupuncture: ankle, Wrist, shoulder	↑: SF12-PCS and SF12-MCS end of treatment; ↓: Pain intensity at 12 weeks postpartum, RMDQ end of treatment
Kvorning et al. 2004[36]	44/44	A	C	/	Until delivery	Comparable	Randomized envelopes	Single-blind	18.20	1. Basic: LR3 and GV20 2. Advanced: BL60, SI3 and BL22-26	↓: VAS score, Pain associated with various physical activity ↑: Duration of pain

(*Continued*)

Table1

(Continued)

Study ID	A/C (*n*)	Interventions	Control		Follow-up	Baseline similarity	Randomization	Blinding	Drop-off (%)	Acupuncture points	Outcome measurement
Long et al. 2014[37]	40/42	A + C	C	/	NR	Comparable	Randomized envelopes	NR	0	Bilateral Shenshu, Dachangyu, and Ashi	↓: VAS score after 3, 4, 5 weeks of treatment, preterm birth rate, cesarean section rate; NS: VAS score after 1, 2 weeks of treatment, gestational weight gain, newborn height, newborn weight
Luo and Huang 2019[38]	40/40	A	SC	/	NR	Comparable	Randomized number table	NR	0	Bilateral Shenshu, Dachangyu, and Ashi	↓: VAS score after 1, 2, 4 weeks of treatment, preterm birth rate, cesarean section rate
Nicolian et al. 2019[39]	96/103	A + C	SC	/	5 weeks	Comparable	Block randomization	NR	14.07	1. Baseline acupoints: Weizhong and Ashi 2. Sacroiliac pain: Guanyuanshu and Ci Liao 3. Low back pain: Shou Tai Yang 4. Sciatica: Huantiao, Chengshan 5. Pelvic gridle pain: Hengu, Zhongdu, Zhubin 6. Kidney deficiency: Shenshu, Zhubin 7. Blood stagnation: Tai Chong, Xue Hai	↑: Proportion of days with NRS < 4/10; ↓: Percentage of weeks with ODI < 20/100
Wang et al. 2009[40]	58/54/47	A + C	SC	SC + NPA	1 week	Comparable	Randomized	Double-blind	4.40	1. Acupuncture point: Shenmen-TF2, Kidney-CW8, Analgesia-SC7 2. Sham point: Wrist-SD5, Shoulder-SF-2, Extra-auricular point	↓: VAS score, DRI score
Zhang 2020[41]	74/74	A	SC	/	NR	Comparable	Randomized	NR	0	Bilateral Shenshu, Dachangyu, and Ashi	↓: VAS score after 1, 2, 4 weeks of treatment

A + C: Acupuncture combined standard care; DRI: Disability rating index; EQ-5D: EuroQol-5 five-dimension scale questionnaire; LBP: Low back pain; NPA: Non-penetrating acupuncture; NR: Not reported; NS: Not significant; ODI: Oswestry disability index; PGQ: Pelvic girdle questionnaire; RMDQ: Roland-Morris disability questionnaire; SC: Standard care; SF12-MCS: 12-Items Short Form Health Survey of mental component summaries; SF12-PCS: 12-Items Short Form Health Survey of physical component summaries; VAS: Visual analog scale.

Risk of bias assessment

The risks of the summaries for each bias are reported in Figure 2 and the bias of the included RCTs with each intervention comparison was assessed as shown in Figure 3. No high risk of bias was observed in any included studies. Seven trials used a randomized table or envelopes; therefore, they were at low risk of the randomization process. The remaining five RCTs reported randomization but without detailed methods, of which the randomized process was assessed as "some concern". Three trials used double blinding and three used single blinding; therefore, they were at a low risk of deviations from the intended interventions. The other six trials had no information about the randomized processes or blinding; therefore, there were some concerns overall. Each trial had a protocol for intervention, and there were no deviations from the intended interventions. All trials had complete outcome data, and no trial selectively reported outcome data. Overall, five trials had a low risk of bias and seven had some concerns.

Primary outcomes

VAS score

Acupuncture/acupuncture combined SC vs. SC alone

Nine trials[30,32,34,35,37–41] with 1,116 patients reported VAS scores. Meta-analysis showed that the VAS score after treatment was significantly decreased ($P < 0.00001$, MD = –2.45, 95% CI = –3.06 to –1.84, Figure 4A). Subgroup analysis was conducted to explore whether the difference in the acupuncture treatment introduced heterogeneity, including the meta-analysis comparing acupuncture combined SC with SC in six studies ($P < 0.00001$, MD = –2.83, 95% CI = –3.14 to –2.26, Figure 4A) and acupuncture alone with SC in three studies ($P = 0.0006$, MD = –1.81, 95% CI = –2.85 to –0.78, Figure 4A). Sensitivity analysis revealed that no trial significantly affected the overall outcome (Table 2).

Acupuncture combined SC vs. non-penetrating acupuncture combined SC

Four trials[30,31,35,40] with 420 patients reported VAS scores. Meta-analysis showed that the VAS score after treatment was significantly decreased in the acupuncture combined SC group compared with NPA group ($P = 0.14$, MD = –0.83, 95% CI = –1.94 to 0.28, Figure 4B).

Secondary outcomes

Acupuncture/acupuncture combined SC vs. SC alone

Spontaneous delivery rate

Four trials[33,34,37] with 486 patients reported the spontaneous delivery rate. Meta-analysis showed that the spontaneous delivery rate after treatment between two groups had no significant difference ($P = 0.18$, RR = 2.80, 95% CI = 0.61–12.76, Figure 5A).

Cesarean section rate

Four trials[33,34,37] with 486 patients reported the cesarean section rate. Meta-analysis showed that the cesarean section rate after treatment was significantly decreased in the acupuncture combined with SC group compared to SC group ($P = 0.01$, RR = 0.71, 95% CI = 0.54–0.93, Figure 5B).

Preterm birth rate

Five trials[33,34,37,41] with 634 patients reported the preterm birth rate. Meta-analysis showed that the preterm birth rate in the acupuncture combined with SC group was significantly decreased compared to SC group ($P < 0.0001$, RR = 0.42, 95% CI = 0.27–0.65, Figure 5C).

Labor duration

Two trials[33,41] with 324 patients reported labor duration. Meta-analysis showed that labor duration in the acupuncture combined with SC group was significantly decreased compared to that in the SC group ($P < 0.00001$, MD = –1.97, 95% CI = –2.73 to –1.20, Figure 5D).

Drowsiness

Four trials[33,34,37] involving 509 patients reported drowsiness. Meta-analysis showed that the drowsiness

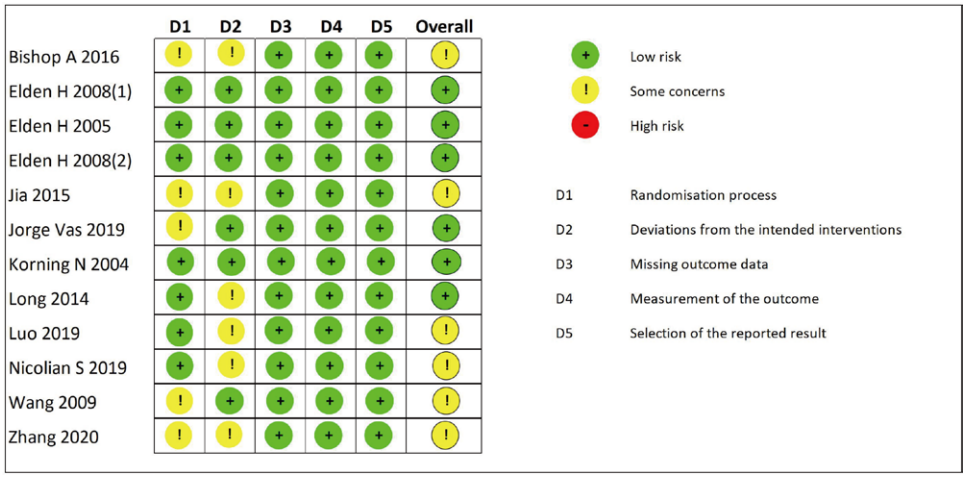

Figure 2. Summary on risk of bias.

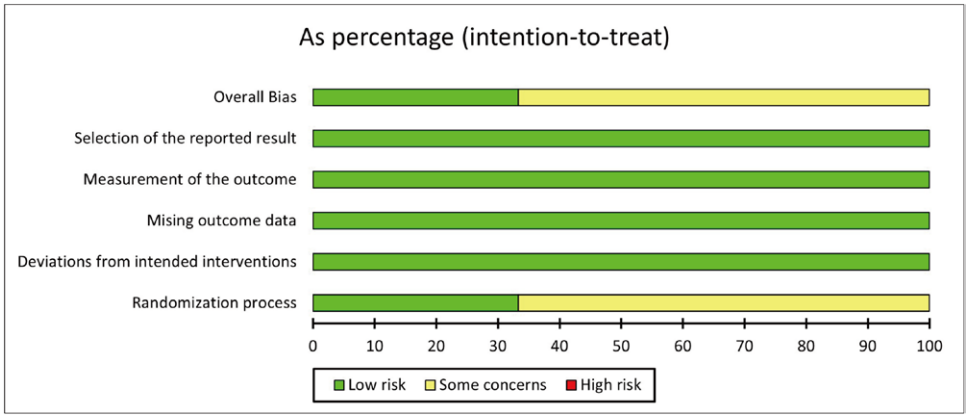

Figure 3. Risk of bias of the included randomized controlled trials.

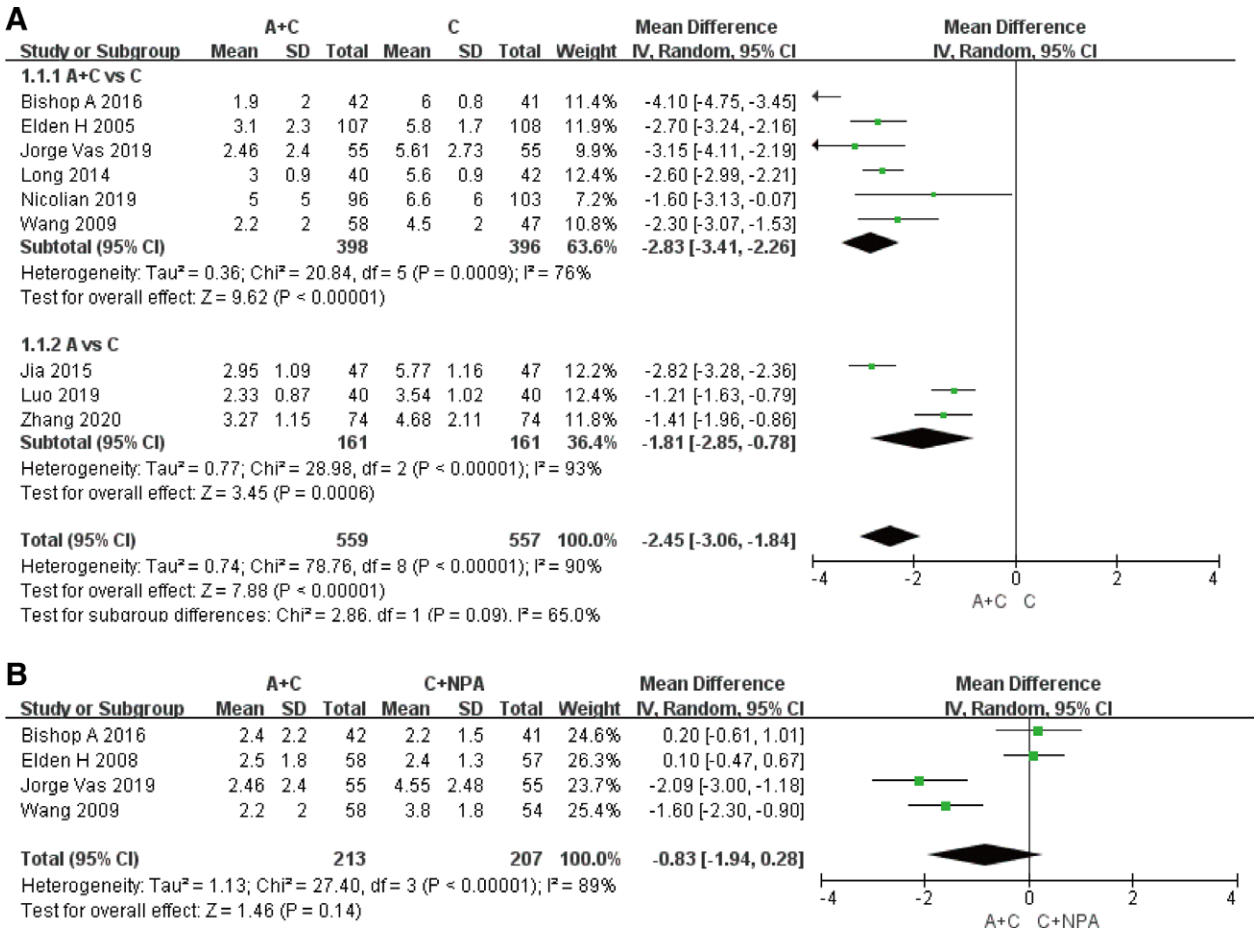

Figure 4. Meta-analysis on primary outcomes. (A) Acupuncture combined SC *vs.* SC alone; (B) Acupuncture *vs.* SC alone. A + C: Acupuncture combined standard care; C: Standard care; C + NPA: Standard combined non-penetrating acupuncture; CI: Confidence interval; df: Degree of freedom; SD: Standard deviation.

occurrence after treatment between two group had no significant difference ($P = 0.17$, RR = 6.13, 95% CI = 0.47–80.88, Figure 5E).

12-Items Short Form Health Survey-physical component summaries

Two trials[30,35] with 174 patients reported the 12-Items Short Form Health Survey of physical component summaries (SF12-PCS). Meta-analysis showed that the SF12-PCS in the acupuncture combined with SC group was significantly improved compared with SC group alone ($P = 0.001$, MD = 7.84, 95% CI = 3.13–12.54, Figure 5F).

12-Items Short Form Health Survey-mental component summaries

Two trials[30,35] with 174 patients reported the 12-Items Short Form Health Survey of mental component summaries (SF12-MCS). Meta-analysis showed that the SF12-MCS after treatment between the two groups had

no significant difference (P = 0.35, MD = 3.40, 95% CI = –3.70 to 10.50, Figure 5G).

ODI score

Two trials[30,39] with 263 patients reported ODI scores. Meta-analysis showed that the ODI score after treatment was significantly decreased in the acupuncture combined with SC group compared to SC group (P = 0.008, MD = –9.14, 95% CI = –15.68 to –2.42, Figure 5H).

Table 2

Sensitivity analyses by excluding one study at a time

Outcome	Excluded study	*Z* value	*P* value
VAS score	Bishop et al. 2016[30]	8.09	<0.00001
	Elden et al. 2005[32]	6.86	<0.00001
	Vas et al. 2019[35]	7.16	<0.00001
	Long et al. 2014[37]	6.53	<0.00001
	Nicolian et al. 2019[39]	7.72	<0.00001
	Wang et al. 2009[40]	7.20	<0.00001
	Jia 2015[34]	6.67	<0.00001
	Luo and Huang 2019[38]	9.48	<0.00001
	Zhang 2020[41]	7.92	<0.00001

VAS: Visual analog scale.

Newborn weight

Four trials[33,34,36,37] involving 406 patients reported newborn weight. Meta-analysis showed that the mean newborn weight between the two groups had no significant difference (P = 0.96, MD = 0.00, 95% CI = –0.08 to 0.09, Figure 5I).

Newborn height

Two trials[34,37] with 176 patients reported newborn height. Meta-analysis showed that the mean newborn height was significantly increased in the acupuncture combined with SC group compared to SC group (P = 0.01, MD = 0.81, 95% CI = 0.16–1.46, Figure 5J).

Adverse reaction

Ten trials[30,31,33–40] with 1,255 patients reported adverse reactions. There are 12 types, as reported in Table 3. Among them, 165 cases were related to treatment and 65 were unrelated to treatment. Each adverse reaction was reported in only one study; therefore, a meta-analysis could not be conducted.

Discussion

Main findings and implications for doctors

Meta-analyses of the VAS score, ODI score, and SF12-PCS showed that acupuncture could effectively relieve pain

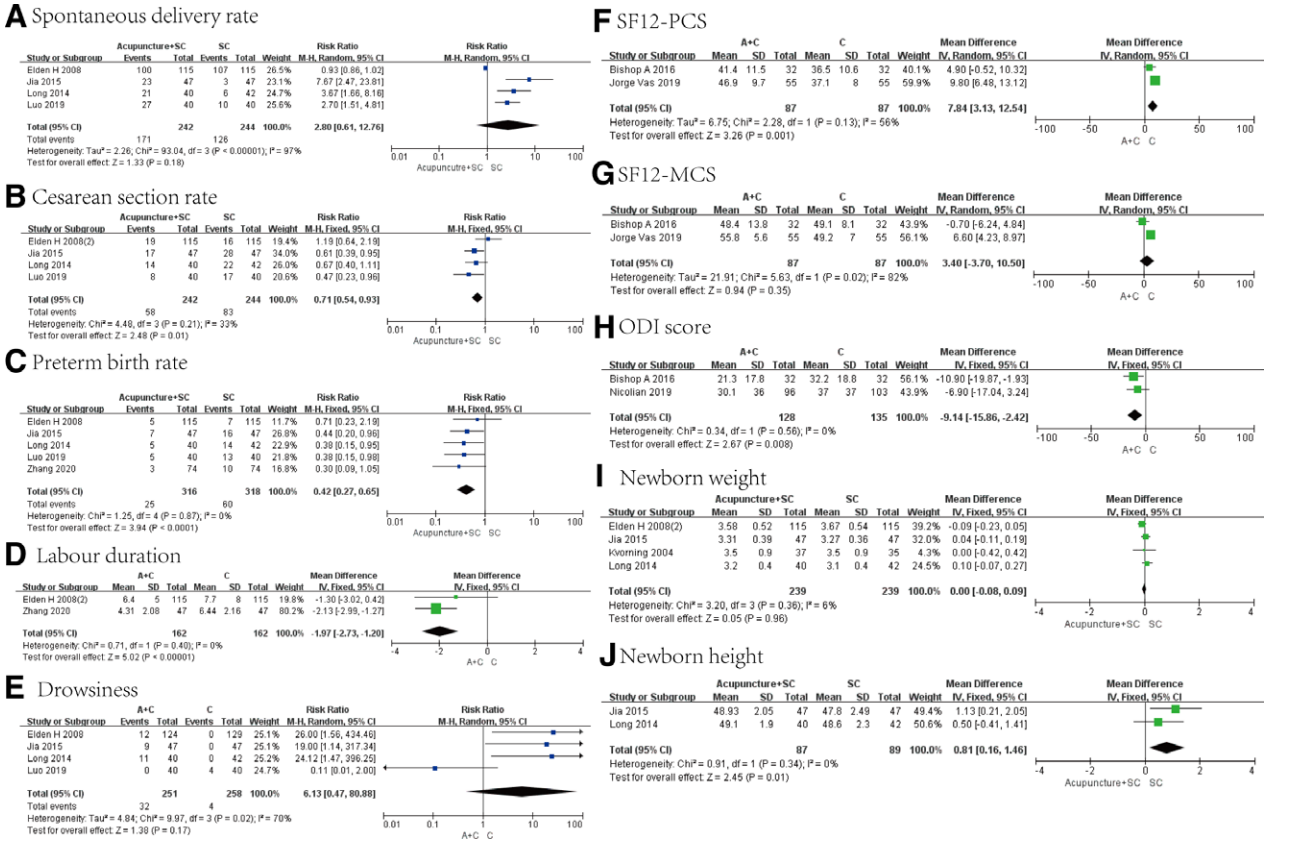

Figure 5. Meta-analysis on safety, maternal, and neonatal condition. (A) Spontaneous delivery rate; (B) Cesarean section rate; (C) Preterm birth rate; (D) Labour duration; (E) Drowsiness; (F) SF12-PCS; (G) SF12-MCS; (H) ODI score; (I) Newborn weight; (J) Newborn height. A + C: Acupuncture combined standard care; C: Standard care; CI: Confidence interval; df: Degree of freedom; ODI: Oswestry disability index; SC: Standard care; SD: Standard deviation; SF12-MCS: 12-Items Short Form Health Survey of mental component summaries; SF12-PCS: 12-Items Short Form Health Survey of physical component summaries.

Table 3

Summary of adverse reaction

Study ID	Group	Adverse reaction												Total	
		Slight drowsiness	Severe drowsiness	Needle sickness	Dizziness and headache	Needle rash	Needle pain	Needle bleeding	LBP aggravate	Premature contractions	Allergy	Hypotension	Others	Number	Ratio (%)
Bishop et al. 2016[30]	A + SC	–	–	–	–	–	–	8	–	–	–	–	–	8	24.24
	SC	–	–	–	–	–	–	–	–	–	–	–	–	0	0
Elden et al. 2008[31]	A + SC	3	–	–	–	–	12	35	–	–	–	–	–	50	86.21
	SC + NPA	2	–	–	–	–	13	34	–	–	–	3	–	52	91.23
Elden et al. 2008[33]	A + SC	12	1	–	5	2	–	–	16	–	1	–	2	39	33.91
	SC	–	–	–	–	–	–	–	2	1	–	–	–	3	2.61
Jia 2015[34]	A	9	–	–	–	–	–	–	–	–	–	–	–	9	19.15
	SC	–	–	–	–	–	–	–	–	–	–	–	–	0	0
Vas et al. 2019[35]	A + SC	–	–	–	–	–	2	–	–	–	–	–	–	2	5.00
	SC	–	–	–	–	–	–	–	–	–	–	–	–	0	0
Kvorning et al. 2004[36]	A	3	–	–	–	2	6	–	–	–	–	–	7	18	48.65
	SC	–	–	–	–	–	–	–	–	–	–	–	–	0	0
Long et al. 2014[37]	A + SC	11	–	–	–	–	–	–	–	–	–	–	–	11	27.50
	SC	–	–	–	–	–	–	–	–	–	–	–	–	0	0
Luo and Huang 2019[38]	A	–	–	1	–	–	–	–	–	–	–	–	–	1	2.50
	SC	4	–	–	–	–	–	–	–	–	–	3	–	7	17.50
Nicolian et al. 2019[39]	A + SC	1	–	–	1	–	24	–	–	–	–	–	–	26	25.24
	SC	–	–	–	–	–	–	–	–	–	–	–	–	0	0.00
Wang et al. 2009[40]	A + SC	–	–	–	–	–	1	–	–	–	–	–	–	1	1.85
	SC	–	–	–	–	–	3	–	–	–	–	–	–	3	5.56

$P = 0.19$; t test. A: Acupuncture; A + SC: Acupuncture combined with standard care; LBP: Low back pain; NPA: Non-penetrating acupuncture.

and improve the physical condition during pregnancy. In addition, meta-analyses of cesarean section rate, preterm birth rate, and newborn height showed that acupuncture could improve maternal and neonatal outcomes compared with SC. The subgroup analysis showed that acupuncture alone and acupuncture combined with SC significantly reduced pain, suggesting that acupuncture could be a potential alternative for pain relief. The most frequently used acupoints in the treatment group were GV20 (Baihui point), BL60 (Kunlun point), and Ashi point, which were located on the calvarium, hindfoot, and pain sites, respectively. These acupoints have been used to relieve headaches[42], postoperative pain in older adult men[43], and abdominal myofascial pain[44]. Some RCTs have designed specific acupoints for different pain sites and syndromes, such as BL26 (Guanyuanshu) for sacroiliac pain, GB30 (Huantiao) for sciatica, and BL23 (Shenshu) for kidney deficiency. Studies have shown that BL23 downregulates the expression of oxidative stress injury-related proteins to relieve pain[45]. Hence, in the clinical application of acupuncture for pregnancy-related LBPGP, we recommend GV20, BL 60, and Ashi points for acupuncture practitioners as the first priority, and specific acupoints should be added according to each patient's condition.

Our safety results suggest that acupuncture could help reduce preterm birth and cesarean section rates and would not aggravate the incidence of adverse reactions such as drowsiness, dizziness, headache, and hypotension. Studies have reported that acupuncture can cause fainting[46] and foreign body granuloma[47], which may affect an individual's physical constitution. Acupuncture practitioners should be aware of the potential adverse effects during and after acupuncture treatment.

Strengths and limitations

The main strengths of our study include the following: 1) for the first time, meta-analyses were conducted between acupuncture and NPA for treating pregnancy-related LBPGP, and the results showed that acupuncture was significantly more effective than NPA; 2) a rigorous methodology was used to perform the systematic review and meta-analysis; and 3) a strict risk of bias assessment was conducted in all RCTs, which made the findings more persuasive and reliable.

Our systematic review and meta-analysis supported acupuncture as a treatment for LBPGP during pregnancy; however, half of the included RCTs did not report any blinding. Although other measures may be taken to avoid nonblinding, such as treating patients according to strict protocols, successful blinding will prevent bias. In addition, some meta-analysis results still had heterogeneity limitations, even when a random model was applied to those analyses, with $I^2 > 30\%$ in the fixed model. Subgroup analysis can only be conducted on VAS score, and other outcomes could not be assessed owing to inadequate data from the included studies. The results showed that heterogeneity did not significantly decrease and was not sufficient to verify that the difference in acupuncture treatment was the primary source of heterogeneity. The proficiency of different acupuncture practitioners is likely to cause different pain-relief effects, which was an inescapable reason that may have led to high heterogeneity. We also conducted a sensitivity analysis of the VAS score by excluding one study at a time and found that the subgroup analysis results were stable.

Interpretation of results

Pregnancy-induced LBPGP is inconvenient and potentially harmful to pregnant women. Choosing analgesics to reduce pain is difficult for pregnant women, because these drugs may cause various adverse effects in the mother and fetus. Acupuncture is an important approach in complementary and alternative medicine that has been reported to be effective for the treatment of LBPGP[48].

Two meta-analyses of acupuncture for pregnancy-related low back and pelvic pain were conducted by other teams in 2015 and 2022[49,50]. Our present updated review confirmed that acupuncture treatment helps relieve pain and improves the physical status of pregnant women with LBPGP. We designed and conducted a meta-analysis comparing acupuncture with non-penetrating acupuncture. In addition, our review, but not others, systematically studied the safety of acupuncture and compared adverse maternal outcomes, such as drowsiness, and neonatal outcomes, such as newborn weight and height. These results confirm the safety of acupuncture. Meanwhile, our review was performed strictly under the guidance of the latest Cochrane Handbook (Version 6.3, 2022), which provides more specific approaches to searching and selecting RCTs; and the risk of bias of the included RCTs was assessed using RoB-2, which provides more appropriate statistical analysis methods to control bias.

Conclusion

In summary, we recommend acupuncture as a potential treatment for LBPGP during pregnancy, as preliminary evidence has shown that it can relieve pain and reduce adverse outcomes in pregnant women. However, more strictly designed RCTs are required to confirm their therapeutic effects and safety.

Conflict of interest statement

The authors declare no conflict of interest.

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Author contributions

Lu Li, Xiaohui Fan conceived and designed the study. Lu Li, Aolin Zhang, Junwei Li, Tao He, Hongliang Xie, Siming Chen performed the literature search and methodology of systematic review. Lu Li, Aolin Zhang, Hongliang Xie, Siming Chen processed and analyzed the data of meta-analysis. Xiaohui

Fan and Chi Chiu Wang advised on results of meta-analysis. Lu Li, Aolin Zhang, Junwei Li, Tao He, Hongliang Xie, Xuan Mou, Tsz Ching Yeung drafted and further edited the manuscript. Lu Li, Chi Chiu Wang, Xiaohui Fan revised the final version of manuscript. All authors read and approved the submission of this manuscript.

Ethical approval of studies and informed consent

Not applicable.

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None.

Data availability

All data generated or analyzed during this study are included in this published article.

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