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META-ANALYSIS

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Efficacy and Safety of Acupuncture for Essential Hypertension: A Meta-Analysis

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Background: The aim of this study was to assess the efficacy and safety of acupuncture therapy for patients with hypertension.

Material/Methods: We searched PubMed, Embase, the Cochrane Library, the Chinese Biomedical Literature Database, the Chinese National Knowledge Infrastructure, and the Wan-fang Data Database from inception through 29 April 2017. Randomized controlled trials investigating acupuncture therapy for hypertension were included. Review Manager 5.3 software was used for the data analysis.

Results: A total of 30 RCTs involving 2107 patients were included. The overall methodological quality of the included studies was low. Pooled results demonstrate that acupuncture plus anti-hypertensive drugs is better than anti-hypertensive drugs alone at reducing systolic and diastolic blood pressure (SBP and DBP). The same result was observed for pooled data from experiments that compared acupuncture plus medication to sham acupuncture plus medication at reducing SBP and DBP. However, studies reveal that using acupuncture alone or anti-hypertensive drugs alone do not differ in the effect on lowering blood pressure. Similarly, acupuncture alone also did not differ from sham acupuncture alone, and electroacupuncture versus anti-hypertensive drugs was not significantly different at reducing SBP and DBP.

Conclusions: Our systematic review indicates there is inadequate high quality evidence that acupuncture therapy is useful in treating hypertension, as the exact effect and safety of acupuncture therapy for hypertension is still unclear. Therefore, research with larger sample sizes and higher-quality RCTs is still needed.

MeSH Keywords: Acupuncture • Essential Hypertension • Meta-Analysis • Randomized Controlled Trial

Full-text PDF: https://www.medscimonit.com/abstract/index/idArt/909995

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Background

Essential hypertension is a major risk factor for cardiovascular disease and stroke [1]. The number of adults with hypertension worldwide is predicted to reach 1.56 billion individuals by 2025 [2]. In China, hypertension affects more than one-fourth of the population. Moreover, the prevalence of hypertension has increased during recent decades and it has become a major health problem because treatment awareness and hypertension control rates are extremely low [3].

The basic treatment for hypertension is non-pharmacological therapy, and includes weight loss, restricted sodium intake, physical activity, and cessation of smoking and alcohol consumption. However, long-term compliance with non-pharmacological treatment is difficult for most patients. Therefore, anti-hypertensive drugs are the preferred option for treating hypertension [4]. However, they are associated with adverse effects such as drug resistance. Therefore, more effective and safe treatment options are urgently required for hypertension patients.

Acupuncture treatment is an ancient Chinese therapy that has played an important role for over 2500 years in the Chinese healthcare system and has now been adopted worldwide. Several systematic reviews have evaluated the efficacy of acupuncture for hypertension [5–11]. Recently, some new trials have been published, leading us to conduct a systematic review and meta-analysis of all available randomized controlled trials (RCTs), to evaluate the efficacy and safety of acupuncture therapy for treating essential hypertension.

Material and Methods

Systematic review details

This systematic review was performed in accordance with the Cochrane Handbook for Systematic Reviews of Interventions, and was reported in compliance with the PRISMA statement (see Supplementary Table 1 for PRISMA checklist) [12]. This systematic review has been registered (Reg. No. CRD 42017068032) in PROSPERO (*https://www.crd.york.ac.uk/prospero/*) [13].

Study search strategy

We systematically searched the PUBMED, EMBASE, the Cochrane Library, the Chinese Biomedical Literature Database (CBM), the Chinese National Knowledge Infrastructure (CNKI), and the Wan-fang databases for inclusion on 29 April 2017 with MeSH terms and key words, and without language restrictions. Search strategy terms were (acupuncture OR electroacupuncture OR acupoint) AND (high blood pressure OR hypertension OR blood pressure) AND (randomized controlled trial OR controlled clinical trial OR randomized OR clinical trials). We also checked the reference lists of relevant reviews and the included trials to identify further studies that met the inclusion criteria for this meta-analysis.

Inclusion criteria

Types of trials

We included randomized controlled trials (RCTs) and quasi-randomized controlled trials (quasi-RCTs) that were published in formal English or Chinese journals.

Types of participants

Based on the International Society of Hypertension Guidelines for the Management of Hypertension (1999 World Health Organization) [14], essential hypertensive patients were those with a systolic blood pressure (SBP) ≥140 mmHg and/or a diastolic blood pressure (DBP) of ≥90 mmHg. All patients with secondary hypertension caused by an identifiable underlying primary cause were all excluded.

Types of interventions

Acupuncture therapy included acupuncture or electroacupuncture with or without lifestyle modifications and/or anti-hypertensive drugs. Control groups received sham acupuncture without any treatment or lifestyle modifications or anti-hypertensive drugs.

Types of outcome measures

Primary outcomes included SBP and DBP changes [pre-treatment BP – post-treatment BP]. Secondary outcomes included the efficacy rates and the adverse events. Efficacy rates were reported as the percentage of the total number of participants that showed reduction of DBP by ≥10 mmHg, or normal DBP (≤90 mmHg), or reduction of SBP by ≥30 mmHg.

Data extraction

Two reviewers (HC and FES) screened all the literature and extracted data independently using a standardized form. The form was pre-designed for collecting information on trial characteristics, including first author, language, number of patients, mean age of the patients, diagnostic criteria, grades of hypertension, acupuncture treatment, control types, sessions of treatment, treatment course, and outcome measures. We defined the change values of blood pressure as pre-treatment BP minus post-treatment BP and extracted the change means and standard deviations (SD) for continuous outcome. For dichotomous

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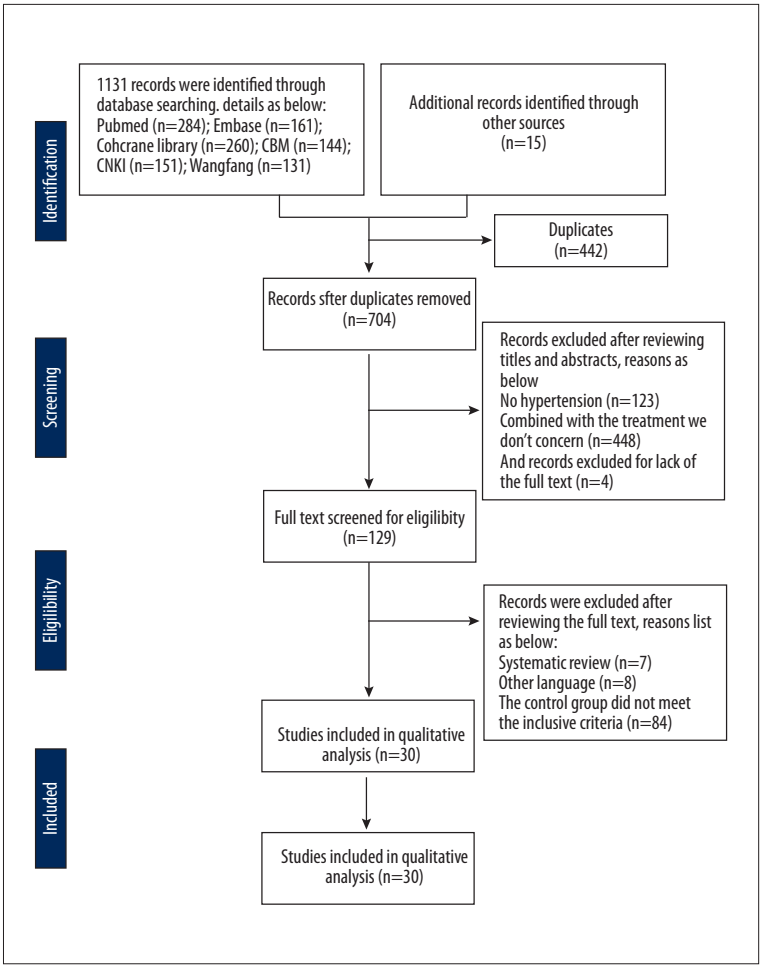

Figure 1. Flow chart of randomized controlled trial selection (based on PRISMA).

outcome measures, we used rates (the number of events out of total number in the study). If change means and standard deviations were missing, we calculated them according to the formula offered by the *Cochrane Handbook for Systematic Reviews of Interventions* (Version 5.10) (see Supplementary Figure 1 for formula). Disagreements were resolved in consultation with the third reviewer (YHG).

Assessment of the reporting quality of the included studies

Overall reporting quality score was evaluated for 30 parameters (items 1–4, 6–19) of the Consolidated Standards of Reporting Trials (CONSORT) [15]. The discussion section (items 20–22) was excluded because the items under this section could not be rated. We also excluded the section on other information (items 23–25) because they were not relevant for the methodology of the included studies. The Standards for Reporting Interventions in Controlled Trials of Acupuncture (STRICTA) includes 17 items that are substituted for item 5, 'interventions' in the CONSORT checklist [16]. Two reviewers (XDT and WBJ) assessed each item for the included studies independently. Each reported item received 1 point, and any item not clearly presented received 0 points. Disagreements were resolved in consultation with the third reviewer (HC).

Risk of bias assessment

Two reviewers (XDT and WBJ) assessed the risk of bias of the included RCTs using the Cochrane Collaboration's tool for assessing risk of bias [17]. Each trial was scored as high, low, or unclear risk for the following 7 domains: (1) random sequence generation (selection bias); (2) allocation concealment (selection bias); (3) blinding of participants and personnel (performance bias); (4) blinding of outcome assessment (detection bias); (5) incomplete outcome data (attrition bias); (6) selective reporting (reporting bias); and (7) any other bias. Disagreements were resolved in consultation with the third reviewer (HC).

Statistical analysis

The overall reporting quality of the included studies and the potential differences between the studies from the Chinese journals and English journals were investigated in compliance

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Table 1. Characteristics of included studies.

Study ID	Language	Mean age (T/C)	Gender (Male/ Female)	*Included criteria	Hyper-tension grades	Intervention		No. of patients evaluated		Course	#Outcome
						Treatment	Control	Treatment	Control		
Chen BG et al., 2006	Chinese	54.75±7.12/ 51.7210.38	41/19	1	1, 2	AC (30 mins a day)	Metroprolol (100 mg per day)	30	30	4 weeks	1, 2, 3
Chen J et al., 2010	Chinese	48.2±7.2/ 50.5± 8.4	31/29	1	1	AC (30 mins a day) plus felodipine (5 mg per day)	Felodipine (5 mg per day)	30	30	15 days	3
Chen NY et al., 2010	Chinese	61.3±8.0/ 62.0± 7.1	41/39	1	Not reported	AC (30 mins a day)	Diovan (80 mg per day)	40	40	30 days	1, 3, 4
Chen Q et al., 2011	Chinese	59±8/ 59± 8	29/31	1	1, 2	AC (30 mins a day)	Metroprolol (100 mg per day)	30	30	30 days	3
Chen YF et al., 2000	Chinese	63.57±8.08/ 65.20± 8.86	38/32	1	2	AC (30 mins a day)	Nifedipine (10–20 mg tid)	35	35	2 weeks	1, 3
Choi WJ et al., 2015	English	48.04±6.13/ 46.20±9.26	Not reported	1	Not reported	AC (20 mins every treatment, 4 times totally)	SA	25	25	2 weeks	2, 4
Cui JK et al., 2013	English	56.7±8.9/ 54.7±8.1	55/37	1	Not reported	AC (once a day except Sunday) plus irbesartan	Irbesartan (150 mg per day)	46	46	4 weeks	3, 4
Flachskampf FA et al., 2007	English	58.8±8.2/ 58.0±7.9	66/74	1	1, 2	AC (30 mins; 22 sessions)	SA	83	77	6 weeks	1, 2, 4
Huang F et al., 2007	Chinese	56.51±6.28/ 58.12±6.15	27/33	1	1, 2	AC (30 mins a day) plus captopril (25 mg tid)	Captopril (25 mg tid)	30	30	4 weeks	1, 3
Kim HM et al., 2012	English	52.08±8.69/ 52.38±10.3	16/12	1	1	AC (20 mins, twice a week)	SA	12	16	8 weeks	1, 2
Liu Y et al., 2015	English	49.4±8.4/ 53.4±8.2	7/24	2	1,2	AC (30 mins, twice a week)	No treatment	15	15	8 weeks	2
Luo H et al., 2015	Chinese	45-75(range)	66/34	1	2	AC (30 mins a day) plus felodipine (5mg)	Felodipine (5 mg)	44	46	20 days	1, 3
Ma ZY et al., 2011	Chinese	66.39±5.47/ 64.58±7.13	47/33	1	1,2	EA (10 mins a day)	Nicardipine (20 mg tid)	40	40	15 days	1, 3
Shen ZK et al., 2007	Chinese	32±8.24/ 21±7.31	31/19	1	Not reported	AC (30 mins a day) plus nifedipine (20 mg bid)	Nifedipine (20mg bid)	25	25	20 days	1, 2, 3
Sun J et al., 2009	Chinese	47.23±5.66/ 48.42±6.13	48/39	1	1	AC (30 mins a day)	lifestyle	44	43	Not reported	2
Tian L et al., 2008	Chinese	59.17±3.16/ 59±3.01	33/27	1	1,2	AC (30 mins a day)	Levamlodipine (2.5 mg a day)	30	30	30 days	1, 2, 3
Yin C et al., 2007	English	52/54	9/21	3	1,2	AC plus antihypertensive	SA plus antihypertensive	15	15	8 weeks	1
Wan WJ et al., 2009	Chinese	63.72±8.23/ 65.24±6.41	36/24	1	1,2	AC (10mins a day)	nicardipine (20 mg tid)	30	30	15 days	1,3
Wang C et al., 2006	Chinese	25-60(range)	34/25	1	Not reported	EA (30 mins a day)	Lotensin (10 mg a day)	30	29	8 weeks	1,3
Wu XM et al., 2015	Chinese	49. 10±8. 7/ 48. 08±8. 8	52/47	1	1,2	AC (10 mins a day)	lifestyle	50	49	4 weeks	1, 2, 3
Wu YR et al., 2011	Chinese	54.75±7.10/ 51.72±10.3	70/50	1	1,2	AC (30 mins a day)	Metroprolol (100 mg a day)	60	60	20 days	1, 3
Xie B et al., 2014	Chinese	56±11/ 53±10	30/30	1	Not reported	AC (30 mins a day)	Captopril (25 mg tid)	30	30	3 weeks	1, 3

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Table 1 conitnued. Characteristics of included studies.

Study ID	Language	Mean age (T/C)	Gender (Male/ Female)	*Included criteria	Hyper-tension grades	Intervention		No. of patients evaluated		Course	#Outcome
						Treatment	Control	Treatment	Control		
Xing H et al., 2016	Chinese	61.83±9.10/ 57.14±9.33	35/28	1	1,2	AC (30 mins a day)	Captopril (25 mg tid)	31	32	4 weeks	1, 3
Yang DH et al., 2010	Chinese	40.4±5.2/ 41.7±4.2	37/23	1	1,2	EA (30 mins a day)	Captopril (25 mg tid)	30	30	2 weeks	1, 2, 3
Zhao DJ et al., 2003	Chinese	40.3±11.4/ 46.1±14.2	37/23	1	1,2	AC plus lifesytle	Lifestyle	30	30	40 days	1
Zhang Y et al., 2012	Chinese	42–46 (range)	Not reported	1	Not reported	AC (30 mins a day)	Captopril (25 mg tid)	14	14	8 weeks	1
Zhang YB et al., 2011	Chinese	53.62±9.83/ 52.16±10.04	53/27	1	Not reported	AC (20 mins a day)	Amlodipine (2.5 mg a day)	45	35	4 weeks	1, 3
Zhang YL et al., 2005	Chinese	63.60±8.20/ 65.20±8.00	47/28	1	Not reported	AC (30 mins a day) plus nifedipine (10mg tid)	Nifedipine (10 mg tid)	45	30	20 days	1, 3
Zhang ZH et al., 2004	Chinese	56.5/55.5	42/18	1	1,2	AC (30 mins a day)	Compounds of Reserpine and Hydrochlo-rothiazidec	30	30	15 days	3
Zheng Y et al., 2016	English	56.53±7.52/ 56.73±4.91	8/22	1	1,2	AC (30 mins a day except weekends)	SA	15	15	2 weeks	1

T – treatment; C – control; mins – minutes; AC – acupuncture; SA – sham acupuncture; EA – electro acupuncture; SBP – systolic blood pressure; DBP – diastolic blood pressure. * Included criteria: (1) SBP: ≥140 mmHg or DBP: ≥90 mmHg; (2) SBP: 120–159 mmHg or DBP: 80–99 mmHg; (3) SBP: 120–180 mmHg and DBP: 80–100 mmHg. # Outcomes: (1) Blood pressure after intervention; (2) Changes in magnitude of blood pressure after intervention; (3) Efficacy rate; (4) Adverse effects.

with the CONSORT and STRICTA statements. The overall scores of the CONSORT and the STRICTA are presented as medians and ranges, and data from each individual item are presented as frequencies. The difference between overall scores of different journals was assessed by the Mann-Whitney U test. Pearson's chi-square test was used when the sample size was more than 40 and Fisher's exact test was used when sample size was less than 40 for assessing the reporting difference of each individual item between the different journals. Statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS) V.19.0 (SPSS Inc, Chicago, Illinois, USA).

Meta-analyses for acupuncture and electroacupuncture were done separately. Continuous data are presented as mean differences (MDs) with 95% confidence interval (CI) and data from studies were pooled using the inverse variance method. Dichotomous data are presented as relative risk (RR) with 95% CI and pooled using Mantel-Haenszel method. We also calculated the required information size based on the standard method [18,19]. Statistical heterogeneity across trials was assessed by the Cochran Q test (P<0.1 for statistical significance) and quantified by the I^2 statistic. Following the *Cochrane Handbook for Systematic Reviews of Interventions* (Version 5.10), we defined I^2 >50% as indicating significant heterogeneity. Heterogeneous data were pooled using the random-effects model. We performed subgroup analysis based on the classes of anti-hypertensive drugs such as calcium channel blockers (CCB), β-receptor antagonists, angiotensin-converting enzyme inhibitors (ACEI), and angiotensin receptor blockers (ARB). Moreover, in order to establish robust primary outcomes, we also performed sensitivity analysis for the primary outcomes. Publication bias was evaluated by visually inspecting a funnel plot. Meta-analysis was performed using RevMan 5.3 software.

Results

Study selection

Figure 1 provides a flow chart summarizing the study selection process based on PRISMA guidelines. The initial search yielded

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Table 2. Overall score of the CONSORT and STRICTA reporting quality of the included studies (N=30; 24 studies from Chinese journals; 6 studies from English journals).

Journals	CONSORT Median (range)	STRICTA Median (range)
Chinese journals (N=24)	10 (6–17)	11 (7–12)
English journals (N=6)	9 (4–29)	12 (11–17)*
All journals (N=30)	10 (4–29)	11 (7–17)

* Indicate a significant difference with the studies published in Chinese journals.

1146 records. After removing duplicate records, screening the titles and abstracts, and doing full text reviews, 30 trials were included in the meta-analysis [20-49].

Characteristics of the included studies

Characteristics of the included trials are summarized in Table 1. The 28 RCTs and 2 qusi-RCTs evaluated a total of 2107 patients (range: 28 to 160 patients per trial) and were published between 2000 and 2016. Six of the included studies were published in English [25–27,29,30,49] and the remaining 24 studies were published in Chinese [20–24,28,31–42,47,48]. Four studies reported adverse effects [22,26,40,41], 5 studies reported no adverse effects [25,27,29,30,38], and the remaining 21 studies did not report any information on adverse

Table 3. CONSORT assessments of the reporting characteristics of the included studies (N=30; 24 studies from Chinese journals; 6 studies from English journals).

Section/ topic	Item	Description	Positive studies	Positive Chinese journals	Positive English journals
			N (%)	N (%)	N (%)
Title and Abstract	1a	Identifying randomized trial in the title	4 (13%)	0 (0)	4 (67%)*
	1b	Structured summary of trial design, methods, results, and conclusions; for specific guidance see CONSORT for Abstracts	28 (93)	22 (92)	6 (100)
Background and objectives	2a	Scientific background and explanation of rationale	23 (77)	17 (71)	6 (100)
	2b	Specific objectives or hypotheses	12 (40)	6 (25)	6 (100)*
Trial design	3a	Description of trial design (e.g., parallel, factorial) including allocation ratio	29 (97)	23 (96)	6 (100)
	3b	Important changes to methods after trial commencement (e.g. eligibility criteria), with reasons	0	0 (0)	0 (0)
Participants	4a	Eligibility criteria for participants	29 (97%)	23 (96)	6 (100)
	4b	Settings and locations where the data were collected	24 (80%)	18 (75)	6 (100)
Outcomes	6a	Definition of pre-specified primary and secondary outcome measures, including how and when they were assessed	28 (93)	22(92)	6 (100)
	6b	Reasoning of any changes to trial outcomes after the trial commenced	0 (0)	0 (0)	0 (0)
Sample size	7a	Protocol of determining sample size	1 (3)	0 (0)	1 (17)
	7b	Explanation of any interim analyses and stopping guidelines, whenever applicable	0 (0)	0 (0)	0 (0)
Sequence generation	8a	Method used to generate the random allocation sequence	21 (70)	18 (75)	3 (50)
	8b	Type of randomization and details of any restrictions (e.g., blocking and block size)	3 (10)	0 (0)	3 (50)*
Allocation concealment	9	Mechanism used to implement the random allocation sequence (e.g., sequentially numbered containers) and description of any steps taken to conceal the sequence until interventions were assigned	4 (13)	0 (0)	4 (67)*

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Table 3 continued. CONSORT assessments of the reporting characteristics of the included studies (N=30; 24 studies from Chinese journals; 6 studies from English journals).

Section/ topic	Item	Description	Positive studies		Positive Chinese journals		Positive English journals	
			N (%)		N (%)		N (%)	
Implementation	10	Individuals that generated the random allocation sequence, enrolled participants, and assigned participants to interventions	1	(3)	0	(0)	1	(17)
Blinding	11a	The group that was blinded after assignment to interventions (e.g. participants, care providers, those assessing outcomes) and the protocol of blinding, if performed	6	(20)	0	(0)	6	(100)*
	11b	If relevant, description of the similarity of interventions	0	(0)	0	(0)	0	(0)
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	23	(77)	17	(71)	6	(100)
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	3	(10)	1	(4)	2	(33)
Participant flow (A diagram is strongly recommended)	13a	The number of participants that were randomly assigned, received intended treatment, and were analyzed for the primary outcome are shown for each group	3	(10)	1	(4)	2	(33)
	13b	The number of participants that were lost or excluded after randomization and the reasons	2	(13)	0	(0)	2	(33)*
Recruitment	14a	Dates defining the periods of recruitment and follow-up	19	(63)	15	(63)	4	(67)
	14b	Reasons for ending or stopping the trial	0	(0)	0	(0)	0	(0)
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	14	(47)	8	(33)	6	(100)*
Numbers analyzed	16	For each group, the number of participants (denominator) included in each analysis and if the analysis was performed as originally assigned	3	(10)	1	(4%)	2	(33)
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (e.g., 95% confidence interval)	29	(97)	23	(96)	6	(100)
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	30	(100)	24	(100)	6	(100)
Ancillary analyses	18	Results of any other analyses performed, such as subgroup and adjusted analyses; distinguishing pre-specified from exploratory analyses	0	(0)	0	(0)	0	(0)
Harms	19	All important harms or unintended adverse effects in each group; for specific guidance see CONSORT for Harms#	8	(27)	3	(13)	5	(83)*

* Indicate a significant difference with the studies published in Chinese journals; # CONSORT for harms can be seen on *http://www.consort-statement.org/checklists/view/32--consort-2010/116-harms*.

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Table 4. STRICTA assessment of the reporting characteristics of included studies (N=30; 24 studies from Chinese journals; 6 studies from English journals).

Section/ topic	Item	Description	Positive studies	Positive Chinese journals	Positive English journals
			N (%)	N (%)	N (%)
Acupuncture rationale	1a	Style of acupuncture (e.g. Traditional Chinese Medicine, Japanese, Korean, Western medical, Five Element, ear acupuncture, etc)	30 (100)	24 (100%)	6 (100%)
	1b	Reasoning for treatment provided, historical context, literature sources, and/or consensus methods, with references provided wherever necessary	9 (30)	5 (21)	4 (67)*
	1c	Extent to which treatment varied	2 (7)	0 (0)	2 (33)*
Details of needling	2a	Number of needle insertions per subject per session (mean and range wherever relevant)	23 (77)	20 (83)	3 (50)
	2b	Names (or location if no standard name) of points used (uni/bilateral)	30 (100)	24 (24)	6 (100)
	2c	Depth of insertion, based on a specified unit of measurement or a particular tissue level	20 (67)	15 (63)	5 (83)
	2d	Response sought (e.g. de qi or muscle twitch response)	23 (77)	17 (71)	6 (100)
	2e	Needle stimulation (e.g. manual, electrical)	29 (97)	23 (96)	6 (100)
	2f	Needle retention time	29 (97)	23 (96)	6 (100)
	2g	Needle type (diameter, length, and manufacturer or material)	22 (73)	16 (67)	6 (100)
Treatment regimen	3a	Number of treatment sessions	30 (100)	24 (100)	6 (100)
	3b	Frequency and duration of treatment sessions	30 (100)	24 (100)	6 (100)
Other components of treatment	4a	Details of other interventions administered to the acupuncture group (e.g. moxibustion, cupping, herbs, exercises, lifestyle modification advice)	10 (33)	5 (21)	5 (83)*
	4b	Setting and context of treatment, including instructions to practitioners, and information to patients	1 (3)	0 (0)	1 (17)
Practitioner background	5	Description of participating acupuncturists (qualification or professional affiliation, years in acupuncture practice and other relevant experience)	1 (3)	0 (0)	1 (17)
Control or comparator interventions	6a	Rationale for the control or comparator in the context of the research question and sources justifying the choice	2 (7)	0 (0)	2 (33)*
	6b	Precise description of the control or comparator. If sham acupuncture or any other type of acupuncture-like control is used, provide details as for Items 1 to 3 above	28 (93)	22 (92)	6 (100)

* Indicates a significant difference with the studies published in Chinese journals.

effects. Twenty-eight of the 30 studies defined the criteria for hypertension as a systolic blood pressure (SBP) ≥140mmHg or diastolic blood pressure (DBP) ≥90 mmHg [22–29,31–48]. Liu et al. [30] included hypertension patients with SBP ranging from 120–159 mmHg or DBP ranging from 80–99 mmHg. Yin et al. [49] included patients with SBP ranging from 120 to 180 mmHg or DBP 80 to 100 mmHg.

We analyzed the therapeutic outcomes of acupuncture or electroacupuncture with or without lifestyle modifications or anti-hypertensive drugs. The 5 most frequently used acu-points were LI11 (quchi; 18 studies), LR3 (taichong; 15 studies), GB20 (fengchi; 12 studies), ST36 (zusanli; 9 studies), and DU20 (baihui; 7 studies). Control groups included untreated patients and patients undergoing treatment by lifestyle modifications

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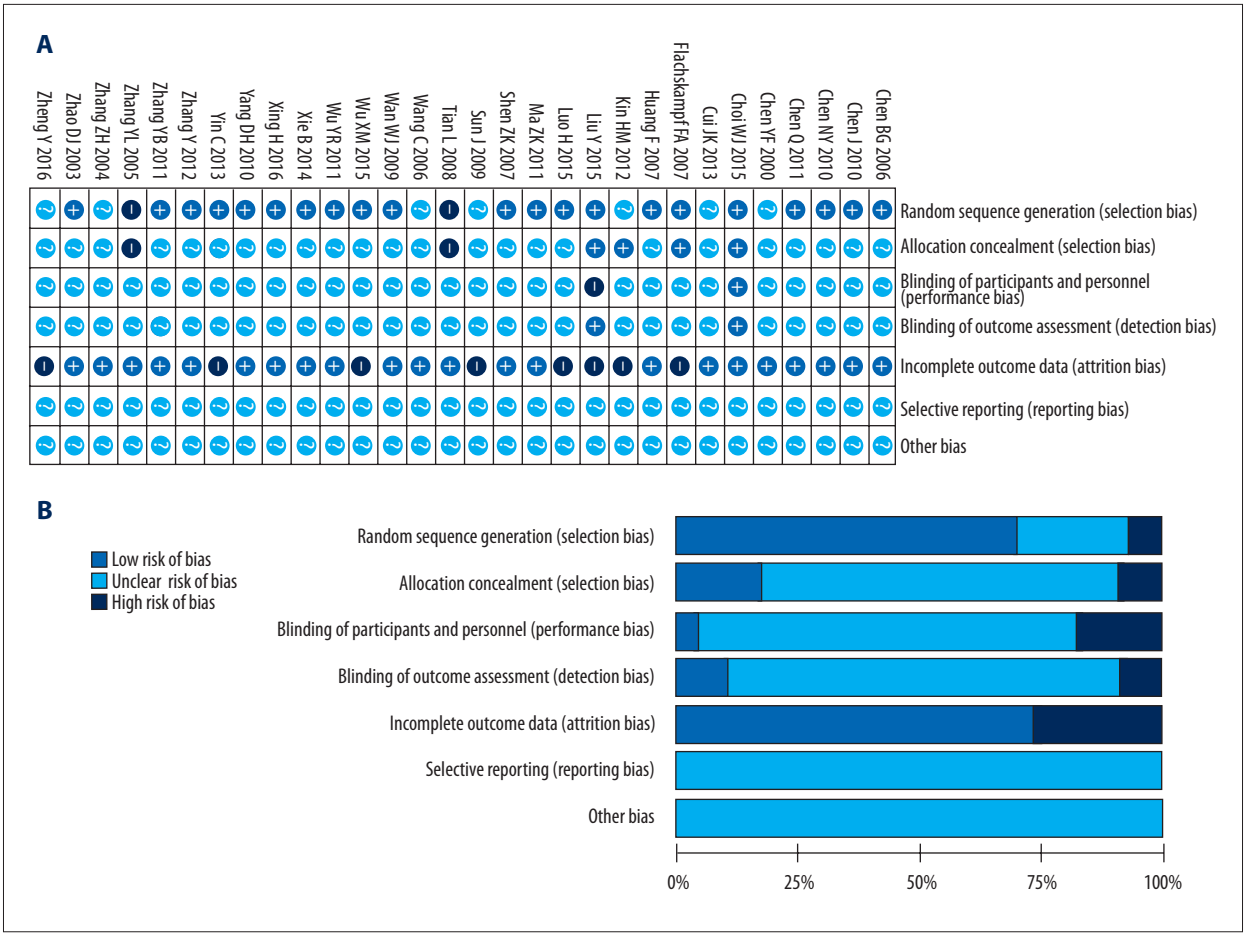

Figure 2. Risk of bias graph of the included trials. (**A**) Summary of the risk of bias in 7 domains in the 30 RCTs. (**B**) Graphical representation of the overall risk of bias in the 7 domains. Green, yellow and red represent low, unclear and high risk of bias. Length of the rectangles (green, yellow or red) show the percentage of studies with low, unclear, or high risk of bias for the 7 domains analyzed.

or anti-hypertensive drugs. The median course of the included studies was 28 days (range: 14–56).

Reporting quality of the included studies

We evaluated the reporting quality of the included studies according to CONSORT and STRICTA guidelines. The CONSORT median quality score was 10 (range: 4–29, Table 2), Based on the CONSORT, Chinese journals (median score: 10; range: 6–17) and English journals (median score: 9; range: 4–29) had similar reporting quality (P=0.875). However, consideration of individual items shows that the quality of English journals is better than Chinese journals for reporting items 1a, 2b, 8b, 9, 11a, 13b, 15, and 19 (all P<0.05; Table 3).

The STRICTA median score was 11 (range: 7–11, Table 2), and using STRICTA, English journals (median score: 12; range: 11–17) have a better reporting quality (P=0.03) than Chinese journals (median score: 11; range: 7–12). Similarly, the STRICTA report shows that the quality of English journals is better than Chinese journals for items 1b, 1c, 4a, and 6a (all P<0.05; Table 4).

Risk of bias of the included studies

Most included studies had poor methodological quality because they lacked sufficient information to assess special items by the Cochrane risk of bias tool (Figure 2). Two trials were quasi-RCTs [35,45], in which the patients were randomized according to even and odd numbers. Twenty-one trials generated a randomized sequence for patients by using a random number table or software [20–23,25,27,28,30–33,36,38–40,42,44,47–49]. The remaining 7 studies did not indicate how random assignments were made. Appropriate allocation concealment was reported in only 5 trials, all published in English [25,27,29,30,49]. Adequate blinding of patients and the doctors was not reported by any of the 30 trials. Blinding of the outcome assessment was mentioned in only 3 trials [25,30,44]. Only 1 study used intention-to-treat analysis [27]. Eight trials

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reported dropouts [27,29–31,34,38,41,48]. Selective reporting is unknown for any of the included studies, since we have no access to the study protocol.

Analyzing the effects of different interventions

We performed the following 8 comparisons based on different types of interventions evaluated in the included studies: (1) acupuncture *vs.* anti-hypertensive drugs; (2) acupuncture *vs.* no treatment; (3) acupuncture *vs.* sham acupuncture; (4) acupuncture plus lifestyle modifications *vs.* lifestyle modifications; (5) acupuncture plus anti-hypertensive drugs *vs.* anti-hypertensive drugs; (6) acupuncture plus anti-hypertensive drugs *vs.* sham acupuncture plus anti-hypertensive drugs; (7) electroacupuncture *vs.* anti-hypertensive drugs; and (8) electroacupuncture plus anti-hypertensive drugs *vs.* anti-hypertensive drugs. The pooled effect estimates for all these comparisons are shown in Figures 3–5.

1. Acupuncture vs. anti-hypertensive drugs

Eight studies with 541 patients reported SBP and DBP compared acupuncture and anti-hypertensive drug treatments [20,22,24,35,39–41,43]. SBP and DBP changes were similar for acupuncture and anti-hypertensive drug treatments [SBP: MD=1.4 mmHg (95% CI: –1.32 to 4.12), I^2=57%; DBP: MD=2.04 mmHg (95% CI: –0.59 to 4.67), I^2=83%].

Nine studies with 517 patients reported efficacy rates of acupuncture and anti-hypertensive drug treatments [20,22–24,35,39–41,46]. The efficacy rates of both these treatments were similar [RR=1.12 (95% CI: 0.98 to 1.28), I^2=78%].

2. Acupuncture vs. no treatment

Only 1 study with 30 patients reported SBP and DBP in patients treated with acupuncture compared to an untreated control group [30]. No differences were observed between treatments in SBP change [SBP: MD=5.2 mmHg (95% CI: –2.99 to 13.39)]. However, DBP changes were greater in patients treated with acupuncture than in untreated patients [DBP: MD=6.1mmHg (95% CI: 1.27 to 10.93)].

3. Acupuncture vs. sham acupuncture

Three studies with 106 patients reported SBP and DBP for acupuncture versus sham acupuncture treatments [25,48,49]. The SBP and DBP changes were similar for both acupuncture and sham acupuncture treatments [SBP: MD=1.59 mmHg (95% CI: –4.63 to 7.8 mmHg), I^2=65%; DBP: MD=–0.01 mmHg (95% CI: –2.59 to 2.57), I^2=15%].

4. Acupuncture plus lifestyle modifications vs. lifestyle modifications

Three studies with 246 patients compared acupuncture plus lifestyle modifications and lifestyle modifications alone [34,38,49]. Two of the three studies (n=187) also reported the efficacy rate of acupuncture plus lifestyle medications and lifestyle modifications alone [34,38]. SBP and DBP changes, as well as efficacy rate, were greater in the combined therapy than in lifestyle modifications alone [SBP: MD=10.38 mmHg (95% CI: 6.72 to 14.04), I^2=86%; DBP: MD=5.74 mmHg (95% CI: 1.94 to 9.54), I^2=91%; RR: 1.2 (95% CI: 1.05 to 1.36), I^2=0%]. This suggests a synergy occurs between acupuncture and lifestyle modification.

5. Acupuncture plus anti-hypertensive drugs vs. anti-hypertensive drugs

Five studies with 365 patients compared treatments of acupuncture plus anti-hypertensive drugs *vs.* anti-hypertensive drugs alone for blood pressure effects [28,31,33,44,45], and 7 studies with 517 patients reported efficacy rates for these 2 treatments [21,26,28,31,33,44,45]. Both SBP and DBP changes, as well as efficacy rates, were higher in acupuncture plus anti-hypertensive drug treatment than in treatment with anti-hypertensive drugs alone [SBP: MD=9.8 mmHg (95% CI: 2.95 to 16.65), I^2=94%; DBP: MD=7.82 mmHg (95% CI: 4.67 to 10.96), I^2=79%; RR=1.17 (95% CI: 1.08 to 1.27), I^2=0%].

6. Acupuncture plus anti-hypertensive drugs vs. sham acupuncture plus anti-hypertensive drugs

Two studies with 170 patients compared the treatments of acupuncture plus anti-hypertensive drugs and sham acupuncture plus anti-hypertensive drugs treatments on blood pressure [27,49]. Changes in SBP and DBP differed between these treatment groups (SBP: MD=8.82 mmHg) (95% CI; 5.1 to 12.54), I^2=35%; DBP: MD=4.44 mmHg (95% CI: 1.7 to 7.19) I^2=36%)

7. Electro-acupuncture vs. anti-hypertensive drugs

Three studies with 200 patients reported SBP and DBP changes with electroacupuncture *vs.* anti-hypertensive drugs [32,36,42] and two (n=99) reported on efficacy rate [32,36]. Electroacupuncture and anti-hypertensive drugs treatments showed similar SBP and DBP magnitude changes and efficacy rates [SBP: MD=1.63 mmHg (95% CI: –3.25 to 6.52), I^2=57%; DBP: MD=–1.98 mmHg (95% CI: –4.85 to 0.62), I^2=31%; RR=0.94 (95% CI: 0.76 to 1.16), I^2=0%].

8. Electro-acupuncture plus anti-hypertensive drugs vs. anti-hypertensive drugs

Only 1 study with 59 patients compared treatment effects of electro-acupuncture plus Lotensin *vs.* Lotensin alone on blood

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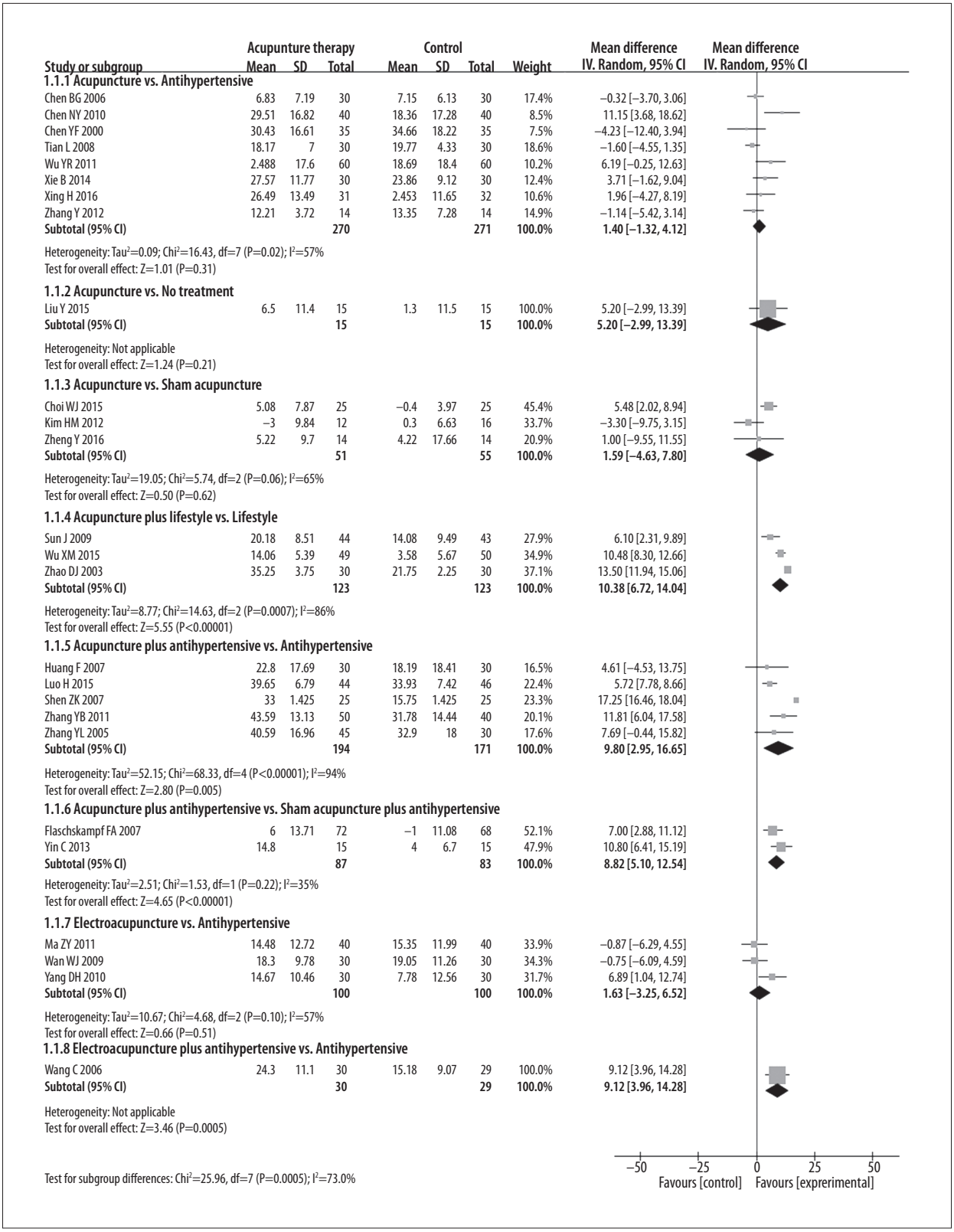

Figure 3. Forest plot of SBP magnitude changes in all 30 trials.

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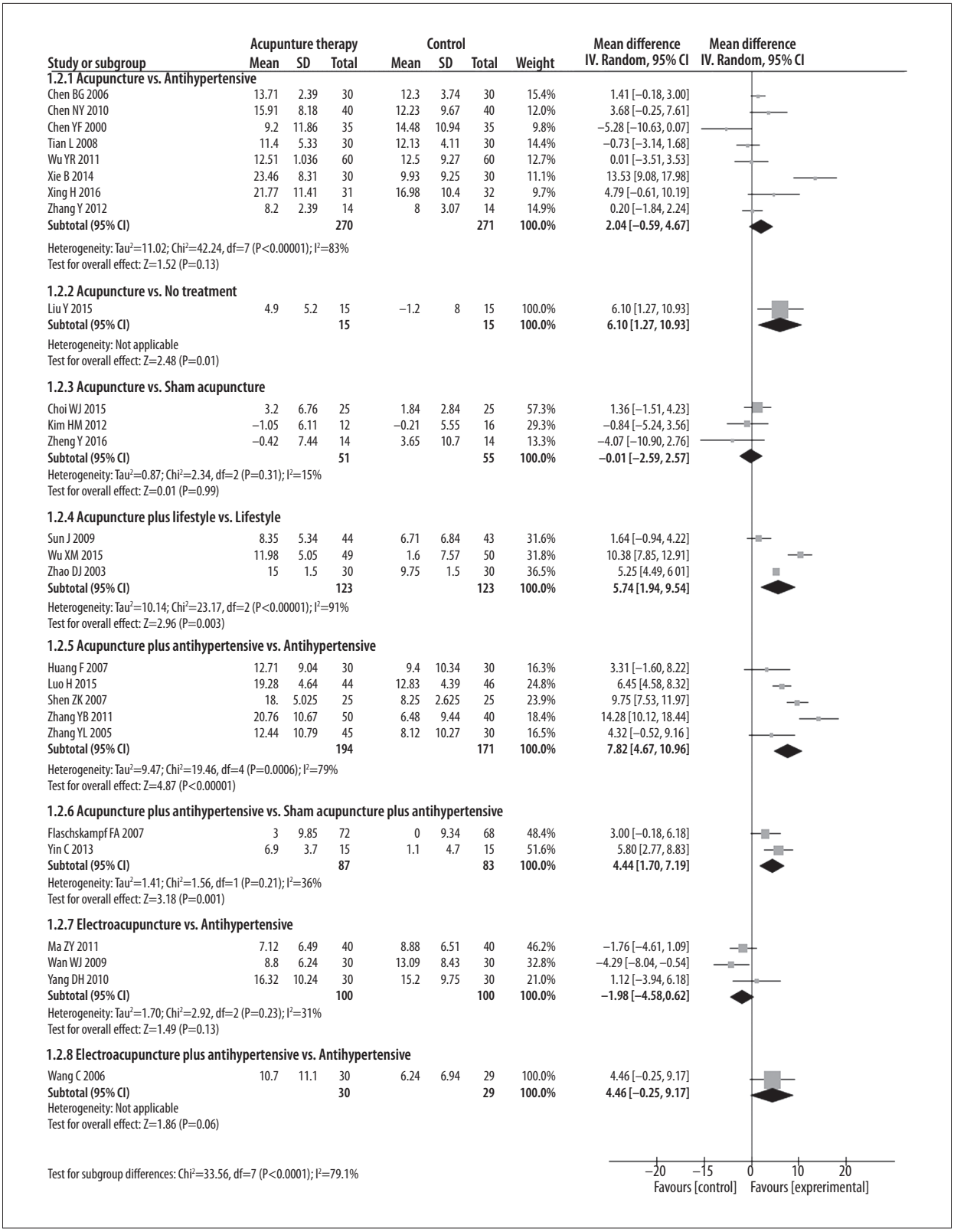

Figure 4. Forest plot of DBP magnitude changes in all 30 trials.

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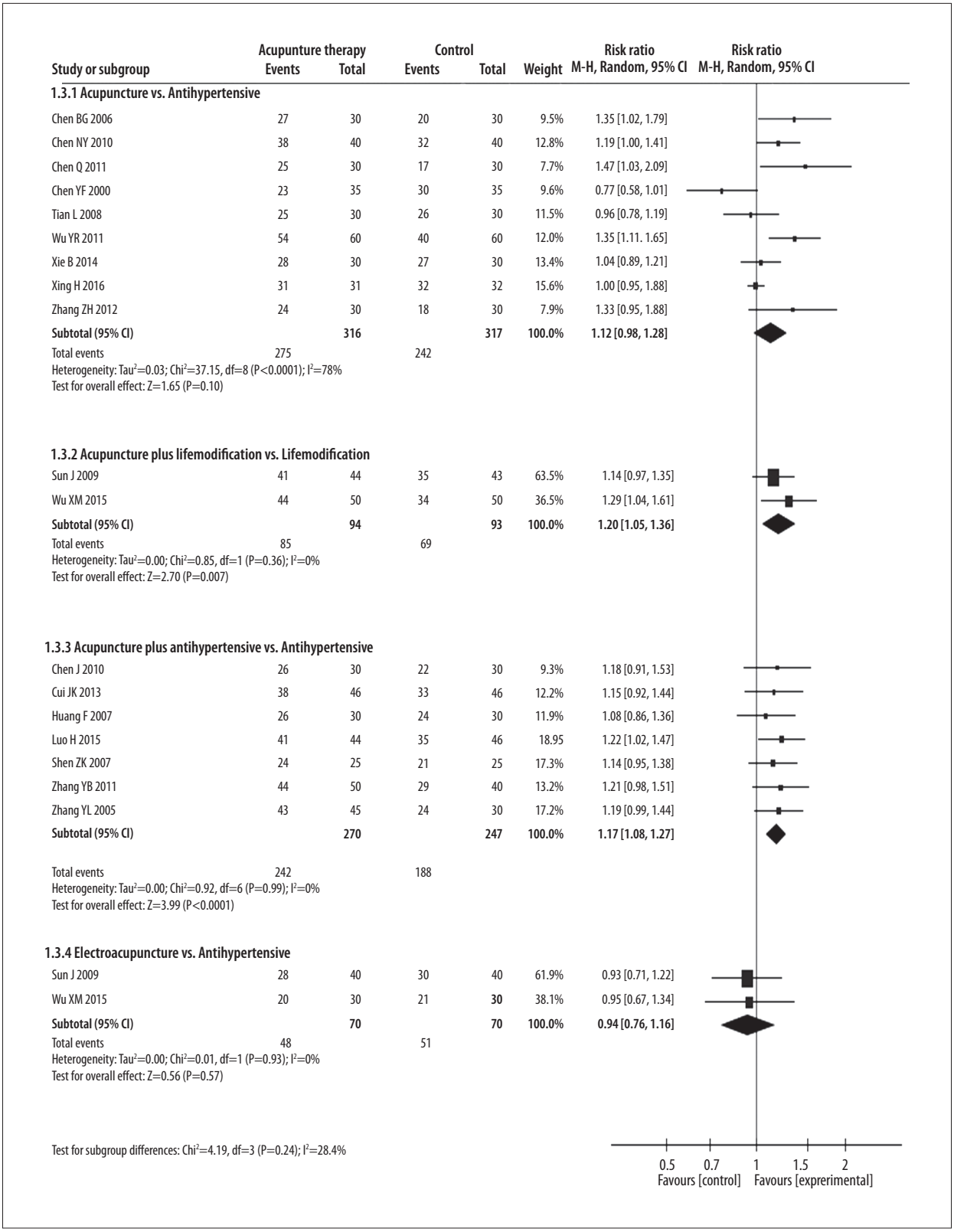

Figure 5. Forest plot of the efficacy rate of acupuncture therapy in all trials.

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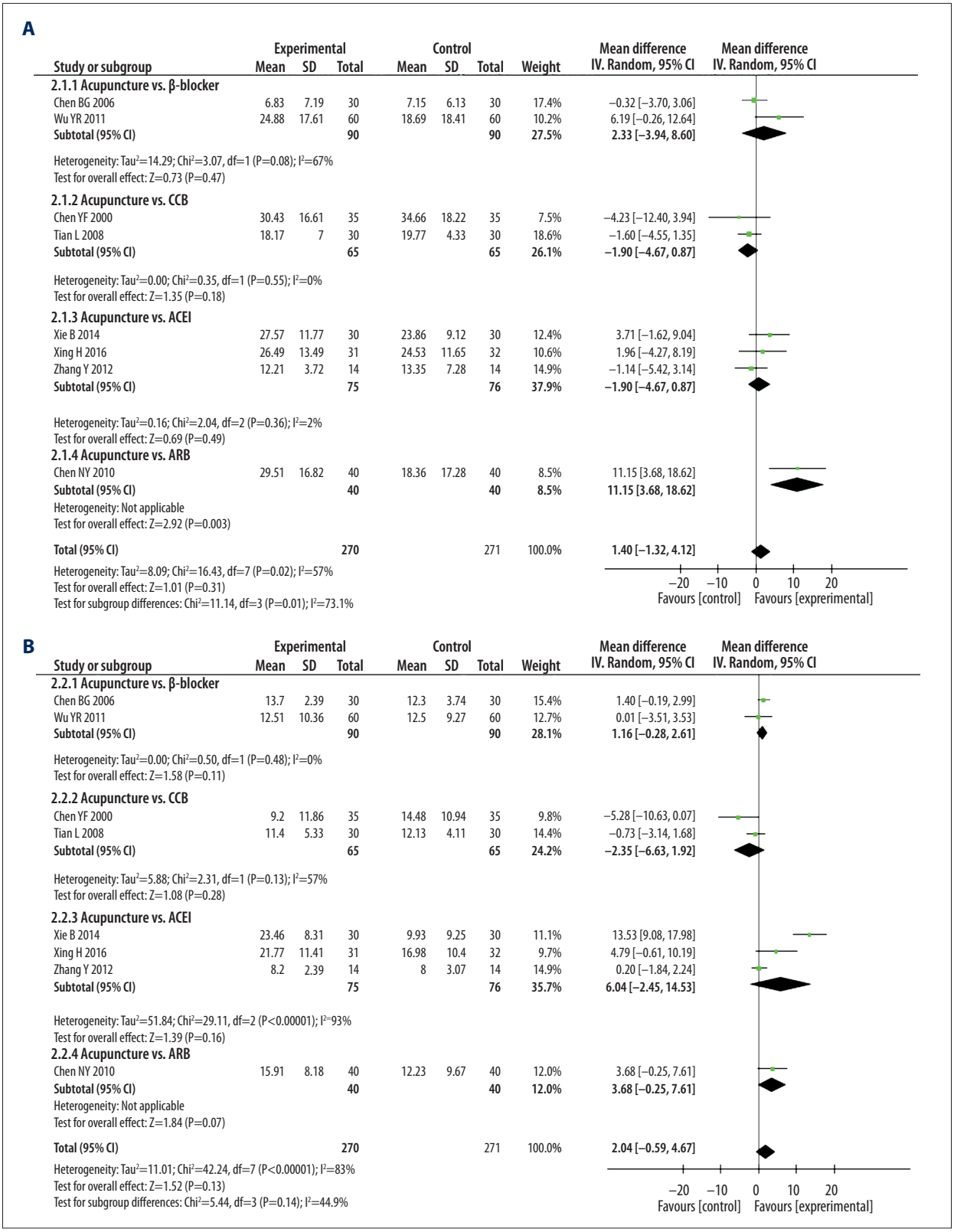

Figure 6. Subgroup analyses of (A) SBP and (B) DBP magnitude changes in patients that underwent acupuncture or anti-hypertensive drug therapies.

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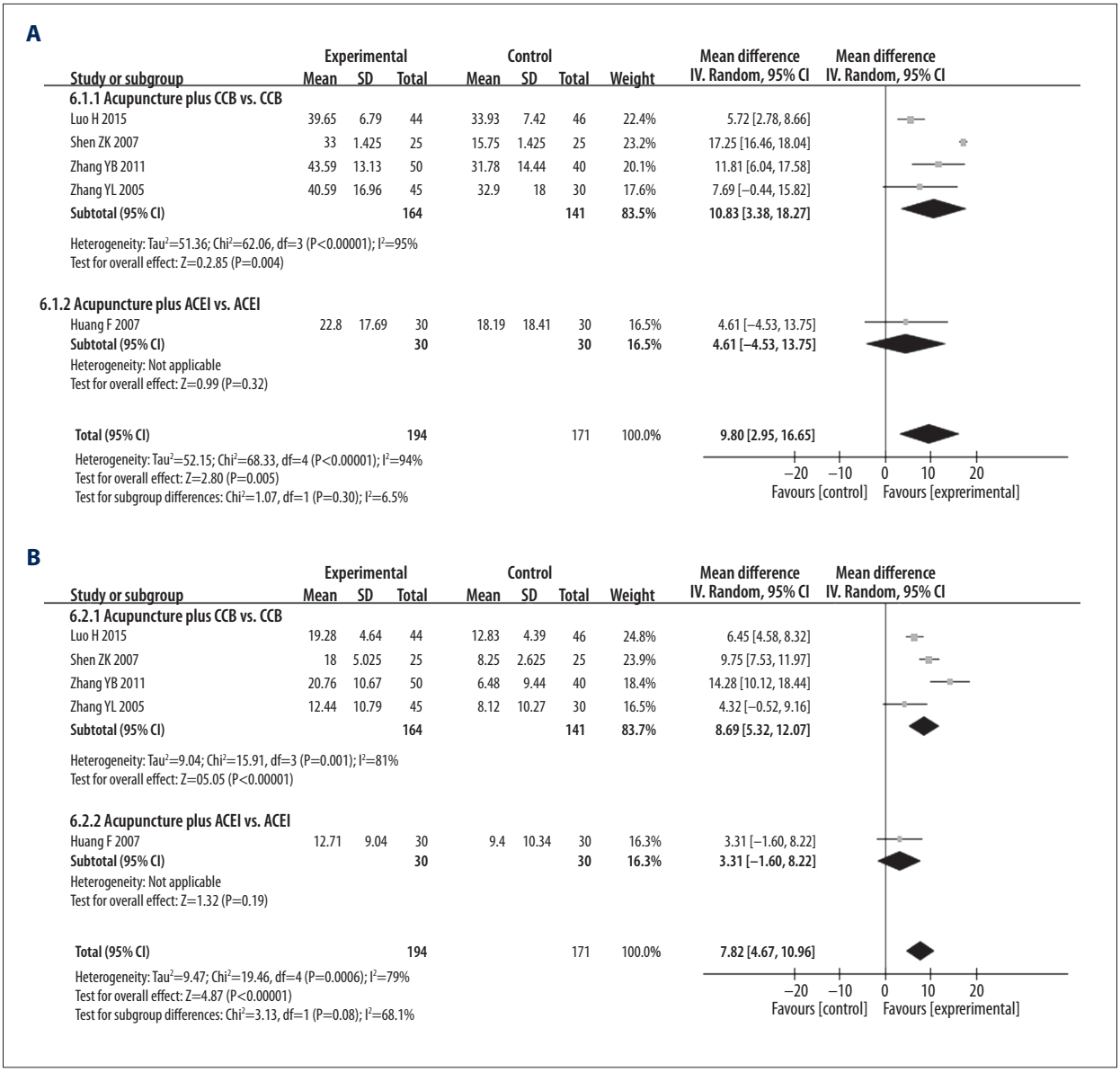

Figure 7. Subgroup analyses of (**A**) SBP and (**B**) DBP magnitude changes in patients that underwent therapy with acupuncture plus anti-hypertensive drugs or anti-hypertensive drugs alone.

pressure [37]. SBP changes were greater in the combined therapy than with lotensin alone [SBP: MD=9.12 mmHg (95% CI: 3.96 to 14.28)]. However, DBP changes were similar in treatment groups [DBP: MD=4.46 mmHg (95% CI: –0.25 to 9.17)].

Subgroup analysis

Clinical heterogeneity is attributed in part to the use of different classes of anti-hypertensive drugs; drugs used included CCB, β-receptor antagonists, ACEI, and ARB. To control for this heterogeneity, we performed subgroup analyses of blood pressure for different classes of anti-hypertensive drugs. Pooled data indicated that DBP changes are similar in acupuncture and anti-hypertensive drug treatments (Figures 6, 7). One study [22] showed that acupuncture lowered SBP better than ARB [SBP: MD=11.15 mmHg (95% CI: 3.68 to 18.62]. Pooled result from 4 studies [31,33,44,45] showed that SBP and DBP changes were also higher in the acupuncture plus CCB treatment than with CCB treatment alone [SBP: MD=10.83 mmHg (95% CI: 3.38 to 18.27), I^2=95%; DBP: MD=8.69 mmHg (95% CI: 5.32 to 12.07), I^2=81%].

Sensitivity analysis for the primary outcomes

We did a sensitivity analysis for SBP and DBP and efficacy rate by omitting studies one at a time. Meta-analysis results for

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Table 5. Sensitivity analysis – systolic pressure.

Study omitted	Estimate	95% Confidence interval (CI)	
		Lower CI limit	Upper CI limit
Acupuncture *vs.* medication			
Chen BG 2006	1.92	–1.41	5.25
Chen NY 2010	0.27	–1.79	2.33
Chen YF 2000	1.90	–0.93	4.72
Tian L 2008	2.15	–0.97	5.27
Wu YR 2011	0.84	–1.88	3.55
Xie B 2014	1.13	–1.83	4.10
Xing H 2016	1.43	–1.59	4.45
Zhang Y 2012	1.94	–1.23	5.10
Acupuncture *vs.* sham acupuncture			
Choi WJ 2015	–2.13	–7.63	3.36
Kim HM 2012	5.05	1.76	8.33
Zheng Y 2016	1.53	–7.03	10.09
Acupuncture plus lifestyle *vs.* lifestyle			
Sun J 2009	12.09	9.14	15.04
WU XM 2015	10.01	2.77	17.25
Zhao DJ 2003	8.58	4.32	12.83
Acupuncture plus antihypertensive *vs.* antihypertensive			
Huang F 2007	10.83	3.38	18.27
Luo H 2015	11.36	5.20	17.53
Shen ZK 2007	7.20	4.19	10.22
Zhang YB 2011	9.23	0.99	17.47
Zhang YL 2005	10.24	2.56	17.91
Acupuncture plus antihypertensive *vs.* sham acupuncture plus antihypertensive			
Flachskampf FA 2007	10.80	6.41	15.19
Yin C 2013	7.00	2.88	11.12
Electroacupuncture *vs.* antihypertensive			
Ma ZY 2011	2.97	–4.51	10.46
Wan WJ 2009	2.92	–4.67	10.53
Yang DH 2010	–0.81	–4.61	2.99

Table 6. Sensitivity analysis – diastolic pressure.

Study omitted	Estimate	95% Confidence interval (CI)	
		Lower CI limit	Upper CI limit
Acupuncture *vs.* medication			
Chen BG 2006	2.21	–1.25	5.67
Chen NY 2010	1.83	–1.07	4.72
Chen YF 2000	2.80	0.14	5.46
Tian L 2008	2.53	–0.53	5.59
Wu YR 2011	2.36	–0.61	5.32
Xie B 2014	0.61	–0.95	2.16
Xing H 2016	1.75	–1.05	4.55
Zhang Y 2012	2.40	–0.85	5.65
Acupuncture *vs.* sham acupuncture			
Choi WJ 2015	–1.79	–5.48	1.91
Kim HM 2012	–0.44	–5.44	4.57
Zheng Y 2016	0.70	–1.70	3.10
Acupuncture plus lifestyle *vs.* lifestyle			
Sun J 2009	7.67	2.65	12.69
WU XM 2015	3.66	0.15	7.18
Zhao DJ 2003	6.01	–2.55	14.58
Acupuncture plus antihypertensive *vs.* antihypertensive			
Huang F 2007	8.69	5.32	12.07
Luo H 2015	8.16	3.78	12.54
Shen ZK 2007	7.18	2.93	11.44
Zhang YB 2011	6.57	3.87	9.28
Zhang YL 2005	8.51	4.99	12.03
Acupuncture plus antihypertensive *vs.* sham acupuncture plus antihypertensive			
Flachskampf FA 2007	5.80	2.77	8.83
Yin C 2013	3.00	–0.18	6.18
Electroacupuncture *vs.* antihypertensive			
Ma ZY 2011	–1.86	–7.14	3.41
Wan WJ 2009	–1.07	–3.55	1.42
Yang DH 2010	–2.72	–5.13	–0.31

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Table 7. Sensitivity analysis – efficacy rate.

Study omitted	Estimate	95% Confidence interval (CI)	
		Lower CI limit	Upper CI limit
Acupuncture *vs.* antihypertensive			
Chen BG 2006	1.12	0.97	1.30
Chen NY 2010	1.14	0.96	1.34
Chen Q 2011	1.12	0.97	1.28
Chen YF 2000	1.19	1.06	1.35
Tian L 2008	1.17	1.01	1.36
Wu YR 2011	1.11	0.96	1.28
Xie B 2014	1.17	0.99	1.37
Xing H 2016	1.14	1.00	1.31
Zhang ZH 2004	1.13	0.97	1.30
Acupuncture plus lifemodification *vs.* lifemodification			
Su J 2009	1.29	1.04	1.61
Wu XM 2015	1.14	0.97	1.35
Acupuncture plus antihypertensive *vs.* antihypertensive			
Chen J 2010	1.17	1.08	1.27
Cui JK 2013	1.18	1.08	1.28
Huang F 2007	1.19	1.09	1.29
Luo H 2015	1.16	1.06	1.27
Shen ZK 2007	1.18	1.08	1.29
Zhang YB 2011	1.17	1.07	1.27
Zhang YL 2005	1.17	1.07	1.27
Electroacupuncture *vs.* antihypertensive			
Ma ZY 2011	0.95	0.67	1.34
Wan WJ 2009	0.93	0.71	1.22

reduced data were similar to the original results (Tables 5–7), suggesting that the pooled data results are robust.

Safety evaluation

Nine of the included studies reported adverse events during the trial [22,25–27,29,30,38,40,41]. No study reported subject dropouts due to adverse events. In 4 studies [22,26,40,41], adverse events such as headache, syncope, dizziness, pain, cough, and bleeding were reported in the treatment group. The adverse effects of headache, dizziness, cough, and hypotension were reported in the control group [22,26,40,41]. The incidence of the adverse events was similar for both groups of patients [RR=0.48 (95% CI: 0.14 to 1.61), I^2=52%].

Publication bias

A funnel plot analysis revealed strong asymmetry (Figure 8), suggesting potential publication bias, probably due to the small sample sizes of the included studies.

Discussion

This systematic review of 28 RCTs and 2 quasi-RCTs showed that acupuncture plus anti-hypertensive drug treatment was better than anti-hypertensive drugs alone or sham acupuncture plus anti-hypertensive drugs, based on change in SBP and DBP. These results suggest that acupuncture enhances the beneficial effects of anti-hypertensive drugs.

DBP changes were greater in patients treated with acupuncture than in untreated patients. Moreover, SBP changes were greater in patients treated with electro-acupuncture plus Lotensin than in Lotensin alone. However, since only 1 study was available to assess both of these comparisons [30], these findings are preliminary and need further evidence.

Our findings also show that lowering of blood pressure is similar in treatments with acupuncture alone and with anti-hypertensive drugs alone. Blood pressure changes are similar for sham acupuncture and acupuncture treatments. Moreover, pooled data from 3 studies showed that blood pressure changes are similar for treatments with electro-acupuncture and anti-hypertensive drugs alone [32,36,42]. These results showed that acupuncture therapy alone was not sufficient for treating hypertension. However, there is significant heterogeneity among the studies; therefore, the quality of the results is low.

Subgroup analysis for different classes of anti-hypertensive drugs reveals that SBP changes are greater for acupuncture treatment than treatment with ARB and β-receptor antagonists. No significant differences are present in DBP changes between acupuncture and the different classes of anti-hypertensive drugs. However, the subgroup analysis reveals that acupuncture combined with CCB was more effective than CCB alone. These results are inconsistent and the data are insufficient to draw any conclusions.

We found that the reporting quality of the included studies was very low, especially for the Chinese journals. STRICTA statement analysis shows that the reporting quality of English journals is better than in Chinese journals. CONSORT statement

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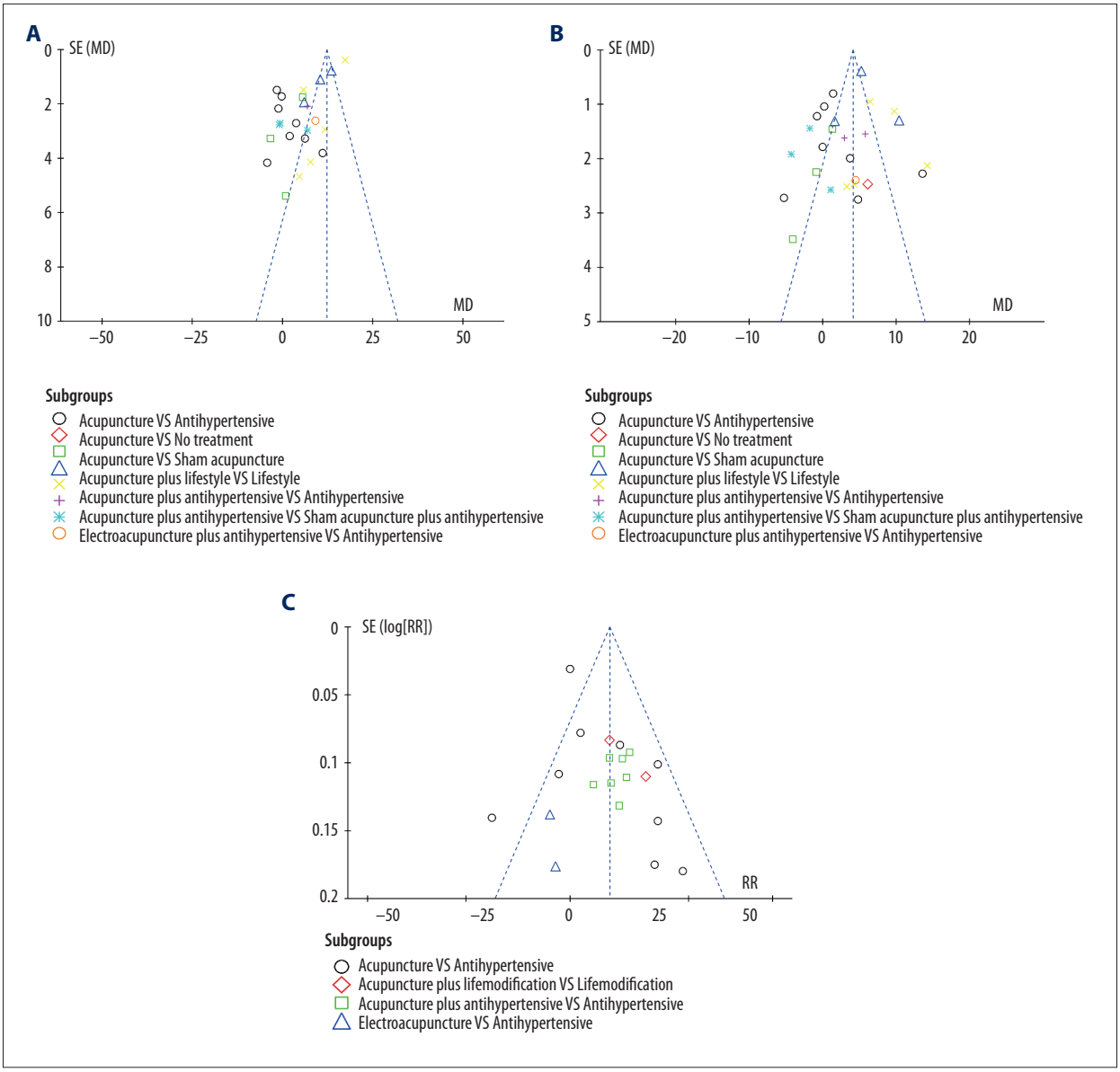

Figure 8. Funnel plot of (**A**) SBP, (**B**) DBP, and (**C**) efficacy rate in all trials.

analysis found no difference between the 2 groups overall, but the English journals had better reporting of the methodological section of the CONSORT statement (sequence generation, allocation, blinding, baseline data, and harms/adverse effects) than Chinese journals. Failure to report details of design methodology is a potential source of increased heterogeneity in the included studies. Therefore, these issues affected the analyses of acupuncture therapy for hypertension.

We also collected the published systematic reviews on the topic (Tables 8, 9). Compared with these systematic reviews, the current systematic review updates the latest evidence, and provides subgroup analysis based on the different classes of anti-hypertensive drugs, which generates most of the clinical heterogeneity. Nonetheless, several limitations to our meta-analysis exist. First, substantial heterogeneity exists among the included studies. In clinics, the methods of acupuncture and selection of the acu-points may vary because the treatment is based on the syndrome differentiation of Traditional Chinese Medicine, which leads to heterogeneity. Moreover, reporting quality of the included studies is low, especially in the methodology section of the study design, which can also be a source for heterogeneity. Second, a lack of translators meant we could only include Chinese and English studies, which leads to a selection bias. Third, sample sizes of the included studies, especially in Chinese trials, are small and the wide confidence intervals indicate high variability.

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Table 8. List and details of reviews (including this review) analyzing acupuncture therapy for hypertension.

Author/year	Language	Clinical characteristics	No. of trials	Search date	Primary outcomes	Subgroup analysis
Zhang et al., 2013	Chinese	AC *vs.* medication; AC *vs.* SA; AC plus medication *vs.* medication	11	October 2012	SBP and DBP change magnitude/adverse effect	Mainly based on different interventions
Guo W et al., 2013	Chinese	AC plus medication *vs.* medication	10	May 31, 2012	SBP and DBP after intervention/efficacy rate/adverse effect	Not performed
Lee H et al., 2009	English	AC plus medication *vs.* SA plus medication; AC *vs.* SA; AC plus medication vs. medication; AC *vs.* medication	11 (3 in meta-analysis)	June, 2007	SBP and DBP change magnitude/adverse effect	Not performed
Li DZ et al., 2014	English	AC *vs.* SA; AC plus medication *vs.* SA plus medication	4	November, 2012	SBP and DBP change magnitude/adverse effect	Mainly based on different interventions
Wang J et al., 2013	English	AC *vs.* SA; AC plus medication *vs.* medication; AC *vs.* medication; AC plus medication *vs.* SA plus medication; AC plus lifestyle modification *vs.* lifestyle modification	35 (24 in meta-analysis)	January, 2013	SBP and DBP change magnitude/adverse effect	Mainly based on different interventions
Zhang YJ et al., 2013	Chinese	AC *vs.* medication; AC plus medication *vs.* medication	13	July, 2013	SBP and DBP after intervention/efficacy rate/adverse effect	Not performed
Zhao XF et al., 2015	English	AC plus medication *vs.* medication; AC *vs.* medication; AC plus medication *vs.* SA plus medication; AC plus lifestyle modification *vs.* lifestyle modification	23	April 13, 2014	SBP and DBP change magnitude/ SBP and DBP after intervention/efficacy rate/adverse effect/	Mainly based on different interventions
The current review	English	AC *vs.* medication; AC *vs.* SA; AC *vs.* no-treatment; AC plus medication *vs.* medication; AC plus medication *vs.* SA plus medication	31	April 30, 2017	SBP and DBP change magnitude/efficacy rate/adverse effect	Mainly based on different classes of antihypertensive drugs

AC – acupuncture; SA – sham acupuncture.

Therefore, the precise effects of acupuncture therapy for treating hypertension remain uncertain given the high overall risk of bias in our included studies. Thus, well-designed and large-sized RCTs are needed.

Conclusions

In conclusion, this review provides evidence that acupuncture enhances the therapeutic effects of anti-hypertensive drugs. However, the benefits and the safety of acupuncture therapy

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Table 9. Main findings of previous reviews that analyzed acupuncture therapy outcomes in hypertension patients.

Author/year	Comparison	No. of trials	Outcomes*,**		
			Blood pressure after intervention	Blood pressure change magnitude	Efficacy rate
Guo et al., 2013	AC plus medication *vs.* medication	4	SBP: –8.35 (–10.89, –5.81) DBP: –5.25 (–11.19, –.69)	Not reported	OR: 5.23 (3.24, 8.44)
Lee H et al., 2009	AC *vs.* SA	3	Not reported	SBP: –5 (–12, 1) DBP: –3 (–6, 0)	Not reported
Lee H et al., 2009	AC plus medication *vs.* SA plus medication	2	Not reported	SBP: –8 (–10, –5) DBP: –4 (–6, –2)	Not reported
Li DZ et al., 2014	AC *vs.* SA	2	Not reported	SBP: 1.33 (–0.25, 5.16) DBP: –0.18 (–3.98, 3.62)	Not reported
Li DZ et al., 2014	AC plus medication *vs.* SA plus medication	2	Not reported	SBP: –8.58 (–10.13, –7.13) DBP: –2.82 (–5.22, –0.43)	Not reported
Wang J et al., 2013	AC *vs.* medication	11	Not reported	SBP: –0.77 (–3.89, 2.35) DBP: 0. 1 (–1.6, 1.79)	Not reported
Wang J et al. 2013	AC plus medication *vs.* medication	7	Not reported	SBP: –10.2 (–14, –6.4) DBP: –4.34 (–6.79, –1.9)	Not reported
Wang J et al. 2013	AC *vs.* SA	3	Not reported	SBP: 0.26 (–2.4, 2.91) DBP: –1.04 (–2.56, 0.47)	Not reported
Wang J et al., 2013	AC plus medication *vs.* SA plus medication	2	Not reported	SBP: –7.74 (–10.43, –4.51) DBP: –4.22 (–6.26, –2.18)	Not reported
Wang J et al., 2013	AC plus lifestyle modification *vs.* lifestyle modification	1	Not reported	SBP: –13.5 (–15.06, –11.94) DBP: –5.25 (–6.01, –4.49)	Not reported
Zhang YJ et al., 2013	AC *vs.* medication	7	SBP: –3.26 (–7.98, 1.46) DBP: –2.17 (–5.02, 0.68)	Not reported	OR: 0.95 (0.45,2)
Zhang YJ et al., 2013	AC plus medication *vs.* medication	4	SBP: –9.5 (–13.66, –5.34) DBP: –0.16 (–2.52, 2.19)	Not reported	OR: 5.13 (2.6,10.11)
Zhao XF et al., 2015	AC *vs.* medication	7	SBP: –0.56 (–3.02, 1.89) DBP: –1.01 (–2.26, 0.24)	Not reported	OR: 1.14 (0.7, 1.85)
Zhao XF et al., 2015	AC plus medication *vs.* medication	3	SBP: –9.04 (–20.11,2.02) DBP: –2.87 (–8.45, 2.72)	Not reported	OR: 4.19 (1.65, 10.67)
Zhao XF et al., 2015	AC plus lifestyle modification *vs.* lifestyle modification	1	SBP: –10.53 (–27.52, 6.46) DBP: –7.52 (–15.06, 0.02)	Not reported	Not reported
Zhao XF et al., 2015	AC *vs.* SA	2	Not reported	SBP: 0.3 (–0.27, 0.88) DBP: –1.4 (–2.37, –0.44)	Not reported
Zhao XF et al., 2015	AC plus medication *vs.* SA plus medication	2	Not reported	SBP: –7.47 (–10.43, –4.51) DBP: –4.22 (–6.26, –2.18)	Not reported

AC – acupuncture; SA – sham acupuncture; No. – number. * Effect size was presented with mean difference (MD, 95% confidence interval [lower limit, upper limit]) in continuous variables or risk ratio or odds ratio (RR or OR, 95% confidence interval [lower limit, upper limit]) in dichotomous variables; ** Lower is better for continuous variables.

for treating hypertension are still unclear because of methodology flaws and low reporting quality of published studies. High-quality RCTs with larger sample sizes are required to better assess the outcomes of acupuncture therapy as treatment for hypertension.

Conflicts of interest

None.

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Supplementary Files

Supplementary Table 1. PRISMA statement.

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number	3
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	3–4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated	3–4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)	5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators	5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made	5
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	5
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means)	6
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis	6
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies)	5–6

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Section/topic	#	Checklist item	Reported on page #
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified	6
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram	6–7
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations	7
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12)	8
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot	8–9
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency	8–9
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15	8
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16])	10
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers)	11–12
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias)	12–13
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review	1

$$SD_{change}=\sqrt{SD1^2+SD2^2-2\times(corr\times SD1\times SD2)}$$

SD_{change}: Standard deviation of change-from-baseline
SD1: Standard deviation of baseline
SD2: Standard deviation of final
Corr: correlation coefficient

According to the Cochrane Handbook for Systematic Reviews of Interventions (Version 5.10).
We input the value Corr as 0.4.

Supplemenatry Figure 1. The formula for calculating the missing change-from-baseline standard deviation.

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