**Effects of acupuncture during in vitro fertilization or intracytoplasmic sperm injection: an updated systematic review and meta-analysis**

Xian Zhang a, Myeong Soo Leeb, Caroline A Smithc, Nicola Robinsond, Yong Zhoua, Yan Wua, Ying-Ying Maoe, Fan Qua\*

a Women’s Hospital, School of Medicine, Zhejiang University, Hangzhou, 310006, China;

b Korea Institute of Oriental Medicine, Daejeon, Korea

c NICM, Western Sydney University, Sydney, Australia

d School of Health and Social Care, London South Bank University, 103 Borough Road, London SE1 0AA,UK

e Zhejiang Chinese Medical University, Hangzhou,310053,China

\*To whom correspondence should be addressed: Dr. Fan Qu, Associate Professor, Women’s Hospital, School of Medicine, Zhejiang University, 1 Xueshi Road, Hangzhou 310006, China Tel.: +86 571 87061501; Fax: +86 571 87061878; Mobile: +86 13429119143; e-mail: syqufan@zju.edu.cn

**Abstract**

**Introduction**: Systematic reviews need constantly updating as new evidence emerges. The aim of this comprehensive systematic review/meta-analysis focused on trials that provided acupuncture during in vitro fertilization (IVF) or intracytoplasmic sperm injection (ICSI) which were compared with routine care for a range of outcomes - implantation rate, biochemical pregnancies (presence of a positive urinary pregnancy test or a positive serum human chorionic gonadotrophin test), clinical pregnancies, ongoing pregnancies, and rates of miscarriage and live birth.

**Methods**: A systematic search of MEDLINE and EMBASE databases for randomized controlled trials (RCTs) on acupuncture treatment during IVF or ICSI was carried out from database inception until July 31, 2017. Study selection, data extraction, quality assessment and bias assessment were carried out by 2 researchers independently, with adjudication by the third researcher when necessary. A meta-analysis was performed to compare outcomes between women receiving acupuncture and those receiving routine care, and pooled relative risks (RR) were calculated.

**Results:** Statistically significant differences were observed in rates of clinical pregnancy (RR = 1.19, 95% confidence intervals (CI): 1.06–1.34 p=0.002), live birth (RR = 1.36, 95% CI: 1.09–1.69 p=0.006), and implantation rate (RR = 1.31, 95% CI: 1.08–1.59 p=0.006) between the acupuncture and the control groups. No significant differences were found for biochemical pregnancies (RR = 1.12, 95% CI: 0.92–1.35 p=0.268), ongoing pregnancies (RR = 1.21, 95% CI: 0.95–1.55 p=0.130), or miscarriage (RR = 0.89, 95% CI: 0.67–1.20 p=0.447) between the two groups. Adverse events were described in 4 studies.

**Conclusions:** Acupuncture may have an impact on the outcome rates of implantation, clinical pregnancy, and live birth; however, well-designed RCTs are warranted to further validate its effects.

**Keywords:** Acupuncture, In vitro fertilization, Intracytoplasmic sperm injection, Systematic review, Meta-analysis, Live birth rate

**Introduction**

Worldwide, in vitro fertilization (IVF) has successfully resulted in the birth of more than 3 million children [[1](#_ENREF_1)]. Each year, more than 300,000 IVF or intracytoplasmic sperm injection (ICSI) cycles are carried out in Europe [[2](#_ENREF_2)]. Moreover, in the United States, the number of children that are conceived through IVF or ICSI comprises 2%–3% of the total number of babies born [[3](#_ENREF_3)]. Acupuncture has been used by numerous infertile couples undergoing infertility treatment as an effective non-pharmacological traditional Chinese medical (TCM) therapy [[4–8](#_ENREF_4)]. Reports suggest that fertility issues are the second leading health condition causing individuals to choose acupuncture treatment in the United Kingdoms [[9](#_ENREF_9)]. However, given that data from clinical trials are inconsistent, physicians and infertile couples face challenges in deciding whether to choose acupuncture for improving the IVF or ICSI outcome [[10](#_ENREF_10)].

In 2012, a systematic review and meta-analysis was conducted which included 17 randomized controlled trials (RCTs). The data indicated that acupuncture did not improve the pregnancy rate in women having IVF or ICSI [[11](#_ENREF_11)]. Several possible assumptions on the sources of heterogeneity in the study were proposed[[11](#_ENREF_11)] and guidance was provided for future trial design [[12](#_ENREF_12)]. Given the release of numerous new studies since 2012, it was necessary to perform an updated review and meta-analysis to inform clinical practice.

**Materials and methods**

***Search strategy***

To investigate whether acupuncture treatment could improve IVF and/or ICSI outcomes, a systematic review and meta-analysis were performed. We searched MEDLINE (1966 to July 2017), SCISEARCH (1974 to July 2017), the Cochrane Menstrual Disorders and Subfertility Group trials register (July 2017), AMED (Allied and Complementary Medicine) (1985 to July 2017), Cumulative Index to Nursing and Allied Health Literature (1982 to July 2017), EMBASE (1974 to July 2017), and reference lists for the relevant studies. Chinese researches were also searched from the Wanfang Database (1982 to July 2017), China Academic Journal Electronic full text Database in China National Knowledge Infrastructure (1982 to July 2017), and Index to Chinese Periodical Literature (1978 to July 2017). ISI Proceedings for conference abstracts, and International Standard Randomized Controlled Trial Number (ISRCTN) Register and meta-register for randomized controlled trials (mRCT) were also searched for randomized controlled trials. To identify published articles that were not identified by electronic searches, relevant references were addressed. When needed, we contacted the authors involved in the studies, and any absent data were obtained. None of our searches involved restrictions in terms of publication type or language.

During our search, we used the following free text terms and Medical Subject Headings (MeSH) terms: (“acupuncture”, “acupressure”, “moxibustion”, “electroacupuncture”, “auricular-acupuncture”, “auriculotherapy”, “acupuncture therapy” and “Traditional Chinese Medicine”) and (“in vitro fertilization”, “fertilization in vitro”, “intracytoplasmic-sperm-injection”, “assisted reproductive techniques”, “oocytes”, “egg collection”, “embryo transfer” and “embryo implantation”).

***Study selection***

In this study, only RCTs in which acupuncture was compared with no acupuncture treatment or sham treatment during IVF/ICSI were selected. Therapeutic intervention included several accepted acupuncture procedures, such as acupuncture using lasers, traditional acupuncture using needles, electro-acupuncture, and auricular acupuncture. Any study that included a crossover design was excluded. Eligible trials required the extraction of data including at least one of the following outcomes: biochemical pregnancy (presence of a positive urinary pregnancy test or a positive serum human chorionic gonadotrophin test), clinical pregnancy (fetal heartbeat or at least one gestational sac present, confirmed by trans-vaginal ultrasound), ongoing pregnancy (pregnancy beyond 10 weeks of gestation, as confirmed by fetal heart activity on ultrasound), live birth (presence of a baby born alive after 24 weeks gestation), miscarriage (presence of miscarriage before the 16th weeks of pregnancy), and implantation rate(number of gestational sacs per number of transferred embryos).

Manuscripts identified were independently analyzed by 2 investigators (X.Z. and Y.Z.). Moreover, full manuscripts were obtained for any citation with the potential to meet the inclusion criteria. After thorough inspection of the entire manuscript, a decision was made to include or exclude the study. When duplicate manuscripts were included, only the most up-to-date version was included. Any disagreement was resolved by review and adequate discussion with a fourth reviewer (F.Q.).

***Assessments Bias Risk***

Risk of bias was assessed independently by two authors (X.Z. and Y.W.) with the “Risk of Bias table” (Table A) in the Cochrane Handbook for Systematic Reviews of Interventions 5.1.0. Sequence generation, allocation concealment, blinding (or masking), incomplete data assessment, selective outcome reporting, and other sources of bias were assessed with three potential responses: Low risk, High risk, and unclear. Disagreements between review authors were resolved by discussion or with a third author (Q.F.).

***Data extraction and quality assessment***

Treatment effects were evaluated and pooled relative risks (RRs) were calculated. This was performed by comparing the rates of clinical, biochemical, ongoing pregnancy, implantation, live birth, and miscarriage among women who underwent acupuncture treatment compared with controls. From each study, the extracted features included population characteristics and interventions. An intention-to-treat approach was used to extract outcome data from each study.

Study quality was evaluated using internal validity criteria selected from a list established by the Cochrane Menstrual Disorders and Subfertility Group. Data regarding adequacy of randomization, blinding, comparability at baseline, concealment of allocation, intention-to-treat analysis, sham acupuncture, power analysis, and Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA) guidelines adherence were determined by investigating the entire manuscript. Moreover, the corresponding authors were contacted if additional information was needed or if clarification was required. Sham acupuncture was accepted when it used any standard method of delivery; for example, the use of acupuncture at sites that are not intended for treatment, the use of standard acupoints, and the application of sham laser acupuncture or blunt (placebo) needles.

***Statistical analysis***

Study heterogeneity was evaluated using Cochran’s Q test and *I2* statistics, which defines significant heterogeneity as *P* < 0.10 and/or *I2* > 50%. When no significant heterogeneity could be observed, a fixed-effects model was applied. In other cases, a random-effects model was used to specify additional conservative estimates. Forest plots of the rates of pregnancy were generated for the acupuncture-complemented treatment versus no/sham acupuncture. Subgroup analyses were performed using the following conditions: I. type of control (placebo or no acupuncture invention); II. adherence to STRICTA guidelines (yes or no); III. number of centers (single or multiple); IV. acupuncture type (electrical acupuncture or traditional acupuncture); V. administration of acupuncture (by acupuncturist or not). Subsequently, sensitivity analysis was performed to explore whether the overall findings were affected if individual studies were excluded. Publication bias was assessed by using funnel plot, Begg's test and Egger's test. STATA software version 12.0 (STATA Corp, College Station, TX, USA) was used to perform the statistical analyses.

**Results**

***Results from risk of bias assessment***

By the Cochrane Handbook for Systematic Reviews of Interventions 5.1.0., of 31 randomized controlled trials (RCTs), there were 17 (54.8%) RCTs with low risk of bias arising from the random sequence generation, 20 (64.5%) RCTs with low risk of bias due to allocation concealment, 10 (32.2%) RCTs with low risk of bias due to blinding of participants and personnel, 27(87.1%) RCTs had low risk of bias in blinding of outcome assessment, 23 (74.2%) RCTs had low risk of bias in incomplete outcome data, and 28 (90.3%) RCTs had low risk of bias due to selective reporting. Table B shows results from the risk of bias assessment.

***Study characteristics***

The electronic searches yielded a total of 238 publications. After evaluation of the selected articles and applying the inclusion/exclusion criteria, 86 publications were selected for further retrieval. The flow chart of the literature search and the selection process is presented in Figure A. Of all 86 publications examined, 31 manuscripts [[13–43](#_ENREF_13)] which included 6098 women met our inclusion criteria. Tables C and D show the specific details of the studies included.

***Adverse event***

Among the included 31 papers, adverse events were described in 4 studies [21,36,38,43], among which, 2 studies [36,38] showed no adverse event and another 2 studies [21,43] reported adverse events. Sator-Katzenschlager et al. [21] reported “inadequate comfort “, while Zheng et al. [43] reported 7 cases (2.5%) with dizziness, and 3 cases (1.1%) with fatigue.

***Outcomes of IVF***

Regarding the clinical pregnancy outcome, data from all 31 included trials (*n* = 6098) were available for analysis [[13–43](#_ENREF_13)], and significant heterogeneity was found among the studies (*I2*= 63.4%, *P*=0.000). When using the random-effects model, clinical pregnancy outcome was significantly different between the acupuncture and the control groups (RR = 1.19, 95% CI: 1.06–1.34, *P* = 0.002; Figure B).

Regarding the biochemical pregnancy outcome, data from 12 out of the 31 included trials were accessible (*n* = 2864) [[17](#_ENREF_17),[19](#_ENREF_19),[20](#_ENREF_20),[23](#_ENREF_23),[24](#_ENREF_24),[26–29](#_ENREF_26),[32](#_ENREF_32),[34](#_ENREF_34),[35](#_ENREF_35)]. Moreover, a significant heterogeneity was found among the studies (*I2*= 77.4%, *P* = 0.000). When the random-effects model was used, the biochemical pregnancy outcome was not significantly different between the two groups (RR = 1.12, 95% CI: 0.92–1.35, *P* = 0.268; Figure C).

Figure D shows that for ongoing pregnancy outcome, data were obtained from 9 out of the 31 included trials (*n* = 2454) [[14–16](#_ENREF_14),[20](#_ENREF_20),[22](#_ENREF_22),[23](#_ENREF_23),[27](#_ENREF_27),[28](#_ENREF_28),[34](#_ENREF_34)]. Significant heterogeneity was found among studies (*I2*= 67.1%, *P*= 0.002). When using the random-effects model, no significant difference was found regarding the outcome of ongoing pregnancy between groups after combining the results from all 9 trials (RR = 1.21, 95% CI: 0.95–1.55, *P* = 0.130).

Regarding the implantation rate, data from 11 out of the 31 included trials were available (*n* = 4333) [[13](#_ENREF_13),[16](#_ENREF_16),[17](#_ENREF_17),[20](#_ENREF_20),[23](#_ENREF_23),[25](#_ENREF_25),[27](#_ENREF_27),[32](#_ENREF_32),[37](#_ENREF_37),[38](#_ENREF_38),[41](#_ENREF_41)]. However, no significant heterogeneity was found among the studies (*I2*= 68.6%, *P*= 0.000). When combining the data from all 11 trials, a significant difference in the implantation rate was observed between the groups based on the random-effects model (RR = 1.31, 95% CI: 1.08–1.59, *P* = 0.006; Figure E).

Regarding the live birth outcome, information was extracted from 12 out of the 31 included trials (*n* = 3188) [[14](#_ENREF_14),[15](#_ENREF_15),[20](#_ENREF_20),[23](#_ENREF_23),[27](#_ENREF_27),[28](#_ENREF_28),[30–32](#_ENREF_30),[36](#_ENREF_36),[38](#_ENREF_38),[41](#_ENREF_41)],and significant heterogeneity was found among the studies (*I2*= 70.1%, *P*= 0.000). Moreover, when using the random-effects model, a significant difference was observed between the groups in the live birth outcome after combining the results from the 12 trials (RR = 1.36, 95% CI: 1.09–1.69, *P* = 0.006; Figure F).

For the miscarriage outcome, data were obtained from 12 out of the 31 included trials (*n*=854) [[13](#_ENREF_13),[15](#_ENREF_15),[20](#_ENREF_20),[27](#_ENREF_27),[30](#_ENREF_30),[31](#_ENREF_31),[34](#_ENREF_34),[37](#_ENREF_37),[40–43](#_ENREF_40)], and no significant heterogeneity was found among the studies (*I2*= 0.0%, *P*= 0.895). In addition, when using the fixed-effects model, no significant difference was found in miscarriage outcome between the groups when the results from the 12 trials were combined (RR = 0.89, 95% CI: 0.67–1.20, *P* = 0.447; Figure G).

***Subgroup analysis***

[Table E](#page5) presents the results of the subgroup analysis of outcomes regarding clinical pregnancy, implantation, and live birthrate. No differences were found between the groups after combining the results from the studies that adhered to the STRICTA guidelines. However, studies that did not adhere to the STRICTA guidelines did show significant differences. Additionally, the analysis of single center studies showed significant differences between the groups, whereas the analysis of multicenter studies showed no differences between the groups. The data from studies in which electrical acupuncture was used showed significant differences between acupuncture versus no/sham acupuncture. However, the data from studies using traditional acupuncture showed no significant differences.

***Sensitivity analysis***

Sensitivity analysis of the method used to combine the corresponding data was conducted by examining individual studies. Pooled results were not significantly altered even when the most powerful study was not included (not shown).

***Publication bias***

Publication bias analysis was conducted with funnel plot, Begg's and Egger's tests. The results showed that CP, BCP and OP had significant publication bias, however, the publication bias of IR, LBR and MR was negligible.

**Discussion**

As more clinical trials on exploring the effects of acupuncture on pregnancy outcomes in women having IVF or ICSI have been published since 2012, there existed differences in the findings between the present meta-analysis and the one published in 2012 by the same group. The current meta-analysis included a higher number of studies and the trend was highly significant. However, the subgroup analysis indicated a different result when studies adhered to the STRICTA protocol, single or multicenter, and the type of acupuncture with traditional acupuncture (TA) or electrical acupuncture (EA). There existed differences on the outcomes of biochemical pregnancy, clinical pregnancy, implantation, ongoing pregnancy, miscarriage and live birth, which might be induced by the different effects of acupuncture on the oocytes or uterus.

The subgroup analysis showed that the pooled outcome from trials that adhered to the STRICTA guidelines or were multi-center studies indicated that acupuncture treatment did not result in significantly improved pregnancy rates of IVF or ICSI. These findings indicate that relatively high-quality trials may not support the main result of the meta-analysis. Whether acupuncture plays a positive role in IVF or ICSI remains to be elucidated by increasing the number of high-quality studies. The subgroup analysis of the results pooled from the studies in which traditional acupuncture was conducted did not show a significant difference with the use of acupuncture. It has been suggested that the clinical therapeutic effect of electrical acupuncture may be very different from that of traditional acupuncture. As such, whether the effect of acupuncture depends on electrical stimulation or the manipulation of an acupuncturist still needs further exploration.

Several systematic reviews and meta-analysis investigating the efficacy of acupuncture treatment on the outcomes of IVF were published between 2012 and 2016. Chen et al. [[44](#_ENREF_44)] showed that various clinical RCTs indicated that acupuncture treatment was beneficial in increasing the pregnancy rate. The finding that acupuncture treatment could improve fertilization was not supported by other studies. Although the results are promising, additional well-designed RCTs are needed to verify these results. Nandi et al. [[45](#_ENREF_45)] found that acupuncture is a safe therapeutic approach that is beneficial for patients. However, whether acupuncture is beneficial for improving the rate of live birth in IVF remains subject to further investigation. Shen et al. [[4](#_ENREF_4)] demonstrated that acupuncture treatment performed only at the time of embryo transfer did not increase the clinical pregnancy rate of IVF. However, a combined benefit was found for acupuncture treatment in IVF when it was carried out during the follicular phase as well as at 25 minutes prior, after embryo transfer (RR=1.56, 95% CI: 1.04–2.33), 30 minutes after embryo transfer, and during the implantation phase (RR=1.76, 95% CI: 1.22–2.55).

The strengths and the potential limitations of this meta-analysis need to be mentioned. In the present study, the effect of acupuncture on IVF or ICSI has been comprehensively evaluated and stratified by many potential modifying factors. Furthermore, robust results were obtained from sensitivity analyses. However, we found significant heterogeneity among studies that may be attributed to differences in study design and quality. By performing the random-effects model, the heterogeneity was already considered among studies. In addition, the body–mass index of patients, the reason for infertility, and the number of times for IVF/ICSI cycles were not studied in this meta-analysis as this information was only available from a small proportion of the original studies. STRICTA guideline, which set the reporting guidelines for the acupuncture rationale, the details of needling, the treatment regimen, other components of treatment, the practitioner background and the control or comparator intervention[46], is an important key factor affecting the quality of trials. However, As shown in Table C, only fourteen studies [[16-18](#_ENREF_16), [21-23](#_ENREF_21), [27-30](#_ENREF_27), [32](#_ENREF_32), [34](#_ENREF_34), [36](#_ENREF_36), [38](#_ENREF_38)] adhered to STRICTA. Among the included 31 papers, adverse events were described only in 4 studies [21,36,38,43], among which, 2 studies [36,38] showed no adverse event and another 2 studies [21,43] reported adverse events. As traditional acupuncture is an invasive and aching therapy, the adverse events during the treatment should be considered in the future researches.

Taken together, although the present meta-analysis indicates that acupuncture treatment is beneficial in IVF/ICSI for improving the clinical pregnancy, implantation, and live birth outcomes, further well-designed RCTs with high-quality and increased samples sizes are still required to verify the data obtained in this study.

**Conclusions**

Acupuncture may have an impact on the outcome rates of implantation, clinical pregnancy, and live birth; however, well-designed RCTs are warranted to further validate its effects.

**Conflict of interest**

None.

**Author contributions**

Q.F. conceived and designed the study. Q.F., X.Z., and Y. Y. M. developed the search strategy for the identification of articles and identified the articles. Q.F., X.Z., and Y. Y. M. acquired and analyzed the data. Q.F., X.Z., and Y.W. drafted the manuscript. All authors have revised and approved the final version of the manuscript.

**Funding sources**

The authors declare no competing financial interests.

Caroline A Smith: As a medical research institute, NICM receives research grants and donations from foundations, universities, government agencies and industry. Sponsors and donors provide untied and tied funding for work to advance the vision and mission of the Institute. I am an author on one of the papers included in this review. I had no role in the data extraction of this paper.

**References**

1. K. Horsey, 3,000,000 IVF babies born worldwide since 1979, Presented at the annual conference of the European Society of Human Reproduction and Embryology (ESHRE) 2006(Progress Educational Trust 2006).
2. A.N. Andersen et al., Assisted reproductive technology in Europe, 2003. Results generated from European registers by ESHRE, Hum Reprod. 22 (2007) 1513–25.
3. K.G. Nygrenand A.N. Andersen, Assisted reproductive technology in Europe, 1997. Results generated from European registers by ESHRE. European IVF-Monitoring Programme (EIM) for the European Society of Human Reproduction and Embryology (ESHRE), Hum Reprod. 16 (2001) 384–91.
4. C. Shen et al., The role of acupuncture in in vitro fertilization: a systematic review and meta-analysis, Gynecol Obstet Invest. 79 (2015)1–12.
5. E. Manheimer et al., The effects of acupuncture on rates of clinical pregnancy among women undergoing in vitro fertilization: a systematic review and meta-analysis, Hum Reprod Update 19 (2013) 696–713.
6. K. Weeks and G. Gaspard, The use of acupuncture with in vitro fertilization as a treatment for female subfertility, J Altern Complement Med. 19 (2013) 732.
7. L.E. Hullender Rubin et al., Acupuncture and in vitro fertilization: a retrospective chart review, J Altern Complement Med. 19 (2013) 637–43.
8. F. Qu, J. Zhou and R.X. Ren, Effects of acupuncture on the outcomes of in vitro fertilization: a systematic review and meta-analysis, J Altern Complement Med. 18 (2012) 429–39.
9. A.K. Hopton et al., Acupuncture in practice: mapping the providers, the patients and the settings in a national cross-sectional survey, BMJ Open 2 (2012) e000456.
10. E. Myers, Acupuncture as adjunctive therapy in assisted reproduction: remaining uncertainties, Fertil Steril. 85 (2006) 1362–1363.
11. F. Qu, J. Zhou and R.X. Ren, Effects of acupuncture on the outcomes of in vitro fertilization: a systematic review and meta-analysis, J Alt Complem Med. 18 (2012) 429.
12. F. Qu et al., Does acupuncture improve the outcome of in vitro fertilization? Guidance for future trials, Eur J Integ Med. 4 (2012) e234–e244.
13. E. Stener-Victorin et al., A prospective randomized study of electro-acupuncture versus alfentanil as anaesthesia during oocyte aspiration in in-vitro fertilization, Hum Reprod. 14 (1999) 2480–4.
14. W.E. Paulus et al., Influence of acupuncture on the pregnancy rate in patients who undergo assisted reproduction therapy, Fertil Steril. 77 (2002) 721–4.
15. W.E. Paulus et al., Placebo-controlled trial of acupuncture effects in assisted reproduction therapy, Human Reproduction 18 (2003).
16. E. Stener-Victorin et al., Electroacupuncture as a perioperative analgesic method and its effects on implantation rate and neuropeptide Y concentrations in follicular fluid, Hum Reprod. 18 (2003) 1454–60.
17. P. Humaidan and E. Stener-Victorin, Pain relief during oocyte retrieval with a new short duration electroacupuncture technique--an alternative to conventional analgesic methods, Hum Reprod. 19 (2004) 1367–72.
18. A.L. Gejervall et al., Electroacupuncture versus conventional analgesia: a comparison of pain levels during oocyte aspiration and patients' experiences of well-being after surgery, Hum Reprod. 20 (2005) 728–35.
19. M.R. Benson et al., P-18: Impact of acupuncture before and after embryo transfer on the outcome of in vitro fertilization cycles: a prospective single blind randomized study, Fertil Steril. 86 (2006) S135–S135.
20. S. Dieterle et al., Effect of acupuncture on the outcome of in vitro fertilization and intracytoplasmic sperm injection: a randomized, prospective, controlled clinical study, Fertil Steril. 85 (2006) 1347–51.
21. S.M. Sator-Katzenschlager et al., Auricular electroacupuncture as an additional perioperative analgesic method during oocyte aspiration in IVF treatment, Hum Reprod. 21 (2006) 2114–20.
22. C. Smith, M. Coyle and R.J. Norman, Influence of acupuncture stimulation on pregnancy rates for women undergoing embryo transfer, Fertil Steril. 85 (2006) 1352–8.
23. L.G. Westergaard et al., Acupuncture on the day of embryo transfer significantly improves the reproductive outcome in infertile women: a prospective, randomized trial, Fertil Steril. 85 (2006) 1341–6.
24. L.B. Craig et al., Acupuncture lowers pregnancy rates when performed before and after embryo transfer, Fertil Steril. 88 (2007) S40–S40.
25. J. Chen et al., [Effects of electroacupuncture on in vitro fertilization-embryo transfer (IVF-ET) of patients with poor ovarian response], Zhongguo Zhen Jiu. 29 (2009) 775–9.
26. A.D. Domar et al., The impact of acupuncture on in vitro fertilization outcome, Fertil Steril. 91 (2009) 723–6.
27. E.W. So et al., A randomized double blind comparison of real and placebo acupuncture in IVF treatment, Hum Reprod. 24 (2009) 341–8.
28. D. Andersen et al., Acupuncture on the day of embryo transfer: a randomized controlled trial of 635 patients, Reprod Biomed Online. 21 (2010) 366–72.
29. I. Moy et al., Randomized controlled trial: effects of acupuncture on pregnancy rates in women undergoing in vitro fertilization, Fertil Steril. 95 (2011) 583–7.
30. C. Madaschi et al., Effect of acupuncture on assisted reproduction treatment outcomes, Acupunct Med. 28 (2010) 180–4.
31. W. Cui et al., [Effect of electroacupuncture on oocyte quality and pregnancy for patients with PCOS undergoing in vitro fertilization and embryo transfervitro fertilization and embryo transfer], Zhongguo Zhen Jiu. 31 (2011) 687–91.
32. R. Zhang et al., Increase of success rate for women undergoing embryo transfer by transcutaneous electrical acupoint stimulation: a prospective randomized placebo-controlled study, Fertil Steril. 96 (2011) 912–6.
33. Z.G. Sun, F. Lian and J.W. Zhang, [Effects of acupuncture combined Chinese materia medica for tonifying shen and soothing gan on the anxiety and depression of patients with in vitro fertilization and embryo transplantation and on the treatment outcomes], Zhongguo Zhong Xi Yi Jie He Za Zhi. 32 (2012) 1023–7.
34. B.H. Rashidi et al., Effects of acupuncture on the outcome of in vitro fertilisation and intracytoplasmic sperm injection in women with polycystic ovarian syndrome, Acupunct Med. 31 (2013) 151–6.
35. D.I. Villahermosa et al., Influence of acupuncture on the outcomes of in vitro fertilisation when embryo implantation has failed: a prospective randomised controlled clinical trial, Acupunct Med. 31 (2013) 157–61.
36. L.B. Craig et al., Acupuncture performed before and after embryo transfer: a randomized controlled trial, J Reprod Med. 59 (2014) 313–20.
37. Y.L. Hong et al., [Effect of electroacupuncture on clinical outcomes and ovarian hyperstimulation syndrome in in vitro fertilization and embryo transplantation], Zhongguo Zhong Xi Yi Jie He Za Zhi. 34 (2014) 1292–6.
38. F. Qu et al., Auricular acupressure reduces anxiety levels and improves outcomes of in vitro fertilization: a prospective, randomized and controlled study, Sci Rep. 4 (2014) 5028.
39. Q. Chen and C. Hau, [Impacts on pregnancy outcome treated with acupuncture and moxibustion in IVF-ET patients], Zhongguo Zhen Jiu. 35 (2015) 313–7.
40. J. Li et al., [Effect of electro-acupuncture on the spindle and oocytes quality in patients with PCOS], Zhongguo Zhong Xi Yi Jie He Za Zhi. 35 (2015) 304–9.
41. Z. Shuai et al., Effect of transcutaneous electrical acupuncture point stimulation on endometrial receptivity in women undergoing frozen-thawed embryo transfer: a single-blind prospective randomised controlled trial, Acupunct Med. 33 (2015) 9–15.
42. B.Z. Yang, W. Cui and J. Li, [Effects of electroacupuncture intervention on changes of quality of ovum and pregnancy outcome in patients with polycystic ovarian syndrome], Zhen Ci Yan Jiu. 40 (2015) 151–6.
43. Y. Zheng et al., Effects of transcutaneous electrical acupoint stimulation on ovarian reserve of patients with diminished ovarian reserve in in vitro fertilization and embryo transfer cycles, J Obstet Gynaecol Res. 41 (2015) 1905–11.
44. Y.R. Chen et al., [Development of researches on acupuncture-assisted fertilization outside of China], Zhen Ci Yan Jiu. 39 (2014) 329–32.
45. A. Nandi et al., Acupuncture in IVF: A review of current literature, J Obstet Gynaecol. 34 (2014) 555–61.
46. H. Macpherson, D.G. Altman, R. Hammerschlag et al., Revised standards for reporting interventions in clinical trials of acupuncture (stricta): Extending the consort statement, PLoS Med. 7 (2010) e1000261.

**Legends**

Figure A.Flowchart of the study selection.

Figure B.Meta-analysis of the studies evaluating the effects of acupuncture on the clinical pregnancy outcome (note: RR, relative risk; CI, confidence interval).

Figure C. Meta-analysis of the studies evaluating the effects of acupuncture on the biochemical pregnancy outcome (note: RR, relative risk; CI, confidence interval).

Figure D. Meta-analysis of the studies evaluating the effects of acupuncture on the ongoing pregnancy outcome (note: RR, relative risk; CI, confidence interval).

Figure E. Meta-analysis of the studies evaluating the effects of acupuncture on the implantation rate (note: RR, relative risk; CI, confidence interval).

Figure F. Meta-analysis of the studies evaluating the effects of acupuncture on the live birth outcome (note: RR, relative risk; CI, confidence interval).

Figure G. Meta-analysis of the studies evaluating the effects of acupuncture on the miscarriage rate (note: RR, relative risk; CI, confidence interval).

Table A. The Cochrane Collaboration’s tool for assessing risk of bias

Table B. Risk of bias table: review authors’ judgments about each risk of bias item presented as percentages across all included studies.

Table C. Quality of the 31 randomized trials involving the use of acupuncture during in vitro fertilization or intracytoplasmic sperm injection treatment included in the systematic review with meta-analysis.

Table D. Characteristics of the 31 randomized trials Involving the use of acupuncture during in vitro fertilization (IVF) or intracytoplasmic sperm injection (ICSI) treatment included in the systematic review with meta-analysis.

Table E. The results of subgroup analysis.