Systematic Reviews

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Acupoint stimulation for postpartum breastfeeding insufficiency: a systematic review and meta-analysis

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Abstract

Background Insufficient lactation, known as hypogalactia, is an important reason for weaning. To date, no effective methods have been established to increase lactation volume. With the advantages of low cost and convenience, acupoint stimulation—defined as any stimulation applied at acupoints—is a promising option.

Objectives The aim of this systematic review was to evaluate the effectiveness of acupoint stimulation for postpartum breastfeeding insufficiency.

Methods A systematic search of seven databases (PubMed, MEDLINE, Embase, Cochrane, CNKI, Airiti Library, ClinicalTrials.gov) was performed from their inception dates to September 30, 2023. Randomized trials were included. The inclusion criteria of the intervention included acupuncture, acupressure (including tuina and massage), electroacupuncture, laser stimulation, catgut embedding, and auriculotherapy. The primary outcomes were the amount of lactation and the level of prolactin. Secondary outcomes were colostrum time and adverse effects. The risks of bias were assessed using RoB 2.0.

Results Twenty-four studies involving 3214 participants were included. When compared to the control group, the experimental group exhibited improved volume of milk production (*MD* = 81.30; 95% *CI* = 58.94–103.67) and higher prolactin levels (*MD* = 41.90, 95% *CI* = 28.57–55.22). Colostrum time was shorter in the control group ([*MD* = − 7.26; 95% *CI* = − 10.69 to − 3.83] for continuous data; [*RR* = 1.70; 95% *CI* = 1.38–2.08] for dichotomous data). Adverse effects were reported in only one trial, which included three cases of fear of acupuncture and one case of hypotension.

Conclusions Acupoint stimulation may have beneficial effects on postpartum breastfeeding insufficiency. However, the results should be interpreted with caution because of the presence of risks of bias and heterogeneity among studies.

Keywords Breastfeeding insufficiency, Acupoint, Meta-analysis, Systematic review

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Introduction/background

The World Health Organization (WHO) and the American Academy of Pediatrics (AAP) recommend exclusive breastfeeding for the first 6 months after birth and continuous breastfeeding with other complementary food up to 2 years of age [1]. Exclusive breastfeeding has a lot of benefits for the mother's health, the baby's health, and the economy. On one hand, breastfeeding is associated with lower risk of diarrheal diseases, respiratory infections, otitis media, and childhood obesity in infants [2]. On the other hand, breastfeeding might also reduce risk of excessive postpartum bleeding in mothers and aid in their rapid return to prepregnancy levels of fitness and health. Over the long term, breastfeeding has the potential to decrease the risk of developing ovarian cancer, breast cancer, and diabetes mellitus [3, 4]. Breastfeeding has economic importance in reducing hospital expenses for diseases, such as necrotizing enterocolitis, infection of the respiratory tract and gastrointestinal tract, sudden infant death syndrome, atopic dermatitis, and asthma [5]. The United States could save more than 13 billion dollars and prevent over 900 deaths if 90% of mothers followed the recommendation of exclusive breastfeeding for the first 6 postpartum months [2]. Factors influencing lactation volume include stress, fluid absorption, breast surgery history, maternal hormone levels, and parity [6]. Common reasons for early weaning include low milk supply, pain, and mastitis. Approximately, 20 to 30% of mothers cease exclusive breastfeeding due to postpartum breastfeeding insufficiency [7–10].

Pharmaceutical and complementary interventions are used to elevate the volume of human milk production. Medical methods include dopamine antagonists, which are the most commonly used galactagogues. Domperidone has been reported as an effective agent, but it has been associated with potentially serious side effects, such as palpitations and arrhythmias [11, 12]. Recombinant prolactin has potential in facilitating breastfeeding, but it is expensive [13, 14]. Most galactagogues are not recommended for routine use because of limited evidence of efficacy, as well as safety concerns [15]. Regarding nonmedical approaches, two notable interventions are Okeya's method, also referred to as Oketani's method, and acupoint stimulation. Okeya's method involves a combination of massage and feeding techniques [16–18]. However, there is limited information available in terms of evidence related to Okeya's method. Currently, there is a lack of widely reported evidence-based approaches for managing breastfeeding insufficiency.

Acupoint stimulation is defined as any stimulation at acupoints. Three prior systematic reviews have examined acupoint stimulation as a treatment for breastfeeding insufficiency [19–21]. However, none of these systematic reviews conducted meta-analysis, and the inclusion of trials was limited. The effect of acupoint stimulation remains uncertain. Therefore, this systematic review and meta-analysis aimed to evaluate the effectiveness of acupoint stimulation for postpartum breastfeeding insufficiency.

Material and methods

The protocol of this review was registered in PROSPERO (CRD42022373785). The review was reported according to the checklist of Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) [22].

Search strategy

We extensively searched the following database from their inception dates to September 30, 2023: PubMed, MEDLINE, Embase, Cochrane Central Register of Controlled Trials, China National Knowledge Infrastructure (CNKI), the Airiti Library, and ClinicalTrials.gov. We also searched reference lists of relevant papers to identify additional trials. We used MeSH terms (lactation, milk secretion, hypogalactia, acupuncture, acupressure, moxibustion, massage, and tuina) in the literature search. We did not apply any language limitations. We presented the literature search strategy in Additional file 1: Table S1.

Selection criteria and exclusion criteria

Inclusion criteria

1. Types of studies: Randomized controlled trials (RCTs) were included.
2. Types of participants: Mothers who had delivered at any gestation were included. There was no limitation on the type of delivery, such as vaginal delivery or a cesarean delivery.
3. Types of intervention: For the experimental group, acupoint stimulation refers to all kinds of methods stimulating acupoints in the body. Acupuncture, electroacupuncture, acupressure, low-level laser, moxibustion, catgut embedding, auriculotherapy, and ear acupressure were all included. For the control groups, routine nursing care refers to the usual postpartum care and other basic methods promoting breastfeeding. Psychological care, feeding posture guidance, dietary advice, and provision of a comfortable environment were all involved.
4. Types of outcome measures: The primary outcomes were the volume of milk production and the serum prolactin level. The secondary outcomes were colostrum time and adverse effects.

    1) The increased production of prolactin, a hormone that stimulates the mammary glands to

produce milk after childbirth, is among the prerequisites for lactation. However, the prolactin level fluctuates extensively with diurnal variability, being correlated with the suckling. The normal range of prolactin in nonpregnant women and pregnant women is less than 25 ng/ml and 80 to 400 ng/ml, respectively. Although prolactin is critical for breast milk production, the absolute levels of prolactin required for adequate lactation remain unknown [23].

2) Colostrum time was defined as the interval to the initiation of milk secretion after the expulsion of the placenta. The standard unit of measurement is "hour."
3) Adverse effects included undesirable sensations or feelings among the participants and abnormal laboratory data (blood cell count or any findings indicating organ damage).

Exclusion criteria

Observational studies and reviews were excluded. Trials that compared the different forms of acupoint stimulation and that compared acupoint stimulation with medicine were excluded. Trials that involved women with a diagnosis of mastitis or acquiring breast disease were excluded. Women who had serious diseases—such as cancer, liver disease, kidney disease, or psychosis—were excluded. Studies with insufficient original data were also excluded.

Data extraction and quality assessment

After the exclusion of duplicate studies, two independent researchers screened the titles and abstracts of the articles for the first exclusion. Then, the full texts of the selected articles that potentially met the eligibility criteria were reviewed. We resolved any disagreement through discussion or consulted the third review author. We extracted data using a predefined data collection form. The information included the age ranges of the participants, details about the interventions, and descriptions of the outcomes. Two independent researchers evaluated the methodological quality of the included studies using the Cochrane risk-of-bias tool (RoB 2.0) [24]. RoB 2.0 consists of five domains, including bias from the randomization process (allocation), bias from the intended interventions (performance), bias from missing outcome data (follow-up), bias from the outcome measurement (measurement), and bias from the selection of the reported results (reporting). The authors rated five domains, abbreviated to allocation, performance, follow-up, measurement, and reporting, as either low risk, some concerns, or high risk. Each result was rated separately. Any disagreement was resolved through discussion or by involving a third assessor.

Statistical analyses

All analyses were performed using Review Manager (RevMan 5.3) and Comprehensive Meta-Analysis version 4 software. For continuous data, the mean difference (MD) was used to combine trials measuring the same outcome in the same unit. Dichotomous data were compared as odds ratios/risk ratios (ORs/RRs). Since statistical heterogeneity was anticipated, we applied a random-effects model to the meta-analysis. Heterogeneity among the trials was assessed by means of p-values, I^2 statistics, and chi-square statistics and was regarded as substantial if $p < 0.10$ and $I^2 > 50$. Additionally, a funnel plot and Egger's test were used to investigate the publication bias. Subgroup analyses were conducted to examine the effects of different types of acupoint stimulation and to address the heterogeneity. The studies were categorized into three subgroups: acupuncture, acupressure, and auriculotherapy. Sensitivity analysis was performed to test the stability of the results. Meta-regression was conducted to identify the sources of heterogeneity.

GRADE assessment

The quality of the evidence was assessed by the GRADE approach (GRADEpro) [25], using five considerations (study limitations, consistency of effect, imprecision, indirectness, and publication bias) to assess the quality of the body of evidence for each outcome. The evidence would be downgraded from "high quality" by one level for a serious limitation or even two levels for a very serious limitation.

Results

Study selection and characteristics

The selection process is shown in Fig. 1. (The details of search strategies are listed in the appendix [see Additional file 1: Table S1]). Database searches yielded 649 studies from the above 7 databases. Excluding the duplicates, there were 368 reports. Then, the title, abstract, and context for eligibility were screened. Four studies were found from reference lists. Finally, a total of 24 studies were included, comprising 3214 women.

The full details of the 24 included studies are presented in Table 1. The ages of the participants ranged from 18 to 45 years. Most trials were conducted in China, except for the studies conducted by Esfahani et al. in Iran [26], Maged et al. in Egypt [27], Suwikrom et al. in Thailand [28], and Neri et al. in Italy [29]. The duration of the intervention ranged from 2 days to 1 month. In this systematic review, the most common acupoints used

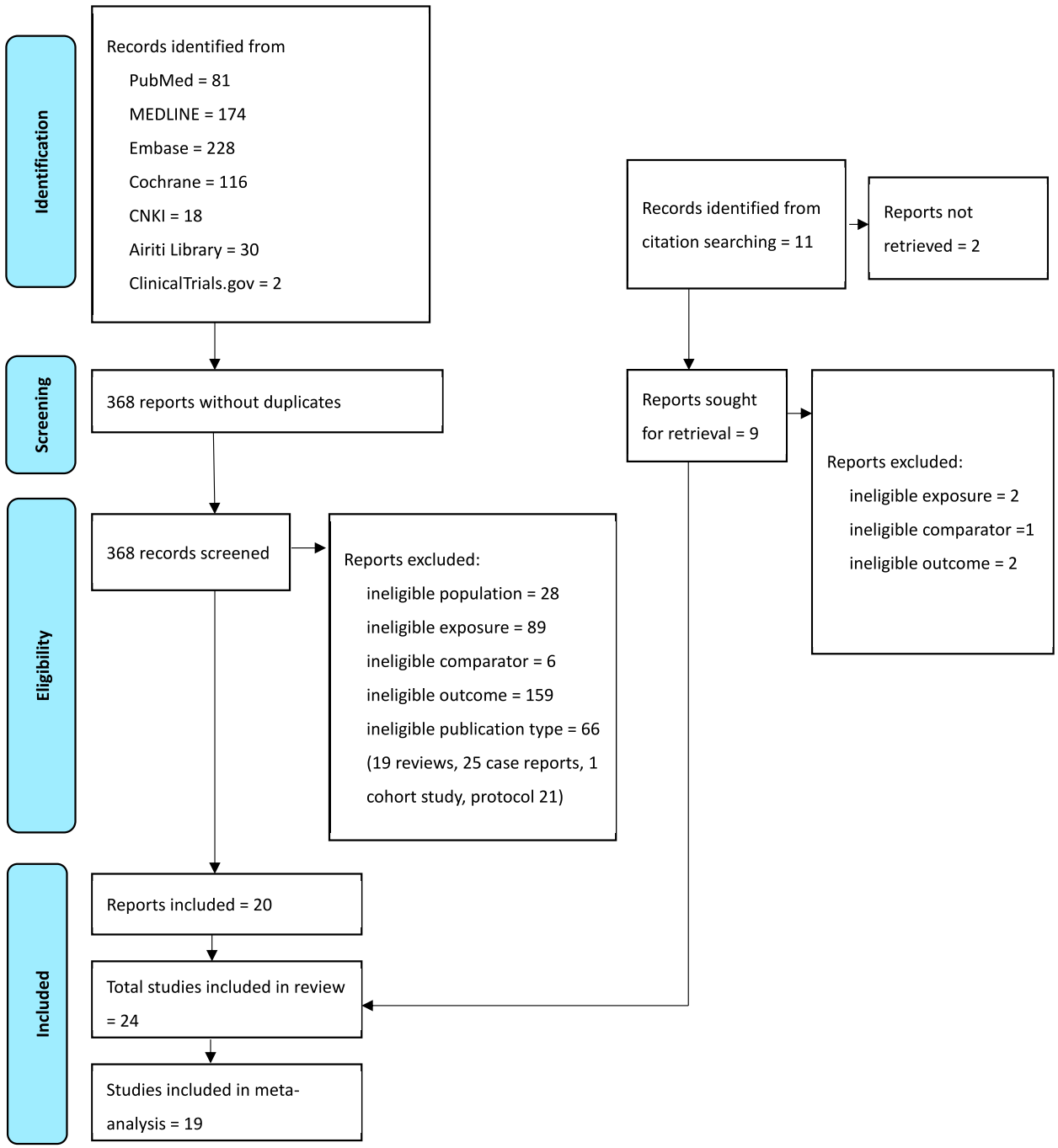

Fig. 1 PRISMA flow diagram

for breastfeeding insufficiency were ST18, ST36, RN17 (CV17), and SI1.

Quality assessment

The risks of bias were evaluated using RoB 2.0, with the signaling details provided in Table S2 ([see Additional file 1]). The double-blind study was not performed due to the characteristics of the intervention. The methodological qualities of the included trials are summarized in Figs. S1, S2, S3, and S4 (in the appendix [see Additional file 1]). Overall, the risk of bias in the included studies was primarily some concerns, and the bias was mainly from outcome measurements. More details were provided in the description of each different outcome.

Table 1 Characteristics of included studies

Study ID	Participants		Intervention		Comparator	Outcome assessment	
	Sample size CG:EG (parity; delivery method)	Age	Acupoint	Experimental intervention	Control intervention	Outcome	Timing of measurements
Chang, 2015 (China) [30]	40:40 (N/A; N/A)	21 ~ 37	• Auricular point: CO18, mammary gland point • QBD: + stomach, spleen • LQS: + liver point, MA-TF1	Acupressure 50–100 times per point a day	Routine nursing	1. Serum PRL level** 2. Efficacy**	Before and after the intervention
Chen, 2012 (China) [31]	45:45 (N/A; N/A)	N/A	• RN17, ST18, SI1, ST36 • Qi and blood deficiency: RN6, SP10, BL20, BL21, SP6 • Liver Qi stagnation: LR3, LR14, PC6	Catgut implantation at acupoints 3 days after labor	Routine nursing	1. Volume of milk production in a day, for 3 days** 2. Times of infant urination and defecation	Three consecutive days after milk production
Esfahani, 2015 (Iran) [26]	29:31 (N/A; N/A)	20 ~ 40	SI1, LI4, GB20, GB21	• Intervention starts 10 days to 6 months after labor Acupressure 3 times a day, • each time for 2–5 min, and for 12 sequential days	Routine nursing	1. Volume of milk production¶	Before intervention, 2 and 4 weeks after intervention
Fang, 2016 (China) [32]	150:150 (N/A; N/A)	21 ~ 45	RN17, ST18, GB21	• Acupressure combined with low-frequency pulse treatment • Acupressure 5 min, 2–3 times per day	Routine nursing	1. Colostrum time¶ 2. Breastfeeding insufficiency score¶ 3. Morbidity of mastitis¶ 4. Efficacy¶	Before and after the intervention
Li, 2014 (China) [33]	40:41 (N/A; N/A)	22 ~ 41	• Acupuncture: RN17, ST18, SI1 • QBD: + RN12 and ST36 • LQS: + LR14 and LR3 • Acupressure: RN17, ST18, DU14, SIII, BL18, BL20, BL21	• Trotter soup or crucian carp soup twice a day as control group • Acupuncture once every day • Acupressure after acupuncture • Retaining the needles for 20 min	Trotter soup or crucian carp soup twice a day	1. Volume of milk production (day 2**; days 4 and 8¶) 2. Efficacy**	Before the intervention and 1, 2, 4, and 8 days after the intervention
Li, 2022 (China) [34]	150:150 (primiparous; -)	20 ~ 33	RN17, LI4, SI1, RN12, LI11, ST18	• Moxibustion 15 min/time soon after labor, once a day • Acupressure 20 min/time after moxibustion for three consecutive days	Routine nursing	1. Volume of milk production (days 2 and 3¶) 2. Colostrum time¶ 3. Pain in the breast (VAS)¶ 4. Satisfaction¶	Three consecutive days after labor (intervention performed in the same 3 days)

Table 1 (continued)

Study ID	Participants		Intervention		Comparator	Outcome assessment	
	Sample size CG:EG (parity; delivery method)	Age	Acupoint	Experimental intervention	Control intervention	Outcome	Timing of measurements
Lin, 2021 (China) [35]	300:300 (N/A; vaginal delivery)	22 ~ 37	LI4, SI1, GB21, RN17, ST18, ST 17, LU1, SP20, BL17, BL18, BL20, BL21	• Acupressure for four times • Neck and spine tuina six times	Routing nursing	1. Volume of milk production** 2. Satisfaction** 3. Breastfeeding status**	Four consecutive days after labor
Lu, 2010 (China) [36]	28:28 (primiparous; vaginal delivery)	20 ~ 29	LU1, LU2, RN12, RN17, ST13, ST14, ST16, ST18, ST36, SP6, SP10	Acupressure once a day 24 h after labor for 3 days	Routine nursing	1. Volume of milk production** 2. Serum PRL level** 3. Colostrum time	2 days after labor
Lu, 2019 (China) [37]	40:40 (primiparous; C-section)	N/A	SP6, ST36, SP10, GB21, RN17, ST13, ST15, ST16, ST18	Acupressure once daily 48 h after labor for 2 days, ipsilateral 15 min	Routine nursing	1. Volume of milk production (day 3**) 2. Serum PRL level (net change**) 3. Surface temperature of the breasts** 4. Volume of breasts** 5. Recovery of the uterus**	Forty-eight hours after labor and after the intervention (prolactin blood sample is assessed 24 h & 72 h after labor)
Lu, 2022 (China) [38]	43:43 (N/A; C-section)	21 ~ 39	• BL17, BL18, BL20, BL21, RN16, RN17, ST11, ST17, SP20, SI1, GB21, LI4 • Acupoints under foot for large intestine, small intestine, and anus • Auricular points: AH6, AH10, TF4, uterus	• Intervention starts soon after mothers back to ward • Acupressure 0.5–1 min twice a day with hot compress for 5 days • Auricular compression four times a day for 5 days	Routine nursing	1. Volume of milk production** 2. Serum PRL level** 3. Colostrum time** 4. Level of breast edema** 5. Recovery situation** 6. Rate of exclusive breastfeeding**	Three consecutive days after labor
Luo, 2017 (China) [39]	80:80 (N/A; N/A)	20–40	• ST18, RN17, Rupang point, SI1 • Blood deficiency: + ST36, SP6 • Liver Qi stagnation: + LR3, PC6	Acupressure 1–2 min 2 h after vaginal delivery or 6 h after C-section	Routine nursing	1. Colostrum time (log value of lactation initiation time**)	N/A
Maged, 2020 (Egypt) [27]	20:20 (primiparous; vaginal delivery)	20 ~ 35	SP6, LR3, SI1	10-mg domperidone three times per day + faradic stimulation 30 min/session; 3 sessions/week for 4 weeks (total: 12 sessions)	10-mg domperidone three times per day	1. Serum PRL level** 2. Infant weight** 3. Pain in breast (VAS score)**	At the beginning and 4 weeks after the intervention (blood sample was collected at 9–10 a.m.)

Table 1 (continued)

Study ID	Participants		Intervention		Comparator	Outcome assessment	
	Sample size CG:EG (parity; delivery method)	Age	Acupoint	Experimental intervention	Control intervention	Outcome	Timing of measurements
Neri, 2011 (Italy) [29]	43:41 (N/A; N/A)	N/A	• SI 1, ST 18, RN17 • Qi and blood deficiency: + ST36, SP6, BL20 • Liver Qi stagnation: + LR 3, PC 6	Acupressure twice weekly for 3 weeks (total six sessions)	Routine care	1. Exclusive breastfeeding rate in the third month after delivery** 2. A telephone interview	Before and 3 weeks after intervention began
Suwikrom, 2021 (Thailand) [28]	30:30 (N/A; N/A)	N/A	RN17, SI1, KI7, LR3, ML77.17, ML77.19, ML77.21, ML77.08, ML77.09, ML77.11, ML88.12 (Ming Huang), ML88.13 (Tian Huang), ML88.14	• Intervention starts 48 h after labor • Acupressure once a day for three consecutive days	Stress reduction and baby suckling or breast milk expression	1. Volume of milk production**	Day 1, day 7, and day 14 after intervention began
Wan, 2020 (China) [40]	134:118 (primiparous; N/A)	20 ~ 40	ST18, ST36, RN17, SI1	• Intervention starts 2 h after labor • Breast acupressure + auricular acupressure • Each breast acupoint: 1–3 min each • 1 min per acupoint for 3 days	Routine nursing	1. Volume of milk production** 2. Colostrum time** 3. Infant status of urination (days 2 and 3**) and defecation (day 3**) 4. Rate of exclusive breastfeeding**	24 h, 48 h, and 72 h after labor
Wang, 2017 (China) [41]	80:80 (N/A; N/A)	N/A	• LU1, LU2, RN17, ST17, ST18, ST36, LR3 • Qi and blood deficiency: SI1 • Liver Qi stagnation: BL18	• Once per day, 3 days per session • Massage widely and then acupressure for 1 min • Spinal pinching for 3–5 times and then pinch on GB21 for 3 times • Rub rib if diagnosed as liver Qi stagnation	Routine nursing	1. Volume of milk production (in group)** 2. Serum PRL level** 3. Neonatal physiological loss of body weight** 4. Value of transcutaneous bilirubin** 5. Satisfaction	Before and 3 days after the intervention began (blood sample is assessed at 9–10 a.m.)

Table 1 (continued)

Study ID	Participants		Intervention		Comparator	Outcome assessment	
	Sample size CG:EG (parity; delivery method)	Age	Acupoint	Experimental intervention	Control intervention	Outcome	Timing of measurements
Xian, 2017 (China) [42]	58:58 (N/A; N/A)	N/A	RN17, ST36, SI1	• Postpartum nourishment diet and acupuncture • Needle retention for 30 min, SI1 prick shortly Acupuncture once a day, 7 days a session • (two sessions in total)	Routine nursing + nutritional postpartum meal	1. Volume of milk production** 2. Elevation of serum PRL level** 3. Breast filling scale**	Before and after intervention and 2 weeks after intervention began
Yu, 2012 (China) [43]	55:52 (N/A; N/A)	21 ~ 42	Auricular points: AH6, AH10, CO4, CO12, CO13, CO18, San Jiao	Auricular acupressure three times daily, for 1–2 min each time for 5 days	Routine nursing	1. Volume of milk production** 2. Serum PRL level** 3. Colostrum times**	Before and 5 days after the intervention began (blood sample is assessed at 9–10 a.m.)
Zheng, 2012 (China) [44]	26:58 (primiparous; N/A)	22 ~ 37	SP6, RN17, ST13, ST14, ST15, ST16, ST18, ST36	• Intervention starts 24 h after labor • Once per day, 30 min/session • Three sessions in total	Routine nursing + postnatal nutritional meal	1. Volume of milk production¶ 2. Serum PRL level 3. Colostrum time	Before treatment and three consecutive days after intervention began (prolactin blood sample is assessed at 8 a.m.)
Zhong, 2014 (China) [45]	30:30 (N/A; vaginal delivery)	20 ~ 40	SI1	• Routine nursing + special postpartum meal • Intervention starts 3 days after labor • Acupressure according to the diagnosis for 5 min and rest for 1 min and replicated above for two times • Three times a day, 7 days for one session • Two sessions at all	Routine nursing + special postpartum meal	1. Volume of milk production¶ 2. Level of breast engorgement** 3. Efficacy	Before treatment, the 7th day after intervention starts, and after the intervention
Zhou, 2009 (China) [46]	58:58 (N/A; C-section)	22 ~ 35	• Auricular point: AH10 and CO18 • QBD type: CO4 and CO13 added • LQS type: CO12 and TF4 added	• Intervention starts on the day after labor • Acupressure for 1 min, four times a day	Routine nursing	1. Volume of milk production¶ 2. Serum PRL level¶ 3. Supplementary feeding¶ 4. TCM symptom score¶ 5. Effective rate**	N/A

Table 1 (continued)

Study ID	Participants		Intervention		Comparator	Outcome assessment	
	Sample size CG:EG (parity; delivery method)	Age	Acupoint	Experimental intervention	Control intervention	Outcome	Timing of measurements
Zhu Ailing, 2018 (China) [47]	53:53 (N/A; N/A)	20 ~ 40	BL20, BL21, SI11, RN17, KI22, KI23, KI24, ST15, ST16, ST18, ST34, ST36, PC1, SP6, SP17, SP18, SI1	• Acupressure bladder meridian for 3–5 times and each for 3–5 min • Tuina shoulder, chest, and limbs for 5–6 min and then acupressure for 3–5 min • Intervention lasts for five consecutive days	Routine nursing	1. Volume of milk production¶ 2. Serum PRL level¶ 3. Colostrum time¶ 4. Scores of breast engorgement¶ 5. Scores of breastfeeding assessment scale¶ 6. Efficacy**	N/A
Zhu Hong, 2018 (China) [48]	30:30 (primiparous; vaginal delivery)	20 ~ 40	ST18, ST36, ST44, SI1, SI2, SI8, SI9, SI11, SI15, PC1, PC2, PC3, PC9	• Intervention starts 2 h after labor • Acupressure 1–2 min per acupoint • Midnight-noon ebb-flow acupressure o 7:00–9:00 stomach meridian o 13:00–15:00 small intestine meridian o 19:00–21:00 pericardium meridian o 15 min each session, for three consecutive days	Routine nursing	1. Volume of milk production** 2. Serum PRL level** 3. Degree of breast filling**	Before and 3 days after intervention began
Zhu Yunfei, 2018 (China) [49]	28:30 (primiparous; C-section)	18 ~ 40	RN17, ST15, ST18, ST36, LR14, KI7	• Intervention starts 3 days after labor • Acupressure for 1 min per acupoint • Once a day, for 5 consecutive days	Routine nursing	1. Volume of milk production (days 3 to 5¶) 2. Breast filling (days 3 to 5¶) 3. Galactostasis (day 5¶) and milk viscosity (days 3 to 5¶)	Before intervention and five consecutive days after intervention began

N/A not available, *CG* control group, *EG* experiment group, C-section cesarean section; *QBD*, Qi-blood deficiency, *LQS* liver Qi stagnancy

**Statistical significance, $p < 0.05$; ¶statistical significance, $p < 0.01$

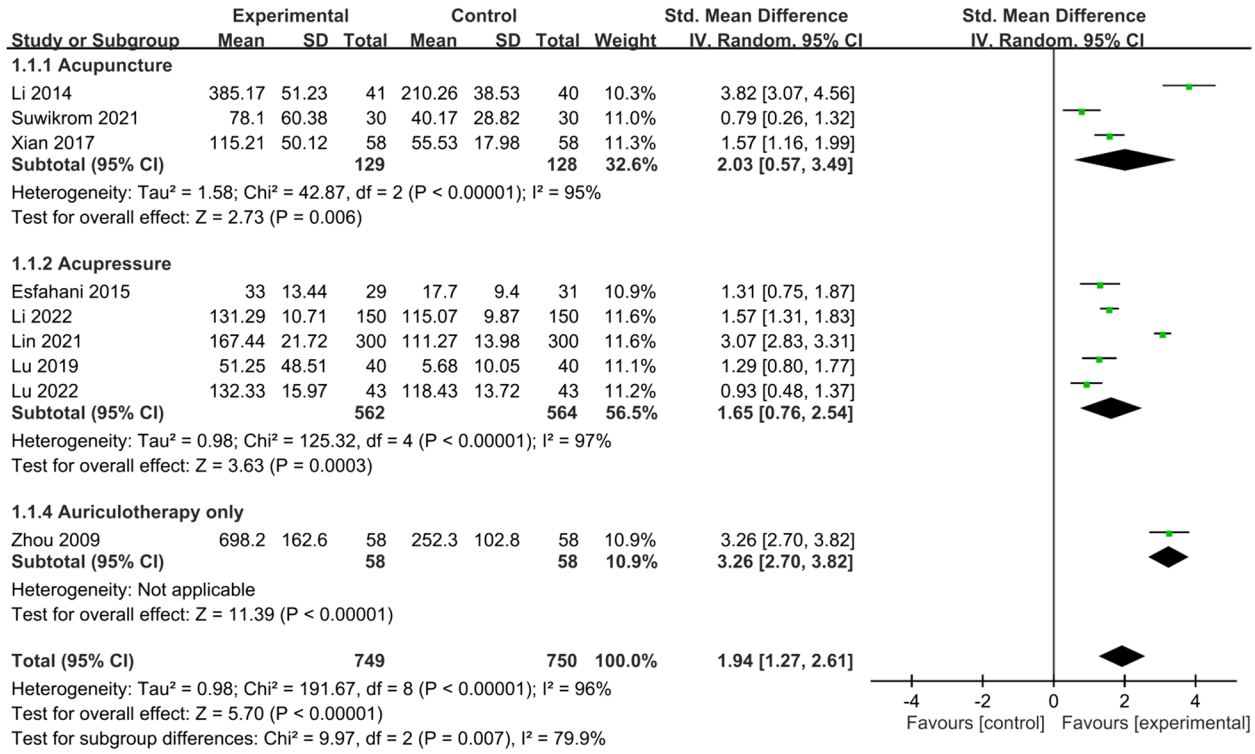

Fig. 2 Forest plot of comparison: volume of breast milk production

Clinical outcomes

Volume of milk production

Among 20 studies [26, 28, 31–38, 40–49] that reported on the volume of milk production, only the raw data from 9 studies [26, 28, 33–35, 37, 38, 42, 46] could be used for the meta-analysis because the other 11 studies [31, 32, 36, 40, 41, 43–45, 47–49] lacked sufficient raw data for comparative analyses.

These nine studies reported post-intervention differences in milk production volume. In increasing milk production, acupoint stimulation was superior to routine nursing in all nine studies ($MD = 81.30$; 95% $CI = 58.94$–103.67; $I^2 = 99\%$) (Fig. 2). A random-effect model was employed owing to the heterogeneity ($I^2 = 99\%$, $P < 0.00001$).

We conducted two subgroup analyses: one based on the type of acupoint stimulation (Fig. 2) and the other on varying duration of the interventions (Fig. S5 in the appendix [see Additional file 1]). In the subgroup analysis of different intervention types, significant effects were detected across all subgroups (acupuncture [$MD = 90.90$; 95% $CI = 11.44$–170.36; $I^2 = 98\%$], acupressure [$MD = 29.20$; 95% $CI = 7.92$–50.48; $I^2 = 99\%$], and auriculotherapy [$MD = 445.90$; 95% $CI = 396.39$–495.41]).

In the subgroup analysis based on intervention duration, significant effects were observed across all subgroups: for interventions lasting 3 days or less ($MD = 15.94$; 95% $CI = 13.75$–18.13; $I^2 = 0\%$), for interventions lasting more than 3 days but not exceeding 7 days ($MD = 175.29$; 95% $CI = 79.87$–270.72; $I^2 = 99\%$), and for interventions exceeding 7 days ($MD = 71.69$; 95% $CI = 8.93$–134.45; $I^2 = 99\%$).

We explored the effect of trial quality on poor-quality studies being excluded from the analyses in order to assess whether any difference would be made to the overall result. By excluding Li et al. (2014) [33], the result remained the same in the volume of lactation (Fig. S6 in the appendix [see Additional file 1]).

Regarding the other 11 studies [31, 32, 36, 40, 41, 43–45, 47–49], we conducted a qualitative analysis. A notable concern in many of these studies was the risk of bias in outcome measurement, primarily attributable to the use of subjective diagnostic criteria [32, 40, 43, 47]. Most trials revealed significant increases in the volume of milk production, except for the study by Zhu Ailing et al. (2018) [47]. Zhu Ailing et al. (2018) reported no significant difference in the volume of milk production between the experimental and control groups in the first 3 days; however, there was a significant intergroup difference after 3 days.

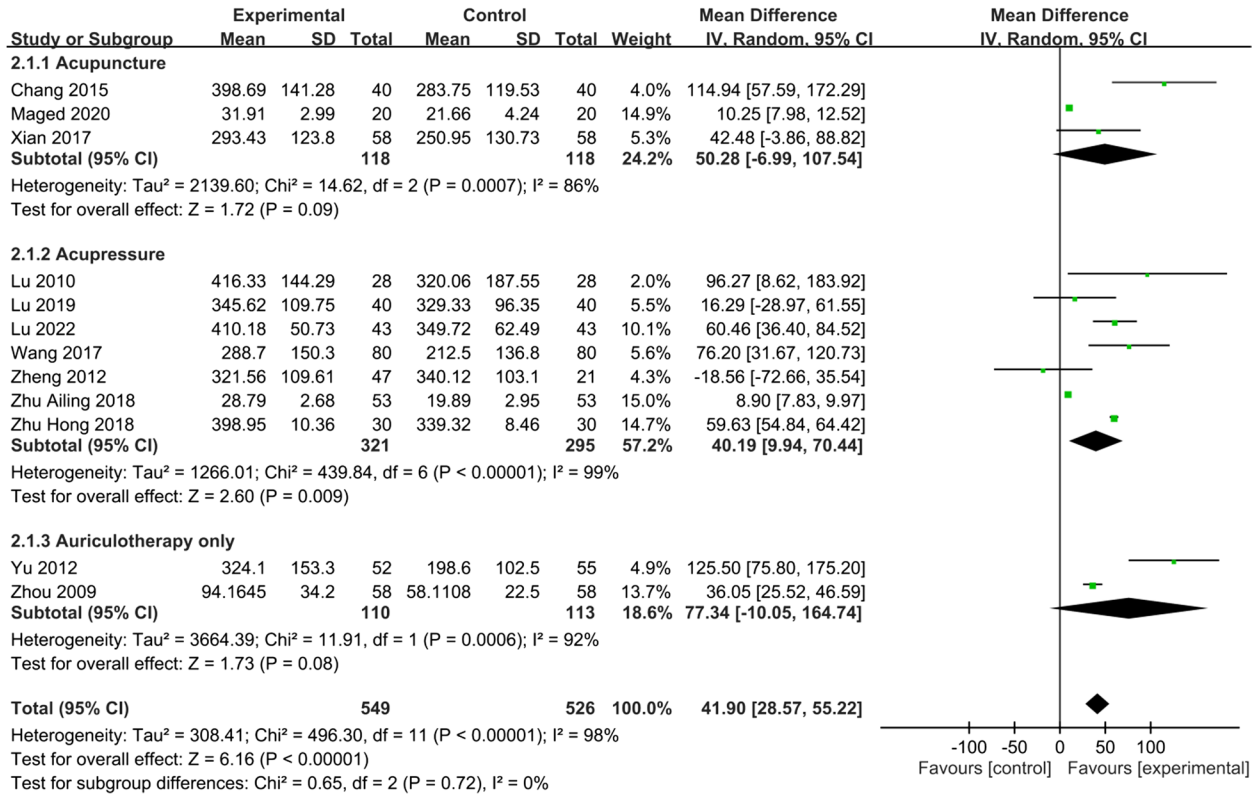

Fig. 3 Forest plot of comparison: prolactin level

Prolactin level

In 12 studies [27, 30, 36–38, 41–44, 46–48], serum prolactin levels (ng/ml) were utilized as an outcome measure. The overall effect demonstrated positive and statistically significant change ($MD = 41.90$, 95% $CI = 28.57–55.22$; $I^2 = 98\%$) (Fig. 3). Within the subgroup analysis, the effect was positive and significant in the acupressure subgroup ($MD = 40.19$, 95% $CI = 9.94–70.44$; $I^2 = 99\%$). In the subgroup of acupuncture ($MD = 50.28$, 95% $CI = -6.99 - 107.54$; $I^2 = 86\%$) and auriculotherapy alone ($MD = 77.34$, 95% $CI = -10.05 - 164.74$; $I^2 = 92\%$), the results did not reach statistical significance. A random-effect model was employed because of the observed heterogeneity.

The risks of bias for the included studies were some concerns predominantly [27, 30, 36–38, 41–44, 46–48]. However, there were allocation bias, attribution bias, and reporting bias in Zheng et al. [44]. The bias was mainly from the difference in the number of participants and unclear data on prolactin levels. We also performed sensitivity analysis by excluding Zheng et al. (2012), and the result remained the same in the level of prolactin (Fig. S7 in the appendix [see Additional file 1]).

Colostrum time

Among eight studies [32, 34, 36, 38, 40, 43, 44, 47] that evaluated colostrum time, four studies put the data into groups. Therefore, dichotomous and continuous

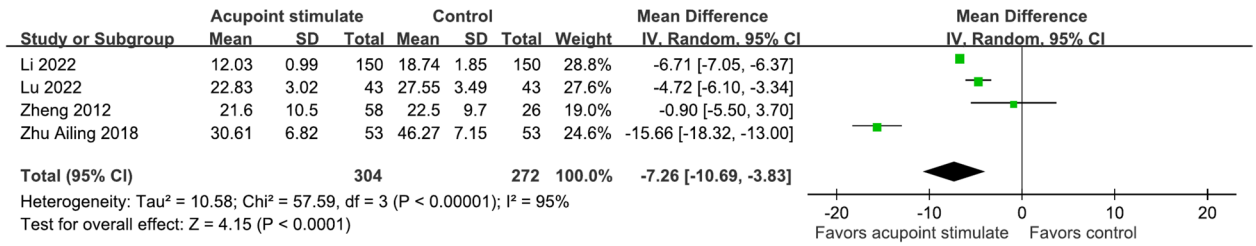

Fig. 4 Forest plot of comparison: colostrum time

data were both in the outcome of colostrum times. In the dichotomous outcome, if colostrum occurs in less than 24 h, it is defined as an event. Meta-analyses were performed separately in the dichotomous data (colostrum occurs in less than 24 h) and in the continuous data of colostrum time. Seven studies [32, 34, 36, 38, 40, 44, 47] compared acupressure with control, and the other one [43] compared auriculotherapy with control. For continuous outcome, four studies [34, 38, 44, 47] were included in the meta-analysis. Statistical difference was revealed between the experimental group and the control group ($MD = -7.26$; 95% $CI = -10.69$ to -3.83; $I^2 = 95\%$) (unit: hour) (Fig. 4). For the other four trials involving dichotomous data [32, 36, 40, 43], the data pertained to the number of individuals whose colostrum production occurred within 24 h. Colostrum time within 24 h refers to the initiation of milk production within 1 day following the delivery of the placenta. Compared with that of controls, the colostrum time of the acupoint stimulation group was shorter ($RR = 1.70$; 95% $CI = 1.38–2.08$; $I^2 = 55\%$) (Fig. 5).

Safety

Six studies [29, 31, 37, 39, 42, 46] documented the incidence of adverse events. Most of the studies reported no adverse effects [31, 37, 39, 42, 46]. No abnormalities in

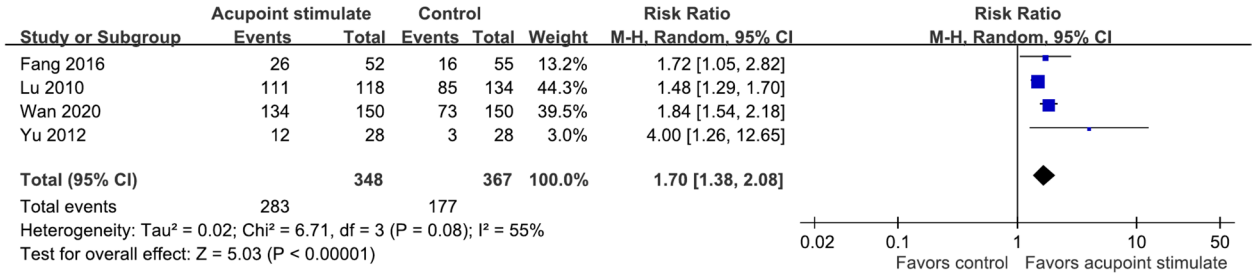

Fig. 5 Forest plot of comparison: colostrum occurs in less than 24 h

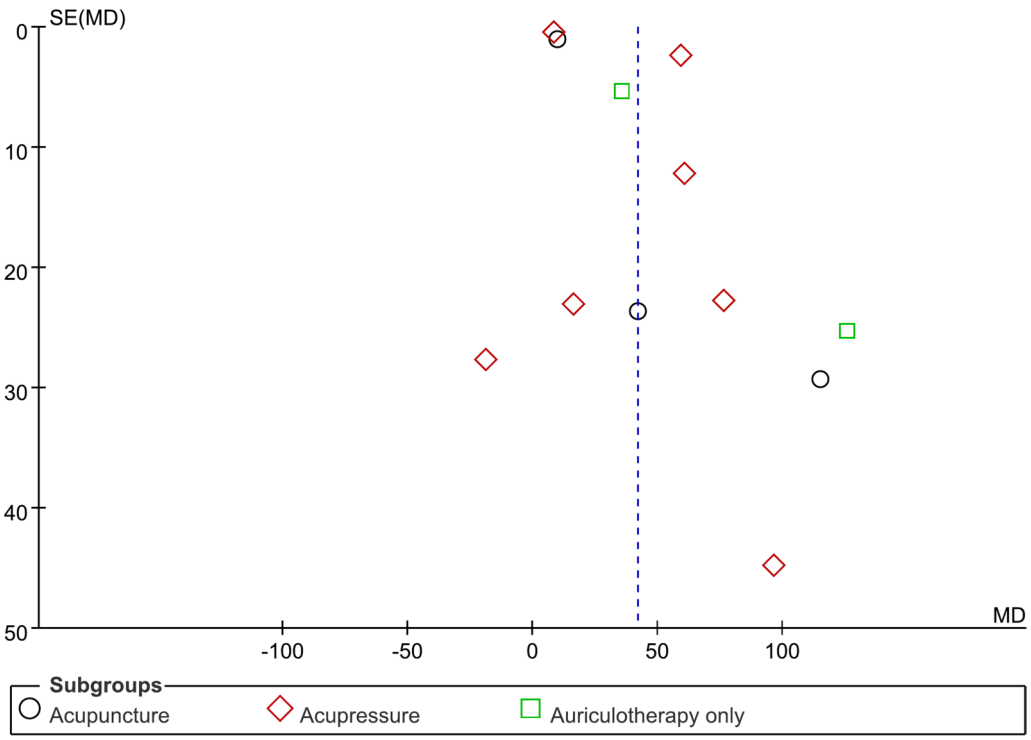

Fig. 6 Funnel plot of comparison: prolactin level

the blood (including kidney function and liver function), urine, or stool data were reported. Only Neri et al. mentioned that three women were afraid of acupuncture, and one woman had hypotension after acupuncture [29].

Funnel plot of publication bias

We investigated publication bias using funnel plot (Fig. 6) and Egger's test. The outcome selected for the funnel plots was the prolactin level, as it involved 12 trials [27, 30, 36–38, 41–44, 46–48]. It is important to note that funnel plot might have limited power to detect bias if there were fewer than ten trials included [50]. Because only nine trials were included in volume of milk production, the other main outcome, funnel plot of it was not performed. Egger's test of volume of milk production yielded a *p*-value greater than 0.05, suggesting no significant publication bias ($p=0.00296$). Conversely, Egger's test for prolactin levels resulted in a *p*-value less than 0.05, indicating possible presence of publication bias ($p=0.00593$).

Meta-regression analysis for heterogeneity

To further investigate heterogeneity within our study, meta-regression analysis was conducted. Covariates such as the year of publication, sample size, and study duration did not show a statistically significant effect on the outcome (Table 2). The covariate "risk of bias" (1 means low risk, 2 means moderate risk, 3 means high risk) significantly influenced the outcomes regarding lactation volume.

GRADE assessment

We assessed quality of evidence by using GRADEpro [25] with the data from forest plot. Based on the GRADE criteria, the quality of the evidence for the majority of indicators (volume of milk production and prolactin level) was low (Table 3). As for the colostrum time, the data quality was very low. In the certainty assessment, we incorporated the concept of the minimally important difference (MID) when evaluating imprecision. When analyzing continuous data such as volume of milk production and prolactin levels, which involved more than 400 participants, we did not find significant concerns regarding imprecision. However, for the colostrum time, which had a smaller sample size of only 304 participants, we identified a substantial issue with imprecision. Regarding the dichotomous outcome, we determined that there were concerns with imprecision for colostrum time (in group) because the small sample size and the confidence interval for the risk ratio surpassed 1.25, which served as the threshold for minimally important difference.

Discussion

The aim of this systematic review and meta-analysis is to assess the efficacy of acupoint stimulation for postpartum breastfeeding insufficiency. This result revealed that acupoint stimulation had a positive effect on postpartum breastfeeding insufficiency in terms of lactation volume, prolactin level, and colostrum time but with low or very low certainty of evidence. Adverse events were rare, and only one case of hypotension was mentioned in the experimental group.

Most clinical trials showed positive evidence of acupoint stimulation. In three previous related systematic reviews [19–21], all included trials were conducted before 2018, and the numbers of included trials were small. No meta-analysis has been performed before. Besides, Anderson et al. set search limits by language [20]. However, relevant studies have been reported in recent years, and the generation of up-to-date evidence is warranted. Boram et al. presented evidence that was consistent with the findings of our analysis; auriculotherapy showed positive effects on increasing the volume of milk production as well as serum prolactin level and facilitating the onset of lactation [19]. Our analysis also demonstrated a significant increase in lactation

Table 2 Univariate random-effects meta-regression analysis for heterogeneity by various covariates

Covariate	Beta	Standard error	95% lower	95% upper	*Z*	*p*-value
Lactation volume						
Year of publication	−0.1454	0.0772	−0.2966	0.0059	−1.88	0.0597
Sample size	0.0022	0.0021	−0.0020	0.0064	1.04	0.2993
Duration	0.0005	0.0004	−0.0003	0.0013	1.30	0.1945
Risk of bias	2.1123	1.0310	0.0915	4.1331	2.05	0.0405
Prolactin level						
Year of publication	0.1573	0.1629	−0.1620	0.4767	0.97	0.3341
Sample size	−0.0228	0.0170	−0.0562	0.0105	−1.34	0.1795
Duration	0.0016	0.0035	−0.0052	0.0083	0.45	0.6511
Risk of bias	−1.4109	1.7830	−4.9055	2.0838	−0.79	0.4288

Table 3 GRADE profile for postpartum breastfeeding insufficiency

Certainty assessment						Summary of findings			
Outcome	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	No. of participants (no. of studies)	Effect		Certainty
						Intervention: comparison	Relative (95% CI)	Absolute (95% CI)	
Volume of milk production	Very serious[a]	Serious[c]	Not serious	Not serious[d]	Not detected[g]	749:750 (20 studies	-	*MD* 81.30 ml (58.94–103.67)	⊕⊕◯◯ Low
Prolactin level	Serious[b]	Serious[c]	Not serious	Not serious[d]	Suspected[h]	549:526 (12 studies)	-	*MD* 1.33 ng/ml (0.81–1.85)	⊕⊕◯◯ Low
Colostrum time	Serious[b]	Serious[c]	Not serious	Serious[e]	Not clear[i]	304:272 (4 studies)		*MD* 7.26 h (10.69–3.83)	⊕◯◯◯ Very low
Colostrum time (in group)	Serious[b]	Serious[c]	Not serious	Serious[f]	Not clear[i]	348:367 (4 studies)	*RR* 1.70 (1.38–2.08)	338 per 1000 (from 183 to 521)	⊕◯◯◯ Very low

CI, confidence interval; *SMD*, standardized mean difference; *MD*, mean difference; *RR*, risk ratios

Explanations:

[a] Allocation bias, performance bias, and measurement bias were found in the studies

[b] Allocation bias and performance bias were found in the studies

[c] Heterogeneity was noticed in most studies

[d] Sample sizes more than 400 in each arm

[e] Rating down due to sample sizes less than 400 in each arm

[f] Confidence interval did not include appreciable benefit (*RR* = 1.25). Rating down due to sample sizes less than 400 in each arm

[g] Egger's test showed *p*-value > 0.05

[h] Egger's test showed *p*-value < 0.05

[i] The number of included studies was relatively small to identify publication bias (< 10 studies)

volume associated with auriculotherapy. Similarly to Anderson et al., our meta-analysis demonstrated acupressure to be associated with benefits in milk production [20]. In our subgroup analysis, the acupuncture subgroup had an increased effect size and reduced heterogeneity compared to the acupressure subgroup. Acupuncture involves direct fine needle insertion, potentially contributing to a greater level of stimulation than acupressure. Similar result in the subgroup analysis was also showed in another systematic review about acupoint stimulation in cancer pain control [51]. Previous studies have shown that acupuncture at specific acupoints activates distinct autonomic pathways for treating specific diseases by bioelectronic stimulation [52]. The depth and intensity of stimulation influence the types of afferent nerve and thus contribute to the effect [53]. Our analysis confirms that very few adverse events were presented, which is similar to the findings from the three previous related systematic reviews. The meta-analysis study provides more up-to-date evidence to support the benefits of acupoint stimulation in lactation.

Few articles have clearly indicated the potential mechanism of acupoint stimulation for lactation because of the vulnerability of infants and postpartum women. An animal experiment revealed that electroacupuncture at SP6 and ST36 affected the activity of the hypothalamus-pituitary-ovary axis [54, 55] and thus influenced hormones, including GnRH, FSH, LH, and estradiol. After the delivery of the placenta, progesterone levels decreased and relieved the inhibitory effect on prolactin, while the prolactin level increased and triggered lactation [56]. Therefore, our findings support the hypothesis that acupoint stimulation has a positive effect on lactation by affecting the hypothalamus-pituitary-ovary axis.

In traditional Chinese medicine, breastfeeding insufficiency is often attributed to a deficiency of Qi (vital energy) and blood or stagnation of the liver Qi. The nipple belongs to the liver channel, and the breast belongs to the stomach channel. Acupoint stimulation on the liver and stomach channels could regulate Qi and blood. Common acupoints found in our systematic review—such as ST18, ST36, and LR3—are located in the stomach meridian and liver meridian. Auriculotherapy, as a

noninvasive procedure, is also capable of regulating visceral function [46].

Traditional Chinese medicine and acupuncture have been used around the world. The concepts of meridian and acupoints have also been widely accepted. The experience summarized in this systematic review could inspire healthcare providers.

The limitations of this systematic review involved several aspects, including the risks of bias, heterogeneity, and low certainty of evidence. First, this systematic review and meta-analysis included several trials with small sample size. Second, some studies grouped the outcome into many levels and thus making it difficult to pool data for the meta-analysis. Besides, the heterogeneity of the included trials was high.

Although the treatment courses, intervention duration, types of intervention, and acupoints varied from trial to trial, we used a random-effects model in the meta-analysis.

Future research should focus on the effective acupoints and the effective duration of intervention when people conduct studies investigating acupoint stimulation for postpartum breastfeeding insufficiency.

Conclusion

This systematic review revealed the beneficial effects of acupoint stimulation in the treatment of postpartum breastfeeding insufficiency. Acupoint stimulation could elevate milk production volume and shorten colostrum time with no safety concerns. However, the results should be interpreted with caution because of the quality of the included studies and the low or very low certainty of evidence.

Abbreviations

AAP	American Academy of Pediatrics
C-section	Cesarean section
CNKI	China National Knowledge Infrastructure
RoB 2.0	Cochrane risk-of-bias tool 2.0
CG	Control group
EG	Experimental group
FSH	Follicle-stimulating hormone
LH	Luteinizing hormone
LQS	Liver Qi stagnancy
MD	Mean difference
N/A	Not available
OR	Odds ratios
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analysis
QBD	Qi-blood deficiency
RCT	Randomized controlled trials
RR	Risk ratios
RevMan 5.3	Review Manager
SMD	Standardized mean difference
US	United States
VAS	Visual analogue scale
WHO	World Health Organization

Supplementary Information

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Additional file 1: Appendix: Table S1. Literature search strategy. Figure S1. Risk of bias graph: review authors' judgements about each risk of bias item (RoB 2.0) presented as percentages across all included studies. Figure S2. Methodological quality summary: review authors' judgements about each methodological quality item for each including study (Milk volume). Figure S3. Methodological quality summary: review authors' judgements about each methodological quality item for each including study (Prolactin level). Figure S4: Methodological quality summary: review authors' judgements about each methodological quality item for each including study (Colostrum time). Figure S5. Subgroup analysis of volume of breast milk production (by duration of the intervention). Figure S6. Sensitivity analysis of volume of breast milk production. Figure S7. Sensitivity analysis of prolactin level. Table S2. Risk of bias judgement: N no, NI no information, PN probably not, PY probably yes, Y yes; ITT Intent-to-treat, PP Per-Protocol.

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Authors' contributions

YCC conceived the article, drafted the research protocol, retrieved the literature, analyzed the data, and wrote this manuscript. YAW and JAL screened studies and evaluated risk of bias. YCC and YAW extracted data and gave suggestions for the discussion. YCC and JAL analyzed the data. JAL gave suggestions on the structure of the article. ZYC and JAL provided methodological guidance and gave suggestions on the conception of the article. All authors have read and approved this manuscript.

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Declarations

Ethics approval and consent to participate

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Consent for publication

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Competing interests

The authors declare that they have no competing interests.

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