Acupuncture and Related Therapies for Obesity: A Network Meta-Analysis

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Obesity, a worldwide public health problem, is described as an adiposity-based chronic disease [1]. Currently, guidelines recommended using body mass index (BMI) to classify individuals as having obesity (BMI ≥30 kg/m²) [2]. Based on the survey conducted previously, the standardized prevalence rates for obesity in adult were 34.9% in United States and 17.7% in China [3, 4]. Moreover, it is associated with other health concerns, such as insulin resistance, type 2 diabetes mellitus, cardiovascular disease, and cancer, which increased individuals and societies' medical burden [5].

Lifestyle modification, pharmacotherapy, and bariatric surgery are considered the mainstay of therapy for obesity [2]. Although diet and exercise play an essential role in the weight management, their precise mode of action remains controversial [6]. Five long-term medicines (naltrexone-bupropion, phentermine-topiramate orlistat, lorcaserin, and lixivatide) have been approved by US Food and Drug Administration (FDA) for the treatment of obesity [7]. The

1. Introduction

Obesity, a worldwide public health problem, is described as an adiposity-based chronic disease [1]. Currently, guidelines recommended using body mass index (BMI) to classify individuals as having obesity (BMI ≥30 kg/m²) [2]. Based on the survey conducted previously, the standardized prevalence rates for obesity in adult were 34.9% in United States and 17.7% in China [3, 4]. Moreover, it is associated with other health concerns, such as insulin resistance, type 2 diabetes mellitus, cardiovascular disease, and cancer, which increased individuals and societies' medical burden [5].

Lifestyle modification, pharmacotherapy, and bariatric surgery are considered the mainstay of therapy for obesity [2]. Although diet and exercise play an essential role in the weight management, their precise mode of action remains controversial [6]. Five long-term medicines (naltrexone-bupropion, phentermine-topiramate orlistat, lorcaserin, and lixivatide) have been approved by US Food and Drug Administration (FDA) for the treatment of obesity [7]. The
latest research suggested that phentermine-topiramate was associated with the highest possibility of achieving at least 5% weight loss [7]. However, little is known about the long-term safety profile of pharmacotherapy for weight loss. The effectiveness of bariatric procedures for treating obesity has been reported in several randomized controlled trials (RCTs) [8–10]. Nevertheless, the evidence on cardiovascular disease and mortality remains to be validated [11]. Therefore, it is necessary to explore other forms of alternative therapies which are both safe and effective in preventing gaining weight.

In reviewing the literature, it became evident that acupuncture and related therapies have been widely used for obesity treatment. As mentioned in the meta-analysis, combination of acupuncture and lifestyle modification is more effective compared with lifestyle modification alone [12]. Results of Yeh’s research suggested that ear acupoint stimulation had remarkable improvements in the anthropometric parameters of Body Weight (BW), BMI, and so on [13]. In addition, another systematic review performed in 2015 has also shown that clinical efficacy of acupuncture catgut embedding therapy was better than that of the control group for simple obesity [14]. However, a major problem is that whether acupuncture or acupuncture-related therapies alone or combined therapy is more effective than lifestyle modification management remains disputable.

By using the technique of network meta-analysis (NMA), both direct and indirect randomized data can be analyzed, and recommended rankings of different treatments can be provided [15, 16]. Therefore, we conducted this Bayesian network meta-analysis to analyse both direct and indirect randomized data can be analyzed, following the same results.

2. Methods

Our research was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Network Meta-Analysis (PRISMA-NMA) checklist [17] (see Appendix 1).

2.1. Data Sources and Search Strategy. Three electronic international databases (PubMed/Medline, Embase, and the Cochrane Library) were searched for potential RCTs (randomized controlled trials). We identified articles published from initiation to December 2017 with a limit to studies of RCTs. We identified articles published from initiation to December 2017 with a limit to studies of RCTs. Nevertheless, the evidence on cardiovascular disease and mortality remains to be validated [11]. Therefore, it is necessary to explore other forms of alternative therapies which are both safe and effective in preventing gaining weight.

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By using the technique of network meta-analysis (NMA), both direct and indirect randomized data can be analyzed, and recommended rankings of different treatments can be provided [15, 16]. Therefore, we conducted this Bayesian network meta-analysis to analyse both direct and indirect comparisons of acupuncture and related methods for treating obesity. In this paper, changes in BW, BMI, and the rates of complications of included studies were analyzed.

\[
\bar{X}_{change} = \bar{X}_{post-treatment} - \bar{X}_{baseline}
\]

\[
SD_{change} = \sqrt{(SD_{baseline})^2 + (SD_{post-treatment})^2 - 2 \times r \times SD_{baseline} \times SD_{post-treatment}}
\]

where \( r \) is a correlation coefficient with a value of 0.5 [19]. For each included RCT, two researchers (XT and XC) independently assessed their risk of bias by the Cochrane Collaboration tool [20]. Bias risks of each study were assessed.
We generated forest plots to illustrate the relative strength of control group. Mean difference (MD) with 95% confidence intervals (CrI) for in-tervention and the treatment effect model was chosen. Subgroup analyses were conducted according to the type of acupuncture treatment and the treatment of control group. Mean difference (MD) with 95% confidence intervals (CrI) was used to analyze continuous data. We generated forest plots to illustrate the relative strength of curative effects.

Second, to indirectly compare the effectiveness among treatments of acupuncture and related therapies, we did a random effects model NMA within a Bayesian framework, by using WinBUGS (Version 1.4.3, MRC Biostatistics Unit, Cambridge, UK) [22, 23]. Models were computed with Markov chain Monte Carlo (MCMC) simulation methods, using four chains with overdispersed initial values. We utilized the Markov chains for 50,000 simultaneous iterations after the first 20000 iterations were discarded because they may have an influence on the arbitrary value. In this process, the convergence of the model was assessed by the Brooks-Gelman-Rubin (BGR) method; a value of potential scale reduction factor (PSRF) close to 1 indicated the better convergence [24]. The continuous outcome was measured by a standard mean difference (SMD) with a 95% credible intervals (CrI) for indirect comparisons.

Finally, plot of surface under the cumulative ranking curve (SUCRA) was generated using the STATA software (Version 13.0; Stata Corporation, College Station, Texas, USA), which indicated the probability of each intervention of being ranked best [25]. In our study, higher SUCRA scores corresponded to a higher rank of the treatment [15]. A Z value and its corresponding p value were calculated, and an R value less than 0.05 indicated a statistically significant difference.

The NMA showed that all treatments other than acupuncture combined lifestyle modification were more efficacious than lifestyle modification. Three treatments were significantly more effective than placebo. Specifically, acupoint catgut embedding (SMD: 1.26; 95% credible interval, 0.63to2.70) and placebo (MD: 1.15; 95% CI, 0.67to1.63). When compared to acupuncture, combination of acupuncture and related therapies showed a marginally stronger effect in weight loss (MD: 1.56; 95% CI, 0.71to3.05). There was no statistically significant difference between combination of acupuncture and related therapies and pharmacotherapy in their effectiveness in BW (MD: 2.44; 95% CI, -1.98to6.86). (Table 4)

BMI. As for the comparison in reducing BMI, acupuncture and related therapies were found to be marginally superior to lifestyle modification (MD: 1.17; 95% CI, 0.09to2.26) and placebo (MD: 0.57; 95% CI, 0.40to0.74). The remaining direct comparisons did not show significant differences (Table 4).

3. Results

3.1. Study Search. We performed this research on Dec 26 2017. As shown in Figure 1, a total of 1050 records were initially identified from the databases. 675 studies left after duplicates were removed. 577 records were excluded after carefully scanning titles and abstracts. Finally, 34 trials with 2283 participants were included in our NMA [26–59], covering 8 groups, manual acupuncture; electroacupuncture; auricular acupuncture stimulation; acupoint catgut embedding; pharmacotherapy; warming acupuncture; lifestyle modification; placebo.

3.2. Study Description. Main characteristics of included RCTs were shown in Table 1. The participants were from Australia [28], the United States [26], Turkey [46], Korea [51], Iran [36], Egypt [48], and China. Age of participants ranged from 15 to 70 years, while the sample size of the studies ranged from 12 to 86. Among the included RCTs, there were one four-arm trials, 5 three-arm trials, and 28 two-arm trials. Fourteen studies compared acupuncture to placebo. Ten studies compared acupuncture to lifestyle intervention. Six studies compared combined therapies to acupuncture alone. Details about acupuncture points used, retention time, frequency, and duration of acupuncture sessions were shown in Table 2. In these research, 30 articles [26–30, 32, 34–38, 41–59] reported the weight loss, while 25 articles reported the change in BMI. The details of mean, standard difference (SD), and sample size between different groups for eligible studies are summarized in Appendix 3. The Cochran’s risk of bias assessment was presented in Table 3. Furthermore, the network plot of included comparisons was shown in Figure 2.

3.3. Pairwise Meta-Analyses

3.3.1. Body Weight. A direct pairwise meta-analysis showed that acupuncture and related therapies showed a greater BW reduction than lifestyle modification (MD: 1.66; 95% Confidence interval, 0.63to2.70) and placebo (MD: 1.15; 95% CI, 0.67to1.63). When compared to acupuncture, combination of acupuncture and related therapies showed a marginally stronger effect in weight loss (MD: 1.56; 95% CI, 0.71to3.05). There was no statistically significant difference between combination of acupuncture and related therapies and pharmacotherapy in their effectiveness in BW (MD: 2.44; 95% CI, -1.98to6.86). (Table 4)

3.4. Network Meta-Analysis

3.4.1. Body Weight. The NMA showed that all treatments other than acupuncture combined lifestyle modification were more efficacious than lifestyle modification. Three treatments were significantly more effective than placebo. Specifically, acupoint catgut embedding (SMD: 1.26; 95% credible interval, 0.46to2.06), acupuncture (SMD: 2.72; 95% CI, 0.06to5.29), and combination of acupuncture and related therapies (SMD: 3.65; 95% CI, 0.96to6.94). Furthermore, moxibustion with warming needle was associated with a significantly improvement than lifestyle modification (SMD: -5.24; 95% CI, -10.15to-0.55) (Table 5).
Records identified through database searching (n = 1050)

Records after duplicates removed (n = 675)

Records excluded after reading titles and abstracts (n = 577)

Full-text articles assessed for eligibility (n = 98)

Full-text articles excluded, with reasons (n = 63)
- Duplicates (n = 8)
- Non-RCTs (n = 23)
- Non-Acupuncture (n = 12)
- Obesity with complications (n = 8)
- Not included outcome (n = 7)
- Other (n = 6)

Studies included in quantitative synthesis (meta-analysis) (n = 34)

Figure 1: PRISMA flowchart.

Figure 2: Network plot. BMI: body mass index; LM: lifestyle modification; AAS: auricular acupoint stimulation; EA: electroacupuncture; ACE: acupoint catgut embedding; WA: warming acupuncture; AR: acupuncture and related therapies; combined therapies: combination of acupuncture and related therapies.
| Study ID and Country | Sample size R/A | Age: mean (SD) or range | Intervention | Control | Adverse events reported | Type of outcomes |
|---------------------|----------------|-------------------------|--------------|---------|-------------------------|-----------------|
| Allison et al. [17] 1995, USA | 35/34 | 19 - 70 | AAS | Placebo | Redness, pain, bleeding | BW, BMI |
| Hsu et al. [18] 2005, Taiwan | 24/22 | 41.5(11.2)/41.0 (10.0) | EA | LM | Ecchymosis(2), abdominal discomfort(1)/None | BW, BMI |
| Richards et al. [19] 1998, Australia | 28/32 | 44.1 (11.7)/43.0 (13.6) | AAS | Placebo | intercurrent illness and discontinued(1)/None | BW |
| He et al. [20] 2008, China | 40/40 | 18 - 50 | Combined therapies# | Pharmacotherapy | NR | BW, BMI |
| Li et al. [21] 2006, China | 26/30 | 16.00(13.8)/16.00(19.5) | EA | AAS | LM | NR |
| Tong et al. [22] 2011, China | 26/30 | 15.00(2.04)/16.00(1.95) | EA | Placebo | None | BW, BMI |
| Hsieh et al. [23] 2009, Taiwan | 26/26 | 18 - 20 | AAS | Placebo | None | BW, BMI |
| Hsieh et al. [24] 2010, Taiwan | 27/28 | 18 - 20 | AAS | Placebo | None | BW, BMI |
| Abdi et al. [25] 2012, Iran | 86/83 | 37.29(10.4)/38.73 (11.1) | AAS | Placebo | None | BW, BMI |
| Darbandi et al. [26] 2012, Iran | 43/43 | 37.57(9.26)/37.65(9.71) | AR+ LM | Placebo | None | BW, BMI |
| He et al. [27] 2012, China | 30/30 | 18-54 | AR+ LM | Placebo | None | BW, BMI |
| Lien et al. [28] 2012, Taiwan | 24/23 | 39.2(11.6)/40.7 (9.7) | AAS | Placebo | Dizziness(1)/None | BW, BMI |
| Darbandi et al. [29] 2014, Iran | 20/20 | 38.0(0.9)/38.0(1.3) | EA | Placebo(AAS) | None | BW, BMI |
| Yeh et al. [30] 2015, Taiwan | 36/34 | 29.9 (7.7)/32.8 (9.5) | EA | Placebo | NR | BMI |
| Chen et al. [31] 2007, China | 40/40 | 43.1(13.6)/44.0(10.3) | ACE | Acupuncture | NR | BW, BMI |
| Huang et al. [32] 2011, China | 34/30 | 30 | ACE | EA | NR | BW, BMI |
| Tang et al. [33] 2009, China | 33/32 | 21-54/22-55 | Combined therapies | EA | NR | BW, BMI |
### Table 1: Continued.

| Study ID and Country         | Sample size R/A | Age: mean (SD) or range R/A | Intervention                        | Control | Adverse events reported R/A | Type of outcomes |
|-----------------------------|-----------------|-----------------------------|-------------------------------------|---------|----------------------------|------------------|
| Shi et al. [35] 2006, China | 40/42           | 17-49/18-51                 | Combined therapies                  | EA      | NR                         | BW, BMI          |
| Hsu et al. [36] 2005, Taiwan| 22/20           | 40.0 (11.5)/41.3 (9.9)      | EA                                  | LM      | mild Ecchymosis(3), abdominal discomfort(1)/None | BW, BMI          |
| Güçü et al. [37] 2012, Turkey| 20/20           | 34.6±6.3/36.8±7.8           | Acupuncture                         | Placebo | NR                         | BW, BMI          |
| Deng et al. [38] 2014, China| 30/30           | 32(7)/33(7)                 | Combined therapies                  | Acupuncture ACE | NR | BW |
| Hassan et al. [39] 2014, Egypt| 21/30           | 45.00 (9.32)/43.47 (9.59)   | AR+ LM                              | LM      | NR                         | BW, BMI          |
| He et al. [40] 2014, China  | 28/28           | NR                          | Combined therapies                  | Acupuncture | NR | BW, BMI |
| Wang et al. [41] 2013, China| 45/45           | 31(10)/32(12)               | EA                                  | Acupuncture | NR | BMI |
| Sujung et al. [42] 2014, South Korea| 22/15| 34.7(11.9)/42.7(10.2) | AAS                                | Placebo | NR | BW, BMI |
| Bu et al. [43] 2007, China  | 32/23           | 32.1(1.1)/33.4(1.3)         | Combined therapies                  | Acupuncture | NR | BW, BMI |
| Shi et al. [44] 2005, China  | 36/32           | 19-58/18-56                 | WA                                  | EA      | NR                         | BW |
| Yang et al. [45] 2010, China| 31/30           | 18-42/18-48                 | AR+ LM                              | LM      | NR                         | BW |
| Cabioglu et al. [46] 2005, Turkey| 22/12| 39.8(5.3)/43.3(4.3) | EA                                  | Placebo | NR | BW |
| Cabioglu et al. [47] 2006, Turkey| 22/21| 39.8(5.3)/42.7(3.9) | EA                                  | Placebo | NR | BW |
| Cabioglu et al. [48] 2008, Turkey| 20/15| 42.1(4.4)/41.8(4.6) | EA                                  | Placebo | NR | BW |
| Cabioglu et al. [48] 2006, Turkey| 20/15| 42.1(4.4)/42.9 (4.3) | EA                                  | Placebo | NR | BW |
| Darbandi et al. [49] 2013, Iran| 20/23| 40.55 (5.0)/41.47 (4.6) | EA                                  | Placebo | NR | BW |
| Fogarty et al. [50] 2015, Australia| 42/44| 38.50 (9.26)/36.48 (8.69) | AR+ LM                              | Placebo | NR | BW, BMI |
| BW: body weight; BMI: body mass index; LM: lifestyle modification; AAS: auricular acupoint stimulation; EA: electroacupuncture; ACE: acupoint catgut embedding; WA: warming acupuncture; AR: acupuncture and related therapies; #combination of acupuncture and related therapies.
| Study ID (Country)       | Style of acupuncture | Names of acupuncture points used                                      | Retention time | Frequency & duration of Acupuncture sessions |
|-------------------------|----------------------|-----------------------------------------------------------------------|----------------|---------------------------------------------|
| Allison et al. 1995, USA | AAS                  | Qai(REN 9), Shufen(REN 9), Shuidao(ST 28), Siman(K14), Zusanli(ST 26), Fenglong(ST 40), Sanginjiao(SP 6) | 2-3 min        | 3 sessions daily for 12 weeks               |
| Hsu et al. 2005, Taiwan | EA                   | Qiai(REN9), Shuifen(REN9)                                              | 40 min         | 2 sessions weekly for 6 weeks               |
| Richards et al. 1998, Australia | AAS              | Shenmen(TF4), Stomach(CO4)                                             | 15-20 min      | 2 sessions daily for 4 weeks                |
| He et al. 2008, China   | Combined therapies#  | Ear acupressure: Shenmen(TF4), Neifenni(CO18), Pi(CO13), Wei(CO14), Sanjiao(CO17), Dachang(CO7), Naodian Body acupuncture: Tianshu(ST25), Guanyuan(RN4), Sanyinjiao(SP9), Fenglong(ST40), Zusanli(ST36) | 30 min         | Ear acupressure: 1 session every 3 days with a total of 10 sessions Body acupuncture: The first 5 days of treatment 1 time, 5 days after treatment 1, 1 month, for a course of treatment. |
| Li et al. 2006, China   | EA                   | Sanginjiao(SP6), Tianshu(ST25), Zusanli(ST36), Quchi(LI11), Fenglong(ST40), Neiting(ST44), Zhongwan(CV12), Pishu(BL20), Shendu(BL23), Qihai(CV6), Yinlingquan(SP9), Ear acupressure: 3 days Body acupuncture: 30 min | 10 min         | 1 session daily with a total of 60 sessions, 2 days rest in-between 10 sessions |
| Tong et al. 2011, China | Acupuncture          | Zhongwan(CV12), Zhongji(CV3), Daheng(Sp5), Xiawan(CV10), Shimen(CV5), Tianshu(ST25), Liangqiu(ST34), Zusanli(ST36), Yinlingquan(SP9) | 30 min         | 1 session every other day for a total of 5 weeks with 12 sessions |
| Hsu et al. 2009, Taiwan | AAS                  | Hunger point, Shenmen point(TF4), Stomach point(CO4), Endocrine point(CO18) | 3 days         | 2 sessions weekly for a total of 6 weeks with 12 sessions |
| Hsieh et al. 2010, Taiwan | AAS               | NR                                                                     | 2/3 days       | 1 session weekly for 30 sessions            |
| Hsieh et al. 2011, Taiwan | AAS               | NR                                                                     | NR             | 1 session weekly for a total of eight weeks |
| Study ID (Country)       | Style of acupuncture | Names of acupuncture points used                                                                 | Retention time | Frequency & duration of Acupuncture sessions |
|------------------------|----------------------|---------------------------------------------------------------------------------------------------|----------------|---------------------------------------------|
| Abdi et al. 2012, Iran | AAS                  | Shenmen(TF4), Stomach(CO4) Hunger point Mouth(CO1) Centre of ear(HX1), Sanjiao(CO17)              | 3 days         | Twice a week for a total of 6 weeks         |
| Darbandi et al. 2012, Iran | AAS                  | Shenmen(TF4), Stomach(CO4) Hunger point Mouth(CO1) Centre of ear(HX1), Sanjiao(CO17)              | 3 days         | Twice a week for a total of 6 weeks         |
| He et al. 2012, China  | AAS                  | Hunger point Stomach(CO4) Spleen(CO14), Large intestine(CO7) Endocrine(CO18), Shenmen(TF4)       | 3 days         | 3 times a day for 4 weeks                  |
| Lien et al. 2012, Taiwan | Placebo              | Shenmen point(TF4), Stomach point(CO4) Hunger point, Endocrine point(CO18)                      | NR             | 3 session weekly with a total of 12 sessions for 4 weeks |
| Darbandi et al. 2014, Iran | EA                  | Tianshu(ST25), Weidao(GB28) Zhongwan(REN12), Shuifen(REN9) Guanyuan(REN4), Sanyinjiao(SP6) Quchi(LI11), Fenlong(ST40) Qihai(REN6), Yinlingquan(SP9) Shenmen(TF4), Stomach(CO4) Hunger point, Mouth (CO1) Center of ear(HX1), Sanjiao(CO17) | 20 min         | 2 sessions weekly for a total of 6 weeks    |
| Lien et al. 2012, Taiwan | AAS                  | Shenmen point(TF4), Stomach point(CO4) Hunger point, Endocrine point(CO18)                      | NR             | 3 sessions weekly with a total of 12 sessions for 4 weeks |
| Yeh et al. 2015, Taiwan | EA                  | Shenmen(TF4), Stomach(CO4) Endocrine(CO18) Hunger point                                         | 20 min         | NR                                          |
| Chen et al. 2007, China | ACE Acupuncture      | Liangqiu(ST34), Zhongwan(CV12) Tianshu(ST25), Shuifen(CV9) Fenglong(ST40)                       | A week         | 1 session weekly with a total of 30 sessions for 4 weeks |
| Huang et al. 2011, China | ACE                  | One set is Tianshu(ST25) Zhongwan(CV12), Guanyuan(CV4) Zusanli(ST36), Weishu(BL21) Ashixue       | 24 hour        | 1 session weekly with a total of 7 sessions for 60 days |
|                         | EA                   | Zongwen(CV12), Tianshu(ST25) Daheng(SP15), Shuifen(CV9) Qihai(CV6), Guanyuan(CV4) Zusanli(ST36), Ashixue | 30 min         | 3 sessions weekly with a total of 12 sessions for 60 days |
| Study ID (Country) | Style of acupuncture | Names of acupuncture points used | Retention time | Frequency & duration of Acupuncture sessions |
|-------------------|----------------------|----------------------------------|----------------|---------------------------------------------|
| **Tangetal. 2009, China** | Combined therapies | EA: Zhongwan(CV12), Xiawan(CV10) Guanyuan(CV4), Tianshu(ST25) Shuifen(CV9), Sanyinjiao(SP6) Zusanli(ST36), Xuehai(SP10) Xinshu(BL15), Geshu(BL17) Pishu(BL20) | EA: 30 min | EA: The first 3 days are 1 times a day, and 1 time after 3 days, 15 days is 1 course of treatment. ACE: After the first acupuncture catgut embedding for 3 consecutive times, the interval is buried for the second time after 15 days, and the acupuncture is performed for the third time after the end of the treatment period. |
| **Shi et al. 2006, China** | Combined therapies | Zhongwan(CV12), Xiawan(CV10) Qihai(CV6), Zhongji(CV3) Tianshu(ST25), Daheng(SP15) Liangmen(ST21), Huaroumen(ST24) Shuidao(ST28), Quchi(CV6) Zhihui(TE6), Hegu(LI4) Liangqiu(ST34), Zusanli(ST36) Shangjuxu(ST37), Fenglong(ST40) Sanyinjiao(SP6), Goujiu(SP4) Neiting(ST44) | 30 min | EA: The first 3 days are 1 times a day, and 1 time after 3 days, 15 days is 1 course of treatment. ACE: After the first acupuncture catgut embedding for 3 consecutive times, the interval is buried for the second time after 15 days, and the acupuncture is performed for the third time after the end of the treatment period. |
| **Hsu et al. 2005, Taiwan** | EA | Qihai(REN-6), Shuifen(REN-9) Shuidao(ST-28), Siman (K-14) Zusanli (ST-26), Fenglong(ST-40) Sanginjiao (SP-6) | 40 min | 2 sessions weekly with a total of 12 sessions for 6 weeks |
| Study ID (Country) | Style of acupuncture | Names of acupuncture points used | Retention time | Frequency & duration of Acupuncture sessions |
|-------------------|-----------------------|----------------------------------|---------------|--------------------------------------------|
| Güçel et al. 2012, Turkey | Acupuncture | Hegu(LI4), Shenmen(HT7), Zusanli(ST36), Neiting(ST44), Sanyinjiao(SP6) | 20 min | 2 sessions weekly with a total of 10 sessions for 5 weeks |
| | Combined therapies | Zhongwan (CV 12), Xiawan(CV 10), Qihai(CV 6), Guanyuan(CV 4), Huaroumen(ST 24), Wailing(ST 26), Daheng(SP 15), Tianshu(ST 25), Neijing(CV 4), Zhigou(TE 6), Zusanli (ST 36) | NR | Acupuncture: 1 session every 3 days with a total of 21 sessions for 4 weeks, 3 days rest between every session, Acupoint catgut Embedding: 1 session weekly with a total of 3 sessions for 3 weeks |
| Deng et al. 2014, China | Acupuncture | Zhongwan (CV 12), Xiawan(CV 10), Qihai(CV 6), Guanyuan(CV 4), Huaroumen(ST 24), Wailing(ST 26), Daheng(SP 15), Tianshu(ST 25), Zhongwan (CV 12), Tianshu(ST 25), Neijing(CV 4), Zhigou(TE 6), Zusanli (ST 36) | 30 min | 1 session every 3 days with a total of 21 sessions for 4 weeks, 3 days rest between every session |
| | Acupoint catgut embedding | Zhongwan (CV 12), Tianshu(ST 25), Neijing(CV 4), Zhigou(TE 6), Guanyuan(CV 4), Zusanli (ST 36) | NR | 1 session weekly with a total of 3 sessions for 3 weeks |
| Hassan et al. 2014, Egypt | AR | NR | NR | NR |
| He et al. 2014, China | acupuncture | Tianshu(ST25), Liangmen(ST21), Daheng(SP15), Zusanli(ST36), Sanyinjiao(SP6), Quchi(LI11), Zhigou(SJ6), Zhongwan(RN12), Qihai(RN06) | 30 min | 1 session daily with a total of 21 sessions for 3 weeks |
| Wang et al. 2013, China | EA | Neijing(ST 44), Shangjixu(ST 37), Xiajuxu(ST39), Fenglong(ST 40), Tianshu(ST 25), Zusanli(ST 36), Quchi(LI11) | 30 min | 1 session every 2 days with a total of 12 sessions for 3 weeks |
| | Acupuncture | Neijing(ST 44), Shangjixu(ST 37), Xiajuxu(ST39), Fenglong(ST 40), Tianshu(ST 25), Zusanli(ST 36), Quchi(LI11) | 30 min | 1 session every 2 days with a total of 12 sessions for 3 weeks |
| Sujung et al. 2014, South Korea | AAS | Shenmen(TF4), Stomach(CO4), Spleen(CO13), Hunger point Endocrine(CO18) | NR | 1 session weekly with a total of 8 sessions for 8 weeks |
Table 2: Continued.

| Study ID (Country) | Style of acupuncture | Names of acupuncture points used | Retention time | Frequency & duration of Acupuncture sessions |
|--------------------|----------------------|----------------------------------|---------------|---------------------------------------------|
| Bu et al. 2007, China | Combined therapies | Acupuncture: Tianshu(ST25), Guanyuan(CV4) Zusanli(ST36), Fenglong(ST40) Sanyinjiao(SP6) AAS: Shenmen(TF4), Endocrine(C018) Spleen(CO13), Stomach(CO4) Dachang(CO7), Sanjiao(CO17) Naodian | Acupuncture: 30 min ear acupressure: 1 day | 1 session every day with a total of 10 sessions for 6 weeks, 1 week rest in-between 10 sessions. |
|                    | Acupuncture          | Tianshu(ST25), Guanyuan(CV4) Zusanli(ST36), Fenglong(ST40) Sanyinjiao(SP6) | 30 min        | 1 session every day with a total of 10 sessions for 6 weeks, 1 week rest in-between 10 sessions. |
| Shi et al. 2005, China | Warming acupuncture | Zhongwan(CV12), Shuifen(CV9) Qihai(CV6), Zhongji(CV3) Tianshu(ST25), Shuidao(ST28) Neiguan(PC6), Hegu(LI4) Xuehai(SP10), Zusanli(ST36) | 40 min        | 1 session every day with a total of 15 sessions for 4 weeks |
|                    | EA                  | Zhongwan(CV12), Tianshu(ST25) Guanyuan(CV4), Zusanli(ST36) Fenglong(ST40), Yinlingquan(SP9) Sanyinjiao(SP6), Pishu(BL20) Weishu(BL21), Ashixue | 40 min        | 1 session every day with a total of 15 sessions for 4 weeks |
| Yang et al. 2010, China | AR                  | Zhongwan(CV12), Tianshu(ST25) Guanyuan(CV4), Zusanli(ST36) Fenglong(ST40), Yinlingquan(SP9) Sanyinjiao(SP6), Pishu(BL20) Weishu(BL21), Ashixue | 30 min        | 1 session daily with a total of 15 sessions for 7 weeks, 3 days rest between every session |
| Cabioglu et al. 2005, Turkey | EA | Hegu(LI 4), Tianshu(ST 25) Quchi(LI11), Zusanli(ST 36) Neiting(ST 44) | 30 min        | Body EA was performed everyday, and EA was performed every other day |
| Cabioglu et al. 2006, Turkey | EA | Body points: Quchi(LI11), Zusanli(ST 36) Neiting(ST 44) | 30 min        | Body EA application was performed daily for 20 days, and EA was applied to each ear on alternating days |
| Study ID (Country) | Style of acupuncture | Names of acupuncture points used | Retention time | Frequency & duration of Acupuncture sessions |
|-------------------|----------------------|----------------------------------|---------------|---------------------------------------------|
| Cabioglu et al. 2008, Turkey | EA | Body points: Hegu(LI 4), Quchi(LI 11), Tianshu(ST 25), Zusanli(ST 36), Taitong(Liv 3), Neiting(ST 44) | 30 min | Body EA application was performed daily for 20 days, and EA was applied to each ear on alternating days |
| Darbandi et al. 2013, Iran | AR | Intervention group: Tianshu(ST 25), Weidao(GB 28), Zhongwan(RN 12), Shuifen(RN 9), Guanyuan(RN 4), Sanyinjiao(SP 6) Excess group: Quchi(LI 11), Fenglong(ST 40) Deficiency group: Qihai(RN 6), Yinlingquan(SP 9) | 20 min | Two treatment per week for a total of 6 weeks(12 treatments) |
| Fogarty et al. 2015, Australia | AR | Hegu(LI 4), Quchi(LI 11), Zusanli(ST 36), Neiting(ST 44), Taichong(LR 3) Auricular acupuncture: Shenmen(TF 4) | NR | NR |

LM: lifestyle modification; AAS: auricular acupoint stimulation; EA: electroacupuncture; ACE: acupoint catgut embedding; WA: warming acupuncture; AR: acupuncture and related therapies; #combination of acupuncture and related therapies.
## Table 3: Risk of bias assessment.

| Study                                   | Random sequence generation | Allocation concealment | Blinding of participants and investigators | Blinding of outcome assessment | Incomplete outcome data addressed | Selective outcome reporting |
|-----------------------------------------|-----------------------------|------------------------|-------------------------------------------|-------------------------------|-----------------------------------|-----------------------------|
| Allison et al. 1995, USA                | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Hsu et al. 2005, Taiwan                 | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Richards et al. 1998, Australia         | Unclear risk               | Low risk               | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| He et al. 2008, China                   | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Li et al. 2006, China                   | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Tong et al. 2011, China                 | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Hsu et al. 2009, Taiwan                 | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Hsieh et al. 2010, Taiwan               | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | High risk                         | Unclear risk                |
| Hsieh et al. 2011, Taiwan               | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Abdi et al 2012, Iran                   | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | High risk                         | Unclear risk                |
| Darbandi et al 2012, Iran              | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| He et al. 2012, China                   | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Unclear risk                      | Unclear risk                |
| Lien et al. 2012, Taiwan                | Low risk                   | Low risk               | High risk                                 | Low risk                      | Low risk                          | High risk                    |
| Darbandi et al. 2014, Iran             | Low risk                   | Low risk               | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Yeh et al. 2015, Taiwan                 | Low risk                   | Low risk               | High risk                                 | Low risk                      | Low risk                          | High risk                    |
| Chen et al. 2007, China                 | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Huang et al. 2011, China                | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Tang et al. 2009, China                 | High risk                  | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Shi et al. 2006, China                  | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Unclear risk                      | Unclear risk                |
| Hsu et al. 2005, Taiwan                 | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Güçel et al. 2012, Turkey               | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Deng et al. 2014, China                 | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Hassan et al. 2014, Egypt               | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| He et al. 2014, China                   | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Wang et al. 2013, China                 | High risk                  | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Su Jung et al. 2014, South Korea        | Low risk                   | Low risk               | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Bu et al. 2007, China                   | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Shi et al. 2005, China                  | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Yang et al. 2008, China                 | High risk                  | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Cabioglu et al. 2005, Turkey            | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Cabioglu et al. 2006, Turkey            | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Cabioglu et al. 2008, Turkey            | Unclear risk               | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Darbandi et al. 2013, Iran             | Low risk                   | Unclear risk           | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
| Fogarty et al. 2015, Australia          | Unclear risk               | Low risk               | High risk                                 | Low risk                      | Low risk                          | Unclear risk                |
Table 4: Pairwise meta-analyses.

| Comparison                      | Pairwise OR (95% CI) | Number of patients | Number of studies | Heterogeneity test |
|--------------------------------|----------------------|--------------------|-------------------|-------------------|
|                                |                      |                    |                   | $I^2$ (%)          | $p$ value        |
| **Body weight**                |                      |                    |                   |                   |                 |
| AR vs. LM                      | 1.66 (0.63 to 2.70)  | 496                | 10                | 55                | 0.02            |
| AR vs. placebo                 | 1.15 (0.67 to 1.63)  | 833                | 14                | 65                | 0.0004          |
| Combines therapies vs. PHA      | 2.44 (-1.98 to 6.86) | 80                 | 1                 | -                 | -               |
| Acupuncture vs. related therapies | 0.25 (0.00 to 0.49) | 413                | 6                 | 0                 | 0.73            |
| Combines therapies vs. acupuncture | 1.56 (0.07 to 3.05) | 378                | 6                 | 99                | <0.00001        |
| **BMI**                        |                      |                    |                   |                   |                 |
| AR vs. LM                      | 1.17 (0.09 to 2.26)  | 314                | 6                 | 74                | 0.002           |
| AR vs. placebo                 | 0.57 (0.40 to 0.74)  | 830                | 12                | 63                | 0.002           |
| Combines therapies vs. PHA      | 0.48 (-0.90 to 1.86) | 80                 | 1                 | -                 | -               |
| Acupuncture vs. related therapies | 0.13 (-0.06 to 0.32) | 325                | 5                 | 0                 | 0.8             |
| Combines therapies vs. acupuncture | 0.77 (-0.37 to 1.92) | 158                | 4                 | 88                | <0.00001        |

BMI: body mass index; LM: lifestyle modification; PHA: pharmacotherapy; AR: acupuncture and related therapies.

0.25 to 1.11, acupuncture (SMD: 1.28; 95% CrI, 0.43 to 2.06), combination of acupuncture and related therapies (SMD: 1.44; 95% CrI, 0.64 to 2.38), and electroacupuncture (SMD: 0.60; 95% CrI, 0.03 to 2.22). Also, the combination of acupuncture and related therapies and acupuncture alone were both superior to the acupuncture combined lifestyle modification in their ability to reduce body mass index (SMD = -1.76, 95% CrI = -2.96 to -0.62; SMD = -1.59, 95% CrI = -2.71 to -0.34) (Table 5).

3.5. Ranking

3.5.1. Body Weight. Ranking of the different treatment methods was displayed Figure 3. The results suggested that, on the aspect of weight loss, combination of acupuncture and related therapies was ranked the optimal method, the best, (88.7%), followed by moxibustion with warming needle (87.8%), manual acupuncture (70.5%), acupoint catgut embedding (ACE, 62.1%), auricular acupoint stimulation (AAS, 48.3%), electroacupuncture (EA, 46.3%), pharmacotherapy (41.9%), acupuncture combined lifestyle modification (AR + LM, 31.2%), placebo acupuncture/sham acupuncture (16.8%), and lifestyle modification (LM, 6.4%) which was ranked as the worst.

3.5.2. BMI. The results suggested that, on the aspect of BMI, combination of acupuncture and related therapies was ranked the optimal method, the best, (90.2%), followed by manual acupuncture (83.3%), pharmacotherapy (64.7%), acupoint catgut embedding (58.6%), auricular acupoint stimulation (55.7%), electroacupuncture (52.1%), placebo acupuncture/sham acupuncture (25.1%), acupuncture combined lifestyle modification (16.9%), and lifestyle modification (LM, 6.4%) which was ranked as the worst.

3.6. Inconsistency Assessment

3.6.1. Body Weight. The Z test illustrates the inconsistency of the NMA specifically (Appendix 4). For the inconsistency test outcome of BW, 95% CI of 8 loops was included 0, which reflected that no significant inconsistency was found. However, another 2 loops (ACE-Acupuncture-Combined therapies; ACE-Combined theories-EA) were found statistical inconsistency between direct and indirect comparisons.

3.6.2. BMI. For the inconsistency test outcome of body mass index, 95% CI of all loops (acupuncture -combined therapies-EA; acupuncture-EA-placebo; AR+LM -EA- LM-placebo; ACE-acupuncture-EA; AAS-EA-LM; AAS-AR+LM-LM-placebo; AAS-EA-placebo) were included 0, which reflected that no significant inconsistency was found.

3.7. Safety. Ten RCTs [26–28, 31, 32, 35, 36, 38, 39, 45] reported adverse events, while no major complications were noticed in all included studies. Three included studies [35, 36, 39] reported that no adverse effects were noted in both experimental group and placebo group. In one included RCT, there were two patients reporting mild ecchymosis and one abdominal discomfort case reported as adverse events after electroacupuncture treatment; no case was reported in the lifestyle modification group [27]. In another study, there were seven subjects in group auricular acupoint stimulation and two subjects in group placebo had mild tenderness [32].

4. Discussion

The aim of this study was to identify the efficacy and safety of acupoint stimulation therapy for obesity. In this NMA, the association of each acupuncture and related therapies with relative weight loss was compared by the combination of direct and indirect evidence from 34 RCTs in 2283 obese patients.

This study has three key findings. First, ranking graphs of the primary outcome suggested that the combination of acupuncture and related therapies was the most effective in losing weight and improving BMI. Second, compared with placebo or sham acupuncture, combination of acupunture-related therapies, manual acupuncture, acupoint
| BMI          | AA         | ACE       | AR+LM     | Acupuncture | Combined theories | EA         | LM         | Pharmacotherapy | Placebo | WA         |
|--------------|------------|-----------|-----------|-------------|-------------------|------------|------------|-----------------|---------|------------|
| **Body weight** | **AA**     | **S**     | **ACE**      | **AR+LM**  | **Acupuncture**   | **Combined theories** | **EA**  | **LM**     | **Pharmacotherapy** | **Placebo** | **WA**     |
| **BMI**      | 1.80 (0.21, 3.41) | 2.90 (0.16, 5.72) | 0.90 (1.10, 2.26) | 3.26 (0.65, 5.88) | 4.18 (1.62, 6.83) | 1.85 (0.37, 3.37) | LM     | **Pharmacotherapy** | 1.20 (-4.13, 6.63) | **Placebo** | 2.33 (0.17, 4.56) |
| **BMI**      | -3.47 (-8.46, 1.35) | -2.31 (-7.69, 2.72) | -1.48 (-9.22, 0.67) | -0.99 (-7.32, 2.93) | -1.04 (-6.34, 3.96) | -3.40 (-8.10, 1.06) | -5.24 (-10.15, -0.55) | -3.50 (-10.48, 3.39) | **-4.72 (-9.77, 0.07)** | 1.80 (0.21, 3.41) | 2.90 (0.16, 5.72) |
| **BMI**      | -0.08 (-1.54, 1.42) | 0.96 (-0.08, 2.00) | 1.03 (-0.58, 2.66) | -0.64 (-2.31, 1.78) | -0.54 (-1.88, 0.84) | 1.59 (-2.71, -0.34) | AR+LM  | -0.81 (-1.77, 0.12) | **-0.71 (-2.20, 0.70)** | 1.76 (-2.95, -0.62) | **-0.16 (-1.01, 0.43)** |
| **BMI**      | 0.04 (-0.68, 0.78) | 0.12 (-1.20, 1.45) | -0.92 (-1.88, 0.08) | 0.67 (-0.11, 1.34) | 0.84 (0.19, 1.58) | **EA** | **LM** | **Pharmacotherapy** | **Placebo** | **0.63 (0.25, 1.11)** |
| **BMI**      | **0.63 (0.25, 1.11)** | **0.72 (-0.71, 2.15)** | **-0.32 (-1.28, 0.69)** | **1.28 (0.43, 2.05)** | **1.44 (0.64, 2.38)** | **0.60 (0.03, 1.22)** | **-0.66 (-1.58, 0.26)** | **0.95 (-0.85, 2.78)** | **Placebo** | **0.63 (0.25, 1.11)** |

BMI: body mass index; LM: lifestyle modification; AAS: auricular acupoint stimulation; EA: electroacupuncture; ACE: acupoint catgut embedding; WA: warming acupuncture; AR: acupuncture and related therapies; combined therapies: combination of acupuncture and related therapies.
**Figure 3:** Surface under the cumulative ranking curves. LM: lifestyle modification; AAS: auricular acupoint stimulation; EA: electroacupuncture; ACE: acupoint catgut embedding; WA: warming acupuncture; AR: acupuncture and related therapies; combined therapies: combination of acupuncture and related therapies; PLA: placebo; PHA: pharmacotherapy.
cat gut embedding, auricular acupuncture therapy, and electroacupuncture are all associated with higher odds of achieving weight loss. Third, combination of acupuncture and related therapies, manual acupuncture, pharmacotherapy, acupuncture cat gut embedding, auricular acupoint stimulation, and electroacupuncture were superior to lifestyle intervention.

Lifestyle modification, like diet intervention and physical activity, is recommended as safe and effective way to lose weight [60]. Results of direct and indirect evidence suggest acupuncture and related therapies had significant beneficial effects in dealing with obesity compared with lifestyle modification. Both experimental and clinical data proved the efficacy of acupuncture for obesity [61]. Experimental data suggests that acupuncture exerts beneficial effects on weight loss [62, 63]. The majority of clinical evidence suggests that acupuncture and related therapies reduced more weight than sham control group [26, 28, 31, 32], which are consistent with our results. Previous animal studies have observed that the expression of obesity-related peptides was upregulated in the hypothalamus after acupuncture treatment, which induced less food intake and weight loss [62, 64, 65]. Similarly, significant decreases in plasma leptin level were observed after EA treatment in obese patients [46]. With regard to insulin level, several experimental studies reported that EA can improve insulin sensitivity [66, 67]. However, results from clinical trials regarding insulin levels are controversial. Cabioglu MT reported that EA increased insulin level compared with control group [56], but Guzel F indicated that acupuncture decreased insulin level [46]. As to effects on lipid metabolism, acupuncture was reported to be effective in decreasing total cholesterol (TC), triglycerides (TG) and LDL-C concentrations [68, 69] of obese rat. Significant decreases in TC [55], TG [35], and LDL-C [55] were observed whereas no changes in HDL-C [55] levels were observed in clinical trials. Furthermore, experimental studies suggest that there was significant decrease in serum TNFα after EA [70]. Except for the noted mechanisms, EA can also induce white adipose tissue (WAT) browning via increasing uncoupling protein-1 (UCP1) gene expression [71].

This NMA has several attractive advantages. We focused on simple obesity patients without complication, which decreased the heterogeneity and improve the quality of this study. In addition, we compared acupuncture and acupuncture-related therapies with the first-line treatment for obesity-lifestyle modification with a Bayesian framework. The rank test of effectiveness provides data to favour acupuncture and acupuncture-related therapies. Lastly, we conducted a comprehensive search and included all eligible studies. We compared five different acupuncture treatments (manual acupuncture; electro acupuncture; auricular acupoint stimulation; acupoint cat gut embedding; moxibustion with warming needle) in the clinical effectiveness in treating patients with obesity.

However, this study has several limitations. First, we failed to evaluate the safety of each acupoint stimulation therapy due to the limited data in primary studies. Future trials should report adverse events clearly to improve the quality of study design. Second, unaddressed concerns still exist regarding the long-term effects of using acupuncture and acupuncture-related therapies on weight management in a clinical setting. The duration of acupuncture sessions and follow-up duration of most included trials ranging from four weeks to twelve weeks. Further clinical evaluation of acupuncture for obesity with longer follow-up appears warranted. Third, blinding of patients and researches was not applied among included studies and the included trials were mainly conducted in China, which may lead to publication bias [72]. Fourth, included study in our NMA lack of research compares the effectiveness between acupuncture, pharmacotherapy, and different types of combination of acupuncture. Further confirmatory comparative effectiveness trials should compare different types of combination of acupuncture. Except one study compared acupuncture and pharmacotherapy [29], additional research is needed to further explore. Finally, we use R-value to estimate the changes in standard deviations (SD), which might enlarge the SD compared with the original values.

Overall, our results indicate that combination of acupuncture and related therapies ranks as the optimal method for reducing both weight and BMI. Further studies will clarify which combination of acupuncture and related therapies is better.

Data Availability
All data used to support the findings of this study are included within the supplementary information files.

Conflicts of Interest
All authors declare that they have no potential conflicts of interest.

Authors’ Contributions
Yanji Zhang, Jia Li, and Guoyan Mo contributed equally to this work. Wei Huang, Zhongyu Zhou, and Yanji Zhang contributed to study design. Xianglin Chen, Hui Liu, and Teng Cai contributed to study selection. Xiangmin Tian, Teng Cai, Xian Zhang, and Xianglin Chen contributed to data collection and quality assessment. Figures 1–3 were prepared by Jia Li and Jing Liu. Tables 1–5 were prepared by Guoyan Mo. Appendices 1–4 were prepared by Jia Li. Huisheng Yang and Teng Cai were responsible for technical and language support. All authors have read and approved the final manuscript.

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**Supplementary Materials**

Appendix 1: the PRISMA-NMA checklist treatment groups for included studies in a network meta-analysis. Appendix 2: search strategies for RCTs on acupuncture for obesity. Appendix 3: summaries of mean, standard difference, and sample size between treatment groups for included studies in a network meta-analysis. Appendix 4: inconsistency test. (Supplementary Materials)

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