

Acupuncture and weight loss in Asians

A PRISMA-compliant systematic review and meta-analysis

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Abstract

Background: Acupuncture is effective for reducing body weight; however, evidence in Asian populations is lacking. We performed a systematic review and meta-analysis to evaluate the efficacy of acupuncture for body weight reduction in Asians.

Methods: The Medline, Embase, Cochrane library, and Chinese databases were searched for relevant studies through October 20, 2018. Publications describing randomized controlled trials (RCTs) comparing acupuncture with other treatments for the reduction of body weight were compiled. Reviewers assessed bias and collected data on trial characteristics and outcomes. The study was conducted based on the reporting items of the guidelines for systematic evaluation and meta-analysis (PRISMA). Review Manager 5.2 software was used to calculate weight mean difference (WMD) and 95% confidence intervals (CIs).

Results: Twelve RCTs involving 1151 subjects were included. Compared with the control groups, the acupuncture groups exhibited significantly greater reductions of body mass index (BMI) (WMD -1.23 kg/m^2 ; 95% CI $-1.94, -0.51$) and waist circumference (WMD -2.56 cm ; 95% CI $-4.43, -0.69$). In the subgroup analyses, significant differences in the reduction of BMI and the reduction of waist circumference were observed between the acupuncture and sham acupuncture groups, the acupuncture plus diet and exercise, and the diet and exercise groups, and the acupuncture and no intervention groups, but not between the acupuncture plus exercise and exercise groups.

Conclusions: Our study demonstrates that acupuncture is effective in the intervention of overweight/obesity in Asians; however, compared with exercise alone, acupuncture combined with exercise had no effect on the BMI or waist circumference in the short term. Long-term studies are needed to evaluate the efficacy of acupuncture in weight reduction in Asians.

Abbreviations: BMI = body mass index, CI = confidence interval, OSA = obstructive sleep apnea, RCT = randomized controlled trials, US FDA = US Food and Drug Administration, WHO = World Health Organization, WMD = weighted mean difference.

Keywords: acupuncture, Asians, meta-analysis, weight loss

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1. Introduction

Obesity is gradually becoming a major public health challenge all over the world. According to World Health Organization (WHO) statistics, in 2016, more than 1.9 billion adults were overweight, and more than 650 million were obese. Between 1975 and 2016, the number of obese people has increased nearly 3 times.^[1] The global average body mass index (BMI) of women increased from 22.1 kg/m^2 in 1975 to 24.4 kg/m^2 in 2014, and that of men increased from 21.7 kg/m^2 to 24.2 kg/m^2 over the same period. If current trends continue, the global prevalence of obesity will reach 21% for women and 18% for men by 2025.^[2] In China, among 46,239 adults surveyed in 2007 to 2008, the prevalence of overweight or obese was 36.67% and 29.77% in men and women, respectively, which doubled compared with the rate in 2002.^[3] In 2014, the obese population of China was the largest in the world; for severe obesity, China is second.^[2] Overweight or obesity leads to serious health issues: cardiovascular diseases, including coronary heart disease and stroke, which are the leading cause of death; diabetes mellitus, a global epidemic disease; hypertension; musculoskeletal disorders, especially osteoarthritis; cancers, such as carcinoma of the endometrium and colon cancer; and obstructive sleep apnea (OSA).^[4,5] Weight reduction is associated with prolonged survival in type 2 diabetes and with reduced risks of morbidity and mortality,^[6] and it can prevent the progression of OSA or even cure mild OSA in obese patients.^[7]

The US Food and Drug Administration (FDA) has approved 6 medications, including orlistat, phentermine, lorcaserin, naltrexone/bupropion sustained-release, phentermine/topiramate extended-release, and liraglutide 3.0 mg, for the treatment of obesity^[8]; however, their side effects and economic costs inhibit their usage. Acupuncture, as a complementary and alternative therapy, is widely used to reduce body weight. The efficacy and superiority of acupuncture for the treatment of obesity has been assessed and validated in meta-analyses.^[9,10]

However, nearly all of these meta-analyses have included Asians and members of other populations. However, due to racial, lifestyle, and other differences, the threshold value of obesity varies among regions. Acupuncture seems to be effective for obesity, but whether it is specifically effective for obesity in Asians is unclear. Thus, we conducted a meta-analysis to evaluate the performance of acupuncture in weight loss in Asians.

2. Materials and methods

2.1. Outcomes measures of efficacy and safety

The primary endpoint of efficacy was the difference in BMI from baseline to the end of the study, and the secondary outcomes were the changes from baseline weight, percentage body fat, waist circumference, and serum lipid levels and the incidence of adverse events.

2.2. Eligibility criteria

Randomized clinical trials (RCTs) that compared acupuncture (electroacupuncture, body, or auricular acupuncture) with placebo, sham acupuncture, lifestyle intervention, or no treatment in the intervention of BMI from baseline to the endpoint were included. If the study was designed as crossover trial, only the first-phase results were analyzed to eliminate carryover effects. According to the WHO, the BMI cut-off of overweight and obesity in adult Asians was more than 23 and 25 kg/m², respectively.^[11] Trials were excluded if they met any the following: they compared different forms of acupuncture; they explored the clinical efficacy of acupoint catgut embedding, acupressure, moxibustion, laser acupuncture, or massage for treatment of overweight or obesity; they provided information on effective rate only between baseline and study end, presenting no BMI data. In addition, studies involving pregnant women or secondary obesity, such as Cushing syndrome-reduced obesity, were excluded.

2.3. Search strategy

The Medline, Embase, Cochrane library, the Chinese Biological Medicine Database (CBM), Wanfang Data, Chinese Technical Periodicals (VIP) and China National Knowledge Infrastructure (CNKI) databases to October 20, 2018 were searched. The search results were not restricted as to language and were limited to humans. The search terms used were acupuncture and overweight, obesity and randomized. The search strategy was adapted according to the demands of the different databases.

2.4. Data extraction

Two reviewers (M.N.X., Y.Z.S.) independently extracted data, which included data on baseline characteristics, interventions,

efficacy, and safety outcomes according to the inclusion and exclusion criteria. Discrepancies between the 2 reviewers were resolved through re-review of the original data, consultation between the reviewers, or, when necessary, through consensus via consultation of a third reviewer (L.Z.). In the case of crossover designs, only the data before crossover were extracted.

2.5. Risk of bias

The Cochrane Collaboration's risk of bias tool, which addresses random sequence generation, allocation concealment, blinding of outcome assessors, incomplete data regarding outcome, selective outcome reporting, and other items, was used to assess the bias risk of the RCTs. The risk of bias of each trial was graded as high, low, or unclear. Two authors (L.Z. and Y.L.) assessed the risk of bias; in the event of disagreement, consensus was reached through consultation with a third reviewer (Z.Q.H.).

2.6. Data synthesis and analysis

Continuous variables were analyzed using the weighted mean difference (WMD) and 95% confidence interval (CI) to express the size of the effect. If the change of mean and standard deviation (SD) from baseline to the endpoint of the trial were not reported, but the pre and postintervention values were reported, and the following formulas were used to calculate the mean and SD:

$$x_{\text{change}} = x_{\text{post-treatment}} - x_{\text{baseline}}$$

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

where r is the correlation coefficient and is assumed to be 0.4.^[12] The statistical software Review Manager version 5.2 (Oxford, UK) was used to analyze the data. Statistical heterogeneity was examined with I^2 tests. A random-effect model was adopted for each outcome. Funnel plots were generated to visually assess publication bias.

2.7. Ethical Approval

Ethical approval was not necessary because the study was a systematic review and meta-analysis, and did not involve animals or humans.

3. Results

3.1. Search results and study characteristics

Figure 1 shows the selection flow diagram. According to the search strategies, a total of 1283 records were identified. After reviewing the titles, abstracts, and full texts, 12 articles^[13–24] were included. The baseline characteristics are shown in Table 1. All of the included trials were performed at a single center. Four studies were from Taiwan,^[13,14,16,24] 7 were from China's mainland,^[15,17–20,22,23] and 1 was from Korea.^[21] There were 608 subjects in the acupuncture groups, which received auricular acupuncture, electroacupuncture, laser acupuncture, body acupuncture, or abdominal acupuncture, and 543 in the control groups, in which sham auricular acupuncture, sham laser, sham acupuncture, placebo acupuncture, lifestyle intervention (diet, exercise), or no treatment were used. There were 4 trials^[14,16,18,21] comparing acupuncture with sham acupuncture, 1 trial^[15] comparing acupuncture with placebo acupuncture,

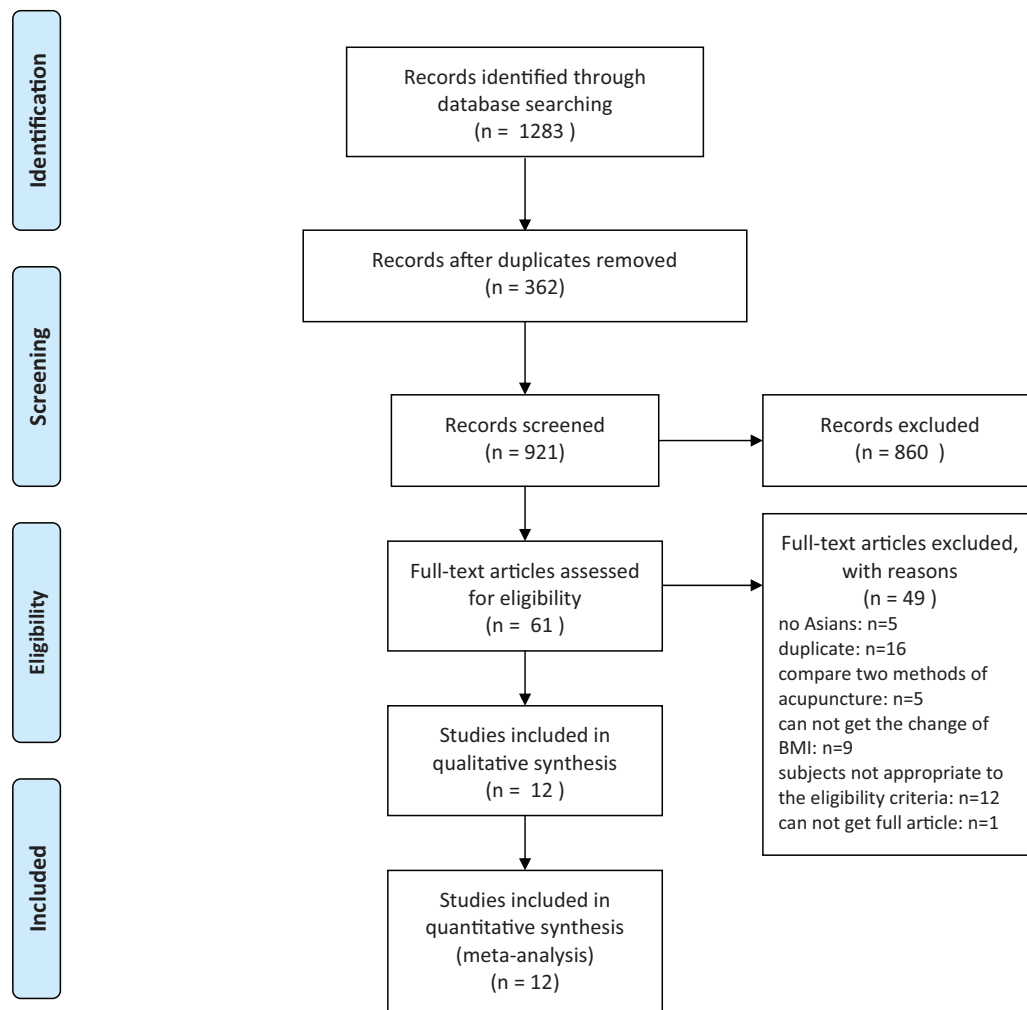


Figure 1. Flow diagram of study selection process.

1 trial^[17] comparing electro-acupuncture plus laser acupuncture with laser acupuncture, 3 trials^[20,22,23] comparing acupuncture plus diet and exercise with diet and exercise, 2 trials comparing acupuncture plus exercise with exercise, and 2 trials^[13,24] comparing acupuncture with no intervention. One trial^[13] used a crossover design.

3.2. Risk of bias assessment

Most of the included articles were evaluated as low quality due to the poor reporting of random sequence generation, allocation concealment, blinding of participants, and personnel or blinding of outcome assessment (Fig. 2).

Visual inspection of funnel plots was used to evaluate publication bias (Fig. 3). In the funnel plot of BMI, there was a suggestion of missing studies in the left of the plot, which indicated plausible publication bias.

3.3. Effect of acupuncture on BMI

The overall efficacy of acupuncture relative to control treatment was evident from a significant difference in the reduction of BMI

(WMD -1.23 kg/m^2 ; 95% CI $-1.94, -0.51$) (Fig. 4). In the subgroup analyses, significant differences in the reduction of BMI were noted between acupuncture and sham acupuncture (WMD -0.80 kg/m^2 ; 95% CI $-1.00, -0.60$), acupuncture plus diet and exercise, and diet and exercise (WMD -2.27 kg/m^2 ; 95% CI $-4.26, -0.29$), and acupuncture and no intervention (WMD -1.70 kg/m^2 ; 95% CI $-2.59, -0.81$). No significant differences were observed in the comparisons of acupuncture with placebo acupuncture (WMD -0.98 kg/m^2 ; 95% CI $-2.26, 0.30$), acupuncture plus laser acupuncture with laser acupuncture (WMD -0.04 kg/m^2 ; 95% CI $-1.21, 1.13$), and acupuncture plus exercise with exercise (WMD -0.50 kg/m^2 ; 95% CI $-2.20, 1.20$).

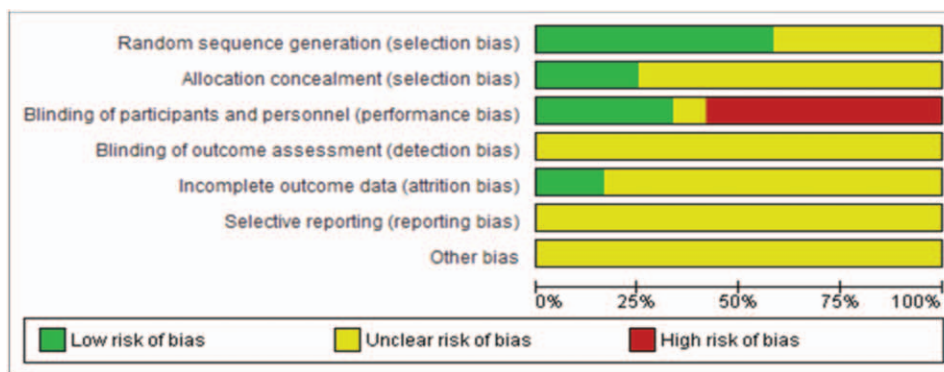
3.4. Effect of acupuncture on waist circumference

The overall efficacy of acupuncture relative to control treatment was evident from the significant difference in the reduction of waist circumference (WMD -2.56 cm ; 95% CI $-4.43, -0.69$) (Fig. 5). In the subgroup analyses, there were significant differences in the reduction of waist circumference between acupuncture and sham acupuncture (WMD -3.69 cm ; 95% CI

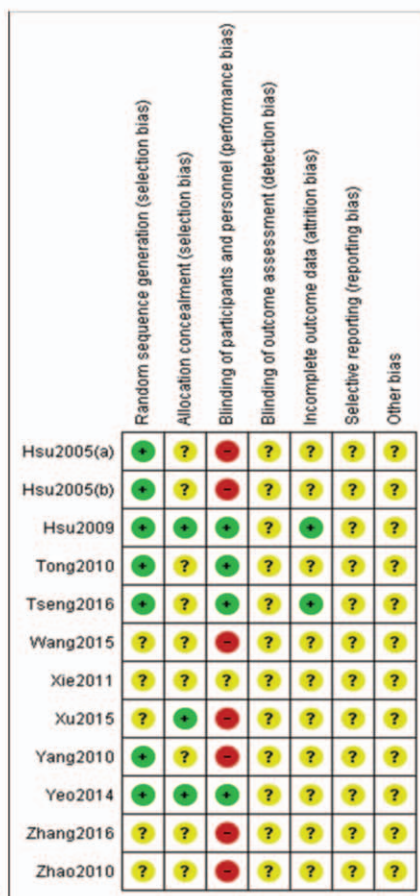
Table 1
Baseline characteristics in the meta-analysis.

Primary study	Location	Study duration	Study arms	No.	Mean years (y)	BMI (kg/m ²)	Waist circumference (cm)	Acupoints	Frequency (period)
Hsu et al., 2009 ^[4]	Taiwan	6 wks	Auricular acupuncture	23	40.0 ± 10.5	31.6 ± 3.9	93.7 ± 11.0	Hunger point, Shen-men point, stomach point, and endocrine point	Two treatments per week, needles were kept on the ear for 3 d and switched to the other ear
Hsu et al., 2005 ^[13]	Taiwan	6 wks	Sham auricular acupuncture Electroacupuncture combined with sit-up exercise	22	39.4 ± 13.6	31.2 ± 3.9	95.8 ± 9.4	RENG, REN9, ST28, K14, ST26, ST40, SP6	Two treatments per week
Hsu et al., 2005 ^[24]	Taiwan	6 wks	Sit-up exercise Electroacupuncture combined with sit-up exercise	22	41.0 ± 10.0 40.0 (11.5)	33.2 ± 4.0 33.8 (3.4)	94.6 ± 6.7 96.7 (7.1)	RENG, REN9, ST28, K14, ST26, ST40, SP6	Two treatments per week
Tseng et al., 2016 ^[16]	Taiwan	8 wks	No intervention Laser acupuncture	20 21 26	41.3 (9.9) 40.5 (9.9) 38.8 ± 11.7	33.7 (2.9) 33.6 (3.4) 31.2 ± 5.3	94.7 (7.3) 93.1 (6.7) 94.5 ± 10.9	ST25, ST36, ST40, ST44, L4, LI11, SP6, PC6	Three times a week
Xu, 2015	China	One course	Sham laser acupuncture Abdominal acupuncture	26 15	Not mentioned	30.7 ± 5.6 27.63 ± 1.26	91.7 ± 10.6 Not mentioned	CV12, CV9, BL24, BL26, ST28, ST25, ST36, SP6	Once every other day, 20 times
Yeo et al., 2014 ^[21]	Korea	8 wks	Body acupuncture No treatment Unilateral acupuncture with indwelling needles	15 15 31	34.7 ± 11.9	27.76 ± 1.12 27.52 ± 1.02 28.5 ± 4.5	91.5 ± 10.7	Shen-men, stomach, spleen, hunger, endocrine	Once a week, needles were kept on the ear for one week and switched to the other ear
Zhao and Shi, 2010 ^[23]	China	8 wks	Indwelling needle unilaterally Sham acupuncture Acupuncture combined with diets and exercises	30 30 30	38.5 ± 12.3 42.7 ± 10.2 29.31 ± 8.28	28.2 ± 3.2 28.3 ± 3.4 29.09 ± 3.64	90.9 ± 7.9 93.6 ± 9.4 100.00 ± 8.77	Hunger acupuncture point Shen-men, stomach, spleen, hunger, endocrine ST25, ST24, ST26, ST32, ST36, ST37, ST39, ST44, SP 6, SP15, SP14, RN12, RN10, RN4	4 times a week for the first 4 wks, 2 times a week for the next 4 wks
Wang et al., 2015 ^[15]	China	3 mos	Diets and exercises Electroacupuncture combined with auricular acupuncture	30 65	30.30 ± 10.41 28.82 ± 8.39	27.84 ± 3.50 27.89 ± 2.80	97.07 ± 9.47 Not mentioned	Electroacupuncture: LI11, ST36, ST39, ST37, ST44, SI0, LI2, ST40. Auricular acupuncture: nasus externus, stomach, spleen, heart, small intestine, lung, large intestine, Sanjiao, endocrine	Electroacupuncture: once every other day auricular acupuncture: change once every 2–3 d
Xie et al., 2011 ^[18]	China	3 mos	Electroacupuncture Acupuncture	65 100	29.94 ± 8.23 Not mentioned	27.44 ± 3.25 29.00 ± 12.22	Not mentioned	LI11, RN12, LI2, CV5, Xuehai Xue, ST36, ST44	1 times every 2 d
Zhang and Wu, 2016 ^[22]	China	8 wks	Sham acupuncture Electroacupuncture combined with diet and exercise	100 120	36.9 ± 9.86	28.65 ± 11.40 29.68 ± 0.56	92.97 ± 13.08	LI11, RN12, LI2, CV5, Xuehai Xue, ST36, ST44 Sham xue RN12, CV5, CV4, LI2, SP15, ST36, SP06, SP09, ST40	5 times every week
Tong et al., 2010 ^[15]	China	One course	Diet and exercise Acupuncture	120 76	38.8 ± 10.68 35.08 ± 9.31	29.80 ± 0.60 30.42 ± 2.94	92.89 ± 12.59 Not mentioned	RN12, RN03, SP15, RN10, RN05, LI2	Once every other day, 12 times in total
Yang et al., 2010 ^[20]	China	3 courses	Placebo acupuncture Electroacupuncture combined with diet and exercise	42 31	34.60 ± 8.55 18–42	31.41 ± 3.12 27.83 ± 1.59	Not mentioned	RN12, LI2, CV4, ST36, ST40, SP09, SP06, BL20, BL21, Ashi Xue	1 time a day, 15 times for 1 course, 3 d interval for each course, 3 courses in total
			Diet and exercise	30	18–48	27.91 ± 1.47			

BMI = body mass index.



A



B

Figure 2. (A) Risk of bias graph; (B) risk of bias summary.

-5.01, -2.37), acupuncture plus diet and exercise, and diet and exercise (WMD -4.35 cm; 95% CI -6.16, -2.54), and acupuncture and no intervention (WMD -0.29 cm; 95% CI -0.54, -0.05). There was no significant difference between acupuncture plus exercise and exercise (WMD -1.07 cm; 95% CI -4.29, 2.16).

3.5. Effects of acupuncture on cholesterol and triglyceride levels

There was no significant difference between the acupuncture and control groups in the reduction of cholesterol (WMD -0.08 mmol/L; 95% CI -0.36, 0.21) or triglyceride (WMD -0.03

mmol/L; 95% CI -0.14, 0.07). Similarly, no significant differences were observed in the subgroup analyses (Fig. 6).

3.6. Adverse events

Only 3 studies^[13,14,24] reported adverse events. Hsu et al^[14] reported that minor inflammation occurred in 1 subject in the acupuncture group, and that mild tenderness occurred in 7 subjects in the acupuncture group and 2 subjects in the sham acupuncture group. Hsu et al^[13] reported that electroacupuncture treatment resulted in mild ecchymosis in 2 subjects and abdominal discomfort in 1 patient. Electroacupuncture treatment led to mild ecchymosis in 3 subjects and abdominal discomfort in 1 patient in 1 study.^[24]

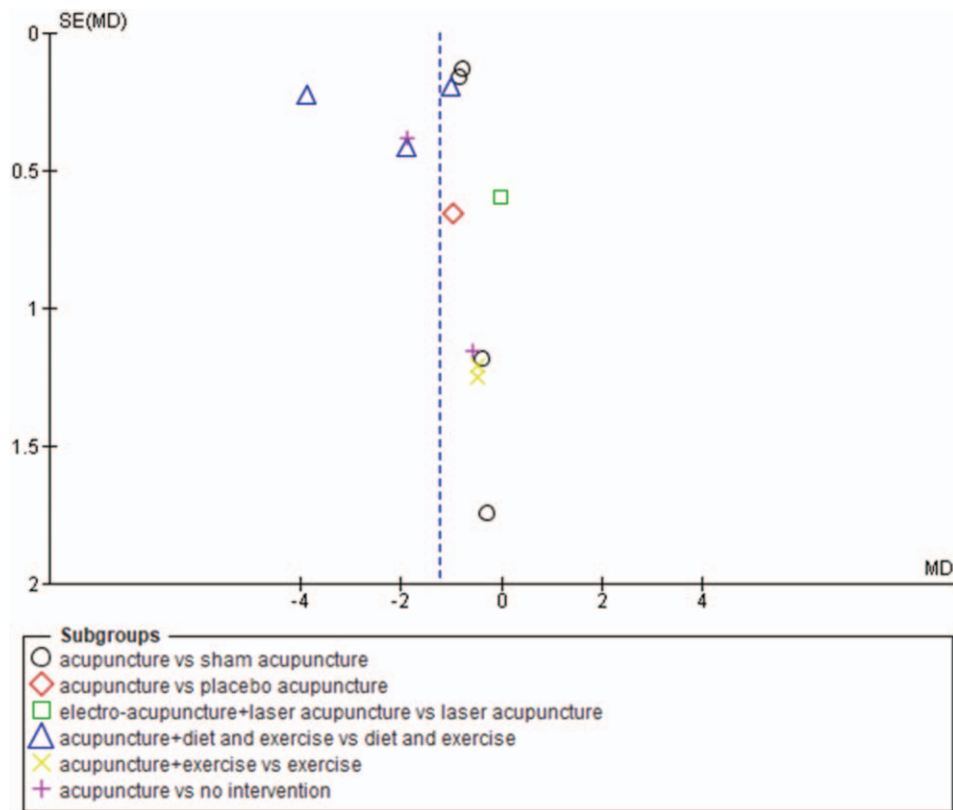


Figure 3. Funnel plot of body mass index (BMI).

4. Discussion

To the best of our knowledge, this is the first meta-analysis and systematic review of acupuncture for the intervention of body weight in Asians. Our results demonstrated that relative to sham treatment, acupuncture was effective for the reduction of BMI and waist circumference. However, relative to diet and exercise intervention, acupuncture reduced weight only when it was provided in addition to diet and exercise treatment; no benefit of acupuncture monotherapy over exercise alone was observed. A previous meta-analysis found that acupuncture was effective in reducing BMI in obese subjects^[10]; a review made similar conclusions.^[2,5] Clinical studies^[26,27] revealed that along with a reduction of BMI, eating desire, hunger feeling, and prospective food consumption were significantly decreased in the acupuncture groups relative to the control groups. The mechanism of the acupuncture-driven inhibition of food intake and body weight gain involves the stimulation of α -melanocyte-stimulating hormone expression and release in the arcuate nucleus of hypothalamus.^[28] Our previous study showed that acupuncture led to weight loss through the demethylation of the hypothalamic Tsc1 promoter and through the inhibition of the activity of the mTORC1 signaling pathway.^[29] However, Kim et al^[9] reported that acupuncture treatment alone was similar to sham acupuncture alone in reducing weight body. Another study found that true acupuncture and sham acupuncture had significant and similar effects in weight loss.^[30] The different results among studies may have several causes, such as study variation in

intervention duration and the selection of acupoints. The intervention duration in our study was 6 weeks to 3 months; the duration in Kim et al's^[9] report was 4 to 12 weeks. The best course of intervention is not yet clear. Furthermore, acupoint selection varied among the different studies, and different combinations of acupoints may produce different effects on weight loss. Presently, it is unclear what combination is optimal for weight loss. Moreover, the similarity of therapeutic effects between acupuncture groups and sham-acupuncture groups has raised the issue of acupoint specificity, which has been intensively discussed. Acupuncture showed its specificity effect in diseases and acupoint, such as Alzheimer disease and mild cognitive impairment patients,^[31] regulation of hypothalamic- pituitary-adrenal cortex axis function,^[32] and Rangu (KI 2) acupoint.^[33] Many brain imaging and other studies have provided evidence of the acupoint specificity of acupuncture, but it is necessary to consider acupoint specificity-related issues, such as sham acupoints and the placebo phenomenon.^[34] Whether there is acupoint specificity in the intervention of obesity by acupuncture, and, if so, what the mechanism is need study.

Although differences exist between Asian and Western populations, such as the consumption of more carbohydrate and less protein by Asian than Western populations, acupuncture treatment for weight loss has been found effective when Western and Asian subjects are considered together.^[35] Lifestyle interventions for obesity include diet and exercise interventions, which play important roles in the prevention and treatment of

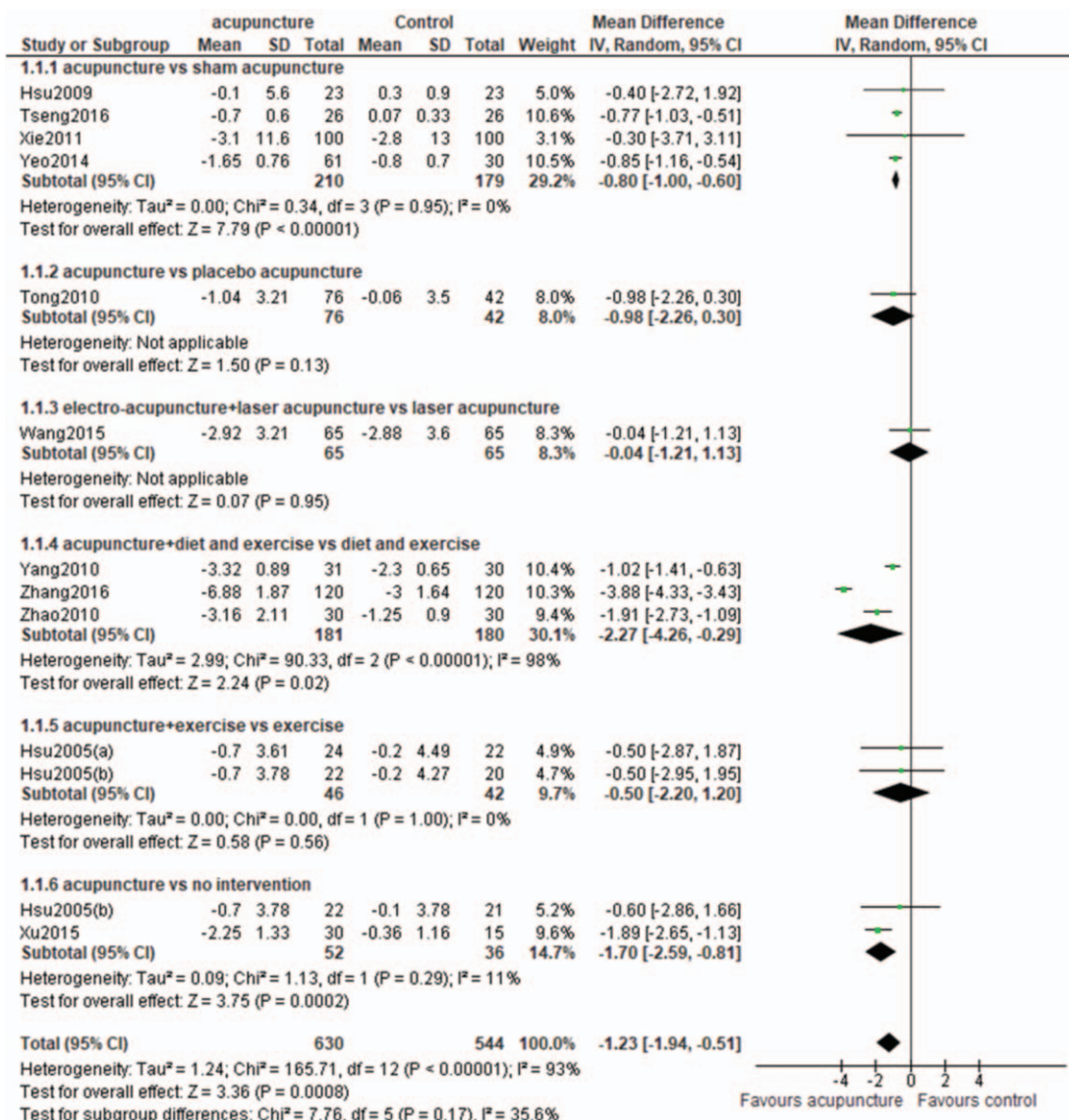


Figure 4. Body mass index (BMI): acupuncture vs control.

obesity.^[36,37] However, some studies have found that exercise alone did not lead to reduced weight. A meta-analysis showed that when lifestyle modification was treated as the reference treatment, acupuncture exhibited superior performance compared with no treatment or placebo treatment.^[38]

Our results demonstrated that compared with diet and exercise, acupuncture plus diet and exercise can bring greater reductions in weight and waist circumference; however, relative to exercise alone, acupuncture plus exercise had no effect on the change of BMI or waist circumference. A previous study reported that diet was superior to total body weight loss, and exercise was beneficial for reducing visceral adiposity.^[39] Do these findings indicate that diet and exercise play different roles in the management of overweight/obesity? We speculate that there may be several reasons for the findings of this meta-analysis. First, the frequency of acupuncture in the 2 trials was 2 treatments per week,^[13,24] which may be insufficient to detect an effect. In the

included trials, auricular needles were maintained on the ear for 3 days^[14] or 1 week,^[21] and then switched to the other ear; all of the remaining trials except 2 used at least acupuncture 3 times.^[13,24] Second, the small sample size might have influenced the results. In the subgroup analysis of acupuncture plus exercise versus exercise alone, 46 subjects were in the treatment group and 44 were in the control group. A small sample size can lead to the inconsistent results and can make it difficult to detect true experimental differences. Furthermore, the risk of error is high, and it is easy to obtain “false-negative” results. Studies with larger sample sizes are needed.

Our results showed that acupuncture had no effects on cholesterol and triglyceride levels in either the main comparison or the subgroup analyses. However, some animal and clinical studies have found that acupuncture can decrease cholesterol and triglyceride levels significantly.^[40,41] Cabioglu and Ergenc^[42] reported that electroacupuncture intervention lead

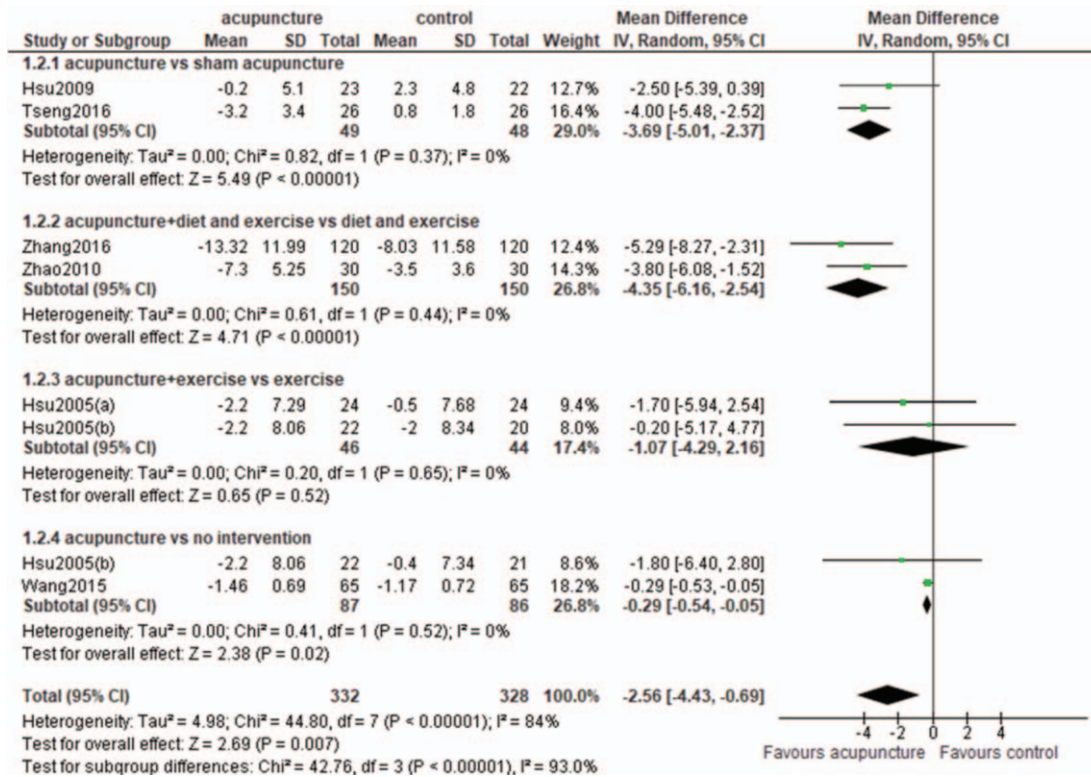


Figure 5. Waist circumference: acupuncture vs control.

to decreases in serum total cholesterol and triglyceride levels in obese women, possibly by increasing serum beta-endorphin level. It is not clear whether there are differences between populations from the East and the West. Additional studies should be conducted to evaluate the effects of acupuncture on cholesterol and triglyceride levels.

Regarding the risk of bias, most of the included articles were evaluated as low quality, and plausible publication bias was found, indicating that the methodological quality of the included studies was not satisfactory. More rigorous trials need to be conducted to confirm the effect of acupuncture on weight loss in the future. Only 3 studies reported on adverse effects. Although acupuncture is considered generally safe, studies should report safety-related outcomes.

There are a few limitations with the present meta-analysis. First, the quality of most of the included trials was low, which limits the robustness of the results. Moreover, the duration of treatment was too short to evaluate the long-term efficacy of acupuncture, and most of the studies did not mention long-term follow-up. Weight regain is a common occurrence in any weight loss attempt. It is important to evaluate the long-term efficacy of acupuncture in the treatment of obesity. Clinical randomized controlled studies with long follow-up periods are needed to obtain reliable results. In addition, the frequency, duration, and type of acupuncture treatment were highly variable across studies. Furthermore, adverse effects were reported in only a few studies, preventing a comprehensive evaluation. In addition, the visual inspection of funnel plots indicated that publication bias may exist. Finally, the countries

and regions represented in our study were Mainland China, Taiwan region, and Korea; these regions are not fully representative of Asia, and selection bias may have been present, possibly affecting our conclusions. However, we did not identify other studies that met the eligibility criteria except for those from the 3 countries and region. We will pay close attention to research on acupuncture treatment for obesity published in Asian countries. Finally, our meta-analysis did not compare the different styles of acupuncture with control treatment due to the small number of included studies.

5. Conclusions

Our meta-analysis demonstrated that acupuncture was effective as an intervention for overweight/obesity in Asians; however, relative to exercise alone, acupuncture plus exercise had no effect on the change of BMI or waist circumference. The evidence is weak due to the low quality of the included studies. Long-term, high-quality studies are needed to evaluate the efficacy of acupuncture for weight loss.

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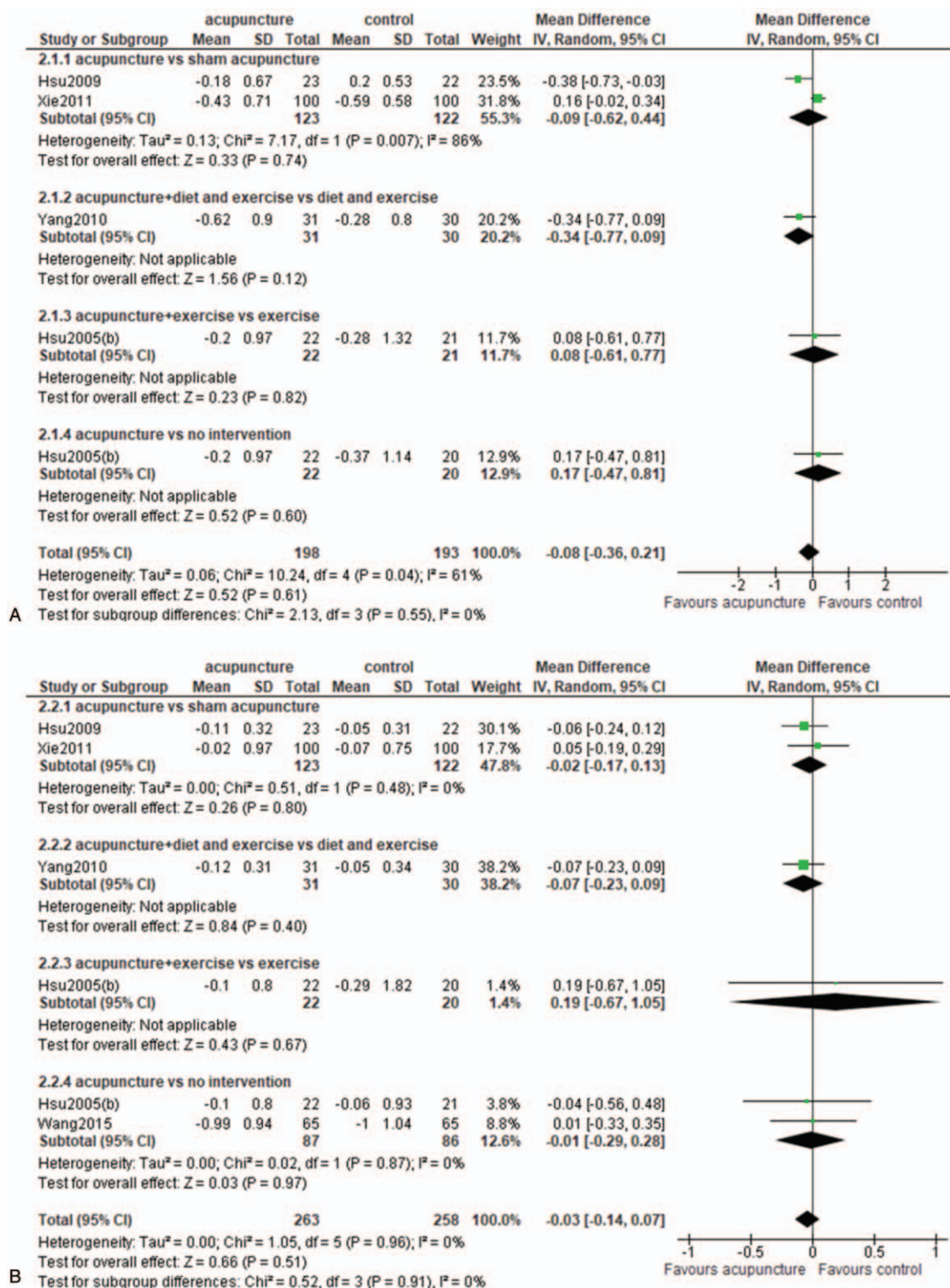


Figure 6. (A) Cholesterol: acupuncture vs control; (B) triglyceride: acupuncture vs control.

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