Acupuncture for the treatment of obesity in adults: a systematic review and meta-analysis

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ABSTRACT

Objective Meta-analysis was used to assess the clinical efficacy of acupuncture treatment for simple obesity and to provide evidence-based medical data for treating obesity with acupuncture.

Methods A comprehensive search of studies on MEDLINE, EMBASE, the Cochrane Central Register of Controlled Trials and Chinese databases (Wan Fang,CNKI and VIP) from 1 January 1915 through 30 November 2015 (MEDLINE search updated through 31 December 2015) was performed. We included only randomised controlled trials (RCTs) that used acupuncture and sham acupuncture groups (MD 0.60 kg, 95% CI 0.21 to 3.83, p=0.03; MDWC 2.74 cm, 95% CI 1.21 to 4.27, p=0.0004). BW was not statistically significantly different between the acupuncture and sham acupuncture groups (MD 0.60 kg, 95% CI −0.20 to 1.39, p=0.14). Begg’s test and funnel plots showed that the potential publication bias of the included studies was very slight (p>0.05).

Conclusion Acupuncture for simple obesity appeared to be an effective treatment, but more studies on the safety of acupuncture used to treat simple obesity are required.

INTRODUCTION

The causes of over-weight and obesity are complex, and as living standards improve and lifestyles change the global prevalence of obesity and its effects on health are increasing. Current estimates are that over 1.1 billion adults and at least 10% of children globally are either overweight or obese.1 The health consequences of obesity range from the psychological consequences of altered body appearance, to physical consequences such as obstructive sleep apnoea and arthritis, and can seriously affect health-related quality of life, particularly if other diseases such as diabetes complicate obesity. These diseases include hypertension, dyslipidaemia, cardiovascular disease and type 2 diabetes mellitus.2 3

The diagnosis of obesity is mainly based on body mass index (BMI), body fat (BF) percentage, waist and hip circumferences (WC and HC, respectively) and waist-hip ratios, with BMI being the most widely used measure.4 5 The main treatments for simple obesity include diet, exercise, herbal therapies, acupuncture and massage. Weight-loss drugs and surgical options are also available. Surgery is effective in clinically controlling obesity but has strict indications and poor patient compliance, and few obese people are willing to undergo surgical treatment. Acupuncture, an important part of Traditional Chinese Medicine (TCM), is particularly suitable for obese patients and is widely used in clinical practice because it is economical, simple and safe. The National Institutes of Health Consensus Conference statement (1998) on acupuncture stated that acupuncture shows promising results for several conditions.6

Widespread use of acupuncture for the treatment of obesity has been accompanied by a growing number of reports discussing the effects of acupuncture on weight loss. It is important to objectively evaluate and analyse this information in order to assess the efficacy of acupuncture in obesity treatment. However, some reviews have not been performed systematically and other important studies might have been overlooked. As new, high-quality randomised controlled trials (RCTs) are increasingly being completed, we conducted a systematic review and meta-analysis of published RCTs in order to evaluate the efficacy of acupuncture versus sham acupuncture for simple obesity treatment and to analyse measurements related to weight loss. We aimed to systematically summarise and evaluate the effect of acupuncture based on weight loss data from obese patients.

METHODS AND MATERIALS

The present analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.
Search strategy

A systematic search of the Cochrane Library, EMBASE and MEDLINE was conducted with no language restriction. We also searched Chinese databases, including Wan Fang, CNKI and VIP. Publications available from the inception of each database through November 2015 were reviewed to identify available randomised sham-controlled acupuncture trials for simple obesity. The following keywords were used in English database searches: ‘simple obesity’, ‘obesity’, ‘obese’, ‘overweight’, ‘acupuncture’, ‘electro acupuncture’ and ‘auricular acupuncture’. The following terms were used in the Chinese database searches: ‘Zhen Jiu’ (which means acupuncture) and ‘Fei Pang’ (which means obesity). We also carefully scanned the references of relevant publications to identify further publications. When questions arose related to either trial design or outcomes, corresponding authors were contacted to confirm the information that we extracted from their reports or to clarify any ambiguities.

Inclusion criteria

The inclusion criteria were as follows: (1) the study must be a randomised sham-controlled clinical trial; (2) diagnostic criteria for obesity must be clear and there must be explicit inclusion and exclusion criteria; the Asia-Pacific adult BMI cut-off point for overweight (23.0 kg/m²) for ages >18 years was employed in this study; (3) participants in the experimental group must have been treated with standard electro or auricular acupuncture either with or without dietary restrictions; and (4) participants in the control group must have received sham acupuncture treatment.

Exclusion criteria

The following were excluded: (1) non-randomised studies; (2) studies where participants had been diagnosed with secondary obesity; (3) studies involving other forms of acupuncture such as transcutaneous electrical nerve stimulation or laser acupuncture; (4) duplicate studies with the same results; (5) reviews of the literature; (6) studies where controls were given complementary or alternative therapies the efficacy of which has not yet been established (such as herbal medicine) or given non-sham acupuncture therapy; (7) reports where the original data (such as experimental and control group interventions) were not clear and did not reveal the exact quantitative data; and (8) studies where the RCT design did not meet randomised controlled criteria or follow basic principles.

Definition of obesity

In clinical practice, obesity can be divided into simple and secondary obesity. Simple obesity occurs without apparent cause and/or endocrine metabolic disease, while secondary obesity is caused by other diseases. Only simple obesity is considered in this paper.

Outcomes

The primary outcome of this study is BMI, while the secondary outcomes are BW, BFM, WC and HC. Net changes in BMI, BFM, WC, HC and BW before and after acupuncture treatments were evaluated.

BFM was measured by the bioelectrical impedance method using an InBody330 (Biospace, Korea) or with a Tanita BC-418 body composition analyzer (Tanita, Tokyo, Japan) according to a standard protocol.7 8

Data extraction and Jadad scale scoring

Two of the authors independently extracted the following data: (1) participant details (such as gender and age) and author details; (2) trial design, sample size, blinding, intervention procedures, withdrawals and dropouts; and (3) net changes in BMI, BFM, WC, HC and BW before and after acupuncture treatment when available. Any disagreements between the two reviewers concerning inclusions or analysis were resolved by a third reviewer. As acupuncture is more difficult to administer using a double-blinded method, this study assigned two points if the control group received sham acupuncture treatment using a single-blind design. Randomised, randomisation hidden, and withdrawal and exit were assigned two points, respectively. Reports that were received ≥3 points were classified as high-quality RCTs while those with <3 points were classified as
low-quality RCTs. Any disagreements concerning methodological quality were resolved by discussion between the reviewers.

**Statistical analysis**

Meta-analysis and statistical analysis were performed using RevMan software v5.2 (The Cochrane Collaboration, Oxford, UK). Reports meeting the criteria for homogeneity were analysed with a fixed-effects model. If they met the criteria for heterogeneity ($I^2>50\%$ or $p<0.05$), they were analysed using a random-effects model. If necessary, subgroup analyses were conducted according to country or district and acupuncture category. We subjected the results to meta-analysis and evaluated the mean differences (MD) in changes from before to after treatment for BMI, BF, HC, WC and BW. Publication bias was analysed with a funnel-plot and Begg’s test.

**Table 1** Characteristics of the randomised controlled trials included in the meta-analysis

<table>
<thead>
<tr>
<th>Author</th>
<th>Year of publication</th>
<th>Country</th>
<th>Mean age (treatment group/control group)</th>
<th>No. of patients (treatment group/control group)</th>
<th>Diagnostic criterion of obesity</th>
<th>Acupuncture point</th>
<th>Type of acupuncture</th>
<th>Duration</th>
<th>Average length of follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabioğlu et al</td>
<td>2005</td>
<td>Turkey</td>
<td>(42.1±4.4)/ (41.8±4.6)</td>
<td>20/15</td>
<td>BMI &gt;30 kg/m²</td>
<td>Hunger, Shenmen, Hegu (LI 4), Quchi (LI 11), Tianshu (ST 25), Zusanli (ST 36) and Neiting (ST 44)</td>
<td>Electro acupuncture</td>
<td>20 days</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Cabioğlu et al</td>
<td>2006</td>
<td>Turkey</td>
<td>(39.8±5.3)/ (43.3±4.3)</td>
<td>22/12</td>
<td>BMI &gt;30 kg/m²</td>
<td>Hunger, Shenmen, Hegu (LI 4), Quchi (LI 11), Tianshu (ST 25), Zusanli (ST 36) and Neiting (ST 44)</td>
<td>Electro acupuncture</td>
<td>20 days</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Cabioğlu et al</td>
<td>2008</td>
<td>Turkey</td>
<td>(40.55±5.30)/ (41.47±4.61)</td>
<td>20/15</td>
<td>BMI &gt;30 kg/m²</td>
<td>Hunger, Shenmen, Hegu (LI 4), Quchi (LI 11), Tianshu (ST 25), Zusanli (ST 36) and Neiting (ST 44)</td>
<td>Electro acupuncture</td>
<td>20 days</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Hsu et al</td>
<td>2009</td>
<td>Taiwan</td>
<td>(40.15±10.5)/ (39.4±13.6)</td>
<td>23/22</td>
<td>BMI &gt;27 kg/m²</td>
<td>Shenmen, Stomach, Hunger, Endocrine</td>
<td>Auricular acupuncture</td>
<td>6 weeks</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Abdi et al</td>
<td>2012</td>
<td>Iran</td>
<td>(37.29±1.00)/ (38.73±1.10)</td>
<td>86/83</td>
<td>BMI &gt;30 kg/m²</td>
<td>Shenmen (TF4), Stomach (CO4), Hunger, Mouth (CO1), Centre of ear (HX1), Sanjiao (CO17)</td>
<td>Ear-pressing plaster</td>
<td>6 weeks</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Güçel et al</td>
<td>2012</td>
<td>Turkey</td>
<td>(36.8±7.8)/ (34.6±6.3)</td>
<td>20/20</td>
<td>BMI &gt;30 kg/m²</td>
<td>LI4, HT7, ST36, ST44, SP6</td>
<td>TCM body acupuncture</td>
<td>5 weeks</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Lien et al</td>
<td>2012</td>
<td>Taiwan</td>
<td>(39.2±11.6)/ (40.7±9.7)</td>
<td>24/23</td>
<td>BMI &gt;27 kg/m²</td>
<td>Shenmen, Stomach, Hunger, Endocrine</td>
<td>Auricular acupuncture</td>
<td>4 weeks</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Darbandi et al</td>
<td>2013</td>
<td>Iran</td>
<td>(36.50±9.26)/ (36.48±8.69)</td>
<td>42/44</td>
<td>BMI &gt;25 kg/m²</td>
<td>Tianshu (ST25), Weidao (GB28), Zhongwan (RN12), Shuifen (RN9), Guanyuan (RN4), Sanjiao (SP6)</td>
<td>Electro acupuncture</td>
<td>6 weeks</td>
<td>Two months</td>
</tr>
<tr>
<td>Yeo et al</td>
<td>2014</td>
<td>South Korea</td>
<td>(34.7±11.9)/ (42.7±10.2)</td>
<td>22/15</td>
<td>BMI &gt;23 kg/m²</td>
<td>Shenmen, Stomach, Spleen, Hunger, Endocrine</td>
<td>Auricular acupuncture</td>
<td>8 weeks</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Darbandi et al</td>
<td>2014</td>
<td>Iran</td>
<td>Electro acupuncture: (38.0±0.9)/ (38.0±1.3); Auricular acupuncture: (39.0±1.8)/ (37.9±1.5)</td>
<td>20/20</td>
<td>BMI &gt;30–40 kg/m²</td>
<td>Electro acupuncture: Tianshu (ST-25), Weidao (GB-28), Zhongwan (REN-12), Shuifen (REN-9), Guanyuan (REN-4), Sanjiao (SP-6); Auricular acupuncture: Shenmen (TF4), Stomach (CO4), Hunger, Mouth (CO1), centre of ear (HX1), Sanjiao (CO17)</td>
<td>Electro acupuncture/Auricular acupuncture</td>
<td>6 weeks</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Fogarty et al</td>
<td>2015</td>
<td>Australia</td>
<td>&gt;18&gt;18</td>
<td>19/16</td>
<td>BMI &gt;25 kg/m²</td>
<td>He gu (LI 4), Quchi (LI 11), Zusanli (ST 36), Neiting (ST 44), Taichong (LR 3)</td>
<td>Electro acupuncture</td>
<td>6 weeks</td>
<td>Not mentioned</td>
</tr>
</tbody>
</table>
RESULTS

Literature search and study selection
Our literature search yielded 634 potential articles (270 in English and 364 in Chinese). After exclusion of duplicates and abstracts that did not meet the inclusion criteria, 21 potentially relevant articles were selected and the full texts were retrieved. Studies from which we were unable to extract data or where non-sham acupuncture was used in the control group were excluded. This left 11 RCTs as shown in figure 1. The characteristics of the 11 included studies were shown in table 1.

Study characteristics
The 11 RCTs that fulfilled the inclusion criteria are listed in table 1 and included two studies conducted in Taiwan, four in Turkey, three in Iran, one in South Korea, and one in Austria.7–17 Table 1 shows the characteristics of the included studies. A total of 643 patients participated in the studies (338 in acupuncture groups and 305 in control groups). In most of the studies, obesity was defined as a BMI >30 kg/m² but was defined as 23–24 kg/m² in South Korea, which is a broad definition of obesity. Shenmen, Stomach and Hunger were the most frequently used acupuncture points in the included studies.

Methodological quality
Studies were generally of good quality with a mean Jadad score of 5.27 (table 2); three studies had a Jadad score of 6, while the others received a Jadad score of 5. All RCTs included in this meta-analysis were classified as high quality.

RESULTS OF META-ANALYSIS
Body mass index
Changes in BMI after acupuncture or sham acupuncture treatment were reported in seven selected RCTs (the study from Darbandi et al16 evaluated both auricular acupuncture and electro acupuncture for obesity). There was no significant heterogeneity between studies (I²=28.0%, p=0.20), so the fixed effects model was used to pool analysis. Results of meta-analysis showed that there were statistically significant differences in BMI between the acupuncture and control groups (MD 0.48 kg/m², 95% CI 0.40 to 0.57, p<0.001). The sensitivity of the seven RCTs was assessed and the results showed that the merger statistics were still significant and the forest plots had not changed, suggesting that the combined meta-analysis results were valid.

To further examine the effects of different acupuncture methods compared with sham acupuncture treatment, subgroup analyses were performed. Five studies compared auricular acupuncture alone with sham auricular acupuncture. They were homogeneous (I²=53%, p=0.07 >0.05), so the
fixed effects model was used to pool results from the analysis. Forest plots indicated that auricular acupuncture compared to sham auricular acupuncture can significantly reduce BMI in obese patients (MD $0.47 \text{ kg/m}^2$, 95% CI $0.35$ to $0.58$, $p<0.001$). Electro acupuncture can also reduce BMI in obese patients (MD $0.50 \text{ kg/m}^2$, 95% CI $0.38$ to $0.62$, $p<0.001$). The reduction in BMI was not statistically significant between obese patients treated with traditional Chinese body acupuncture and controls (MD $1.97 \text{ kg/m}^2$, 95% CI $−0.90$ to $4.84$, $p=0.18$; figure 2).

**Body fat mass**
Four studies reported a reduction in obesity in terms of BFM changes with acupuncture compared with sham acupuncture treatments. The combined results, based on the fixed effects model ($I^2=0\%$, $p=0.60$) showed a statistically significant reduction in obesity (MD $0.66 \text{ kg}$, 95% CI $0.51$ to $0.80$, $p<0.001$; figure 3). Subgroup analyses showed that both auricular and electro acupuncture can reduce BFM in obese patients with traditional Chinese body acupuncture and controls (MD $1.97 \text{ kg/m}^2$, 95% CI $−0.90$ to $4.84$, $p=0.18$; respectively).

**Waist circumference**
Because of significant heterogeneity between studies ($I^2=95.0\%$, $p<0.001$), the results of five studies (378 participants) that used the random effects model were pooled in order to analyze WC reduction in obese patients. Meta-analysis of acupuncture studies showed significant differences between the acupuncture and sham acupuncture groups (MD $2.02 \text{ cm}$, 95% CI $0.21$ to $3.83$, $p=0.03$). Subgroup analyses showed that both auricular and electro acupuncture can reduce WC in obese patients compared with sham auricular acupuncture (MD $2.24 \text{ cm}$, 95% CI $0.40$ to $4.09$, $p=0.02$; MD $1.20 \text{ cm}$, 95% CI $0.31$ to $2.09$, $p=0.008$, respectively; figure 4).

**Hip circumference**
Four trials compared acupuncture treatment with sham acupuncture as regards HC reduction. The data from these trials indicated that they showed significant heterogeneity ($I^2=96\%$, $p<0.001$), so the random effects model was used to pool analysis. There were significant differences between the acupuncture treatment and control groups in obese patients as shown by a forest plot (MD $2.74 \text{ cm}$, 95% CI $1.21$ to $4.27$, $p=0.0004$). Subgroup analyses showed that both auricular and electro acupuncture can reduce HC in obese patients compared with sham acupuncture (MD $3.05 \text{ cm}$, 95% CI $1.57$ to $4.52$, $p<0.001$; MD $2.00 \text{ cm}$, 95% CI $1.37$ to $2.63$, $p<0.001$, respectively; figure 5).

**Body weight**
Ten selected RCTs compared changes in body weight between acupuncture treatment and sham acupuncture groups. There was significant heterogeneity between studies ($I^2=62\%$, $p=0.005$), so the random effects model was used to pool analysis. Meta-analysis showed that there were no statistically significant differences in BW between the acupuncture
and control treatment groups (MD 0.60 kg, 95% CI −0.20 to 1.39, p = 0.14).

Subgroup analyses were used to further explore the effects of different acupuncture methods on BW. Forest plots showed that there were no significant differences in auricular acupuncture compared with sham auricular acupuncture, electro acupuncture compared with sham electro acupuncture, and TCM body acupuncture compared with sham TCM body acupuncture. The mean differences in BW change were not significantly different between the different treatment groups: 0.48 kg, 95% CI −0.72 to 1.67, p = 0.43; 1.77 kg, 95% CI −0.10 to 3.64, p = 0.06; and 0.13 kg, 95% CI −0.80 to 1.06, p = 0.78, respectively (figure 6).

Subgroup analyses were also used to further investigate the effects of acupuncture methods in different countries or regions. The forest plots revealed that BW changes were significantly different between acupuncture and sham acupuncture in Turkey and Iran. The results showed that acupuncture reduced BW compared with sham acupuncture in four studies conducted in Turkey (MD 1.92 kg, 95% CI 0.02 to 3.81, p = 0.05). However, results from two studies conducted in Iran showed that sham acupuncture seems to be more effective in reducing BW (MD −0.56 kg, 95% CI −1.11 to 0.00, p = 0.05; figure 7).

Evaluation of publication bias

Begg’s test is used to examine publication bias. The potential for publication bias could not be excluded, except for the evaluation of the relationship between obesity and acupuncture methods and countries or regions; however, the funnel plot showed that the potential publication bias of the included studies was very small (all p > 0.05; figure 8).

DISCUSSION

Obesity is an independent risk factor for many chronic diseases. The increase in the prevalence of obesity has been accompanied by an increase in the prevalence of diabetes, cardiovascular disease, cancer and other conditions. Patients with simple obesity use exercise, diet control and other methods to help them lose weight, but the effects have not been clarified. In recent years, RCT studies have reported that acupuncture can reduce BW, BMI and HC in obese patients.

Figure 5  Pooled estimates of hip circumference decrements after acupuncture treatment.

Figure 6  Subgroup analyses of body weight decrements according to acupuncture categories. TCM, Traditional Chinese Medicine.
RCTs can be used to examine the effects of interventions. However, they vary greatly in research quality and study characteristics, making it difficult to translate findings into clinical practice. Therefore, our study used meta-analysis to retrieve, screen and quantitatively analyse recently published RCT data on acupuncture used to treat simple obesity. Our study aimed to evaluate the effect of acupuncture on reducing BMI, BW, HC and other indicators and to provide scientific and reliable evidence for simple obesity patients. This study included 11 RCTs which met the inclusion and exclusion criteria. Differences in BMI, BFM, WC and BW before and after treatment in acupuncture and control groups were calculated as efficacy evaluation indicators. Meta-analysis results showed that differences in BMI before and after treatment in the acupuncture group were significantly higher than in the control group (p<0.001). Subgroup analysis showed auricular acupuncture and electro acupuncture were both effective for reducing BMI in obese patients (p<0.001). The pooled analysis also showed that both electro and auricular acupuncture can significantly reduce BFM, WC and HC (p<0.05). However, the differences in BW before and after treatment in the acupuncture groups were not significantly higher than in the sham acupuncture group (p>0.05). BMI is the most important of the indicators we studied as it is used to determine overweight and obesity and to estimate the risk of heart disease, high blood pressure and other conditions.

The forest plot of subgroup analysis used to explore the effects of acupuncture methods in different countries or regions showed that acupuncture significantly reduced BW (both p=0.05). This suggests that in different countries or regions, acupuncture may have different effects due to different acupuncture methods.

This meta-analysis has some limitations. First, one of our inclusion criteria was that the control group received sham acupuncture treatment, so none of the included studies were from the mainland of China, which may have affected the conclusions. Second, only 11 studies published in English were included, which may have led to publication bias. Third, the sample size of this meta-analysis was not very big. Therefore, further studies with a larger sample size are required to validate our findings.

The results of our meta-analysis demonstrated that acupuncture can reduce BMI, HC and WC, which suggests that acupuncture is effective for the treatment of obesity. However, due to the small number of included studies and limited sample size, our conclusions remain to be confirmed by further high quality RCTs.

Acknowledgements The authors thank the researchers of the studies included in the present meta-analysis.

Contributors R-QZ planned the study, R-QZ, JT, F-YL and Y-HM screened the literature. L-XH and X-LY extracted the data from the literature. JT and R-QZ conducted the meta-analysis and wrote the manuscript. R-QZ submitted the study.

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**Main message**

- Obesity is an increasing global health problem.
- The literature on the use of acupuncture to help weight loss is increasing, but the efficacy of acupuncture has not been determined.
- Acupuncture can reduce body weight, hip circumference, waist circumference and body mass index, which suggests that acupuncture is effective for the treatment of obesity.

**Current research questions**

- Could acupuncture be used as a promising treatment for obesity?
- What is the molecular mechanism by which acupuncture controls obesity?
- Does treatment of obesity by acupuncture have any potential long-term side effects?


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