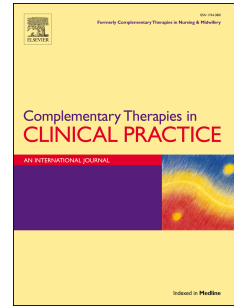


Journal Pre-proof

Effects of auriculotherapy on weight and body mass index reduction in patients with overweight or obesity: Systematic review and meta-analysis

Carolina Rodrigues de Mendonça, Larissa Silva Coelho dos Santos, Matias Noll, Erika Aparecida Silveira, Jalsi Tacon Arruda



PII: S1744-3881(19)30673-5

DOI: <https://doi.org/10.1016/j.ctcp.2019.101069>

Reference: CTCP 101069

To appear in: *Complementary Therapies in Clinical Practice*

Received Date: 1 September 2019

Revised Date: 24 October 2019

Accepted Date: 24 October 2019

Please cite this article as: de Mendonça CR, Coelho dos Santos LS, Noll M, Silveira EA, Arruda JT, Effects of auriculotherapy on weight and body mass index reduction in patients with overweight or obesity: Systematic review and meta-analysis, *Complementary Therapies in Clinical Practice* (2019), doi: <https://doi.org/10.1016/j.ctcp.2019.101069>.

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2019 Published by Elsevier Ltd.

Effects of auriculotherapy on weight and body mass index reduction in patients with overweight or obesity: Systematic review and meta-analysis

Carolina Rodrigues de Mendonça^{1,2*}, Larissa Silva Coelho dos Santos¹, Matias Noll^{2,3},

Erika Aparecida Silveira² and Jalsi Tacon Arruda⁴

¹ Physical therapy undergraduate course, Faculdade do Esporte ESEFFEGO,

Universidade Estadual de Goiás (UEG), Goiânia, Goiás, Brazil

² Graduate Program in Health Sciences, School of Medicine, Universidade Federal de Goiás, Brazil

³ Instituto Federal Goiano, Ceres Campus, Goiás, Brazil

⁴ Department of Medicine, Centro Universitário de Anápolis - UniEvangélica, Anápolis, Goiás, Brazil

***Corresponding author:** Carolina Rodrigues de Mendonça

ORCID iD: <https://orcid.org/0000-0002-9902-8227>

UEG Faculdade do Esporte-ESEFFEGO, Avenida Oeste, 56-250 - Setor Aeroporto, Goiânia - GO, 74075-110, Brazil

Email address: carol_mendonca85@hotmail.com

Patient consent

Not required

Conflict of interest:

None

Grant support: IF Goiano and Funded by FAPEG - Foundation for Research Support of the State of Goiás

ABSTRACT

Objective: Auriculotherapy is based on the stimulation of reflex points in the ear.

However, little is known about its weight-reducing effects. The aim of the present systematic review and meta-analysis was to investigate the effects of auriculotherapy on weight and/or (BMI) reduction in overweight or patients with obesity.

Methods: Twelve articles were selected for systematic review. Four randomized controlled trials (RCTs) investigating weight reduction and five investigating BMI reduction were selected for the meta-analyses

Results: The results revealed an association between auriculotherapy and weight reduction (WMD, 1.507; 95% CI, 0.606–2.407; $p < 0.000$). Auriculotherapy was also significantly associated with BMI reduction (WMD, 0.865; 95% CI, 0.533–1.196; $p < 0.004$).

Conclusions: We found that auriculotherapy was effective in reducing weight and/or BMI in overweight or patients with obesity. However, the findings should be interpreted with caution due to heterogeneity.

Keywords: Auriculotherapy; Acupuncture, Ear; Body mass index; Obesity; Weight Loss

1 INTRODUCTION

Obesity is defined as a chronic disease characterized by increased body fat reserves, and it is influenced by genetic and environmental factors, eating habits, and lifestyle¹. The global obesity epidemic is worsening worldwide, and its implications for physical and economic health continue to be threatening². Therefore, a multidisciplinary approach should be used to manage and reduce the burden of this disease, which is associated with a high body mass index (BMI)³.

Currently, the most commonly used strategies for the treatment of obesity include lifestyle modifications (diet and physical activity), pharmacotherapy, psychotherapy, and bariatric surgery⁴⁻⁸. However, other therapies involving complementary and alternative medicine, such as acupuncture, have been shown to be beneficial for reducing the weight of patients with obesity⁹. A study showed that the effect of acupuncture on body weight can be maximized when it is combined with auriculotherapy and lifestyle modifications¹⁰.

Auriculotherapy, also known as auricular acupuncture, is based on the stimulation of auricular points using acupuncture for therapeutic purposes. It is a safe, simple, and low-cost technique^{11,12} used for the treatment of several conditions, including chronic and acute pain, temporomandibular dysfunction, anxiety, and insomnia¹³⁻¹⁵. However, little is known about the efficacy of auriculotherapy for the management of obesity.

Accordingly, the aim of this systematic review and meta-analysis was to investigate the effects of auriculotherapy on weight and/or BMI reduction in overweight or patients with obesity.

2 METHODS

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines¹⁶. The protocol was registered with PROSPERO on September 20, 2018 (CRD42018109260, http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42018109260).

2.1 *Criteria for eligibility*

Studies investigating the effects of auriculotherapy on weight and/or BMI reduction in overweight or patients with obesity were considered eligible. The eligibility criteria were specified according to the PICO (Population, Intervention, Comparison, Outcome) structure, which is explained in the recommended notification items for systematic reviews and meta-analyses¹⁶. Accordingly, “P” represented overweight or patients with obesity, “I” represented the use of auriculotherapy, “C” represented the use of other therapies or placebo, and “O” represented body weight (kg) and BMI (kg/m^2). Randomized clinical trials and observational studies published in English, Spanish, or Portuguese were included, with no restriction on the year of publication. Overweight and obesity were defined as per the recommendations of the World Health Organization (WHO): overweight (BMI, 25–29.9 kg/m^2), obesity (BMI, $\geq 30 \text{ kg/m}^2$). BMI values recommended by WHO for Asia–Pacific populations were also considered as follows: overweight (BMI, 23–24.9 kg/m^2), obesity (BMI, $\geq 25 \text{ kg/m}^2$)¹⁷. The exclusion criteria were as follows: studies on acupuncture in other body regions, studies including pregnant women in the study group, studies with incomplete data, review articles, and case reports.

2.2 *Search strategy*

Following development of the search protocol and definition of terms, two authors (LSCS and CRM) searched the following databases for articles published until October 2018: PubMed, ScienceDirect, SciELO, and PEDro.

The following combination of keywords was used for the PubMed search: ("Auriculotherapy"[Mesh]) AND "Obesity"[Mesh]) OR ("Acupuncture, Ear"[Mesh] AND "Obesity"[Mesh]) OR ("Acupuncture, Ear"[Mesh] AND "weight loss"[Mesh]) OR ("Auriculotherapy"[Mesh] AND "weight loss"[Mesh]) OR ("Auriculotherapy"[Mesh] AND "overweight"[Mesh]) OR ("Acupuncture, Ear"[Mesh] AND "overweight"[Mesh])). For the ScienceDirect and SciELO searches, the combination of keywords was auriculotherapy AND obesity. For the PEDro search, the term “auricular acupuncture” was used. Then, the following filters were selected: acupuncture, clinical trial, and observational studies.

2.3 Selection of studies

The titles and abstracts of the retrieved studies were independently read and assessed by two researchers (LSCS and CRM). The decisions of the first researcher (LSCS) were compared with those of the second researcher (CRM), and a Cohen Kappa statistic was generated, which showed strong agreement between the two (95.45% agreement; adjusted kappa, 0.91). Next, the selected articles were read in full, following which the two researchers (LSCS and CRM) applied the inclusion and exclusion criteria. This process was also associated with strong agreement between the researchers (90.00% agreement; adjusted kappa, 0.80). Disagreements were resolved by a third researcher (JTA). The study selection process is illustrated in a flowchart prepared according to the PRISMA guidelines (Figure 1).

2.4 Data extraction and quality assessment

The following data were collected from the included studies: author, year of publication, type of study, country, number of participants, age, sex, auricular points used, type of intervention, type of comparison group, duration of treatment, outcomes, and results. Some authors were contacted for additional information. The quality of studies was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system with online software (<https://gdt.gradeapro.org/app/#>)¹⁸. The quality of the study evidence was classified into four categories: high, moderate, low, or very low.

2.5 Statistical analysis

The population size and mean and standard deviation values for treatment-induced changes in weight and BMI were subjected to meta-analysis, and the results were expressed as weighted mean differences (WMDs). The percentage of variability attributable to the heterogeneity of the studies was estimated by I^2 statistics, with a p-value of <0.05 considered statistically significant. Heterogeneity was classified on the basis of the I^2 values as follows: 25%, low heterogeneity; 50%, moderate heterogeneity; and 90%, high heterogeneity. A random effects model was used, and meta-analysis were performed with a confidence interval (CI) of 95%. Funnel plots and Egger tests were used to identify any publication bias in terms of weight and BMI outcomes. Shapiro-Wilk test was performed to test the normality of variables. All statistical analyses were performed using STATA 13.0 software (Stata Corporation, College Station, TX, USA), with a p-value of <0.05 considered statistically significant.

3 RESULTS

A total of 107 eligible studies were identified (Figure 1), one of which was excluded because it was a duplicate article. From the remaining 106 studies, 85 were excluded after the initial reading stage. The other 21 were read in full, and 12 studies were eventually included in our systematic review¹⁹⁻³⁰ (Figure 1). The meta-analyses included four and five studies that investigated weight reduction^{19,20,22,23} and BMI reduction^{19,20,22,23,29}, respectively; two studies were not included because they showed discrepant results in funnel plots^{28,30}.

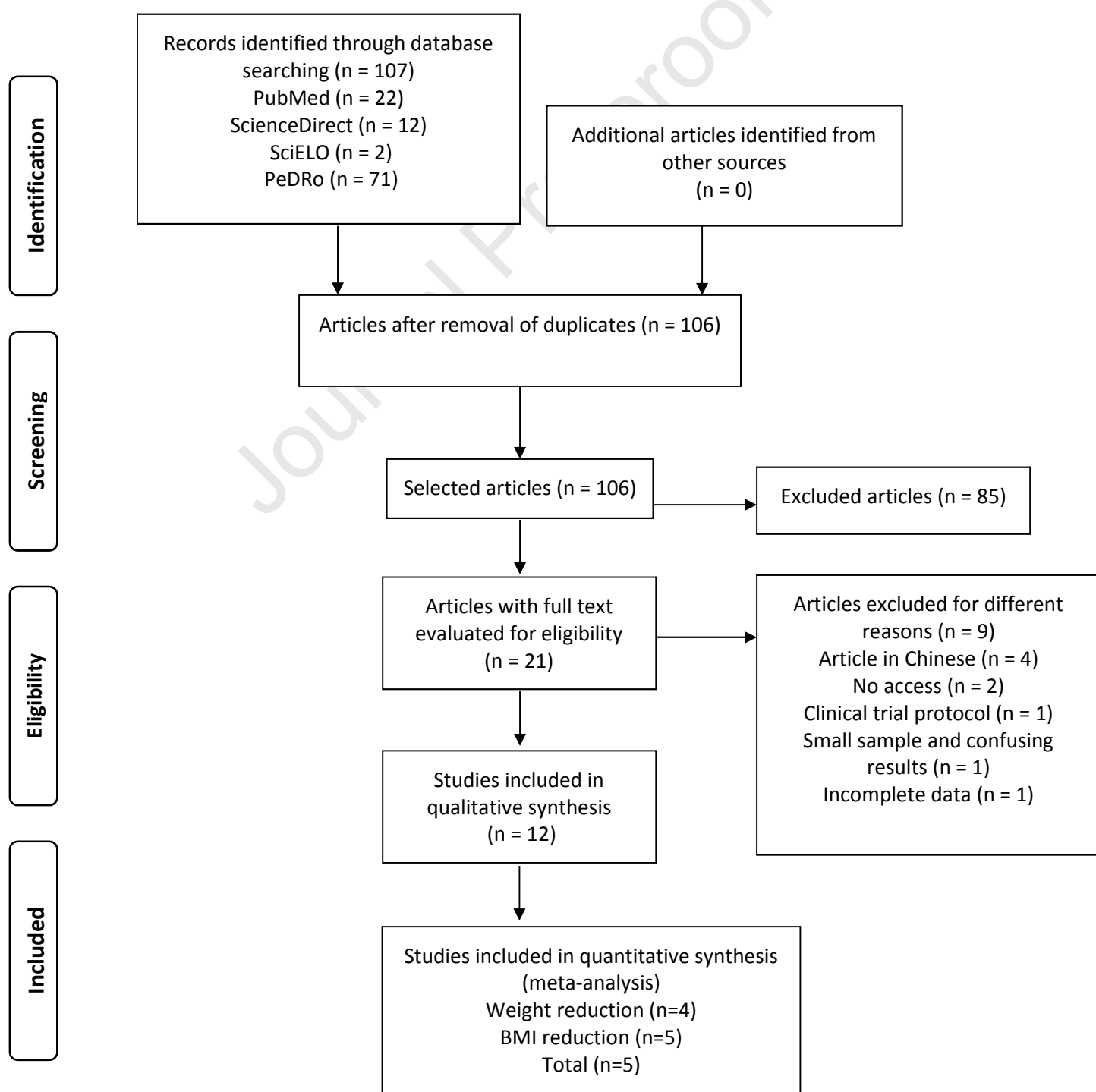


Figure 1: PRISMA flow diagram showing the selection of studies for a systematic review and meta-analysis on the effects of auriculotherapy on weight and/or body mass index reduction in overweight or patients with obesity.

The sample size in the 12 included studies¹⁹⁻³⁰ ranged from 24 to 195, with a total of 874 participants. From these, 398 patients were included in the auriculotherapy group and 476 in the control group (Table 1). Two studies divided the included patients into three groups^{24,28}, while two compared auriculotherapy^{24,27}. One of the latter two studies also evaluated the effects of combined auriculotherapy and body acupuncture²⁴. Seven studies reported the effects of auriculotherapy versus those of placebo^{19,21-23,25,29,30}, while three compared auricular therapy with no treatment^{20,26,28}.

Five studies used microneedles^{22,24-27}, four used seeds^{19,20,23,29}, two used electrical stimulation^{25,29}, and two used magnetic spheres^{21,28}. Ten studies (83%) were conducted in Asian countries, including China^{20-22,24,28}, South Korea^{23,30}, Iran¹⁹, Taiwan²⁹, and Turkey²⁶. The remaining two studies were conducted in Austria²⁵ and Peru²⁷.

The most common stimulation points were *Shen Men*, *Stomach*, *Endocrine*, and *Hunger*. Mouth, small intestine, anti-aggression, spleen, San Jiao, colon, and center of the ear points were also used. The treatment lasted from 4 weeks to 3 months. Table 1 presents details on the overall treatment duration and frequency and duration of the sessions. Eight studies reported weight reduction and BMI changes^{19,20,22,23,25,27,28,30}; two reported only BMI changes^{26,29}, and two reported only weight reduction^{21,24}.

Table 1. Characteristics of the studies included in a systematic review and meta-analysis on the effects of auriculotherapy on weight and/or body mass index reduction in overweight or obese adults.

Study	Methods	Risk of bias (GRADE)	Sample size/sex/mean age	Country	Participants and intervention time	Intervention	Comparison or Control	Outcome	Results
Cayir et al. 2017 ²⁷	Controlled RCT	⊕⊕⊕⊕ HIGH	N = 50 100% F 36.2 years	Peru	Obese women, BMI ≥ 30 kg/m ²	Before (n = 25) Body acupuncture Intervention time: 12 weeks	Before (n = 25) Ear acupuncture Six sessions at once every 2 weeks	Weight (kg) and BMI (kg/m ²) reduction	Weight Body acupuncture group: 2.6 \pm 2.4 Ear acupuncture group: 4.2 \pm 3.4 p = 0.015 BMI: Body acupuncture group: 1.0 \pm 0.9

						0.25-mm diameter and 25-mm length	15–20 minutes before meals for 30 s, three times a day		Ear acupuncture group: 1.7 ± 1.3
						Stimulation: 30 minutes	The needles were changed every 15 days.		$p = 0.091$
						After (N = 21)			
							After (n = 17)		
Cha and Park 2016 ²⁰	Controlled RCT	⊕⊕⊕ MODERATE	N = 58 100% F >20 years	China	Obese women, BMI ≥ 35 kg/m ²	Before and after (n = 30) Auricular Intervention time: 8 weeks acupressure with vaccine seeds and fixing adhesives	Before and after (n = 28) Control: no pressure therapy pressure therapy reduction	Weight (kg) and BMI (kg/m ²) reduction	Weight Ear acupuncture group: 1.07 ± 1.52 Control group: $+0.26 \pm 0.97$ $p < 0.001$ BMI Ear acupuncture group: 1.14 ± 2.48
						Sessions: once a week			

						Stimulation: 3 minutes			Control group: +0.18 ± 1.13 p = 0.006
						Points: Stomach, hunger, Shen Men, spleen, endocrine			
Yeo et al., 2014 ³⁰	Blinded RCT	⊕⊕⊕⊕ HIGH	N = 91 79.12 F >19 years	Korea	Men and women BMI ≥ 23 kg/m ²	Before and after (n = 31) Ear acupuncture Sessions: once a week Continuous stimulation	Before and after (n = 30) Control: placebo	Weight (kg) and BMI (kg/m ²) reduction	Weight Ear acupuncture group: +4.4 ± 1.5 Control group: +2.2 ± 1.9 p = 0.003 BMI Ear acupuncture group: 6.1 ± 2.0 Control group:

					as overweight.				3.1 ± 2.7
									p = 0.004
					Intervention				
					time: 8 weeks				
Set et al. 2014 ²⁶	Clinical, prospective cohort study	⊕⊕ LOW	N = 24 100% F 42.9 years	Turkey	Obese and depressed women BMI > 29.9 kg/m ²	(N = 24) Auricular acupuncture Six sessions every 15 days, bilaterally	NA	BMI reduction	BMI: decreased from 39.0 ± 4.7 kg/m ² to 37.2 ± 4.3 kg/m ² p < 0.001
					Intervention time: 3 months	Pressure with 0.22 × 1.3-mm sterile, disposable needles Stimulation: 15– 20 minutes before meals Points: auto- aggression and			

						stomach			
Yeh et al. 2015 ²⁹	RCT	⊕⊕⊕⊕ HIGH	N = 70 50% F 50% M 18–50 years	Taiwan	Adults with BMI ≥ 27 kg/m ² ; WC, ≥80 cm in women and ≥90 cm in men Intervention time: 10 weeks	Before (n = 67) Ear acupuncture with seeds and electrical stimulation (20 minutes) Sessions: once a week Stimulation: 1 minute, four times a day Points: Shen Men (TF4), stomach (CO4), endocrine (CO18), hunger After (n = 36)	Before (n = 67) Control: placebo Electrical stimulation of pseudo points, with no acupressure. Points: ankle, elbow, shoulder, clavicle After (n = 34)	BMI (kg/m ²) reduction	BMI: Auricular acupuncture group: 2.08 ± 2.00 kg/m ² p < 0.001 Control group 1.02 ± 2.06 kg/m ² p = 0.007
Schukro et al.	Controlled RCT	⊕⊕⊕	N = 42	Austria	Obese women:	Before (n = 28)	Before (n = 28)	Weight (kg)	Weight

2014 ²⁵		MODERATE	100% F >18 years		BMI \geq 25 kg/m ²	Ear acupuncture with electrical stimulation using a P-Stim® device Electrical stimulation: For 4 days Points: hunger (18), stomach (87), colon (91) After (n = 21)	Control: placebo and No electrical stimulation After (n = 21)		Ear acupuncture group: 3.73%; 95% CI, 4.70 to 2.76 Placebo group: 0.70%; 95% CI, 1.57 to 0.16 p < 0.001 BMI Ear acupuncture group: 3.62%; 95% CI, 4.39 to 2.84 Placebo group: 0.82%; 95% CI, 1.55 to 0.10 p < 0.001
Kim et al. 2014 ²³	Controlled RCT	⊕⊕⊕⊕	N = 58	Korea	Adults with BMI \geq 25 kg/m ²	Before (n = 29) Ear acupuncture	Before (n = 29) Control: placebo	Weight (kg) and	Weight Ear acupuncture

20.6 years	with seed	No stimulation	BMI (kg/m ²)	group: 3.1 ±
Intervention	application	Patients received	reduction	0.73
time: 4 weeks	Stimulation:	treatment after		Placebo group:
	5 seconds, 10	study completion		0.2 ± 1.05
	times per			p < 0.001
	auricular point,	After (n = 24)		BMI
	three times a day			Ear acupuncture
	for a total of 4			group: 1.23 ±
	weeks, with			0.34
	each procedure			Placebo group:
	performed 30			0.15 ± 0.45
	minutes before			p < 0.001
	meals			
	Points: Shen			
	Men, mouth,			
	stomach,			
	endocrine, small			
	intestine.			
		After (n = 25)		

Abdi et al. 2012 ¹⁹	RCT	⊕⊕⊕⊕ HIGH	N = 169 18–55 years	Iran	Adults with BMI ≥ 30 kg/m ² Intervention time: 12 weeks (6 weeks with auriculotherapy and 6 weeks with diet only)	Before (n = 102) Ear acupuncture: Seeds applied twice a week Stimulation: 30 minutes before meals for approximately 20 seconds Points: Shen Men (TF4), stomach (CO4), hunger, mouth (CO1), center of ear (HX1), San Jiao (CO17) After (n = 86)	Before (n = 102) Control: placebo Only adhesive tape was used. Points: hip (AH5), spleen (CO13), nose, and esophagus (CO2) After (n = 83)	Weight (kg) and BMI (kg/m ²) reduction	Weight Ear acupuncture group: 3.66 ± 0.32 Placebo group: 2.27 ± 0.33 p = 0.000 BMI Auricular acupuncture group: 1.66 ± 0.19 placebo group: 0.95 ± 0.17 p = 0.000
Hsieh et al. 2011 ²¹	RCT	⊕⊕⊕⊕ HIGH	N = 55 90.09% F	China	Women with WC ≥ 80 cm	Before and after (n = 27)	Before and after (n = 28)	Weight (kg) reduction	Auriculotherapy group:

			18–20 years		and men with WC \geq 90 cm	Auriculotherapy with Japanese Magnetic Pearls	Control: placebo Only adhesive tape was used.		–0.8022 kg p < 0.0001 Control group: –0.0143 kg p = 0.0001
Hsu et al. 2009 ²²	RCT	⊕⊕⊕⊕ HIGH	N = 45 100% F 39.5 years	China	Women with BMI \geq 27 kg/m ²	Before (n = 30) Auriculotherapy Points: hunger, Shen Men, stomach, endocrine After (n = 23)	Before (n = 30) Control: placebo Only adhesive tape was used. After (n = 22)	Weight (kg) and BMI (kg/m ²) reduction	Weight Auriculotherapy group: 0.5 \pm 1.8 Placebo group: 0.7 \pm 2.8 P = 0.77 BMI Auriculotherapy group: 0.5 \pm 1.8 Placebo group: 1.1 \pm 2.9 P = 0.46
Yeh and Yeh	RCT	⊕⊕⊕⊕	N = 38	China	Adults with	Before and after	Before and after	Weight (kg)	Weight

2008 ²⁸		HIGH	84.2% F 22–50 years		BMI \leq 27 kg/m ² Seven patients with obesity (BMI \geq 27 kg/m ²) Intervention time: 9 weeks	(n = 19) Auriculotherapy, once a week Points: Shen Men, mouth, stomach, endocrine, and bowel	(n = 19) Control: no intervention	and BMI (kg/m ²) reduction	Auriculotherapy group: 59.85 \pm 15.62 Control group: 61.20 \pm 12.90 p = 0.615 BMI Auriculotherapy group: 23.30 \pm 4.97 Control group: 23.39 \pm 4.19 p = 0.658
Qunli and Zhicheng 2005 ²⁴	RCT	⊕⊕⊕ MODERATE	N = 195 4% M 96% F 35.5 years	China	Adults with BMI \geq 25 kg/m ² Intervention time: 4 weeks	Before and after (n = 55) Auriculotherapy: 36 needles, for 30 minutes every two days by alternating	Before and after (n = 64) Body acupuncture: 30 minutes, once every 2 days Before and after	Weight (kg) reduction	Weight reduction Auriculotherapy group: 49.9% Body acupuncture 81.2%

	the ears	(n = 76)	Auriculotherapy
		Auriculotherapy	+ body
		+ body	acupuncture
		acupuncture	93.4%

RCT, randomized clinical trial; F, female; M, male; BMI, body mass index; BFP, body fat percentage; WC, waist circumference; HC, hip circumference; NA, not applicable; CI, confidence interval

3.1 Meta-analysis

The four studies with weight reduction as the outcome measure^{19,20,22,23} included 164 and 157 individuals in the auriculotherapy and control groups, respectively. The effects of auriculotherapy were significantly superior to those of control treatment in terms of weight loss (WMD, 1.434; 95% CI, 1.339–1.529; $p = 0.000$), with high heterogeneity among studies ($I^2 = 92.1\%$). Accordingly, a random effects model was selected (WMD, 1.507; 95% CI, 0.606–2.407; $p = 0.000$; $\tau^2 = 0.7105$; Figure 2).

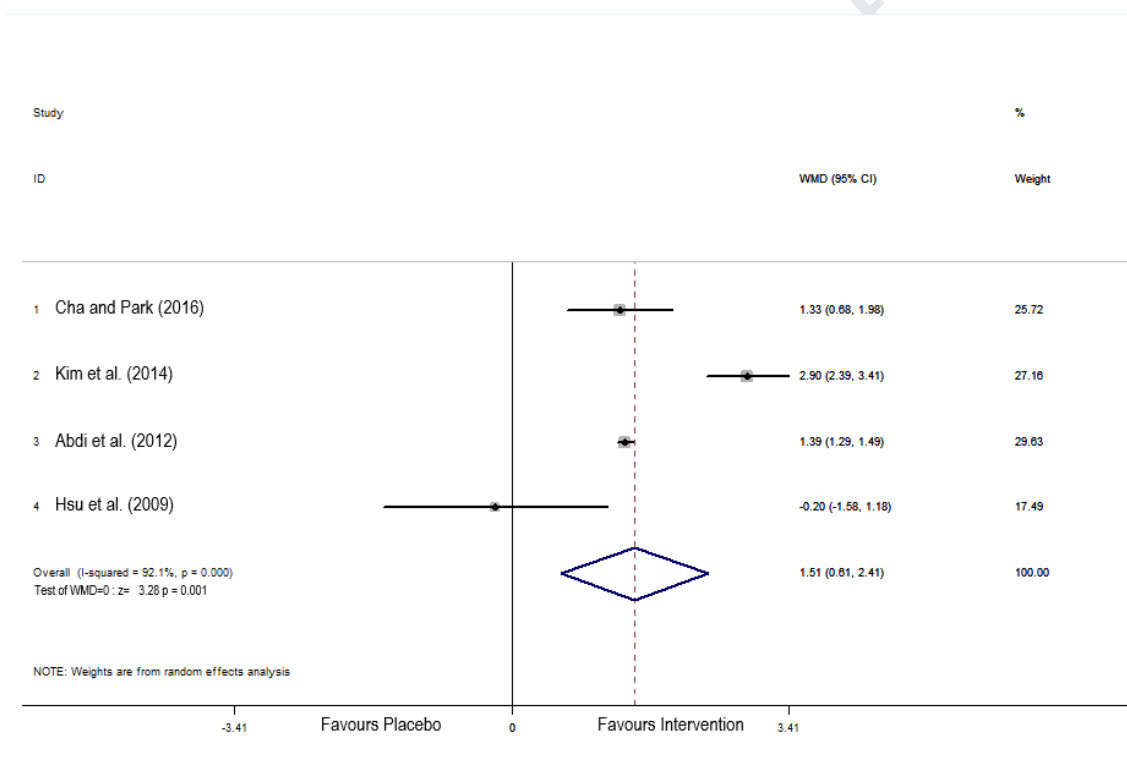


Figure 2: Results of a meta-analysis for the effects of auriculotherapy on weight reduction in overweight or patients with obesity.

The five studies with BMI reduction as the main outcome measure^{19,20,22,23,29} included 200 and 191 individuals in the auriculotherapy and control groups, respectively. Meta-analysis showed that BMI reduction was significantly greater in the auriculotherapy group than in the control group (WMD, 0.731; 95% CI, 0.679–0.784; p

= 0.004). There was high heterogeneity among studies ($I^2 = 73.6\%$), so we selected a random effects model (WMD, 0.865; 95% CI, 0.533–1.196; $p = 0.004$; $\tau^2 = 0.0680$; Figure 3).

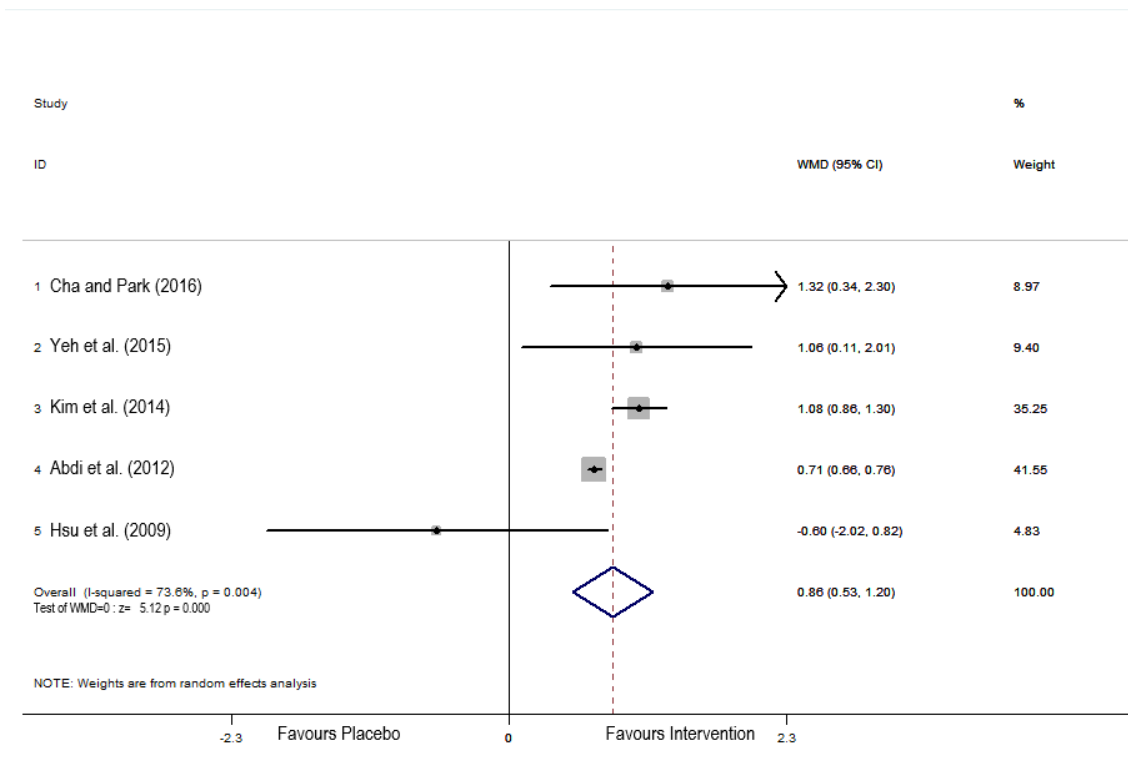


Figure 3: Results of a meta-analysis for the effects of auriculotherapy on body mass index reduction in overweight or patients with obesity.

3.2 Publication bias

Funnel plots revealed a symmetrical pattern among studies, with no publication bias (Figures 4 and 5). This was confirmed by Egger tests, where p-values of 0.241 and 0.238 ruled out apparent bias in the studies documenting weight reduction and BMI reduction, respectively. The normality test indicated that intervention group and placebo is not normally distributed, possibly due to the low number of articles included in the study. Analysis of the methodological quality of the studies using the GRADE criteria

indicated moderate to high quality. All studies were approved by relevant ethics and research committees and reported no conflicts of interest.

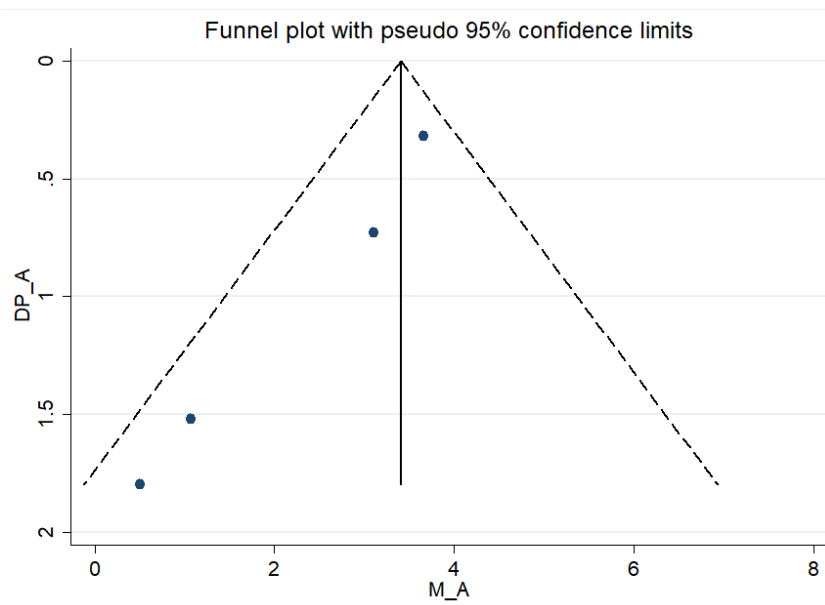


Figure 4: Funnel plot for intervention studies included in a meta-analysis for the effects of auriculotherapy on weight reduction in overweight or patients with obesity.

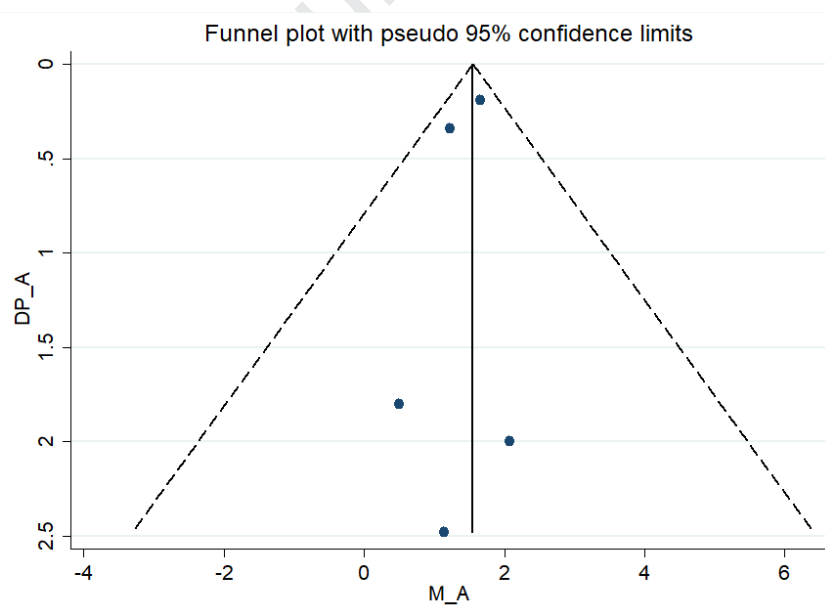


Figure 5: Funnel plot for intervention studies included in a meta-analysis for the effects of auriculotherapy on body mass index reduction in overweight or patients with obesity.

4 DISCUSSION

To the best of our knowledge, this is the first systematic review and meta-analysis evaluating the effects of auriculotherapy on weight and/or BMI reduction in overweight or patients with obesity. Other researchers are interested in investigating this issue³¹, no however this is the first study to present findings. Although the effects of acupuncture on weight reduction have already been reported, studies addressing the effects of auriculotherapy have documented contradictory results; this motivated us to conduct a systematic review and meta-analysis. We found that auriculotherapy may be effective in reducing weight and/or BMI in overweight or patients with obesity. Our results are significant and indicate that this treatment method could be an effective adjunct to other obesity treatments in addition to being a safe and low-cost procedure.

The two studies that were excluded from our meta-analyses reported a 6.1% reduction in BMI after 8 weeks of auriculotherapy³⁰ and a reduction in the waist and hip circumference after 9 weeks of auriculotherapy²⁸. Another study³², which was not included in this systematic review, showed that combined treatment with auriculotherapy and body acupuncture was more effective than acupuncture alone in terms of weight reduction in individuals with obesity.

We identified variations in the stimulation points used for auriculotherapy among the studies included in our review. This can be attributed to the existence of two basic theories that explain the mechanism of action of auriculotherapy: the Traditional Chinese Medicine theory and Nogier's theory. While the Traditional Chinese Medicine theory is based on meridians, five elements, and yin–yang, Nogier's theory, which has a French origin, is based on the representation and anatomical correlation of an inverted fetus on the auricle with reflex points on the body³³.

Hou et al. reported a large variation in the combination of points and materials used for auriculotherapy³⁴. In the studies included in our review, several materials such as needles, seeds, and electrodes were used for auriculotherapy. However, few studies have compared the effectiveness of the technique according to the material used, so there is no consensus on the most effective material. Nevertheless, it has been established that auriculotherapy has beneficial effects on several diseases, regardless of the material used^{33,35}.

With regard to the duration of treatment, good weight loss results were observed in a study by Abdi et al.,¹⁹ who performed the treatment twice a week for 12 weeks. This study was also found to have high methodological quality as per the GRADE system. The other studies, except that by Yeh and Yeh²⁸, also documented a significant reduction in weight and/or BMI in the auriculotherapy group relative to that in the control group. Although weight loss was observed in the auriculotherapy group in the study by Yeh and Yeh²⁸, there was no significant difference from the results for the control group.

Most of our analyzed studies were conducted in the Asia-Pacific region, primarily China. This was probably because China holds the oldest records of acupuncture practice and related studies, which led to the origin of auriculotherapy³⁴. Moreover, analysis using the GRADE system revealed moderate to high methodological quality for all selected studies except that by Set et al.,²⁶ which had low methodological quality because it was an observational study.

Although WHO recommends that BMI values of $\geq 25 \text{ kg/m}^2$ and $\geq 30 \text{ kg/m}^2$ define overweight and obesity, respectively, our selected studies reported lower BMI values, although they were in accordance with the standards accepted by WHO for countries in the Asia-Pacific region. One of the limitations of our study is the limited

number of articles included in the systematic review and meta-analyses. In addition, the number of articles included in meta-analysis was not enough to perform meta-regression. Unfortunately, we had to exclude several studies from the initial selection because of the following reasons: highly discrepant^{28,30}, small samples³⁶, incomplete and contradictory³⁷ lack of comparisons between an auriculotherapy group and a placebo group^{24,27}, and weight loss results not expressed as mean and standard deviation values^{21,24,25}. Furthermore, we could not include studies published in Chinese^{32,38-40}, even though auriculotherapy is widely used in China. Nevertheless, we included studies conducted and published in China and English-speaking countries, as well as some studies conducted in Korea and Japan but published in English.

5 CONCLUSIONS

In conclusion, we found that auriculotherapy was effective in reducing weight and/or BMI in overweight or patients with obesity. The materials used for this treatment do not seem to modify its effects, which may help in increasing patient compliance. Auriculotherapy is an inexpensive treatment with little or no side effects and can be used alone or in combination with other obesity treatments, including nutritional interventions and physical exercise. However, the findings should be interpreted with caution due to heterogeneity. Further studies should be conducted in adults with obesity (≥ 30 kg/m²) and severe obesity (≥ 35 kg/m²) according to the WHO criteria; moreover, the duration of auriculotherapy and the stimulation points should be standardized through additional research.

Authors' contributions

Carolina Rodrigues de Mendonça: protocol development, data collection or management, data analysis, manuscript writing, and critical review

Larissa Silva Coelho dos Santos: protocol development, data collection or management, data analysis, and manuscript writing

Jalsi Tacon Arruda: discordance analysis, data analysis, and critical review

Matias Noll: manuscript writing and critical review

Erika Aparecida da Silveira: manuscript writing and critical review

Acknowledgments

The authors thank the Health Ministry Library and the Eduardo Bonilha Library for their assistance in optimizing the search for full articles.

ORCID iD

Carolina Rodrigues de Mendonça <https://orcid.org/0000-0002-9902-8227>

6 References

1. Zhang K, Zhou S, Wang C, Xu H, Zhang L. Acupuncture on Obesity: Clinical Evidence and Possible Neuroendocrine Mechanisms. *Evidence-Based Complementary and Alternative Medicine*. 2018;2018.
2. Friedrich MJ. Global Obesity Epidemic Worsening. *Jama*. 2017;318(7):603.
3. Afshin A, Forouzanfar MH, Reitsma MB, et al. Health Effects of Overweight and Obesity in 195 Countries over 25 Years. *N Engl J Med*. 2017;377(1):13-27.
4. Gloy VL, Briel M, Bhatt DL, et al. Bariatric surgery versus non-surgical treatment for obesity: a systematic review and meta-analysis of randomised controlled trials. *Bmj*. 2013;347:f5934.
5. Manning S, Pucci A, Finer N. Pharmacotherapy for obesity: novel agents and paradigms. *Ther Adv Chronic Dis*. 2014;5(3):135-148.
6. Ostovan MA, Zibaenezhad MJ, Keshmiri H, Shekarforoush S. The impact of education on weight loss in overweight and obese adults. *Int Cardiovasc Res J*. 2013;7(3):79-82.
7. Philippou C, Andreou E, Menelaou N, Hajigeorgiou P, Papandreou D. Effects of diet and exercise in 337 overweight/obese adults. *Hippokratia*. 2012;16(1):46-50.
8. Zhang Y, Li J, Mo G, et al. Acupuncture and Related Therapies for Obesity: A Network Meta-Analysis. *Evidence-Based Complementary and Alternative Medicine*. 2018;2018.
9. Sui Y, Zhao HL, Wong VC, et al. A systematic review on use of Chinese medicine and acupuncture for treatment of obesity. *Obes Rev*. 2012;13(5):409-430.

10. Kim SY, Shin IS, Park YJ. Effect of acupuncture and intervention types on weight loss: a systematic review and meta-analysis. *Obes Rev.* 2018;19(11):1585-1596.
11. Zhu L, Kim Y, Yang Z. The Application of Auriculotherapy to the Treatment of Chronic Spontaneous Urticarial: a Systematic Review and Meta-analysis. *Journal of acupuncture and meridian studies.* 2018.
12. Jin Y, Chen X, Huang W, Hong Z, Hu F, Zhou Z. Analysis of the prescription of auricular acupoint therapy for simple obesity based on complex network techniques. *World Journal of Acupuncture - Moxibustion.* 2018;28(1):38-43.
13. Vieira A, Reis AM, Matos LC, Machado J, Moreira A. Does auriculotherapy have therapeutic effectiveness? An overview of systematic reviews. *Complement Ther Clin Pract.* 2018;33:61-70.
14. Dellovo AG, Souza LMA, de Oliveira JS, Amorim KS, Groppo FC. Effects of auriculotherapy and midazolam for anxiety control in patients submitted to third molar extraction. *Int J Oral Maxillofac Surg.* 2018.
15. Rodrigues MDF, Rodrigues ML, Bueno KS, et al. Effects of low-power laser auriculotherapy on the physical and emotional aspects in patients with temporomandibular disorders: A blind, randomized, controlled clinical trial. *Complement Ther Med.* 2019;42:340-346.
16. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic reviews.* 2015;4(1):1.
17. Lim JU, Lee JH, Kim JS, et al. Comparison of World Health Organization and Asia-Pacific body mass index classifications in COPD patients. *Int J Chron Obstruct Pulmon Dis.* 2017;12:2465-2475.
18. Carrasco-Labra A, Brignardello-Petersen R, Santesso N, et al. Improving GRADE evidence tables part 1: a randomized trial shows improved understanding of content in summary of findings tables with a new format. *J Clin Epidemiol.* 2016;74:7-18.
19. Abdi H, Abbasi-Parizad P, Zhao B, et al. Effects of auricular acupuncture on anthropometric, lipid profile, inflammatory, and immunologic markers: a randomized controlled trial study. *J Altern Complement Med.* 2012;18(7):668-677.
20. Cha HS, Park H. [Effects of Auricular Acupressure on Obesity in Women with Abdominal Obesity]. *J Korean Acad Nurs.* 2016;46(2):249-259.
21. Hsieh CH, Su TJ, Fang YW, Chou PH. Effects of auricular acupressure on weight reduction and abdominal obesity in Asian young adults: a randomized controlled trial. *The American journal of Chinese medicine.* 2011;39(3):433-440.
22. Hsu CH, Wang CJ, Hwang KC, Lee TY, Chou P, Chang HH. The effect of auricular acupuncture in obese women: a randomized controlled trial. *J Womens Health (Larchmt).* 2009;18(6):813-818.
23. Kim D, Ham OK, Kang C, Jun E. Effects of auricular acupressure using *Sinapsis alba* seeds on obesity and self-efficacy in female college students. *J Altern Complement Med.* 2014;20(4):258-264.
24. Qunli W, Zhicheng L. Acupuncture treatment of simple obesity. *Journal of traditional Chinese medicine = Chung i tsa chih ying wen pan.* 2005;25(2):90-94.
25. Schukro RP, Heiserer C, Michalek-Sauberer A, Gleiss A, Sator-Katzenschlager S. The effects of auricular electroacupuncture on obesity in female patients--a prospective randomized placebo-controlled pilot study. *Complement Ther Med.* 2014;22(1):21-25.
26. Set T, Cayir Y, Pirim AB. Effects of ear acupuncture therapy for obesity on the depression of obese women. *Acupunct Med.* 2014;32(5):427-429.
27. Yasemin C, Turan S, Kosan Z. The Effects of Auricular and Body Acupuncture in Turkish Obese Female Patients: A Randomized Controlled Trial Indicated Both Methods Lost Body Weight But Auricular Acupuncture Was Better Than Body Acupuncture. *Acupunct Electrother Res.* 2017;42(1):1-10.

28. Yeh CH, Yeh SC. Effects of ear points' pressing on parameters related to obesity in non-obese healthy and obese volunteers. *J Altern Complement Med*. 2008;14(3):309-314.
29. Yeh ML, Chu NF, Hsu MY, Hsu CC, Chung YC. Acupoint Stimulation on Weight Reduction for Obesity: A Randomized Sham-Controlled Study. *West J Nurs Res*. 2015;37(12):1517-1530.
30. Yeo S, Kim KS, Lim S. Randomised clinical trial of five ear acupuncture points for the treatment of overweight people. *Acupunct Med*. 2014;32(2):132-138.
31. Yao J, Chen L, Zhang L, et al. Effect of auriculotherapy and intervention types on weight control: A systematic review and meta-analysis protocol. *Medicine (Baltimore)*. 2019;98(34):e16959-e16959.
32. Bu TW, Tian XL, Wang SJ, Liu W, Li XL, Tan YH. [Comparison and analysis of therapeutic effects of different therapies on simple obesity]. *Zhongguo zhen jiu = Chinese acupuncture & moxibustion*. 2007;27(5):337-340.
33. Yi-ting J, Xia C, Wei H, Zhe-hao H, Feng H, Zhong-yu Z. Analysis of the prescription of auricular acupoint therapy for simple obesity based on complex network techniques. *World journal of acupuncture-moxibustion*. 2018.
34. Hou P-W, Hsu H-C, Lin Y-W, Tang N-Y, Cheng C-Y, Hsieh C-L. The history, mechanism, and clinical application of auricular therapy in traditional Chinese medicine. *Evidence-Based Complementary and Alternative Medicine*. 2015;2015.
35. Lan Y, Wu X, Tan H-J, et al. Auricular acupuncture with seed or pellet attachments for primary insomnia: a systematic review and meta-analysis. *BMC Complementary and Alternative Medicine*. 2015;15(1):103.
36. Shen EY, Hsieh CL, Chang YH, Lin JG. Observation of sympathomimetic effect of ear acupuncture stimulation for body weight reduction. *The American journal of Chinese medicine*. 2009;37(6):1023-1030.
37. Shiraishi T, Onoe M, Kojima TA, et al. Effects of bilateral auricular acupuncture stimulation on body weight in healthy volunteers and mildly obese patients. *Experimental biology and medicine (Maywood, N.J.)*. 2003;228(10):1201-1207.
38. Shi Y, Zhang LS, Zhao C, He CQ. [Comparison of therapeutic effects of acupuncture-cupping plus acupoint catgut embedding and electroacupuncture on simple obesity of stomach and intestine excess-heat type]. *Zhongguo zhen jiu = Chinese acupuncture & moxibustion*. 2006;26(8):547-550.
39. Li WH, Wang JD, Gu LM, Wang YZ. [Treatment of simple obesity with electroacupuncture and auricular acupoint pressing: a report of 177 cases]. *Zhong xi yi jie he xue bao = Journal of Chinese integrative medicine*. 2004;2(6):449, 458.
40. Yu AS, Yang JS, Wei LX, Xie YY. [Observation on therapeutic effect of simple obesity treated with acupuncture, auricular point sticking and TDP]. *Zhongguo zhen jiu = Chinese acupuncture & moxibustion*. 2005;25(11):828-830.

Journal Pre-proof

Highlights

- The meta-analysis of the data of the reviewed studies showed that auriculotherapy was effective in reducing weight and/or BMI in overweight or patients with obesity.

Journal Pre-proof