

SOUTH BAYLO UNIVERSITY

**The Effectiveness of Auricular Acupuncture Therapy in Treatment of
Obesity:
Literature Review**

by

Tamie Yahagi

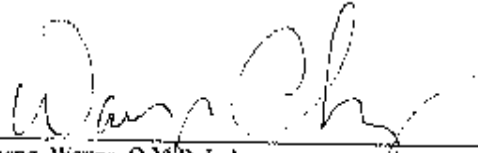
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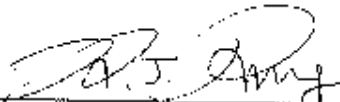
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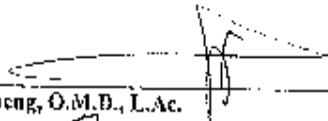
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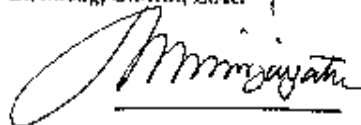
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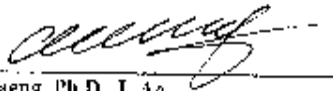
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The Effectiveness of Auricular Acupuncture Therapy in Treatment of Obesity: Literature Review

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SOUTH BAYLO UNIVERISTY at Anaheim, 2018

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ABSTRACT

The purpose of this literature review is to determine the effectivity and risks of auricular acupuncture on weight loss and to evaluate and analyze the effectiveness of auricular acupuncture compared to other weight loss methods including body acupuncture and treatments combined with exercise and diet. Three electronic databases PubMed, EBSCO host database, and the National Center for Complementary and Alternative Medicine at the National Institutes of Health (NIH) were used to search for randomized controlled trials (RCTs) of auricular acupuncture on weight loss from April 2009 to April 2017 with an English and Japanese language restriction. The key words used in the search were ear acupuncture, auricular therapy, obesity, weight loss or reduction, and weight control to determine the relevance of the articles to this literature review. Eleven articles were selected for analysis. This literature review showed that auricular acupuncture is effective on weight loss and biochemical markers. When combined with diet, it is shown to be more effective on weight loss. When compared to body acupuncture, auricular acupuncture resulted in greater weight loss. This review identified only a few minor adverse events, therefore, auricular acupuncture may be a safe and non-pharmaceutical treatment option.

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I. INTRODUCTION

Obesity is an increasingly prevalent chronic condition that is associated with serious morbidity and mortality including type 2 diabetes, mellitus, cardiovascular disease and malignancies. According to the World Health Organization (WHO), a crude measure of obesity is the body mass index (BMI).

$$BMI = \frac{Weight(kg)}{Height(m)^2}$$

A person with a BMI of 25 or more is considered overweight, while a BMI greater than 30 is generally considered obese. In 2014, the WHO reported that there were more than 1.9 billion adults age 18 years and older who were overweight, 600 million of which were obese. Overall about 13% of the world's adult population, 11% of men and 15 % of women, was obese in 2014. According to Centers for Disease Control and Prevention⁷, approximately 70% of the United States adult population is overweight, with over half of these considered obese. The annual cost of obesity to the United States economy is approximately \$200 billion (Campaign to End Obesity: Long Term Returns of Obesity Prevention Policies⁴) and American spend over \$60 billion annually in attempts to lose weight (Marketdata Enterprises).

Treatment of obesity in Western Medicine

Pharmaceutical therapy for weight loss has been studied and available on the market for decades. Benzohetamine, diethylpropion, phendimetrazine, phentermine and sibutramine are all commonly used as the anti-obesity drugs. These agents are an anorexiant or an appetite suppressor. In general, the anorexiants are sympathomimetic and act primarily by inhibiting reuptake of serotonin and norepinephrine into the presynaptic neuron, increasing the levels that

remain in the synaptic cleft and they exert greater activity. Additionally, they may treat obesity by increasing the metabolic rate (Sperber²⁶). Studies have shown that the safety of pharmaceutical drugs is a concern, including one study showing the anti-obesity drug Rimonabant increases the risk of psychiatric adverse reactions such as depression, mood disorders and anxiety (Christensen⁹), and other studies finding that adverse reactions from amfepramone were paranoid ideation, restlessness, aphasia, transient ischemic attacks due to vasospasm, schizophrenia, psychotic symptoms, dry mouth, constipation, dizziness, and chronic bronchitis. Fenproporex was found to cause withdrawal syndrome, aggression, anxiety, irritability, nightmares and insomnia, followed by severe depression and attempted suicide (Luccheta *et al*¹⁶).

History of Auricular Acupuncture

There is a growing tendency for people to choose complementary and alternative medicine. Among current modalities of complementary and alternative medicine, acupuncture including auricular acupuncture is one of the most widely used therapies. Studies have shown auricular acupuncture therapy may reduce body weight in obese patients (Pittler and Ernst¹⁸). Auricular acupuncture therapy is based on the theory that the outer ear represents all parts of the body. Modern auricular acupuncture was discovered by the physician, Paul Nogier. He discovered that the radial artery pulse showed a reaction to the stimulation of the auricle. He later realized this response was caused by the autonomic nervous system. Modern auricular acupuncture theory is based on this unique vascular reflex. One study found that ear acupuncture increases metabolic function and promotes the consumption of body fat, which results in weight loss (Yeo, Kim & Lim²⁹). The auricle is innervated by the greater auricular nerve as well as the lesser occipital nerve, the auricular branch of the vagus nerve, and the

auriculotemporal branch of the mandibular nerve. The vagus nerve is not only involved in controlling the cardiovascular, respiratory, immune, and endocrine systems, but also regulates gut physiology, appetite and obesity (Browning *et al*⁵). The shen men acupoint is thought to interact with the vagus nerve (Yeh *et al*²⁸). Since the modern auricular acupuncture was established in Western world, many RCTs of auricular acupuncture for pain, emotion issue and weight loss were conducted. Technically, ear acupuncture is easy to perform, it is also relatively inexpensive and has minimal adverse effects (Shen *et al*²³). Therefore, RCTs of auricular acupuncture has become more popular.

Treatment of Obesity in TCM

In Traditional Chinese Medicine (TCM), obesity is conceptualized in a variety of ways such as heat in the stomach and intestine, a deficiency of qi in the sleep and stomach, or excess of phlegm-dampness or phlegm-heat (Yeh, Chen & Lin³⁰). TCM obesity treatments are mainly involved with acupuncture, Chinese herbs and food therapy to normalize and balance qi, fluid and damaged organs.

The increasing prevalence of obesity in the world today requires a treatment protocol that is safe, effective, and not cost prohibitive. Pharmaceutical treatments have proven to be effective and affordable, but often carry severe side effects. Treatment with acupuncture, both body and auricular, has been shown to be effective in studies. TCM also relies on acupuncture as part of the treatment protocol for obesity. This literature search will analyze the current research to determine if auricular acupuncture can be part of a safe, effective, and affordable obesity treatment protocol to reduce the economic and health impacts of obesity.

The primary objective of this literature review was to review and analyze previous studies on the effectiveness of auricular acupuncture on weight loss to draw a definitive conclusion. A secondary objective is to compare the effectivity of auricular acupuncture compared to body acupuncture, exercise and diet. A tertiary objective is to identify potential mechanisms of auricular acupuncture's effects on obesity.

II. LITERATURE BACKGROUND

The effectiveness of auricular acupuncture has been found by different methods and designs to show scientific evidence. With scientific evidence of the effectiveness of auricular acupuncture, more people suffering from obesity can be helped. Three studies performed blood sampling and biochemical analysis in addition to the measured obesity parameters. Abdi et al¹ conducted a study to examine the effectiveness of auricular acupuncture on body weight loss and its impact on lipid profile and immunologic and inflammatory markers in obese subjects with BMI between 25 and 45 kg/m². Subjects received experimental or sham acupuncture for six weeks (1st period) in combination with a low-calorie (1000-kcal) per day and a low-calorie diet alone for next six weeks (2nd period). When compared between first and second period both groups showed that the changes for most of parameters were more significant in the first period. When compared between experimental and sham group, the experimental group was more effective in reducing the levels of anthropometric factor and anti-Hsp antibodies. They concluded auricular acupuncture with diet restriction was effective for weight loss and dyslipidemia. This study was well-organized and added different approaches like blood tests to evaluate the effectiveness of auricular acupuncture. However, diet is often effective in the first six weeks than the second six weeks. An additional group who dieted first and used the combination second may produce different results. Hsu et al¹⁴ examined obese women with BIM ≥ 30 kg/m², to evaluate the relationship between the effect of auricular acupuncture and obesity-related hormone peptides. Sixty obese women were assigned randomly into experimental and sham groups for the six-week study. They found no statistical difference in the percentage reduction in body weight (BW), BMI, and WC in the two groups. However, the experimental group

revealed a significant increase in ghrelin level and a decrease in leptin level, whereas sham group showed no significant changes in these levels. Ito et al¹⁵ conducted a study with ten adults (nine female and one male) who were randomly assigned to experimental and sham groups. Each group received detention needle stimulus weekly for four weeks. They focused on weight reduction and feeding-related cytokines with auricular acupuncture and showed that a statistically significant difference in the percentage change in body weight and active ghrelin levels in the auricular acupuncture groups existed. Those biochemical evaluations showed auricular acupuncture effects on blood level are more significant than just weight reduction because it shows a scientific mechanism for auricular acupuncture to affect weight loss.

Darbandi et al¹⁰ and Cayir, Set & Kosan⁶ gave an opportunity to compare body acupuncture and auricular acupuncture on weight loss. Body acupuncture's effect on weight loss has been studied for decades. Darbandi et al¹⁰ focused on abdominal fat mass in 80 obese men, BMI between 30-40 kg/m², treated by body electroacupuncture and auricular acupuncture. Subjects were divided to four groups (real body electroacupuncture, real auricular acupuncture, sham body electroacupuncture and sham auricular acupuncture) with twice a week treatment for six weeks combined with a low-calorie diet which consisted of base metabolic calorie requirements plus 500 calories for energy per day. The diet was a moderate-carbohydrate and moderate-fat diet, called isocaloric diet which is informative and educative to participants. When trying on new diet, people don't know how much and what they can eat for a day to lose weight. Darbandi et al concluded acupuncture, either body or auricular treatment, had a positive effect on reducing BMI, Trunk Fat Mass (TFM), Waist Circumference (WC) and Hip Circumference (HC). Although the two type of acupuncture

had similar effects, they pointed out that body electroacupuncture is more effective at reducing WC and auricular at HC. Cayir, Set & Kosan's study compared the efficacy of body acupuncture and auricular acupuncture for the management of obesity on fifty obese women divided into two groups, body acupuncture and auricular acupuncture. The body acupuncture group received treatment twice a week (total 24 sessions) and auricular group received treatment every 15 days for a total of 6 sessions, drawing the conclusion that auricular acupuncture is more effective in reducing body weight than body acupuncture. Both studies showed that auricular acupuncture is effective in treating obesity, however, while Darbandi performed a robust study with control groups and consistent treatment, Cayir, Set & Kosan's study lacked a control group and had variations in treatment interval and number of treatments between groups. This leads us to conclude, based on these studies, that while both body and auricular acupuncture are effective treatments for obesity the shortcomings in Cayir's study do not allow us to conclude that there is a benefit of one treatment over another. The follow on to this research would be a designed experiment where the results from different treatment frequencies and total number of treatments for both auricular and body acupuncture could be compared and contrasted to identify which treatment type and frequency provided the most effective results.

Schukro et al²¹ tested the effects of auricular electroacupuncture on weight loss in fifty-six obese women with a BMI ≥ 25 kg/m². Participants were divided into an auricular electroacupuncture and a sham group (dummy electro device was used) and received treatments four times a week for 6 weeks. The results showed that the relative reduction of body weight was significantly greater in the auricular electrical stimulation group than in the sham group. Schukro's study concluded that auricular electrical acupuncture is effective on

weight loss. This study used a significantly higher frequency of treatment than the other studies. It also lacked a comparison group such as auricular acupuncture alone. This creates the questions of what the impact of treatment frequency on the effectiveness is and what is the difference in effectiveness between auricular acupuncture and auricular electroacupuncture. Again, the results of a study of the effectiveness of auricular acupuncture creates as many questions as answers provided, leading us to conclude that a well-designed experiment is required to answer these questions.

Acupuncture is a holistic medicine, body and mind are connected. Set, Cayir & Pirim²² found depressive symptoms are commonly associated with obesity and studied the effectiveness of auricular acupuncture for obesity on the depression of thirty obese women. They concluded that auricular acupuncture has independent effects on weight loss and depression. This study showed that weight loss auricular treatment can affect emotions even if there is no correlation between weight loss and depression. Emotion and mental health are very important for health overall. This study leads us to conclude body and mind are connected.

Shen et al²³ examined the sympathomimetic effect of auricular acupuncture stimulation on body weight reduction. Fourteen adults were divided into two groups (auricular group and sham group), with once a week treatment for two weeks then switched the groups. Mechanisms were found to account for the temporary and short-term effects of ear acupuncture stimulation in the treatment of obesity. Shen analyzed that this short-term effect is caused by increasing micturition and increasing water intake which is a part of the sympathomimetic effect. This study did not control food intake and diet and would be effective and significant if they educated the participants about diet.

There are no significant auricular acupuncture points for weight loss. Each study selected different auricular acupuncture points and the number of points based on previous studies or what they have been using for weight loss at their clinic. Yeo, Kim & Lim²⁸ studied the efficacy of the five ear acupuncture points (shenmen, spleen, stomach, hunger, endocrine) for treating obesity and compared with the hunger ear acupuncture point. Their study suggested after 8 weeks of treatment that the five ear acupuncture points and the hunger point alone treatments are both equally effective for obese people. Their results showed that the choice of auricular acupuncture points did not impact the effectiveness of auricular acupuncture weight loss. However, Belivani et al³ reported that trials of auricular acupuncture on weight loss are contradictory, with one systematic review suggesting that auricular acupuncture treatment does not specifically affect weight loss (Ruan et al., 2016). More relevant and consistent clinical evidence is required to show how effective auricular acupuncture is on weight loss.

The safety of auricular acupuncture is also important because the ear possesses abundant capillaries which make it highly vulnerable to inflammation and infections (Abbate²). Clinical evidence on the safety of auricular therapy has not been clearly established to date, despite the increasing number of studies in recent years reporting harm data associated with auricular therapy (Tan et al²⁷).

III. MATERIAL AND METHODOLOGY

As described in section II, the primary objective of this literature review is to assess the effectiveness of auricular acupuncture in treating obesity, while additionally to compare the effectivity of auricular acupuncture compared to body acupuncture, exercise and diet, and lastly to identify potential mechanisms of auricular acupuncture's effect on obesity.

3.1 Date sources

The following sources were searched from April 2009 to April 2017 with an English and Japanese language restriction: Pub Med, EBSCO Host database, and the National Center for Complementary and Alternative Medicine at the National Institutes of Health (NIH). The key words used in the search were ear acupuncture, auricular therapy, auricular acupuncture, auricular acupressure, obesity, weight loss or reduction and weight control to determine the relevance of the article to this research project.

3.2 Inclusion criteria

This review was restricted to randomized controlled trial (RCT) clinical studies, with inclusion criteria of RCTs that compare auricular acupuncture to: body acupuncture, electro auricular stimulation, no treatment, placebo treatment, sham treatment, pharmacological or non-pharmacological treatments, animal study, with co-interventions such as lifestyle modification, diet or physical exercises were included to assess the effects of ear acupuncture on obesity. In this review, all appropriate definitions of overweight and obesity were accepted. It is RCTs of auricular acupuncture related to obesity with control groups of participants regardless of sex, race and ages including adolescents and young adult from April 2009 to April 2017.

3.3. Exclusion criteria

Exclusion criteria were massage, acupoint injection, herbal treatment, drug induced obesity, preclinical studies case series, case reports, self-control, in vivo studies, no data reports, and non-randomized controlled trials to evaluate the effects of ear acupuncture.

Process of the articles included in and excluded from in this literature review is listed in Figure 1.

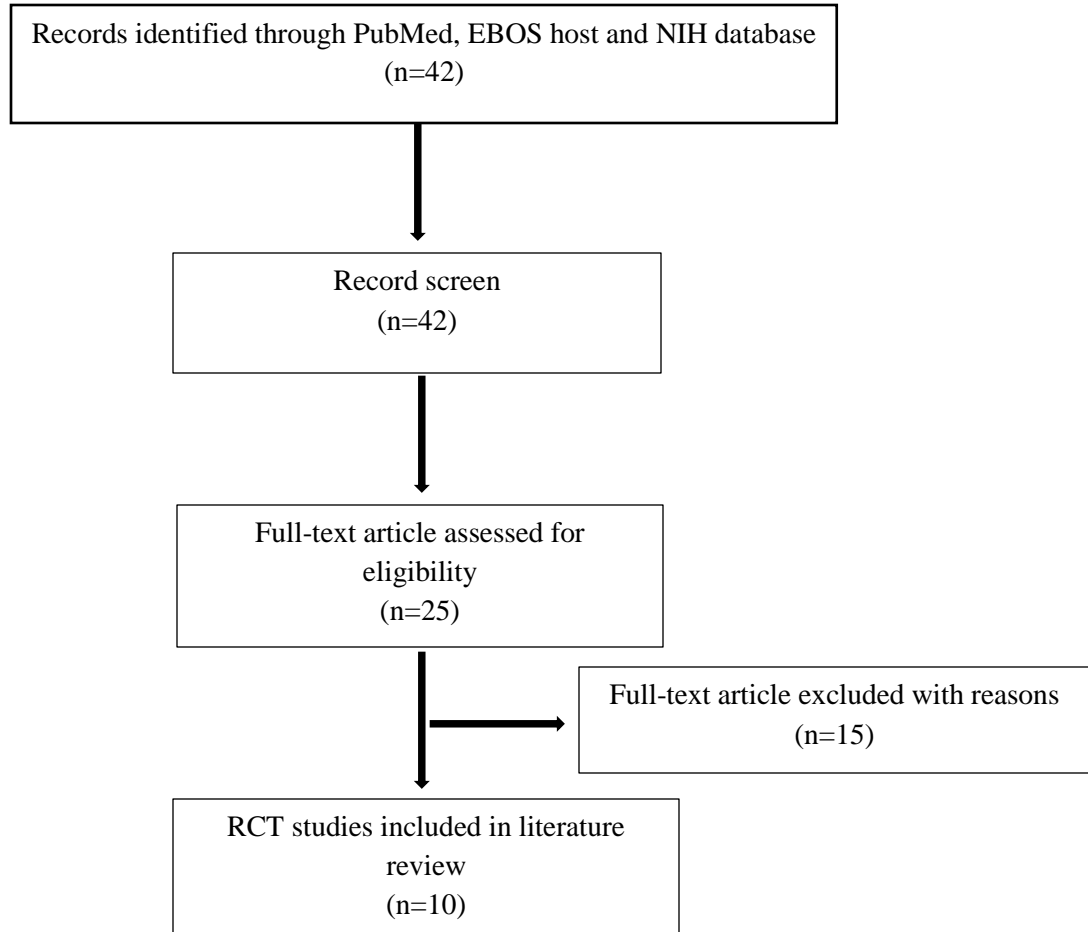


Figure 1: Flow Chart for Over All Research Process

IV. RESULTS

4.1. Description of the RCTs.

There were over 40 articles identified during the literature search, with ten articles meeting the inclusion criteria and included in the literature review. Three of the trials were conducted in Taiwan, two each in Iran and Turkey, and one each in Austria, Korea and Japan. Interestingly six of the studies were conducted in countries in which obesity rates were lower when compared with other countries as showed in Table 1.

Table 1: Global obese levels according to ProCon.org in 2016.

COUNTRY	% of Adult population that is obese
USA	36.2%
TURKEY	32.1%
IRAN	25.8%
CHINA	6.2%
KOREA	4.7%
JAPAN	4.3%

Most of the studies divided the participants into two groups randomly, with one study³¹ utilizing three groups approach (2 treatment and 1 sham group). The participants age ranges were between 16-65 with a body mass index (BMI) between 23 and 40 kg/m².

4.2. Auricular Acupuncture Intervention

4.2.1 Auricular points

In all articles Auricular acupuncture points were chosen based on Traditional Chinese Medicine (TCM) theory and their clinic experience. Almost all studies used Stomach point, the other frequent points used were hunger in 8 studies, shenmen in 5 studies, endocrine in 3 studies, Sanjiao in 3 studies, mouth in 2 studies, anti-aggression in 2 studies, center of ear in 1 study, colon in 1 study and lung in 1 study, spleen in 1 study (Table 2). Yeo et al³⁰ conducted a study comparing five acupuncture point group (treatment 1) to single point, hunger, group (treatment 2). The treatment 1 and 2 groups showed a significant improvement in BMI and weight after 4 weeks. However, treatment 2 group did not show improvement in waist circumference after 8 weeks. It concluded auricular acupuncture was found to be effective in weight loss in the short term and five acupuncture points may be better for reducing WC. Appendix A, contains a description of the interventions summarized.

Table 2. Frequent auricular acupuncture points in the studies

Auricular acupuncture points	Frequency
Stomach	10
Hunger	8
Shenmen	5
Endocrine	3
San Jiao	3
Mouth	2
Anti-Aggression	2
Center of ear	1
Colon	1
Lung	1
Spleen	1

4.2.2. Auricular acupuncture and Diet

Only four studies^{1,10,21,29} intervened with auricular acupuncture and nutrition advice including a low-calorie diet. All four studies showed improvement in BMI in both auricular acupuncture group and sham group. Changes in BMI for each group is shown in table 3. Three studies concluded that the changes in most anthropometric parameters were more significant in intervention with auricular acupuncture and a low-calorie diet than with diet alone or sham auricular acupuncture with diet. Yeh et al²⁹ studied auricular electric stimulation and auricular acupressure on obese outpatients with nutrition consultation and found there were no significant differences between electric stimulation group and sham group in cholesterol, triglyceride, leptin and adiponectin. However, there was a significant reduction in BMI and improvement in

physiological indicators. The authors concluded that it might be led by 30 to 60 min weekly diet consultation which increased the participants' motivation and awareness of dietary calorie control.

Table 3. Changes in BMI auricular acupuncture group and sham group

Author	AA group	Sham Group	p-value
Abdi ^[1]	1.3 ± 0.04	0.36 ± 0.14	P <0.002
Darbandi et al ^[10]	1.0 ± 0.4	0.7 ± 0.2	P <0.005
Schukro et al ^[21]	3.61 ± 0.77	0.82 ± 0.73	P <0.001
Yeh et al ^[29]	2.08 ± 2.00	1.02 ± 2.06	P <0.001

4.2.3 Body acupuncture

Two studies^{6,10} compared the effects of auricular acupuncture and body acupuncture. Cayir et al⁶ conducted twice a week treatment, total of 24 sessions, using 8 body acupuncture points. Dabandi et al¹⁰ also used 5 basic body acupuncture points on abdomen then adding points based on participants signs and symptoms twice a week for 6 weeks. Body acupuncture points selections are described in Table 4 below.

Table 4. Summary of body acupuncture points

	LI4	LI11	ST25	ST36	SP6	SP9	CV 6	CV4	CV12	ST40	GB28
Cayir ^[6]	x	x	X	x	X	X	X	-	x	-	-
Dabandi ^[10]	-	*	X	-	X	*	*	X	x	*	x

*LI11 & ST40 for excess mood, CV6 & SP9 for deficiency mood.

The authors found that auricular acupuncture is more effective in reducing body weight respectively in women and men. Cayir et al⁶ showed that after 12 weeks of acupuncture treatment, the auricular acupuncture group lost an average of 1.6 kg more than the body acupuncture group. The comparison of changes in weight for the Cayir study are shown in Table 5.

Table 5. The Changes in weight for body acupuncture and auricular acupuncture after 12 weeks treatment (Cayir et al⁶)

	BA	AA	p-value
Change in weight*	2.6±2.4	4.2±3.4	0.0015

*kg (SD) [95% CI]

4.3 Effects on anthropometric parameters

The majority of the studies used either body weight (BW) or BMI as one of the main anthropometric parameters. Other anthropometric parameters including body fat percentage (BFP), waist circumference (WC), hip circumference (HC) and blood pressure (BP) were used. Darbandi et al¹⁰ focused on abdominal fat reduction therefore they included trunk fat mass (TFM). They concluded that those treated with auricular acupuncture showed significant decreases in BMI, TFM, WC and HC whereas the sham group did not show any changes. Their study suggested that reduction in WC and HC may be affected by a decrease in BMI and TFM.

The majority of studies concluded that auricular acupuncture was effective in reducing BW, BMI and BFP. However, Hsu et al¹⁴ found no effect on weight loss. The study concluded neither real or sham auricular acupuncture showed significant reduction in BW, BMI and HC.

Interestingly, one study²³ found that after the first four-week treatment, the body weight reduction effect was lost. The author concluded auricular acupuncture alone for weight reduction may only have a temporary and short-lasting effect. Figure 2 shows the effectiveness on anthropometric parameters below.

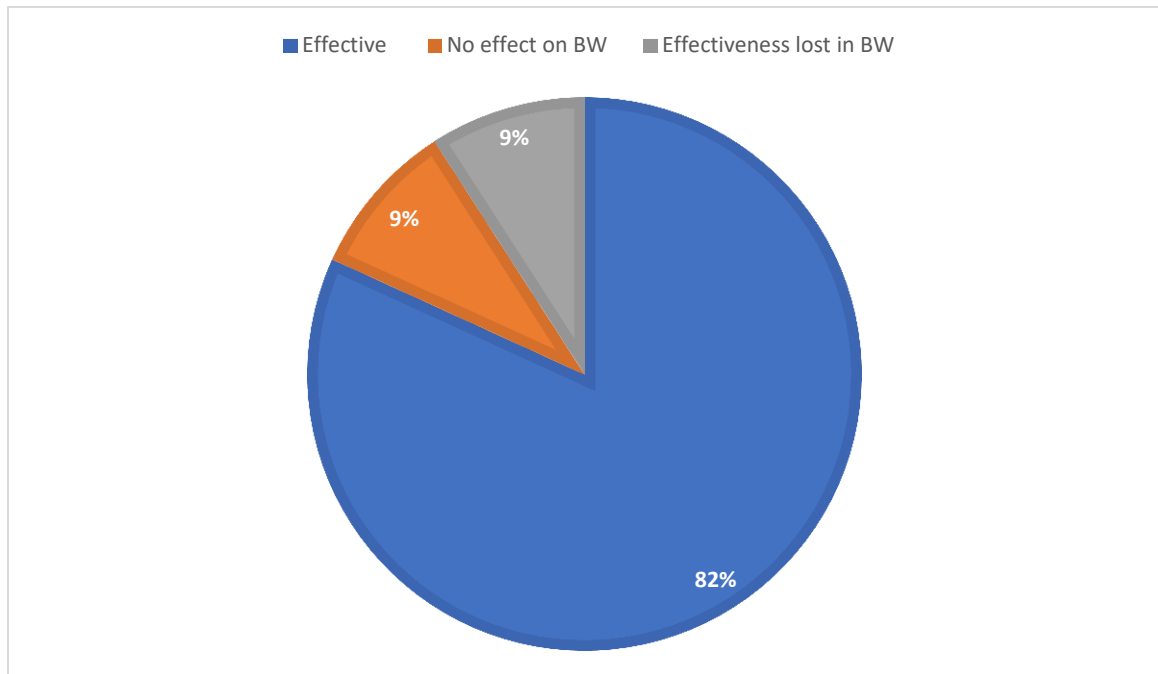


Figure 2. Effectiveness in reducing BW, BMI and BFP

4.3.1 Comparison between experimental and control (sham) groups

Six studies^{1,10,14,22,23,29} showed the effects of auricular acupuncture on anthropometric parameters were more significant in the experimental groups than the sham groups. However, Hsu et al¹⁴ found there was no statistical difference in percentage reduction, especially in BW (0.5% reduction in experimental group and 0.7% in sham group) between the two groups. Yeh et al²⁹ found there were no significant differences in decreasing BMI, BP, and levels of total

cholesterol, triglyceride, leptin and adiponectin between the two groups. Figure 3 shows comparison between experimental groups and control (sham) groups.

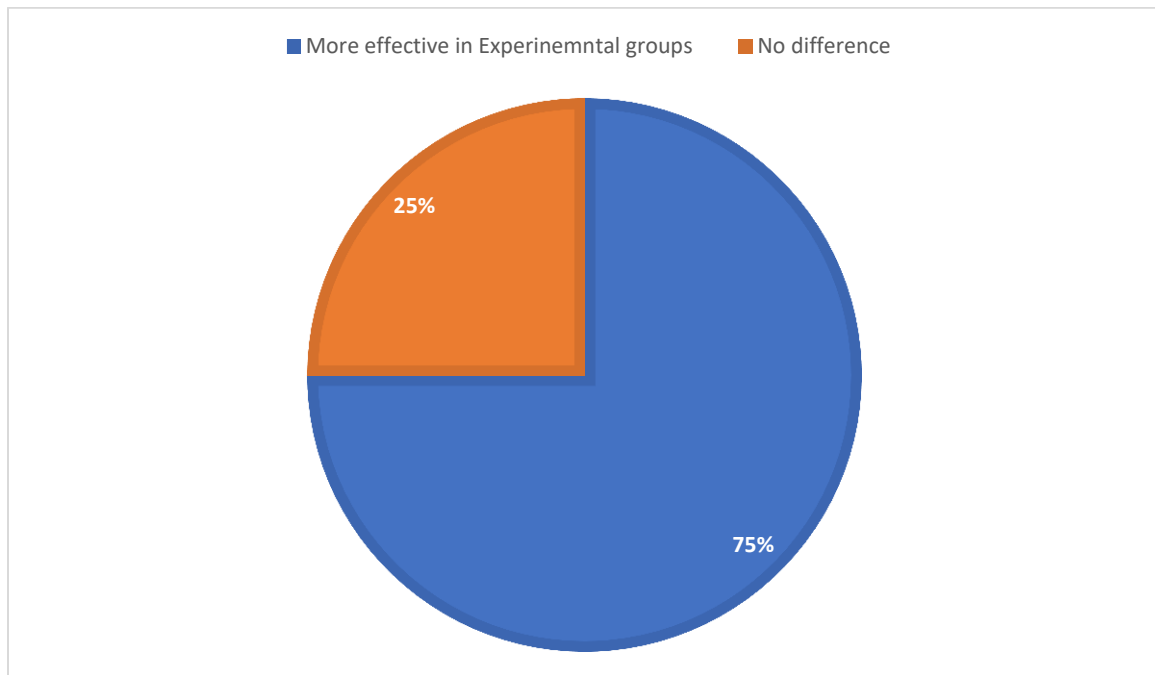


Figure 3. Comparison between experimental and control groups

4.4. Effects on obesity-related hormone and peptide

Three studies^{14,15,31} collected insulin, adiponectin, leptin and ghrelin as outcome measurements. One author noted obese related hormones, peptides, and neurotransmitters in the periphery and central nervous system, and their potential role in obesity (Miller¹⁸). Two hormones, leptin and ghrelin, have been known to be involved in controlling food intake and energy balance. Belivani et al³ found that leptin is a peptide secreted by adipose tissue effectively reduces hyperphagia and obesity. Elevated circulating leptin levels are found in obese individuals. Ghrelin is a growth hormone secreted and synthesized in the stomach, that

blocks leptin-induced reduction, subsequently leading to an increased food intake and body weight.

Two studies^{15,29} found that auricular acupuncture is not effective on adiponectin, leptin and ghrelin when compared to sham auricular acupuncture group. Yeh et al²⁹ studied auricular electrical stimulation combined with acupressure and weekly nutrition consultation for 10 weeks on obese patients and showed leptin and adiponectin were not significantly different between experimental and sham group, however across the groups there was a significant improvement. Ito et al¹⁵ found the level of adiponectin and leptin did not show any change in both the experimental and sham group. Interestingly, active ghrelin levels in the sham group at 1 week were significant. In contrast, Hsu et al¹⁴ found only the experimental group showed significant increase in ghrelin level and a decrease in leptin level.

Insulin is also an obesity related hormone which regulates the glucose level in the blood stream. In this literature search there were two studies^{14,15} that measured insulin levels, which concluded auricular acupuncture did not change insulin levels. Table 6 shows a summary of the results of these three studies reductions of obese related hormones levels.

Table 6. Summary of three study's results in reduction of obese related hormones

Author	Hsu et al ^[14]		Ito et al ^[15]		Yeh et al ^[29]	
	Experimental group	Sham group	Experimental group	Sham group	Experimental group	Sham group
Ghrelin, pg/mL	-67.4*	-13.5	0.63	-93.91*		
Adiponectin, µg/mL	-0.5	-0.6	0.822	0.258	-0.53	-1.3*
Leptin, ng/mL	6.1**	0.3	0.48	-1.02	4.63**	2.29**
Insulin, IU/mL	0.9	-0.2	1.8	-3.22		

* Negative effect (hormone level increased significantly), **Positive effect (hormone level decreased significantly), Others: No significant change

4.5. Effects on inflammatory and immunologic markers

Abdi et al¹ focused on serum anti-heat shock protein (Hsp)-27,60,65,70 and C-reactive protein (hs-CRP) in 169 obese patients for 12 weeks. The experimental group was treated with auricular acupressure with plaster seeds and a low-calorie diet for 6 weeks (1st period), then only low-calorie diet for 6 weeks (2nd period). The author found that in first and second period of study all immunological and inflammatory factors including anti-Hsp antibodies and hs-CRP decreased significantly in the experimental groups, however only anti-Hsp 70 antibodies and hs-CRP decreased in the control group. The author concluded that auricular acupuncture has immunomodulatory but not anti-inflammatory effects on the immune system by regulation of the levels of anti-Hsp antibodies. Table 7 summarizes the level of inflammatory and immunologic markers.

Table 7 Comparison of inflammatory and immunologic markers of participants of the auricular group.

Abdi et al ^[1]	Experimental Group			Sham Group		
	1 st sample	After 6 weeks	P-value	1 st sample	After 6 weeks	p-value
Anti-HSP27	0.36 (0.34-0.39)	0.34 (0.32-0.37)	p<0.001	0.35 (0.33-0.38)	0.35 (0.33-0.39)	–
Anti-HSP60	0.74 (0.70-0.76)	0.72 (0.68-0.75)	p<0.001	0.74 (0.72-0.76)	0.74 (0.72-0.75)	–
Anti-HSP65	0.79 (0.78-0.82)	0.78 (0.76-0.80)	p<0.001	0.79 (0.78-0.82)	0.79 (0.77-0.82)	–
Anti-HSP70	0.60 (0.57-0.63)	0.59 (0.55-0.52)	p<0.001	0.60 (0.59-0.64)	0.60 (0.58-0.63)	p<0.05
Hs-CRP	1.97 (1.30-4.05)	0.0 (0.0-1.27)	p<0.001	2.25 (1.30-4.07)	0.30 (0.0-2.47)	p<0.001

Values are expressed as median and interquartile range. A two-sided p-value of <0.05 was considered statically significant. Bold is positive effects (reduce). – no data was provided.

4.6. Effect on psychological outcomes

Set et al²² conducted the study in auricular acupuncture on the depression of 24 obese women. The author found a significant reduction in depression scores and weight loss after auricular acupuncture was used for the treatment of obesity (Table 8). However, the author found there was no significant correlation between the percentage reduction of BMI and depression score after the auricular acupuncture treatments for obesity.

Table 8. Comparison of depression scores before and after ear acupuncture for obesity (Set et al^[22])

	Before	After	p-value
Depression score	4.4±2.3	2.7±1.4	<0.001
BMI	39.0±4.7 kg/m ²	37.2±4.3 kg/m ²	<0.001

4.7. Adverse events associated with auricular acupuncture

Five studies^{1,6,14,15,22} reported adverse events associated with the treatment. Out of Five studies, only one study reported report an event categorized as significant as minor side effects such as pain in the puncture region (Table 9). Therefore, auricular acupuncture is relatively safe.

Table 9. Reported adverse events related to auricular acupuncture treatment from April 2009 -2017

Reported Adverse Events	Number of Patients
Minor inflammation at the acupuncture site on the ear	1
Mild tenderness at the acupuncture sites on the ear	9

V. DISCUSSION

This project demonstrated an effect of auricular acupuncture on weight loss in obese subjects. A total of eleven RCTs, consisting of 615 subjects, were evaluated and are summarized in Table 10. Of the 615 subjects, 70% were female and 30% were male, although there is no data showing that obesity rates are higher for females than males. The skewing of the population toward female is driven by the fact that most of the studies focused on weight loss in women. The studies ranged in length from 6 weeks to 12 weeks including follow-ups. Most of these studies were conducted in Asian countries, where obesity rates are significantly lower than the global average, which may be because auricular acupuncture was originated in Asia and due to lack of scientific data and evidence for the effectiveness of auricular acupuncture on weight loss in western country like the U.S, where mostly health issues are treated by pharmaceutical medications. Despite methodological limitations including small samples sizes, inadequately controlled study design and length of study, the analysis of the results showed positive effects on weight loss, anthropometric parameters, obesity related hormones (leptine, ghrelin,etc.), neuro-endocrine markers(insulin resistance, glucose and lipid metabolism, etc.), and inflammatory markers. The current data suggested that auricular acupuncture exerts its effects on obesity through the different mechanisms mentioned above. This current clinical data is very important for the treatment of obesity, as obesity is not only being over-weight, but it is also a chronic metabolic disease. It was found that the hormone peptide findings were more notable than weight reduction in one study. Positive effects on biochemical markers may be more important for chronic metabolic disease such as an obesity.

In this literature review, it was found that 82% of the studies concluded reduction in BW and BMI. However, one study²² concluded that the body weight reduction is lost after 4 weeks,

which is similar to Ito et al's¹⁵ findings that after 4 weeks of treatment three of the five participants' body weight returned to pretreatment levels (their starting weight), which corresponded with an increase in calorie intake after week 1. This may be because of an increase in food intake after losing some weight. This temporary and short-lasting effect may be led by an increase in the threshold level for acupuncture stimulation, leading to a reduction in the effect over time.

As a result both body and auricular acupuncture have an effect on improving obesity (Cayir et al⁶). However, they concluded auricular acupuncture is more effective in reducing body weight than body acupuncture, possibly due to auricular acupuncture's heavier involvement with the vagus nerve. One animal study¹⁷ showed that the auricular vagus nerve stimulation (AVNS) group significantly reduced body weight after a 6 week-auricular treatment when compared with the sham group. Once stimulation of the vagus nerve by acupuncture is clearer and shows significant evidence of effectiveness, acupuncture will become the primary treatment method for obesity.

In this literature review no RTCs with auricular acupuncture and exercise combined were found. There are a several possible reasons for not finding these types of studies. First of all, this literature review has limitations on the data source and years. Secondly, exercise need to be consistent in regimen, which may increase withdrawal rates. Withdrawals occurred after 3 weeks owing to dissatisfaction with weight loss, difficulty in following the dietary regimen and schedule confliction (Yeo, Kim & Lim³¹). This shows us that people are looking for a quick and easy "Fix" (weight loss) these days. This is one reason the U.S is heavily reliant on drugs to combat obesity.

According to my findings, auricular acupuncture therapy exerts beneficial effects on obesity. In this literature review, effectiveness on weight reduction was 82% and an average weight loss ranged between 0.3 kg to 4.2 kg. In addition to weight reduction, clinical data suggested that it also affects obesity related biochemical marks especially leptin levels, which showed significant decrease ranging between 4.63 ng/mL ($p < 0.01$) to 6.1 ng/mL ($p < 0.001$). Additionally, immunologic markers such as anti-Hsps were significantly reduced ($p < 0.05$) in one study¹. Also, psychologic status can be affected by auricular acupuncture, Set et al²² showed a mean depression score of 4.4 ± 2.3 before treatment, decreasing to 2.7 ± 1.4 after treatment ($t = 6.461$, $p < 0.001$). Moreover, the combination of auricular acupuncture and diet restriction were found to be more effective than auricular acupuncture alone. The weight loss range was between 2.75 kg to 3.21 kg and other anthropometric parameters' p-values were $p < 0.001$. However, it was observed that auricular acupuncture may have a temporary and short-lasting effect, without adding stronger stimulation, diet restriction or exercises, the individual may return to their baseline body weight. Additionally, data suggests that auricular acupuncture is more effective in reducing body weight than body acupuncture. The auricular acupuncture group lost 1.6 kg more than the body acupuncture group on average. To achieve and maintain weight reduction, this literature review suggested that the best course of treatment is a combination of auricular acupuncture and diet. It was determined that one should not rely on only auricular acupuncture stimulation for body weight reduction and treating obesity.

Table 10. Description of Auricular Acupuncture RCTs

First Author (Pub year, location)	Subject's mean age	Number of Participants Male/Female	Intervention type	Auricular acupuncture points	Treatment frequency and length	Type of control group	Measured variables	Adverse events reported
Shen et al²³ (2009, Taiwan)	24-46	0/14	AA	Hunger, Stomach, Lung San Jiao	1 x week unilaterat for 4 wks	sham auricular acupuncture (eye, frontalis, clavicle, finger)	BW, HR, BP, RR, Pupil size, abdominal distension, hunger, constipation, thirst, perspiration, micturition(frequency), defecation, activity, energy, abdominal circumference	NR
Hsu et al¹⁴ (2009, Taiwan)	16-65	0/45	AA (instructed to maintain former diet)	Hunger, Stomach, Shen men Endocrine	2 x wk unilat for 6 wks	Sham AA	BW, BMI, WC	Minor to mild tenderness at the acupuncture sites on ear
Abdi et al¹ (2011, Iran)	18-55	169	AA with a low-calorie diet	Shen men, Stomach, Hunger, Mouth, Center of Ear, San Jiao	2 x wk bilat for 6 wks total 12 wks	Sham AA (Hip, Spleen, Nose, esophagus)	BW, BMI, WC, HC, FBG, TC, TG, HDL-C, LDL-C, DBP, SBP, Anti-HSP antibody, Hs-CRP	None
Schukro et al²¹ (2014, Austria)	>18	0/56	Electro AA with diet restriction	Hunger, Stomach, Colon	4 x wk for 6 wks	placebo (p-stim dummy)	BW, BMI, BF	None

Table 10. continued.

Set et al²² (2014, Turkey)	42.9	0/24	AA	Anti- aggression, Stomach	Every 15 days 6 sessions	None intervention	BMI	NR
Ito et al¹⁵ (2014, Japan)	24-44	1/9	AA with monitored food intake	Hunger, Stomach	1 x wk	Placebo	BW, WC, BMI, Urinalysis, blood biochemistry and hematological tests	None
Yeo et al³¹ (2014, Korea)	NR	16/75	AA	Shenmen, Spleen, Stomach, Hunger, Endocrine	1 x wk unilat for 8 wks	Hunger point alone, Sham AA	BMI, WC, BFM, PBF, BP	NR
Darbandi et al¹⁰ (2014, Iran)	18-50	80/0	Electro BA with low-calorie Auricular acupressure with low-calorie diet	Shenmen, Stomach, Hunger, Mouth, Center of ear, San jiao	2 x wk bilate for 6 wks	Sham Body Acupuncture, Sham auricular Pressure (hip, spleen, nose, esophagus)	BMI, TFM, WC, HC	NR
Yeh et al²⁹ (2014, Taiwan)	18-50	35/35	Electro AA with diet restriction	Shenmen, Stomach, Endocrine, Hunger	1 x wk for 10 wks	Sham AA (Hip, Spleen, Nose, esophagus)	BMI, BP, total cholesterol, triglyceride, adiponectin, leptin	NR
Cayir et al⁶ (2017, Turkey)	20-47	0/50	Body acupuncture, AA	Antiaggression, Stomach	Every 15 days bilat for 6 sessions	Compared to body acupuncture	BMI, BFP	None

AA, auricular acupuncture; BW, body weight; BF, body fat; BMI, body mass index; BP, blood pressure; HC, hip circumference; FBG, fasting blood glucose; TC, total cholesterol; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; HSP, heat shock protein; CPR, C-reactive protein; NR, not reported; PBF, percentage body fat.

VI. CONCLUSION

In conclusion, auricular acupuncture therapy has a positive effect on obesity. In addition to reductions in body weight, clinical data suggested that it also affects obesity related biochemical marks like leptin levels (largest percentage change in experiment group -25% and in control group -11%), anthropometric marks (82% is more effective than control groups) and psychologic status (depression score improved by up 2.6). Moreover, the combination of auricular acupuncture and diet restriction (change in BMI average p-value $p < 0.002$) were found to be more effective than auricular acupuncture alone (change in BMI average p-value $p < 0.12$). It is very important to note that auricular acupuncture may have a temporary and short-lasting effect, without adding stronger stimulation, diet restriction or exercises, the individual may return to their baseline body weight. Additionally, data suggests that auricular acupuncture is more effective in reducing body weight than body acupuncture (BA 2.6 ± 2.4 CI 95%, AA 4.2 ± 3.4 CI 95%). However, this literature review concluded that one should not depend on only auricular acupuncture therapy for treating obesity and weight loss.

Although those effects can be achieved by other innervations, lack of adverse reactions make auricular acupuncture a preferred treatment option for obesity. These results support previous literatures reviews, but due to a lack of high quality study designs, further studies including a larger sample from a variety of geographic location, a more detailed assessment of diet, and a longer duration would be suggested.

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APPENDIX A

Description of 10 RTCs intervention

First Author (Pub year, location)	Type of Intervention	Special direction
Shen et al ²³ (2009, Taiwan)	Ear press needles	<ul style="list-style-type: none"> • N/A
Hsu et al ¹⁴ (2009, Taiwan)	Stainless steel, 36-gauge 0.5-inch needles	<ul style="list-style-type: none"> • Kept the needles for 3 days. • Replaced twice a week. Not to apply any pressure.
Abdi et al ¹ (2011, Iran)	Ear-pressing plasters with seed	<ul style="list-style-type: none"> • Kept the seeds on for 3 days. • Changed once each 3-4 days. • Apply pressure 30 mins before meal for 20 sec.
Schukro et al ²¹ (2014, Austria)	Single-use titanium, 27-gauge x 3mm length permanent needles connected to a Pstim electroacupuncture device. Current (2mA) pulses of 1 Hz every 3 s (3 h of stimulation followed by pause of 3 h of avoid development of tolerance).	<ul style="list-style-type: none"> • Needling only on the treatment day.
Set et al ²² (2014, Turkey)	Sterile, disposable, 0.22 x 1.3 mm* permanent needles	<ul style="list-style-type: none"> • Changed every 15 days. • Apply pressure 15-20 mins before meals.
Ito et al ¹⁵ (2014, Japan)	Intradermal 0.12 x 3 mm* needles	<ul style="list-style-type: none"> • Replaced every 7 days.
Yeo et al ³¹ (2014, Korea)	Tac-like, 0.2 x 2 mm* needles	<ul style="list-style-type: none"> • Replaced every 7 days.

Continued

<p>Darbandi et al¹⁰ (2014, Iran)</p>	<p>BA: Stainless steel needles left for 20 mins with electrical stimulator. AA: Ear-pressing plaster with seeds</p>	<ul style="list-style-type: none"> • Kept for 3 days. • Apply pressure before meals.
<p>Yeh et al²⁹ (2014, Taiwan)</p>	<p>Electrical stimulation currency 2/100 Hz dense-disperse waveform with a 0.25 ms pulse duration for 20 mins then auricular acupressure with ear-pressing plaster with seeds</p>	<ul style="list-style-type: none"> • Electrical stimulation 1 x week. • Replaced seeds every 7 days. • Apply pressure for 1 min, 4 times a day.
<p>Cayir et al⁶ (2017, Turkey)</p>	<p>BA: Stainless steel, disposable, single-use 0.25 x 25 mm needles left for 30 mins AA: Sterile press 0.22 x 1.30 mm* needles</p>	<ul style="list-style-type: none"> • Changed needles every 15 days. • Manual stimulation of all 4 needles 15-20 mins before meals for 30 sec.

BA: body acupuncture, AA: Auricular acupuncture, * Diameter x length