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Clinical study on electroacupuncture for obese patients with binge eating disorder

A retrospective study

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Abstract

Binge eating disorder (BED) is a common dietary disorder among obese people. Obesity and eating disorders are related to mental health and physical health. At present, there is no definite and effective method for treatment in clinic. The curative effect of electroacupuncture on obesity is definite. Although there is no conclusive evidence to support its long-term benefits, electroacupuncture has been increasingly used in clinic. This retrospective study determined the prognosis and outcome of electro-acupuncture on obese patients with BED.

One hundred forty-three patients with BED and obesity were found from 658 people who participated in the scientific experiment of obesity treatment in Nanjing Hospital of Traditional Chinese Medicine and Nanjing Brain Hospital from March 2015 to June 2018, and 84 patients (aged 18–40 years old) with valid data and uninterrupted treatment were found to be eligible for this retrospective study. According to the intervention methods, the patients were divided into electro-acupuncture combined with cognitive group (n = 32), cognitive therapy group (n = 28), and control group (n = 24). In this study, the 5th edition of Diagnosis and Statistics Manual of Mental Diseases, fasting blood glucose, fasting insulin, total cholesterol (TC), triglyceride, high-density lipoprotein, low-density lipoprotein, body fat rate, muscle mass, visceral index grade, nutrient intake (energy, protein, fat, carbohydrate), body weight, and weight changes before and after treatment were observed.

Compared with the cognitive therapy group, negative emotion score, TC, triglyceride, high-density lipoprotein, waist circumference, BW, BMI, body fat percentage of the electroacupuncture combined with cognitive group were lower, while positive emotional scores were higher, and there were significant differences in negative emotional scores, TC, waist circumference and BMI ($P < .05$). The dietary energy and three major nutrients in the electroacupuncture combined with cognitive group were lower than those in the cognitive group and the blank group ($P < .05$).

The current results suggest that electroacupuncture combined with cognitive therapy is more effective than cognitive therapy alone in treating obese patients with BED. Future prospective studies are necessary to further study the mechanism of electroacupuncture on the obese with BED.

Abbreviations: BED = Binge eating disorder, BMI = body mass index, BW = body weight, DSM-V = the 5th edition of Diagnosis and Statistics Manual of Mental Diseases, FBG = fasting blood glucose, FP = body fat percentage, HDL-C = high density lipoprotein, LDL-C = low density lipoprotein, TC = total cholesterol, TG = triglyceride, WC = waist circumference, WHR = waist-hip ratio.

Keywords: obesity, binge eating disorder, electroacupuncture, cognitive therapy, a retrospective study

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The authors have no conflicts of interest to disclose. The study protocol was approved by the Ethics Committee of Nanjing Hospital of Traditional Chinese Medicine, and written informed consent was obtained from each subject.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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1. Introduction

Obesity has become one of the most important public health challenges in global health issues.[1] Obesity is a complex multifactorial disease. The determining elements of obesity include genetic susceptibility, dietary behavior, environmental factors, and socio-cultural environment.[2] Binge eating disorder (BED) is a common eating disorder in obese people and its prevalence among adults with obesity is almost twice that of the general population.[3] BED occurs with significant psychopathology, mental and physical comorbidity, obesity, and life impairment.[4] Negative emotions may be the inducing factors. At present, it is generally believed that the highly sensitive to food cues and rewards and the emotional regulation defect lead to cognitive control defects and trigger binge eating.[5] Excessive eating or high-sugar and high-fat diet can relieve mental stress and create a sense of comfort when people are under stress,[6] while the dietary structure and overeating are the main causes of obesity and metabolic syndrome.[7,8] These may create a vicious circle. Metabolic syndrome is a combination of risk factors related to cardiovascular disease and diabetes. These factors include abnormal blood glucose, elevated blood pressure, elevated triglyceride levels, decreased levels of high-density lipoprotein cholesterol, and obesity (especially central obesity).[7] Overeating often causes changes in fat, blood sugar, which leads to the development of risk factors for metabolic syndrome and ultimately affects fat metabolism and aggravates obesity. An Australian community study investigated an increase in the prevalence of BED and obesity over a 10-year period from 1995 to 2005 and found obesity rates associated with BED increased from 8.5% to 20%.[9] In summary, since BED and obesity often coexist, it is particularly important to develop effective methods to prevent and treat them.

Due to the increased prevalence of obesity with BED, it is necessary to develop and test a comprehensive treatment. It is currently believed that the most effective treatment for BED is cognitive therapy.[10,11] Studies have shown that some combinations of obesity treatment and cognitive therapy for eating disorders can significantly reduce overeating and weight in patients with obesity and eating disorders.[12] Acupuncture is a unique means of treating diseases in China. It is a kind of medical treatment of "inside disease and external treatment." It is through the conduction of meridians and acupoints, as well as the application of certain methods of operation to treat systemic diseases. Acupuncture therapy is simple, low cost, and with few adverse reactions, so it is very popular among Chinese.[13] Also in some Western countries, patients and their families are increasingly asking for acupuncture as an adjunct to treatment.[14] Among them, electroacupuncture, a special type of acupuncture, stimulates points by current and is commonly used due to its ease of operation and sustained stimulation delivery. A large number of clinical studies in China have shown that acupuncture can reduce human parameters such as BMI and improve dyslipidemia in patients, such as total cholesterol (TC), triglyceride (TG), low-density lipoprotein (LDL-C), and high-density lipoprotein (HDL-C).[2,15]

The purpose of this retrospective study was to determine the efficacy and safety of electroacupuncture combined with cognitive therapy for binge eating with obesity. A retrospective study of 84 BED patients with obesity was performed to compare the association of electroacupuncture with cognitive therapy + lifestyle control, cognitive therapy + lifestyle control therapy, and blank group with relative being eating disorder relief and weight loss.

2. Materials and methods

2.1. Study population and protocol

This retrospective study included 143 patients who met the diagnostic criteria of BMD and obesity from 658 participants in the scientific experiment of obesity treatment at Nanjing Hospital of Traditional Chinese Medicine and Nanjing Brain Hospital in Jiangsu province, China from March 2015 to June 2018. The patients were screened for data, and 84 patients (aged 18–40 years) with valid data and uninterrupted treatment were eligible for this retrospective study. Inclusion criteria:

(1) in line with the diagnosis of BED of DSM-5 developed by the American Psychiatric Association in 2013 [16,17];

(2) The 2016 consensus of Chinese experts on medical nutrition and treatment of overweight and obesity and the Chinese parameters of The American society of clinical endocrinology and the American college of endocrinology guidelines for obesity treatment: body mass index (BMI) $\geq$ 30 kg/m^2.[18,19]

Comply with simple obesity diagnosis and diagnosis by psychologist; no weight loss or related treatment within 3 months; exclusion criteria:

(1) current diagnosis of mental illness or bipolar disorder and/or high level of suicide;
(2) those who have received any other weight-loss treatment within the last 3 months;
(3) clinical conditions affecting appetite regulation (eg, hypothyroidism and Cushing syndrome);
(4) history or clinical manifestations of bleeding tendency, including current use Anticoagulant;
(5) obvious liver damage, serum transaminase >2 times normal upper limit, abnormal endogenous creatinine clearance, severe liver, and kidney dysfunction.
(6) Patients have various serious heart and cerebrovascular diseases.

2.2. Research design and setup (Fig. 1)

2.2.1. Blank group (Group A): 24 people (male = 15 persons, female = 9 persons). The group did not carry out any intervention measures. The relevant indicators were tested before and 12 weeks after enrollment.

2.2.2. Cognitive therapy group (Group B): 28 people (male = 14 persons, female = 14 persons). Members were evaluated by the same dietitian and psychological counselor for nutrition intervention + exercise intervention + CBT. In this study, a wide-ranging version of cognitive therapy with additional emotional intolerance and other modules will be used.[20] Cognitive therapy is divided into 4 phases. Phase 1 (Interviews 0–7) includes twice-weekly interviews that weigh the pros and cons of BED, help patients establish the value of treatment, create treatment options, and introduce regular feeding. Phase 2 (Interviews 8–11), once a week, found that patients ignored their thoughts and feelings related to binge eating behavior, and then helped them identify and correct treatment goals, including revisions to progress and plans, trying to find any progress difficulties. Phase 3 (Interviews 12–15) was interviewed weekly and uses a variety

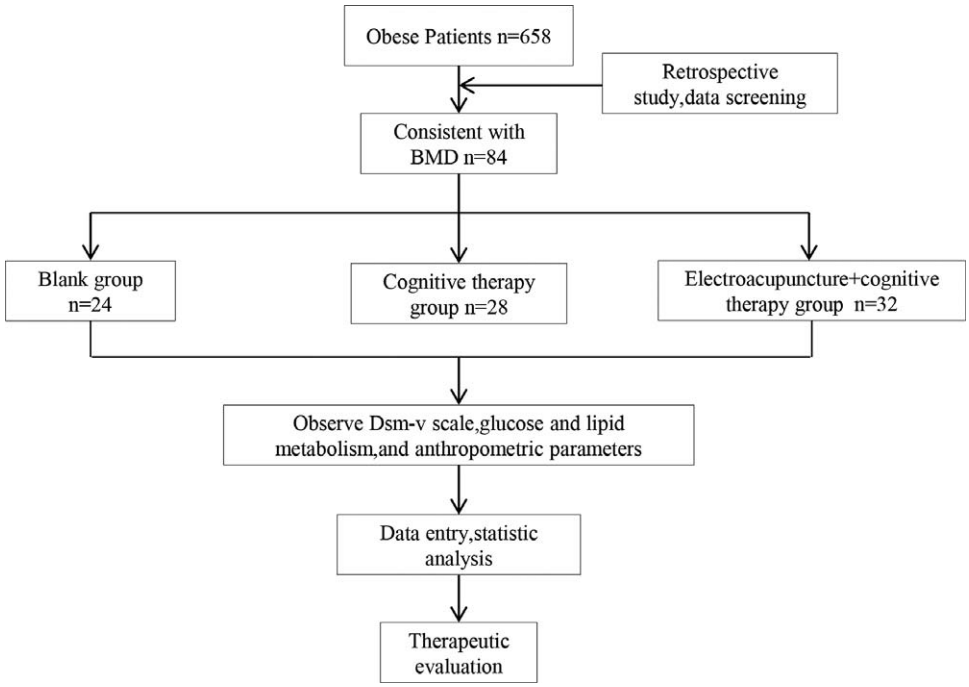

Figure 1. Technology roadmap.

of possible strategies to avoid repetitive symptoms. The purpose of the interview was to resolve recurrence problems and discover new ones, verify progress, and continue to improve.

Nutritional intervention (modified): A 24-hour dietary survey was used to record the dietary intake of the patients before enrollment and analyze their total energy and intake of the three major nutrients. At the beginning of the experiment, the nutritionist proposed personalized recommendations based on each patient's recipe. The daily dietary energy was reduced by 100-200 Kcal on the basis of last week until the standard intake (2250 kcal/d for males and 1800 kcal/d for females).[21]

Exercise intervention: daily moderate aerobic exercise for 30 minutes, 5 to 7 times a week, heart rate needs to reach 60% to 70% of maximum heart rate during exercise.[22] Daily recording diet and exercise, nutritionists 3 times a week supervision and feedback, establish a social network (WeChat) to promote treatment continuity, treatment for 12 weeks.

2.2.3. Electroacupuncture + cognitive therapy group (Group C): 32 people (male = 12 persons, female = 20 persons). Patients of this group were treated with simultaneous intervention measures of electro-acupuncture therapy and cognitive therapy). Acupuncture was performed by licensed acupuncturists with more than 3 years of experience. Chinese medicine electro-acupuncture therapy: acupuncture points (Fig. 2): LI4, LI11, CV4, CV6, CV12, ST24, ST26, ST36, ST40, ST44, SP6, SP15, LR3 [23–25]; acupuncture method: select Hua Tuo brand disposable stainless steel needle (diameter 0.25 mm; length 40 mm), Acupuncture depth of 15 to 35 mm, After the arrival of Qi, connect needles with the electrcoacupuncture apparatus (Hua Tuo brand, model: sdz-11), Bilateral SP15 are connected to the positive electrode, and bilateral ST24 are connected to the negative pole; stimulation frequency: sparse wave 2 Hz/100 Hz; current intensity: Depending on the patient's tolerance, change from 1 mA to a maximum of 10 mA, leaving the needle for 30 minutes. Electroacupuncture treatment will be performed 3 times a week for 36 acupuncture treatments for 12 weeks. Interventions of the cognitive therapy were the same as those of the cognitive therapy group.

2.3. Observation indicators and detection methods

The 5th edition of Diagnosis and Statistics Manual of Mental Diseases (DSM-V) scale measurement: Before treatment, 4 weeks, 8 weeks, and 12 weeks of treatment, the DSM-V scale was measured by an experienced psychiatrist.

Determination of Glycolipid Metabolism Index: Venous blood samples were taken from all patients before enrollment and after treatment on an empty stomach (overnight fasting for 8–10 hours). Determination of TC, TG, HDL-C, LDL-C by high-performance liquid chromatography; immunofluorescence assay for FBG and fasting insulin.

Determination of ergonomic parameters: referring to the method of measurement in "Acupuncture Treatment of Obesity,"[26] under the circumstance of fasting in the morning, taking off shoes, avoiding crowns and wearing only a small amount of clothes, body weight (BW), BMI, waist circumference (WC), hip circumference and waist-hip ratio (WHR) were measured in all the patients before treatment and after 4, 8, and 12 weeks of treatment. BMI = body mass (kg)/height $(m)^2$. The WC measurement requires that the patient's erect feet be separated from the shoulder width, measuring the circumference of the midpoint of the line connecting the iliac crest and the 12th inferior costal margin, which should be made at the end of natural expiratory period. Hip circumference represents the most prominent horizontal circumference of the buttocks. At the same time, OMRON-HBF 306 body fat measuring instrument was used to determine the percentage of body fat (FP) by bioelectrical

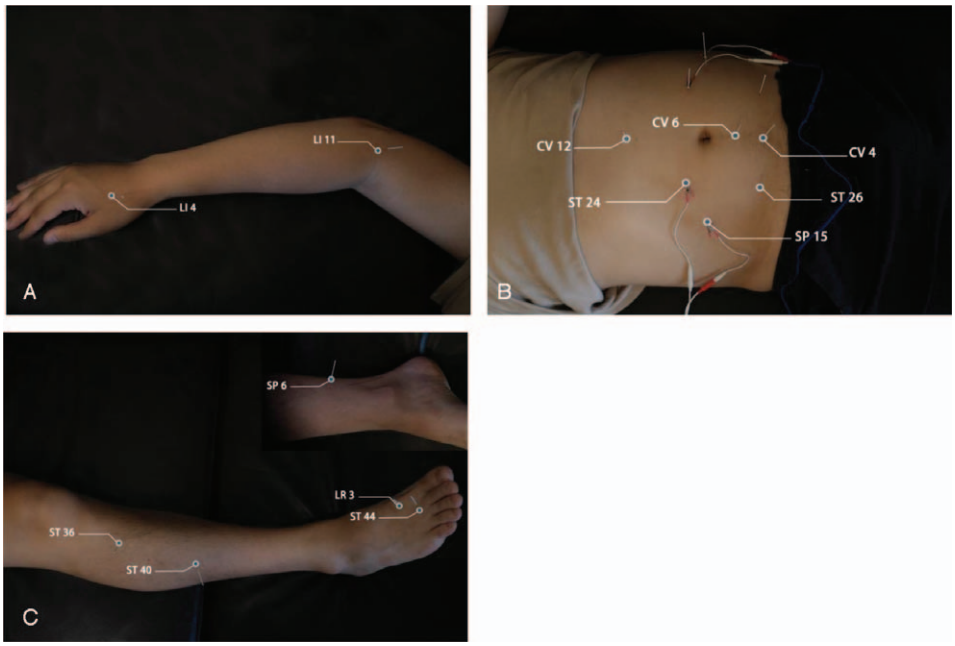

Figure 2. Acupoints selected for the treatment.

impedance method. The reference range of FP was 12% to 22% for males and 20% to 30% for females.[27]

Causes for withdrawal and acupuncture-associated adverse events, including bleeding, subcutaneous hemorrhage, hematoma, fainting, serious pain, and local infection, were recorded during the study.

2.4. Data processing

Blind analysis was carried out by special statisticians, the data was analyzed by SPASS25.0. The results were expressed in the form of mean ± standard deviation (x ± SD). Gender indicators in the basic information analysis table are expressed as number/percentage. The analysis of variance was performed by ANOVA analysis. Duncan's new complex range method was used to make multiple comparisons for those conforming to normal distribution, while Kruskal-Wallis test was used for those not conforming to normal distribution, and $P < .05$ was considered to be statistically significant. The outliers were eliminated by Z-score standardization method, and the missing values were filled by mean interpolation method. The difference was statistically significant ($P < .05$).

3. Result

3.1. Analysis of basic information (Table 1)

As for basic information, Table 1 shows that, compared with the blank group, there are significant differences in the longer course of disease between the cognitive therapy group and the electroacupuncture combined with cognitive therapy group ($P < .05$), while there are no significant differences in age and BMI. The proportion of gender (male/female) in the three groups was relatively balanced, and the number of electroacupuncture combined with cognitive therapy was slightly higher than that of the other 2 groups, making it easy to observe the efficacy of electroacupuncture combined with cognitive therapy.

3.2. Comparison of DSM-V scale among 3 groups before and after 12 weeks of treatment (Table 2)

The results showed that the score of positive emotion was significantly increased ($P < .05$) and the score of negative emotion was significantly decreased ($P < .05$) in the electro-acupuncture combined with cognitive therapy group (Group C) after 12 weeks of treatment. The negative emotion score in the cognitive therapy

Table 1

Analysis of basic information.

Indicators	Group A	Group B	Group C
Age/yr	31.31 ± 3.83[a]	33.42 ± 5.56[a]	33.46 ± 5.22[a]
Gender (person/%)			
Male	15 (36.58)	14 (34.15)	12 (29.27)
Female	9 (20.93)	14 (32.56)	20 (46.51)
Total amount	24 (28.57)	28 (33.33)	32 (38.10)
Course of disease/month	2.40 ± 1.07[a]	4.14 ± 1.52[b]	4.59 ± 1.58[b]
BMI	28.95 ± 3.48[a]	27.79 ± 2.19[a]	28.47 ± 4.31[a]

BMI is the index before enrollment. Different lowercase letters showed statistically significant difference ($P < .05$).
Group A = blank group, Group B = the cognitive therapy group, Group C = electroacupuncture combined with cognitive therapy group.

Table 2

DSM-V scale of the 3 groups before and after 12 weeks of treatment.

	A0	A12	B0	B12	C0	C12
PES/score	22.96 ± 5.13^{ab}	23.48 ± 3.42^{ab}	23.64 ± 3.80^{ab}	25.04 ± 4.32^{b}	21.81 ± 4.35^{a}	25.19 ± 4.37^{b}
NES/score	24.91 ± 3.15^{b}	23.96 ± 3.48^{b}	24.61 ± 3.53^{b}	20.68 ± 4.74^{a}	24.50 ± 3.76^{b}	20.44 ± 5.14^{a}

[a,b,c] Different lowercase letters indicated statistically significant differences ($p < 0.05$).

A0 = blank group before treatment, A12 = blank group after 12 weeks treatment, B0 = cognitive therapy group before treatment, B12 = cognitive therapy group after 12 weeks treatment, C0 = electroacupuncture combined with cognitive therapy group before treatment, C12 = electroacupuncture combined with cognitive therapy group after 12 weeks treatment, PES = positive emotional score, NES = negative emotional score.

group (Group B) was obviously decreased after 12 weeks of treatment ($P < .05$).

3.3. Comparison of glucose and lipid metabolism and insulin sensitivity among 3 groups before and after 12 weeks of treatment (Table 3)

TC, TG, LDL-C, and FBG of obese patients with BED in Group C decreased significantly ($P < .05$) and HDL-C increased significantly ($P < .05$) after 12 weeks of treatment, and TC, TG, and HDL-C were significantly different from those in the Group B ($P < .05$). There were significant differences in TC, TG, HDL-C, LDL-C, and FBG between Group C and the blank group (Group A) ($P < .05$). After 12 weeks of treatment, TC, LDL-C, and FBG in Group B were significantly decreased ($P < .05$), while HDL-C was obviously increased ($P < .05$).

3.4. Comparison of anthropological and body composition indexes among 3 groups before and after 12 weeks of treatment (Table 4)

WC, WHR, BW, BMI, and FP were significantly decreased in Group C after 12 weeks of treatment ($P < .05$). And there were significant differences in BW, BMI, and FP among Group B and Group C ($P < .05$). There were significant differences in WC, WHR, BW, BMI, and FP between Group C and Group A ($P < .05$). There were significant differences in WC and WHR in Group B before and after 12 weeks of treatment ($P < .05$).

3.5. Comparison of dietary nutrient intake among 3 groups before and after 12 weeks of treatment (Table 5)

Before and after the nutritional intervention, study and compare the dietary intake of patients. It was found that the energy and fat intake of patients significantly decreased in Group C and Group B after 12 weeks of treatment ($P < .05$). Compared with Group B after 12 weeks of treatment, the intake of energy and carbohydrate in Group C decreased significantly ($P < .05$), and the intake of protein in Group C increased significantly ($P < .05$). There were significant differences in intake of energy, protein, fat, and carbohydrate between Group C and Group A after 12 weeks of treatment ($P < .05$).

4. Security

A total of 6 patients reported acupuncture-related adverse reactions, including 5 cases of subcutaneous hemorrhage at the acupuncture site and 1 case of tingling sensation after acupuncture. All adverse reactions were reported as mild; none of them required special medical intervention. Patients fully recovered from adverse reactions and remained in the trial.

5. Discussion

BED is defined as periodic binge eating, without the behavior of controlling weight and the compensatory behavior, such as vomiting, catharsis, excessive exercise.[28] The basic feature of BED is recurrent overeating, accompanied by a sense of loss of control during eating and consuming more food than most people in similar situations, which must be at least once a week for 3 months.[29] The pathogenesis of BED is complex and yet unclear. It is currently considered to be the result of a combination of psychological factors, biological factors, social and cultural factors, and a multifactorial disease. Neuroimaging studies have shown that cortical striatal circuit changes in BED are similar to those observed in substance abuse, including functional changes in the prefrontal, insular, and frontal cortex and striatum.[30] A review has identified some substantial similarities in executive function between obesity and substance use disorders, including an increase in impulsive decision-making and a bias toward disease-related stimuli in both cases.[31] Therefore, BED is closely related to overweight and obesity.[32] Overeating in obese

Table 3

Glucose and lipid metabolism and insulin sensitivity in 3 groups before and after 12 weeks treatment.

	A0	A12	B0	B12	C0	C12
TC	5.42 ± 0.70^{c}	5.53 ± 0.74^{c}	5.41 ± 0.57^{c}	4.88 ± 0.54^{b}	5.49 ± 0.72^{c}	4.24 ± 0.74^{a}
TG	2.30 ± 0.73^{d}	2.24 ± 0.64^{cd}	1.95 ± 0.69^{bc}	1.68 ± 0.53^{b}	2.01 ± 0.58^{cd}	1.29 ± 0.30^{a}
HDL-C	1.01 ± 0.19^{a}	1.10 ± 0.13^{ab}	1.02 ± 0.16^{a}	1.15 ± 0.23^{b}	1.08 ± 0.19^{ab}	1.33 ± 0.19^{c}
LDL-C	3.23 ± 0.56^{b}	3.19 ± 0.42^{b}	3.06 ± 0.67^{b}	2.77 ± 0.48^{a}	3.18 ± 0.65^{b}	2.76 ± 0.43^{a}
FBG	6.10 ± 0.67^{c}	6.25 ± 1.81^{c}	6.11 ± 0.78^{c}	5.47 ± 0.49^{b}	6.09 ± 0.84^{c}	4.88 ± 0.44^{a}
FINS	18.85 ± 7.83	17.87 ± 6.80	17.63 ± 4.65	15.63 ± 6.07	18.15 ± 6.20	15.29 ± 6.55

[a,b,c] Different lowercase letters indicated statistically significant differences ($p < 0.05$).

A0 = blank group before treatment, A12 = blank group after 12 weeks treatment, B0 = cognitive therapy group before treatment, B12 = cognitive therapy group after 12 weeks treatment, C0 = electroacupuncture combined with cognitive therapy group before treatment, C12 = electroacupuncture combined with cognitive therapy group after 12 weeks treatment, TC = total cholesterol, TG = triglyceride, HDL-C = high density lipoprotein, LDL-C = low density lipoprotein, FBG = fasting blood glucose, FINS = fasting insulin.

Table 4

Anthropological and body composition indexes in 3 groups before and after 12 weeks treatment.

	A0	A12	B0	B12	C0	C12
WC	98.83 ± 10.32^{b}	98.50 ± 12.81^{b}	94.25 ± 10.43^{b}	87.07 ± 5.63^{a}	95.81 ± 8.73^{b}	85.06 ± 7.17^{a}
HC	107.67 ± 8.21^{b}	104.21 ± 7.45^{ab}	104.21 ± 8.13^{ab}	102.75 ± 7.64^{a}	104.41 ± 6.06^{ab}	101.25 ± 5.86^{a}
WHR	0.92 ± 0.06^{b}	0.93 ± 0.08^{b}	0.90 ± 0.07^{b}	0.86 ± 0.06^{a}	0.92 ± 0.06^{b}	0.85 ± 0.07^{a}
BW	81.71 ± 12.26^{b}	78.40 ± 13.28^{b}	78.21 ± 9.47^{b}	76.26 ± 9.47^{b}	76.42 ± 9.43^{b}	67.16 ± 7.08^{a}
BMI	28.95 ± 3.48^{b}	27.75 ± 3.77^{b}	27.79 ± 2.19^{b}	26.73 ± 2.73^{b}	28.47 ± 4.31^{b}	24.15 ± 2.20^{a}
FP	34.35 ± 5.25^{b}	32.78 ± 5.34^{b}	33.72 ± 6.94^{b}	32.36 ± 5.43^{b}	35.00 ± 4.36^{c}	29.66 ± 3.10^{a}

[a,b,c] Different letters between within a row denote significant difference ($P < .05$).

A0 = blank group before treatment, A12 = blank group after 12 weeks treatment, B0 = cognitive therapy group before treatment, B12 = cognitive therapy group after 12 weeks treatment, C0 = electroacupuncture combined with cognitive therapy group before treatment, C12 = electroacupuncture combined with cognitive therapy group after 12 weeks treatment, WC = waist circumference, HC = hip circumference, WHR = waist-hip ratio, BW = body weight, BMI = body mass index, FP = body fat percentage.

patients not only leads to poor mental health and poor quality of life, but also hinders weight loss. Losing control overeating is a common behavior in obese adults (ie, BMI $\geq 30\,kg/m^2$). Scholars believe that this behavior is due to the opioid system (endogenous peptides and their receptors), which is closely related to the intake of delicious foods (especially high-sugar and high-fat diet), and is one of the key systems to regulate overeating. Because it promotes energy intake by regulating the pleasant response of people to delicious foods and increasing the stimulation of the diet to the human body.[33] With heavy intake of high-sugar and high-fat diets, increased nutrients will increase the number of opioid receptors, or develop a closer relationship between opioid receptors, which in turn intensifies overeating behavior.[34] Thus the relationship between BED and obesity is complex and may be bidirectional.[35]

In terms of psychological status, it is found that stress, anxiety, and general irritability make restrained obese people more sensitive to food stimuli and attractive "external" food interacts with painful emotions to cause a carnival. Dietary control and disinhibition are considered to be an important cause of binge eating.[36] Current studies show that the lifetime prevalence rate of any binge eating behavior is 4.5%,[34] as both obesity and eating disorders are associated with physical and mental health consequences. Compared with the general population, patients with BED often have the diagnosis of comorbid psychosis and physical illness, lower quality of life, more suicidal ideation and attempt, and reduced social function.[37–39] Obesity and other people with eating disorders are at higher risk than those with any single disease, [40] with about 76% of adults and 85% of adolescents suffering from mental illness, such as anxiety, substance use disorders, and other diseases, such as obesity, diabetes, and cardiovascular disease.[37] Based on increasing evidence of high prevalence and clinical significance of BED, the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) has now identified it as a mental illness and an official diagnosis of eating disorders.[16,17] The treatment for BED includes drug therapy and psychotherapy. A variety of drugs have been studied, mainly focused on antidepressants, but there are significant differences between researches. Compared with placebo, there is no reliable observation of binge eating frequency or sustained weight loss.[41–43] Psychotherapy has proven to be beneficial in the treatment of BED.[44] Clinical trials of metaphysical analysis of BED have found that most of the psychotherapies for BED are CBT.[45]

In this case, we took electroacupuncture combined with cognitive therapy. In the electroacupuncture group, acupuncture was performed on LI4, LI11, CV4, CV6, CV12, ST24, ST26, ST36, ST40, ST44, SP6, SP15, LR3. Then connect needle to electrodes. It was performed 3 times/wk and every course lasted 12 weeks. At the same time, it combined with cognitive therapy. The acupoints are mainly selected from Large Intestine Meridian of Hand-Yangming, Stomach Meridian of Foot-Yangming, Spleen Meridian of Foot-Taiyin, and Conception Vessel. CV12 is Front-Mu Point of the Stomach and Fu-Convergence of Eight Influential Points. It is the crossing point of Small Intestine Meridian of Hand-Taiyang, Triple Energizer Meridian of Hand-Shaoyang, and Stomach Meridian of Foot-Yangming, with functions in harmonizing the stomach and invigorating the spleen, relieving dyspepsia; LI11 is the He-Sea Point of hand-Yangming meridian, and can purge fu-organs to eliminate heat. The combination of 2 points can Tongli sputum, reducing turbidity and fat; most obese patients have abdominal fat deposition and muscle relaxation, so ST24, ST26, SP15, CV4, CV6 were selected locally to promote the circulation of Qi and achieve dampness and fat elimination; ST40, ST36, and SP6 played the role in invigorating spleen for diuresis, remove dampness and eliminating phlegm; ST44 clears internal fire; LR3 balanced liver and regulated Qi. Common points help clearing heat and dissolving damp, soothing the liver and strengthening the spleen, regulating Qi and dispersing stasis. Among them,

Table 5

Dietary intake in the 3 groups before and after 12 weeks treatment.

	A0	A12	B0	B12	C0	C12
Energy/kcal	2524.30 ± 338.32^{cd}	2476.54 ± 353.83^{c}	2646.90 ± 284.34^{de}	2230.75 ± 187.62^{b}	2680.58 ± 142.46^{e}	1930.34 ± 60.34^{a}
Protein/g	159.53 ± 41.30^{a}	151.18 ± 40.53^{a}	151.81 ± 23.48^{a}	169.87 ± 46.24^{a}	120.79 ± 12.89^{b}	128.55 ± 49.50^{b}
Fat/g	99.10 ± 25.54^{b}	94.21 ± 25.87^{b}	128.60 ± 25.42^{c}	81.73 ± 26.79^{a}	148.69 ± 23.90^{d}	80.23 ± 6.07^{a}
Carbohydrate/g	247.13 ± 65.43^{cd}	253.14 ± 44.96^{d}	226.52 ± 41.42^{bc}	209.31 ± 54.64^{b}	216.37 ± 28.13^{b}	173.52 ± 42.53^{ba}

[a,b,c] Different lowercase letters within a row denote significant difference ($P < .05$).

A0 = blank group before treatment, A12 = blank group after 12 weeks treatment, B0 = cognitive therapy group before treatment, B12 = cognitive therapy group after 12 weeks treatment, C0 = electroacupuncture combined with cognitive therapy group before treatment, C12 = electroacupuncture combined with cognitive therapy group after 12 weeks treatment.

ST24 and SP15 were connected to the electro-acupuncture instrument to enhance the effect. Electroacupuncture treatment is the combination of acupuncture and electroacupuncture instruments. A small amount of low-frequency pulse current is output through the needle to the acupuncture point. The waveforms output by the electro-acupuncture instrument include sparse-dense waves, intermittent waves, and continuous waves. Different waveforms have a variety of functions, such as pain relief, sedation, relief of vasospasm, muscle excitation, inhibition of sensation, and motor nerves. Studies have shown that, showing that sparse-dense waves can effectively regulate the nutritional metabolism of tissues, increase the gastrointestinal peristalsis of patients, and have a good therapeutic effect on obesity.[46] This study also adopts this waveform, alternately circulating sparse waves and dense waves to better prevent the electrical adaptation of the operation site. The pulse current can provide continuous stimulation to patients, improve the therapeutic effect of the acupuncture, regulate the autonomic nervous system, reduce gastric acid secretion, control calorie intake, promote energy metabolism and reduce fat accumulation.

In this study, we found that when patients try to eat normally, they can not adapt to new eating habits for short time and some physical and psychological problems occur, such as abdominal distension, stomach discomfort, or reflux. In this case, the urge to eat becomes strong. At this time, the combination of the electroacupuncture and cognitive treatment group has obvious advantages. While in the simple psychological cognitive treatment group, the resistance is greater, mainly by distracting attention, delaying tactics to alleviate their anxiety and physical discomfort and so on.

This study involves endocrine, neuropsychology, nutrition, and acupuncture, which multi-disciplinary works to treat obesity, a worldwide problem. The comprehensive application of multiple means may be a helpless choice, but through the research, we can know it is by no means disorder or blind and we need more time to assess its effectiveness. We believe that the diagnosis and treatment of BED should be carried out step by step. Comprehensive application of basic lifestyle control treatment, cognitive therapy, nutritional intervention, drug therapy, and traditional Chinese acupuncture strives to use the simplest, minimum invasive method to achieve the best results.

6. Limitations

Our results provide a preliminary indication of the efficacy of electricity in the treatment of obesity. Then our research has also some limitations. First, it is a retrospective study that uses a standard prescription to assess the efficacy of assisted acupuncture. We did not make a personalized treatment plan based on the experience of the acupuncturist, which may have led to performance bias; the data in previous studies was limited and we are unable to assess the safety of each acupoint stimulation therapy. Secondly, random and blind methods can not be achieved in the retrospective study. Third, the sample size is small, and a large number of samples need to be included in the future. Further research is needed to further explore.

7. Conclusion

It was considered that the human fat cells were updated once every 3 months. During the study period, the statistics of the 4th week and the 8th week showed no meaning. Therefore, we did not include the statistical analysis of the above 2 parts in the final statistics for the convenience of viewing. And the statistics of the 12th week showed that electroacupuncture combined with cognitive therapy for obese patients with BED was better than simple cognitive therapy. Table 1 showed that compared with the blank group, there are significant differences in the longer course of disease between the cognitive therapy group and the electroacupuncture combined with cognitive therapy group ($P < .05$), while there are no significant differences in age, BMI, and gender. Table 2 showed that electroacupuncture combined with cognitive therapy was superior to cognitive therapy in improving the scores of positive and negative emotions. Table 3 showed that ectroacupuncture combined with cognitive therapy was better than the cognitive therapy group in lowering blood lipid and blood glucose after 12 weeks. Table 4 indicated that electroacupuncture combined with cognitive therapy was superior to cognitive therapy alone in reducing body fat tissue. Table 5 showed electroacupuncture combined with cognitive therapy was greater than cognitive therapy group in regulate dietary nutrient intake. Therefore, future prospective studies are needed to further study the mechanism of electro-acupuncture on obesity and BED.

Author contributions

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Corrections

Details about CC, L and SZ being cofirst authors have been added.

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