Efficacy of Auricular Acupressure Combined with Transcutaneous Electrical Acupoint Stimulation for Weight Reduction in Obese Women

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Background: *Obesity leads to significant morbidity and mortality. Transcutaneous electrical acupoint stimulation (TEAS) and auricular acupressure (AA) are alternative treatments for weight reduction, however, there is no study of the combined treatments.*

Objective: *To determine the efficacy of the combined treatment of TEAS and AA, compared with AA alone.*

Material and Method: *A prospective randomized clinical trial was conducted in 40 obese women, aged 21-60 years, 20 were randomly assigned to receive either TEAS+AA or AA for 8 weeks. TEAS was performed using electrodes attached to the 10 acupuncture points and were electrically stimulated with 0.2 ms pulses, at 40 Hz for 30 minutes per session. AA was performed using magnetic pellets attached to 3 auricular acupoints on each side. Self-pressure on the magnetic pellets 10 times per session, 3 sessions a day was assigned. Anthropometric parameters were obtained at the beginning and the end of the present study.*

Results: *Sixteen in the TEAS+AA and 13 in the AA group completed the present study. Weight and BMI were significantly decreased in TEAS+AA group compared to the AA group (1.91 vs. 0.42 kg and 0.76 vs. 0.18 kg/m^2, respectively). After adjustment of the covariance, the treatment protocol was the only variance which had significant effect for weight reduction ($F = 4.62$; $p = 0.04$).*

Conclusion: *The combined treatment of AA and TEAS achieved higher weight reduction than the single treatment of AA in obese women during an 8 week period.*

Keywords: *Acupressure, Auricular acupuncture, Obesity, Transcutaneous electrical stimulation, Weight loss*

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Obesity is increasingly a problem which is becoming a worldwide epidemic[1] leading to several progressive conditions. Obese subjects are at risk of a number of health complications including cardiovascular disease, diabetes, metabolic syndrome, pulmonary disease, osteoarthritis and cancer, each of which may lead to further morbidity and/or mortality[1,2]. Currently, there is no accepted treatment as a "cure" for obesity and few treatments can achieve or maintain a healthy weight for the long term[3]. The efficacy of the conventional therapies is limited; moreover, anti-obesity treatment is has a burden of cost which is generally not reimbursed by health care systems. Complementary and alternative medicine is now more popular than ever before and has potential applications in the treatment of obesity[4,5]. It is well established that acupuncture treatment is one of a complementary and/or alternative approach which has beneficial effects for obesity treatment[6-8]. Various methods, including needle acupuncture, transcutaneous electrical acupoint stimulation (TEAS) and acupoint pressure and locations (*e.g.* body acupuncture and auricle) have been used for obesity treatment and yield various outcomes[6,7,9-12]. There are a limited numbers of international publications that describe the use of TEAS and/or auricular acupressure, in particular the combination of these two methods for obesity treatment[13-18]. The present study found that TEAS treatment achieved weight reduction in obese women[13], however, the result was not completely satisfactory. To maximize the benefit of treatment for weight reduction in obese women, the present study aimed to evaluate the efficacy of the combined use of TEAS with auricular acupressure (AA) compared to

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the treatment of AA alone.

Material and Method

A prospective randomized clinical trial was conducted in obese women at the Acupuncture Clinic, Srinakharinwirot University Hospital, during the months February to July 2011. Forty obese women, aged over 15 years, with body mass index (BMI) > 23 kg/m^2[2,19] who sought obesity treatment by an alternative method were informed about the study. Exclusion criteria were pregnancy and lactation, severe underlying disease, including hematological or bleeding disorders, cardiovascular diseases or uncontrolled hypertension, pulmonary or uncontrolled asthma or psychiatric disorders. Also excluded women were who had a history of pacemaker placement, epilepsy, active dermatological problems at the site of acupuncture points, or were currently committed to other methods for weight reduction.

The present study protocol was approved by the ethics committee of the Faculty of Medicine, Srinakharinwirot University. Written informed consent was obtained from all participants before enrolment in the present study.

Groups and intervention

The present study participants were randomized by using computer-generated random numbers into one of the treatment group: TEAS+AA (n = 20) and AA (n = 20). Transcutaneous electrical acupoint stimulation (TEAS) was performed using electrodes attached to the following 10 acupoints: one point each at Guanyuan (RN 4), Qihai (RN 6), Xiawan (RN 10), Zhongwan (RN 12) and 2 points each at Tianshu (ST 25), Shuidao (ST 28) and Daheng (SP 15) (Fig. 1). An electrical stimulator model HM Stim2 fit® (Wuxi Jiajian Medical Instrument Co Ltd, Wuxi, China) was applied with 0.2 ms pulses, at 40 Hz in the constant mode within the subject's tolerance level via the electrodes. The electrodes were left in place for 30 minutes and then removed. Auricular acupressure (AA) was performed using magnetic pellets attached to the auricular acupoints of Shenmen, hungry and stomach point on both auricles (Fig. 2). Participants were advised to perform a self-stimulation (pressure) on the magnetic pellets 10 times per session, 3 sessions a day before meals. Magnetic pellets were left in the ear auricles and were twice weekly replaced with a new set. Participants who were assigned to TEAS+AA received both transcutaneous electrical acupoint stimulation and auricular acupressure treatments. The AA group received only auricular acupressure treatments. Treatment was conducted twice weekly for 8 weeks by a single licensed acupuncturist (LR). During the study

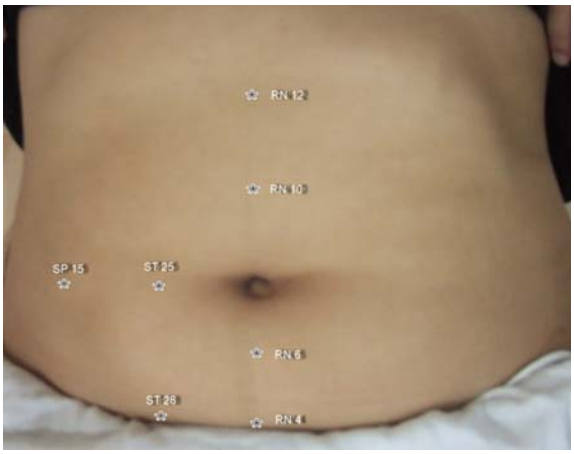

Fig. 1 Acupuncture points which were used for transcutaneous electrical acupoint stimulation Guanyuan (RN 4), Qihai (RN 6), Xiawan (RN 10), Zhongwan (RN 12), Tianshu (ST 25), Shuidao (ST 28), and Daheng (SP 15)

Fig. 2 Auricular acupoints which were used for auricular acupressure Shenmen (P1), stomach (P2) and hungry (P3) point

period, no specific instructions were given to the participants in regard to diet or exercise for weight reduction, however, use of medication for weight reduction was not permitted.

Measurements

Demographic data and anthropometric parameters including age, weight, height, skinfold thicknesses, mid-upper arm circumference (MUAC), waist and hip circumference, were obtained at the beginning and the end of the present study. Measurements of anthropometric parameters were made in accordance with the WHO Expert Committee guidelines[20]. Weight was measured to the nearest 100 g using an electronic scale (Seca®, Model 767, Hamburg, Germany). Standing height was measured by a height rod (Seca®, Model 220, Hamburg, Germany) while MUAC, waist and hip circumferences were measured by a normal non-stretch tape to the nearest millimeter. MUAC was measured midway between the tip of the left shoulder blade and the tip of the elbow. Waist circumference was measured at the midpoint between the lower costal margin and the top of the iliac crest while the subject was in a standing position. Hip circumference was measured in the standing position at the maximum circumference over the buttocks. Triceps skinfold (TSF), biceps skinfold (BSF), subscapular skinfold (SSS) and supra-iliac skin fold (SISF) were measured on the left side using a Lang skinfold caliper. The body mass index was calculated as the ratio of weight/(height)^2 (kg/m^2)[19]. All measurements were carried out by trained staff. Any adverse events during the treatment were recorded.

Statistical analysis

After testing for normal distribution by Kolmogorov-Sminov test, all anthropometric data were found normally distributed and were descriptively presented as mean, standard deviation and 95% confidence interval. Differences of anthropometric characteristics and their change from baseline between two groups were examined using student's t-test. The outcome measures at the end of the present study were compared with the measures obtained at baseline using the paired t-test. Analysis of covariance was used to test the main and interaction effects of categorical variable of treatment methods on a continuous dependent variable of weight change during treatment. Data were analyzed as per intention-to-treat analysis until the day of withdrawal. Statistical analysis was performed with SPSS (version 11.0,SPSS, Chicago, IL, USA). A p-value < 0.05 was considered as statistically significant.

Results

Of 40 participants, 16 in TEAS+AA and 13 AA group completed the present study. Three women in TEAS+AA group withdrew in the fourth and one in the sixth week of the present study. Six women in AA group withdrew during the 4th to 6th week of the present study. Their major reason for withdrawal was inconvenience to get to the clinic. One participant in AA group did not return to the clinic after the enrollment and this case was excluded from further study. Prior to the withdrawal date, none of the withdrawn participants had any symptoms of adverse effects.

Mean age of the study population was 36.3 $\pm$ 10.6 (range 21-60 years). Baseline characteristics of the present study population are showed in Table 1. Participants in TEAS+AA group were significantly older (40.9 $\pm$ 10.3 yr (TEAS + AA) vs. 31.8 $\pm$ 9.1 yr (AA); p = 0.005) and heavier (71.5 $\pm$ 9.0 kg (TEAS + AA) vs. 64.2 $\pm$ 8.9 kg (AA); p = 0.01) than participants in AA group. At the beginning of the present study, BMI, waist circumference and waist/hip ratio were found significantly higher in TEAS+AA group than in AA group (Table 1). Mean duration of treatment were not significantly different between groups (7.3 $\pm$ 1.5 (TEAS + AA) vs. 7.1 $\pm$ 1.5 wk (AA); p = 0.69).

At the end of the present study, anthropometric parameters including weight, BMI, hip circumference, all skin fold thickness and MUCF were not significantly different between groups (Table 1). In TEAS+AA group, weight, BMI, waist circumference, waist/hip ratio, TSF and SSCF thickness were significantly decreased at the end of the study compared to the beginning (Table 2). Even weight reduction and anthropometric parameters changes were observed in AA group, only waist circumferences were found to show significant reduction at the end of the study. Weight and BMI were significantly decreased in the TEAS+AA group compared to the AA group (1.91 vs. 0.42 kg and 0.76 vs. 0.18 kg/m^2, respectively). Table 2 depicts the changes in parameters at the end of the present study.

An analysis of covariance revealed the significant effect of treatment methods (F = 4.62; P = 0.04), but not for the initial weight (F = 0.03; P = 0.86), on weight reduction at the end of treatment from the beginning of the present study. No adverse events were reported by the participants during the present study.

Table 1. Anthropometry at baseline and at the end of study in study population. Data are present in Mean ± SD

	TEAS[1] with AA (n = 20)	AA[2] (n = 20)	p-value
Age (yr)	40.9 ± 10.3	31.8 ± 9.1	0.005
Height (cm)	158.0 ± 5.8	156.0 ± 5.2	0.27
Weight (kg)			
- Baseline	71.5 ± 9.0	64.2 ± 8.9	0.01
- End of study	69.6 ± 8.7	63.8 ± 10.0	0.06
BMI (kg/m^2)			
- Baseline	28.6 ± 2.7	26.3 ± 2.9	0.02
- End of study	27.9 ± 2.7	26.1 ± 3.3	0.08
Waist (cm)			
- Baseline	87.8 ± 8.1	78.0 ± 7.0	< 0.001
- End of study	84.1 ± 7.8	75.3 ± 6.2	0.001
Hip (cm)			
- Baseline	101.4 ± 5.9	98.2 ± 5.4	0.09
- End of study	100.1 ± 5.9	96.1 ± 6.6	0.07
Waist/ Hip ratio			
- Baseline	0.87 ± 0.06	0.79 ± 0.06	0.001
- End of study	0.84 ± 0.06	0.78 ± 0.06	0.009
Triceps skinfold thickness (mm)			
- Baseline	15.6 ± 3.7	16.4 ± 3.0	0.50
- End of study	14.6 ± 3.8	16.5 ± 3.6	0.13
Biceps skinfold thickness (mm)			
- Baseline	7.7 ± 4.0	5.8 ± 3.3	0.14
- End of study	7.1 ± 3.4	5.3 ± 2.7	0.09
Subscapular skinfold thickness (mm)			
- Baseline	30.1 ± 4.1	28.4 ± 4.7	0.23
- End of study	28.2 ± 4.1	28.1 ± 5.2	0.92
Suprailiac skinfold thickness (mm)			
- Baseline	32.4 ± 4.1	30.9 ± 5.5	0.37
- End of study	31.5 ± 4.0	31.5 ± 5.8	0.99
Mid arm circumference (cm)			
- Baseline	28.1 ± 2.9	27.3 ± 2.8	0.42
- End of study	27.7 ± 2.9	26.8 ± 2.7	0.36

[1]TEAS = transcutaneous electrical acupoint stimulation; [2]AA = auricular acupressure

Discussion

The present study showed the effectiveness of transcutaneous electrical acupoint stimulation combined with auricular acupressure; the treatment methods achieved significant weight reduction and decreased anthropometric parameters of body fat mass greater than those when auricular acupressure was the sole treatment. Even though there was a difference in baseline body weight between groups, the present study still confirmed the efficacy of these combined treatments on weight reduction after adjustment for these differences.

With regard to TCM theory, stimulation at the specific acupuncture points will correct the imbalance of life force (Qi) which is believed to be the cause of obesity and leads to weight loss[7]. Various methods are used to stimulate acupuncture points including needle acupuncture with or without stimulation, moxibustion, acupressure and TEAS[7]. Moxibustion treatment, using the application of heat by burning small pellets of combustible material on or near the acupoints and even the traditional needle acupuncture, are usually unacceptable to the patients due to their fear and pain awareness. In this case, acupoint pressure and TEAS may be the best alternate methods for obese patients who are willing to lose weight. TEAS is considered to be safe and a useful treatment without adverse reactions. The present study in obese women showed the promising effect of TEAS on weight and BMI reduction (1.2 kg and 0.47 kg/m^2 in an 8-week

Table 2. Change in anthropometric characteristics from the beginning of the study

	TEAS[1] with AA (n = 20)		AA[2] (n = 20)		p-value Between groups
	Mean (95% CI)	Paired t-test (p-value)	Mean (95% CI)	Paired t-test (p-value)	
Weight change[1] (kg)	1.91 (1.00, 2.81)[3]	< 0.001	0.42 (-0.59, 1.44)	0.39	0.03
BMI change (kg/m^2)	0.76 (0.39, 1.12) [3]	< 0.001	0.18 (-0.25, 0.62)	0.38	0.04
Waist change (cm)	3.66 (1.24, 6.08) [3]	0.005	2.83 (0.33, 5.33) [3]	0.03	0.62
Hip change (cm)	1.38 (-0.02, 2.78)	0.05	1.16 (-1.00, 3.34)	0.27	0.86
Waist/ Hip ratio change	0.02 (0.00, 0.04) [3]	0.02	0.01 (-0.01, 0.04)	0.12	0.68
Triceps skinfold thickness (mm)	1.03 (0.07, 1.97) [3]	0.04	-0.4 (-1.66, 0.86)	0.51	0.06
Biceps skinfold thickness (mm)	0.55 (-0.23, 1.33)	0.16	0.87 (-0.61, 2.34)	0.23	0.67
Subscapular skinfold thickness (mm)	1.85 (0.55, 3.15) [3]	0.008	-0.46 (-1.85, 0.91)	0.48	0.02
Suprailiac skinfold thickness (mm)	0.93 (-0.08, 1.94)	0.07	-1.80 (-3.87, 0.27)	0.08	0.01
Mid arm circumference (cm)	0.35 (-0.22, 0.93)	0.21	0.16 (-3.39, 0.67)	0.49	0.62

[1]TEAS = transcutaneous electrical acupoint stimulation; [2]AA = auricular acupressure; [3]Significant differences from the beginning of the study ($p < 0.05$)

period, respectively) and the reductions were comparable to needle acupuncture[13]. The present study was aimed to optimize the treatment for obesity using the combination of two acupuncture-based techniques, TEAS and auricular acupressure, both techniques were felt to be comfortable by the patients. Compared to the present study of TEAS treatment[13], TEAS combined with AA achieved more weight and BMI reduction (1.9 kg and 0.76 kg/m^2, respectively) with an equal duration of treatment. Even though these two arms of study were not performed at the same time, all treatments were performed in the same clinical setting by the same acupuncturist. It might suggest that AA might enhance the effect of TEAS on weight and BMI reduction. Unlike the previous report which showed the efficacy of a 2-combined acupuncture treatment-needle acupuncture and auricular acupuncture[15] the present study is the first report of using a combination of TEAS and AA for weight reduction in obesity. Auricular acupuncture or acupressure have been reported and are respected as one of the most often used for obesity treatment[7]. Common acupoints used for obesity treatment are hunger point, Shenmen and stomach point as used in the present study[12,21,22]. From anatomical studies, it is known the external ear is innervated by several nerves including vagus, glossopharyngeal, trigerminal, facial and the second and third branches of the cervical spinal nerves[7], the auricular branch of the vagus nerve is thought to share a common pathway with the main nerve that innervates the digestive tract. Stimulation to the auricle might interfere with the signal from the digestive tract and lead to weight loss[7]. The outcomes on weight and BMI reduction by AA as the sole method of treatment in the present study may not be comparable to other studies[11,17,18], which might be explained by the differences in the numbers of acupoints used, duration of treatment, material used for acupressure and the drop-out rate. However, the overall outcome of the combined treatment of AA and TEAS in the present study showed the efficacy to be the same as the outcome from various studies which were analyzed and presented in a in meta-analysis review (weight reduction ranging from 1.5 to 1.9 kg)[6].

The mechanism of TEAS and AA in weight reduction is not well established. TEAS which transmits a mild current through the selected acupoints for weight reduction by TCM is believed to increased the neural activity of the ventromedial and lateral hypothalamus leading to decrease in appetite[23,24]. Increased levels of serotonin in the central nervous system (CNS) and plasma were also observed and led to weight loss by suppressing appetite and rearranging the psychomotor balance[8,25]. Previous studies regarding acupuncture therapy also found the increase of beta endorphin both in the CNS and serum which induced lipolitic activity and caused weight loss[26-28]. Neurophysiologic theories of auricular acupoint stimulation for weight reduction have been proposed[11,23,24,29,30]. In animal models, stimulation of the auricular regions was found to increase the activation to ventromedial hypothalamus, a satiety center and led to improved weight loss[23,24,29],

and this association was also found in human subjects. Acupoint stimulation either by acupuncture or by acupressure leads to weight reduction by stimulating the auricular branch of the vagal nerve and by raising serotonin levels[11,30]. The exact mechanism of weight loss is outside the scope of the present study and further research is needed to elucidate the mechanism. It is worth mentioning that our protocol of treatment with TEAS and AA treatment produced less pain and is also free from the complications of needle acupuncture. The present study still supports our concept to simplify acupuncture therapy, to use a common set of acupoints for all types of obesity classified by TCM, rather than the specific set of acupoints for each type of obesity[31,32]. Application of this common set of acupoints can achieve weight reduction resembling the various protocols in a meta-analysis review[6]. The advantages in our approach are that it may help the inexperienced acupuncturists to classify the correct obesity type. Moreover, all of the applied acupoints were not on the back, our recommended acupoints are only on the abdominal wall which may help patients to limit movement so they can lie continuously on their backs during treatment.

The limitations of the present study are the small sample size, the relatively short study duration and high drop-out rate during the study. A further study with a larger number of participants is advocated to show the significant effect of treatment. Moreover, the present study included neither diet modification nor exercise programs in the protocol as the authors wished to bring out that weight reduction was due to the effect of either TEAS or AA. Further study of combined therapy of TEAS with AA and diet modification or exercise is advocated to clarify the optimal efficacy of these methods. The present study was not designed for comparison with placebos. From our previous work in the same clinical setting as the present study, without any interventions, the obese women who were on the list waiting for acupuncture treatment had an average weight gain of 1.2 kg/month[10]. As the weight trended to increase in the obese women and all of the participants were obese women who sought treatment, the placebo arm for the present study might be unsuitable due to ethical concerns.

In conclusion, the obese women during an 8-week period, the combined treatment of transcutaneous electrical acupoint stimulation and auricular acupressure achieved higher reduction rates of weight, BMI and some body fat parameters than the single treatment with auricular acupressure alone. Weight reduction obtained is comparable with the results from a recent meta-analysis review of various acupuncture methods for obesity. This combined treatment is acceptable to the patients and is free from adverse events. Further long term study with sufficient numbers of subjects is encouraged to maximize the results.

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Potential conflicts of interest

None.

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ประสิทธิภาพของการกดจุดบริเวณใบหูร่วมกับการกระตุ้นจุดฝังเข็มบริเวณลำตัวด้วยไฟฟ้า ผ่านทางผิวหนังเพื่อการลดน้ำหนักในผู้หญิงอ้วน

ลัคนา ฤกษ์ศุภผล

***ภูมิหลัง**: โรคอ้วนเป็นสาเหตุสำคัญที่นำไปสู่ความเจ็บป่วยและการเสียชีวิต การกระตุ้นจุดฝังเข็มด้วยไฟฟ้า ผ่านทางผิวหนังและการกระตุ้นจุดบริเวณใบหูเป็นการรักษาทางเลือกวิธีหนึ่งสำหรับโรคอ้วน อย่างไรก็ตามไม่ปรากฏรายงานการรักษาโดยใช้ 2 วิธีนี้ร่วมกันมาก่อน*

***วัตถุประสงค์**: การศึกษานี้มีวัตถุประสงค์เพื่อประเมินประสิทธิภาพของการรักษาร่วมกันของ 2 วิธี เปรียบเทียบกับการกดจุดบริเวณใบหูวิธีเดียว*

***วัสดุและวิธีการ**: การศึกษาแบบไปข้างหน้าแบบสุ่มในผู้หญิงอ้วนจำนวน 40 คน อายุระหว่าง 21-60 ปี โดยแบ่งเป็น 2 กลุ่มด้วยวิธีสุ่ม กลุ่มละ 20 คน ใช้เวลาการรักษา 8 สัปดาห์ การกระตุ้นจุดฝังเข็มด้วยไฟฟ้าผ่านทางผิวหนังที่จุดฝังเข็ม 10 จุดบริเวณลำตัวโดยใช้ไฟฟ้า 0.2 ms ความถี่ 40 Hz เป็นเวลา 30 นาทีต่อการรักษา 1 ครั้ง การกระตุ้นจุดบริเวณใบหูทำโดยการติดเม็ดแม่เหล็กที่จุดบริเวณใบหู 3 จุดต่อข้าง และให้ผู้ป่วยกดกระตุ้นที่จุดแปะเม็ดแม่เหล็กด้วยตนเองประมาณ 10 ครั้งต่อชุด จำนวน 3 ชุดต่อวัน ข้อมูลของขนาดร่างกายจะได้รับการบันทึกเมื่อเริ่มต้นและสิ้นสุดการรักษา*

***ผลการศึกษา**: อาสาสมัครที่ได้รับการรักษาด้วย 2 วิธีจำนวน 16 คน และผู้ที่ได้รับการรักษาด้วยวิธีเดียวจำนวน 13 คน เข้าร่วมการรักษาจนสิ้นสุดโครงการ ผู้ที่ได้รับการรักษาด้วย 2 วิธีมีน้ำหนักและดัชนีมวลกายลดลงมากกว่าผู้ที่ได้รับการรักษาด้วยวิธีเดียว (น้ำหนักลดลง 1.91 และ 0.42 กิโลกรัม ดัชนีมวลกายลดลง 0.76 และ 0.18 กก./ตร.ม. ตามลำดับ) หลังจากควบคุมปัจจัยต่างๆ พบว่า วิธีการรักษาเป็นปัจจัยเพียงปัจจัยเดียวที่มีผลต่อน้ำหนักที่ลดลง (F = 4.62; P = 0.04)*

***สรุป**: การรักษาด้วยวิธีการกดจุดที่บริเวณใบหูร่วมกับการกระตุ้นจุดฝังเข็มบริเวณลำตัวด้วยไฟฟ้าผ่านทางผิวหนังเป็นเวลา 8 สัปดาห์ มีประสิทธิภาพในการลดน้ำหนักในผู้หญิงอ้วนมากกว่าการรักษาด้วยวิธีการกดจุดที่บริเวณใบหูเพียงวิธีเดียว*