Randomized fMRI Trial of the Central Effects of Acute Acupuncture on Glucose Levels and Core Body Temperature in “Overweight” Males

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ABSTRACT

Objective: This study focuses on how acupoints ST 36 (Zu San Li) and SP 9 (Yin Ling Quan) and their sham acupoints act acutely on the limbic system via dopamine to affect satiety, glucose (GLU) blood levels, and core body temperature (CBT).

Design: This controlled clinical trial compared real acupuncture (ACU) versus minimal sham acupuncture (min SHAM) effects on metabolic physiology using functional magnetic resonance imaging (fMRI).

Setting: The study took place at the West China Hospital in Chengdu, Sichuan Province, China.

Subjects: The study subjects were 19 right-handed healthy, “overweight,” nondieting adult Chinese males ages 21–45 (10 for ACU treatment and 9 for min SHAM) who had abstained from eating 12 hours prior to the fMRI experiment.

Results: Values for GLU and CBT indicated no significant differences ($P > 0.05$) in both inter- and intragroup comparisons resulting from variable individual responses to treatment. Hunger survey feedback was significant ($P < 0.05$) between the ACU and min SHAM groups. Soreness, or De Qi, was the only significant ($P < 0.05$) intergroup sensation.

Conclusions: Acupuncture stimulation activated neurophysiological pathways involving dopamine, basal metabolic rate, heart rate, and satiety regulation. This project will be of great importance in helping scientists understand how acupuncture can be studied as a safe inexpensive treatment modality for weight control.

Key Words: Acupuncture, Dopamine, Glucose, Core Body Temperature, Satiety, De Qi, Overweight, fMRI

INTRODUCTION

ACUPUNCTURE IS EMERGING as an important modality of complementary medicine in Western countries.¹⁻³ A variety of symptoms can be treated by acupuncture clinically.⁴ Most importantly, acupuncture has been used to treat obesity and weight-related issues specifically (as noted in a recent review),⁵ and numerous studies have shown that

manual⁶ and electroacupuncture⁷⁻¹⁰ are effective means of weight loss and weight control.

This study can help examine the brain areas activated by acupuncture that may suppress appetite and prevent weight gain by decreasing food intake. In animal models, damage to the ventromedial hypothalamus (VMH) led to hyperphagia and increased appetite, while damage to the lateral hypothalamus (LH) caused hypophagia and decreased

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appetite.¹¹ However, the dorsal striatum is crucial in food consumption. In a study by Volkow et al.,¹² when dopamine (DA)-deficient mice were treated with DA in the dorsal striatum, feeding behavior was restored. DA has site-specific action regulating the intake of food; this agent reinforces the effects of food.¹³ DA is necessary to begin the consumption process.¹⁴ It acts upon the prefrontal area, VMH, and arcuate nucleus (ARC) to reduce the consumption of food and prevent hyperphagia, which, in turn, is affected by leptin, insulin, and other hormones.¹⁵ It may be inferred that disruptions in DA production and/or structure may predispose certain individuals to obesity.

One study showed there was a delayed hypothalamic response to reach satiety in obese individuals,¹⁶ hence, this study may aid in evaluating behavioral and physiological responses of overweight individuals to hunger and acupuncture. The most important aspect of our study was to depict mechanistically how and why real acupuncture (ACU) and minimal sham control acupuncture (min SHAM) affect glucose (GLU) homeostasis, and hypothalamic regulation of core body temperature (CBT) and basal metabolic rate (BMR). Sun et al.¹⁷ studied how ghrelin affected GLU homeostasis centrally and peripherally. Ghrelin causes the release of growth hormone-releasing peptides and neuropeptide Y (NPY) as well as increasing appetite.¹⁸ It has been shown that ACU decreases ghrelin, hence, appetite decreases as had been shown by the current researchers' preliminary unpublished results. Other key neurocircuits that control GLU metabolism were reviewed by best Rother et al.¹⁹ It was expected ACU would affect liver gluconeogenesis via insulin and its mediators, as well as gastrointestinal afferents that carry information centrally regarding energy intake. Pissios and Maratos-Flier²⁰ proposed that central serotonin affects GLU homeostasis, because inhibition of serotonin reuptake decreases appetite. The arcuate nucleus pro-opiomelanocortin (ARC POMC) neurons respond to serotonin as well as leptin and GLU, which are affected by ACU treatment.⁹ Low leptin and other adipokine levels during fasting stimulate food intake and decrease BMR (as discussed in two full reviews).^{21,22} Leptin controls GLU and lipid metabolism via adenosine monophosphate-activated protein kinase and stearyl-coenzyme A desaturase 1 in the liver and muscle,²³ which may be targeted by ACU treatment.

The development of imaging techniques, such as positron resonance imaging (PET) and functional magnetic resonance imaging (fMRI), has provided new tools for us to obtain a noninvasive appreciation of the anatomy and physiological function involved during acupuncture in humans and animals.^{5,24} There have been no direct publications that correlated clinical outcomes in pathological conditions with induced acupuncture changes in the brain. The current researchers use fMRI to answer questions relating to acupuncture effectiveness with respect to obesity and the physiology of metabolism. Recent research has not addressed this

area in overweight individuals. The current authors believe the physiology and response to acupuncture may be different in overweight individuals. Furthermore, trial design and data interpretation have been problematic in acupuncture research. The current authors' min SHAM technique is based on a study by Kleinhenz et al.,²⁵ who used the Streitberger needle method as a form of acupuncture control. This is discussed further in this article in more detail.

METHODS AND SUBJECTS

Subjects

The study was performed on 19 right-handed volunteer Chinese males, ages 21–45 (10 for ACU treatment and 9 for min SHAM), who had no history of neurologic and psychiatric disease. All subjects were acupuncture naïve and gave written informed consent as approved by the West China University of Medical Science. All research procedures were approved by the West China Hospital Subcommittee on Human Studies. All patients were free to withdraw from the study at any time without obligation. Table 1 shows inclusion and exclusion criteria used to recruit subjects.

Experimental Design

Subjects were recruited and prescreened based on a standard questionnaire. Subjects were assigned randomly by a computer program to groups A and B (the acupuncturist was the only nonblinded individual in the research group). Group A received the standard ACU treatment. Group B was treated with the min SHAM treatment. Session I, Experiments I (which included group A) and II (which included group B) consisted of the protocols discussed in the sections below.

Physiological Measurements. Height (cm) and weight (kg) were measured for each subject in order to calculate body-mass index (BMI) and waist-to-hip ratio (WHR). A brief chest and heart auscultation was performed on each patient. Prior to scanning, initial CBT was measured sublingually with an Omron[®] electronic thermometer (MC-142L). Initial GLU was taken from the left index finger and was measured via the OneTouch[®] Ultra[™] Blood GLUcose Monitoring System (Lifescan, Johnson & Johnson Co.). The instrument used glucose oxide (>0.8 international units [IU]) and a buffer (0.05 mg). This instrument's range was 20–600 mg/dL or 1.1–33.3 mmol/L. Accuracy was a slope of 0.986, y-intercept = −5.5 mg/dL, and CC = 0.984. Precision was 1.6%–3.2% for blood and 2.4%–4.4% for the control. Blood pressure was measured via an Omron[®] electronic blood pressure monitor (HEM-645). Sensitivity was ±4 mm Hg (±5% accuracy) with a range of 0–299 mm Hg. A hunger survey was then conducted asking each patient to evaluate his hunger on a standard Likert scale from 0 (no hunger) to 10 (starvation).

TABLE 1. INCLUSION AND EXCLUSION CRITERIA USED TO SELECT SUBJECTS FOR THE EXPERIMENT

<i>Inclusion criteria</i>	<i>Exclusion criteria</i>
Right-handed adult (ages 21–45) Chinese males	Left-handed non-Chinese males or females (ages <21 and >45 years)
Body-mass index >18 and <30	Normal weight/body-mass index
Waist-hip ratio >0.9	Waist-hip-ratio <0.9
Nonsmokers	Smokers
Nondieters (regular diet and exercise program in past 3 months)	On a weight-loss program in past 3 months
Not claustrophobic	Claustrophobic
Not on prescription or nonprescription medication especially antidepressants and appetite suppressants	Taking antidepressants or appetite suppressing drugs (i.e., loperamide)
Never experienced acupuncture (acupuncture naïve)	Had major acupuncture treatment in the past, especially recently
Healthy (no neurological and/or endocrine problems)	Neurological and/or endocrine disorders
12 hour fast prior to experiment	Ate within 12 hours of the experiment

After a 21-minute scan, during which the ACU or min SHAM treatment was done (described below), CBT and GLU (based on a sample taken from the right index finger) evaluations were performed, and a hunger survey was conducted. Each patient was asked to evaluate any De Qi sensations he felt during the treatment. A standard Likert scale (0 being no sensation and 10 being the most intense sensation felt) was used to evaluate the De Qi sensations listed. When the anatomical scan and postscan were done, the final CBT and GLU (left middle finger) were evaluated, and a hunger survey was conducted. Subjects were asked if they thought they received real or sham acupuncture.

Treatment Methods

After a 5-minute prescan of each patient, a certified acupuncturist prepared for either the ACU or min SHAM procedure, depending on random patient assignment. The scan began when the four needles were inserted at time 0 minutes. For ACU, 4 acupoints were used bilaterally—ST 36 and SP 9. ST 36 is 3 cun below ST 35 (Du Bi), which is in the depression lateral to the patellar ligament on the lower border of the patella when the knee is flexed, and 1 cun lateral to the anterior crest of the tibia. When the knee is flexed, SP 9 is located along the posterior border of the upper tibia. For min SHAM, the four SHAM acupoints were located 2 cun lateral and dorsal to ST 36, and 2 cun medial to SP 9 on the same plane bilaterally. The acupuncturist used paramagnetic (0.18 mm × 40 mm (Beijing Jianlekang Medical Instrument Co., Ltd., Beijing, China) needles for both ACU and min SHAM.

For ACU, after a 1-minute pause, the acupuncturist inserted needles vertically to a depth of 2–3 cm and rotated needles in a “tonifying and reducing” technique clockwise and counterclockwise at a rate of 60 times per minute (1 Hz) in an alternating bilateral diagonal manner at 30-second intervals for a total of 2 minutes. The subject was allowed to raise his right index finger if his De Qi sensations were

painful. Each man’s lower legs were covered to mask treatment choice. The scan continued for 21 minutes with the needles in.

For min SHAM, after a 1-minute pause, the acupuncturist inserted the needles superficially and immediately removed them, but pretended to rotate the needles as described for the ACU procedure. Each man’s lower legs were covered to mask the treatment choice.

After either treatment, a 7-minute anatomical scan and a 9-minute postscan were conducted.

Imaging

The fMRI experiment was performed using a 3.0 Tesla Signa (GE) MR device with a standard head coil. All subjects were asked to remain awake and think about nothing, with their eyes closed during all scans. The images covered the entire brain and were parallel to the AC–PC line. Functional images were acquired with a single-shot gradient-recalled echo planar imaging (EPI) sequence (TR/TE: 2 000 ms/30 ms; field of view (FOV): 240 mm × 240 mm; matrix size: 64 × 64; flip angle: 90°; in-plane resolution: 3.75 mm × 3.75 mm; slice thickness: 5 mm thick with no gaps, 43 sagittal slices). A set of T1-weighted high-resolution structural images was collected (TR/TE: 5.7 ms/2.2 ms; FOV: 256 mm × 256 mm; matrix size: 256 × 256; flip angle: 7°; in-plane resolution: 1 mm × 1 mm; slice thickness: 1 mm with no gaps).

Image Preprocessing and Analysis

The first 5 time points were discarded to avoid the instability of the initial MRI signal. The fMRI runs were intensity-scaled to yield a whole-brain mode value of 1000. Data sets were preprocessed using SPM5 (www.fil.ion.ucl.ac.uk/spm). Images were realigned to the first image. If translation and rotation were >1 mm in any direction or >1°, the subject was excluded. The images were then normalized to a Montreal Neurological Institute (MNI) template and

FIG. 1. Regions of interest (ROIs) chosen for the functional magnetic resonance imaging connectivity analysis between real acupuncture and minimal sham acupuncture at acupoints ST 36 and SP 9. Left area shows the hypothalamus mask regions and the right area indicates the amygdala mask regions.

resampled to $3\text{ mm} \times 3\text{ mm} \times 3\text{ mm}$. Resting data used a bandpass filter of 0.01–0.1 Hz. Finally, the images were smoothed at $6\text{ mm} \times 6\text{ mm} \times 6\text{ mm}$. A connectivity analysis was done (data not shown) and the hypothalamus (HYP) and amygdala (AMY) were chosen initially as the regions of interest as shown in Fig 1.

RESULTS

Parametric Test Statistics

There was an outlier present for subject 067 (CBT $1=35.34$), which was substituted with the average of the remaining values (36.31), and that value was used in the following calculations. On a repeated measures analysis of variance, there was no significant within-group difference ($P>0.05$) found in the ACU and min SHAM groups for CBT and GLU. There were no significant group differences ($P>0.05$) seen in the intergroup analysis using the same test. These results show that, despite visual trends seen in CBT and GLU in the 2 groups, no significance was found (see Figs. 2 and 3, respectively).

There were individual differences that are of interest. In CBT, all ACU patients had a higher CBT during ACU, which was lower at the completion of the treatment except for patients 028 (CBT values: 36.25; 36.21; 36.43) and 045 (CBT values: 36.59; 36.54; 36.46). However, individual min SHAM patients differed in CBT outcomes. In general, there was a slight increase or no change from before, during, or after treatment. Patient 020 had a major decrease in CBT

(CBT values: 37.12; 36.67; 36.71). Patients 029 (CBT values: 36.61; 36.62; 36.56) and 055 (CBT values: 36.93; 36.94; 36.77) had a slight increase followed by a decrease post-treatment. Patients 066 (CBT values: 36.42; 37.34; 37.23) and 087 (CBT values: 36.82; 36.96; 36.98) had major continuous increases in CBT after treatment.

In most ACU individuals, GLU decreased during treatment and post-treatment, except in patient 018 (GLU values: 4.3; 4.3; 4.2) who remained relatively the same. In patients 045 (GLU values: 5.5; 5.8; 6.7) and 089 (GLU values: 4.2; 4.3; 4.9), there was a major increase during and

FIG. 2. Measurement of corrected average core body temperature (CBT) in °C shown before (Pre-Acu), during (Acu), and after (Post-Acu) acupuncture (ACU), or minimal sham (min SHAM) treatments in “overweight” adult Chinese males ($n=10$ for ACU and $n=9$ for min SHAM). There was no significant difference between or within groups as shown by a Student’s t -test ($P>0.05$) despite a visual increase in CBT during both treatments. Standard errors bars are shown for each time point.

FIG. 3. Measurement of uncorrected average blood glucose (GLU) in mmol shown before (Pre-Acu), during (Acu), and after (Post-Acu) real acupuncture (ACU), or minimal sham (min SHAM) treatment in “overweight” adult Chinese males ($n=10$ for ACU and $n=9$ for min SHAM). There was no significant difference between or within the two groups as shown by a Student’s t -test ($P>0.05$) despite a visual decrease in blood GLU during treatments. Standard errors bars are shown for each time point.

after treatment. Patient 054 (GLU values: 5.3; 4.7; 5.6) had a decrease during treatment followed by an increase in GLU. Patient 067 (GLU values: 4.8; 5.2; 4.8) showed an increase only during treatment. Yet, min SHAM patients showed a decrease in GLU during treatment except patient 020 (GLU values: 4.6; 4.7; 4.7), who had a slight increase during treatment. Patients 055 (GLU values: 4.9; 4.6; 6.0) and 068 (GLU values: 5.5; 4.8; 6.2) showed major GLU increases at the end of treatment.

Non-Parametric Test Statistics

The original categorical De Qi data was best analyzed using a Mann-Whitney rank sum test based on an analysis done by Park et al.²⁶ The results indicated that, of the 12 different sensations, only soreness, numbness, and fullness were significant ($P<0.05$, 1-tailed). The remaining sensations were insignificant ($P>0.05$, 1-tailed), compared between ACU and min SHAM De Qi. A two sample Kolmogorov-Smirnov rank sum test was conducted to determine if there were intergroup differences between ACU and min SHAM group De Qi sensations. Only soreness was found to be significantly different ($P<0.05$, 2-tailed) between the two groups (see Fig. 4). For individual De Qi data in the ACU group, there were no reports of warmth, tingling, itching, aching, pressure, or heaviness sensations. For soreness, the highest score was 8.5 and the lowest was 0. For numbness, the highest score was 7 and the lowest was 0. For fullness, the highest was 8 and the lowest was 0. Only 1 patient felt coolness (score of 2). For sharp pain, the highest score was 7 and the lowest was 0. Only 1 patient felt dull pain (score of 2). For sharp pain, the highest score was 7 and the lowest was 0. Only 1 patient felt dull pain (score of 2). For other sensations reported, 1 patient felt pain for 1 minute after needle insertion. However, in the min SHAM group, there were no reported sensations of warmth, dull pain, tingling, itching, aching, and pressure. For soreness, the highest score was 3 and the lowest was 0. For numbness, the highest score was 3 and the lowest was 0. For fullness, the highest score was 4 and the lowest was 0. Only 1 patient reported coolness (score of 4). For sharp pain, the highest score was 4 and the lowest was 0. For heaviness, the

FIG. 4. Averaged major De Qi sensations (soreness, numbness, fullness, coolness, warmth, sharp pain, dull pain, and heaviness) comparison between real acupuncture (ACU) and minimal sham (min SHAM) treatments in “overweight” adult Chinese males ($n=10$ in ACU and $n=9$ min SHAM). Significant intragroup differences were found only between soreness, numbness, and fullness ($P\leq 0.05$; 1-tailed; Mann-Whitney Rank sum test). Only soreness was significant in an intergroup comparison ($P\leq 0.05$; 1-tailed; Kolmogorov-Smirnov Rank Sum test). Standard errors bars are shown for each sensation.

FIG. 5. Averaged hunger sensation comparison between real acupuncture (ACU) and minimal sham (min SHAM) treatments in “overweight” adult Chinese males ($n=10$ in ACU and $n=9$ in min SHAM). Significant intergroup differences were found before (Hunger 1), during (Hunger 2), and after (Hunger 3) treatment ($P \leq 0.05$; 1-tailed; Kruskal-Wallis Rank Sum test). There was no interaction between time and ACU or min SHAM groups. Standard errors bars are shown for each time point.

highest score was 2 and the lowest was 0. For other sensations felt, patients 026, 047, 053, and 055 were sore for 1 second after needle insertion and felt that the needle insertion was painful.

For the ordinal repeated measures hunger data, the Kruskal-Wallis rank sum test was used to determine that there was no significant within-group differences among hunger 1, 2, and 3, and no interaction between time and group ($P > 0.05$). However, the intergroup comparison showed a significant difference between ACU and min SHAM hungers ($P < 0.05$). See Fig. 5. For individual hunger data in the ACU group, most patients had a slight increase or no change during treatment except for patients 017 (HUNGER values: 4.0; 6.0; 7.0), 027 (HUNGER values: 3.5; 9.0; 9.0), 028 (HUNGER values: 5.5; 7.0; 7.5), and 067 (HUNGER values: 3.0; 6.0; 7.0), all of whom showed dramatic increases in hunger values during and after treatment. Patient 018 (HUNGER values: 7.0; 5.0; 6.0) had a steady decrease during and after treatment. However, in the min SHAM hunger group, most patients showed a steady increase or no change in hunger values except patient 020 (HUNGER values: 5.0; 3.0; 1.0) who had a steady decrease in hunger values.

DISCUSSION

The neurophysiological results of this study were rather unexpected. Most of these results were insignificant, although, visually, it could be perceived that GLU decreased during real ACU and min SHAM treatments, and CBT increased during real ACU and min SHAM. Some significance was found in certain De Qi sensations, such as soreness and hunger ($P < 0.05$; Kruskal-Wallis Rank Sum test and Mann-Whitney test, respectively). Based on pre-

vious studies, fasting plasma levels in obese subjects showed that levels of ghrelin, adiponectin, cholecystokinin (CCK), and NPY decreased, while leptin levels increased.^{8,20} Unlike the findings in obese individuals, the current authors suggest that the acupoints chosen caused a release in ghrelin during ACU to stimulate appetite, hence increasing hunger in the study’s “overweight” population. This is different, compared to other studies that showed ACU suppressed appetite by increasing serotonin levels²⁷ and promoted satiety in the HYP.²⁸ The VMH, lateral hypothalamus, and ventral striatal regions are known to regulate glycometabolism,²⁹ while the HYP and brainstem are central nervous system (CNS) centers that affect gastric function.³⁰ Based on Traditional Chinese Medicine (TCM) principles, the combination of ST 36 and SP 9 actually increases the hunger response; hence, this combination would be useful for treating anorexia or patients receiving chemotherapy. ST 36 is supposed to promote satiety, regulate intestinal motility, cause sedation,⁸ and increase excitability of the satiety center in the VMH.³¹ This acupoint has been reported to increase motility in individuals with hypoactive intestines and vice-versa.¹ Stimulation of ST 36 also increases the amplitude and frequency of gastric peristalsis in normal individuals, shortening gastric emptying time and delaying contractions.¹ Therefore, it would have been useful to auscultate the subjects’ stomachs and intestines before, during, and after ACU or min SHAM procedures to verify these findings.

Furthermore, ST 36 and SP 9 were chosen specifically, based on their functions in TCM and acupuncturist recommendations and approvals. However, it was noted by the experienced acupuncturist in the current research group, that for the specific hypotheses hypothesis tested and goals of the study, other acupoints could have been chosen. For GLU metabolism and thermoregulation, acupoints LI 4, LIV 3, GV 3, GV 4, LI 10, and ST 36 bilaterally were recommended. For HYP activation, acupoints GB 34, LIV 3, LI 4, SP 6, and SP 9 bilaterally were suggested. Most importantly, ST 36 and SP 9 are crucial points in obesity and weight loss acupuncture studies as summarized by Cho et al.⁵

Studies have shown that mere electrical stimulation of the VMH caused increased GLU uptake via the sympathetic nervous system in skeletal muscle without increasing plasma insulin concentration.^{32,33} In the current study, ACU stimulation could be correlated to the electrical stimuli by causing GLU to decrease during treatment. This indicates that ACU probably has a central effect on the overall physiology. It is necessary to look at the activations and deactivations in specific brain areas during rest, stimulation, and poststimulation in order to verify this assumption in future studies. ACU treatment in this study had no statistically significant effect on GLU; hence, it may be a time effect only; as hunger increases, GLU decreases then increases. A possible interaction may be occurring, or this

difference probably contributed to hormonal interplay and acupuncture stimulation of the CNS. Thus, if electroacupuncture or prolonged manual ACU treatment had been used for this experiment, this probably would have produced significant physiological results.

Based on the connectivity results (data not shown), it can be assumed that the mode of action for ACU and min SHAM is mediated by the limbic system, specifically, by the neurotransmitter DA. DA is known to increase heart rate and blood pressure,³⁴ hence, it would affect CBT in the subjects. DA also has a role in pain processing,³⁵ which may explain De Qi or other sensations felt during ACU stimulation. With respect to the physiological data, it can be inferred that the reason for the variability in the treatment groups resulted because ACU was tailored to the unique physiology of each individual, despite having a homogeneous experimental population. Choosing appropriate acupuncture controls is difficult in this field of study; hence, the choice of the control method was unique with noteworthy results. Kleinhenz et al.²⁵ used the Streitberger needle method, which mimics needle penetration in ACU but does not fully penetrate all of the skin layers. The current study combined this method with the standard sham placebo acupuncture protocol. Surprisingly, all subjects believed that they received real acupuncture based on their descriptions of De Qi and their perceptions of the experimental design.

Limitations in most acupuncture studies involve obtaining individuals that meet the inclusion criteria and building an adequate sample size. A large group size is needed to do a power analysis in multiple sessions to capture the activation and deactivation patterns evoked by acupuncture stimulation at particular acupoints. Although the current study's subject number size was considered to be small, there are numerous studies^{36–40} in this field that have had valid results with ≤ 20 total subjects. Most importantly, using single-gender subjects is also widely accepted in the literature⁴¹ to avoid gender differences and to enhance subject homogeneity, particularly in functional imaging studies. Therefore, the emphasis should be on the fMRI aspect and findings in this study. To obtain repeatable and valid results with the fewest confounding factors, a representative homogeneous male population in a specific age bracket (young adults only) was chosen. Choosing women in that age group would have confounded the results with hormonal interplay and variability. The current researchers plan to include females in a future larger study. Other confounding factors included De Qi mixed with pain, artifactual activation, appropriate controls, patient anxiety, and anticipation of pain or discomfort from acupuncture treatment. Hui et al.⁴² described this in their study regarding the influence of patient sensations on fMRI blood oxygen level–dependant (BOLD) signal changes. In this particular study, it was difficult to obtain an ideal overweight population. In the Sichuan Province (China), the BMI of the subjects was much lower than

in other countries or regions, but the subjects had a higher WHR (>0.9), which led the current research team to classify the subjects as being “overweight” or “unfit” in principle. Most importantly, a 2007 epidemiological survey conducted in the Sichuan Province for people above age 18 classified these individuals as overweight at a lower BMI and, thus, supported the selection of the BMI range in this pilot study (>18 to <30 BMI).⁴³ This could be a result of dietary (hot, spicy food) and lifestyle (genetic hypertension and smoking) factors.⁴³

CONCLUSIONS

In summary, individual differences in response to acupuncture should be taken into account as seen by the variable results in a representative study population. More subjects are needed to verify these pilot study results, as well as implementing a different experimental design in future studies. This includes using different acupoints and sham points as well as electroacupuncture for comparison. Most importantly, our use of the control method was effective for future experiments, because all patients in the current study believed that they were receiving verum acupuncture based on their De Qi and experimental setup interpretation.

ACKNOWLEDGMENTS

The authors would like to thank Qiyong Gong, MD, PhD, and the research staff at the West China Hospital for their assistance in carrying out the experiment and data collection. This research is supported by the National 111 Base Program for Introducing Talents of Discipline to Universities; Project for the National Key Basic Research and Development Program (973) under Grant Numbers 2011CB707700, 2011CB707702, and 2006CB705700; Changjiang Scholars and Innovative Research Team in University (PCSIRT) under Grant Number IRT0645; CAS Hundred Talents Program; CAS Scientific Research Equipment Develop Program (YZ0642, YZ200766); the Knowledge Innovation Program of the Chinese Academy of Sciences under Grant Number KGCX2-YW-129; 863 under Grant Number 2008AA01Z411; Fundamental Research Funds for the Central Universities; and National Natural Science Foundation of China under Grant Numbers 30873462, 31150110171, 30870685, 30873462, 81000640, 81000641, 81071217, 81071137, 31028010, 60532050, 90209008, 30970774, and 60901064.

DISCLOSURE STATEMENT

No competing financial interests exist.

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