

ORIGINAL ARTICLE

PHYSIOLOGICAL AND SUBJECTIVE EFFECTS OF THE FEET ACUPRESSURE IN ADULT WOMEN

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Abstract Objectives: We evaluated the effects of acupressure at two meridian points (KI1 and KI3). Methods: Subjects (11 adult women) were tested twice on different days, once after acupressure and once after bed rest alone. Outcomes were measured by evaluating objective indices (blood pressure, pulse rate, and skin surface temperature, deep temperature, and blood flow volume in the feet) and subjective indices (comfort and warmth or cold sensations in the feet), and the temporal changes after intervention were analyzed. Results: There were significant temporal changes in pulse rate, skin surface and deep skin temperatures, blood flow volume, and scores of foot comfort and warmth after acupressure, whereas there were no significant differences after bed rest alone. There were no significant changes in blood pressure after either treatment. Conclusion: Acupressure at these two points is a safe and effective method to warm up the feet.

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Key words: acupressure; skin temperature; blood flow volume; comfort sensation; thermal sensation.

1. Introduction

The need for integrated medicine combining complementary and alternative medicine (CAM) with Western medicine is increasing; such integrated systems are holistic and can improve quality of life. The role of nursing in CAM is to build an approach based on knowledge of Western medicine and nursing science and to harness CAM skills to increase the kinds of intervention available and heighten nursing effectiveness¹⁾. Although the need for CAM is increasing, some of the methods have ambiguous mechanisms of action or insufficient scientific evidence. These methods should therefore not be accepted uncritically but should be applied on a scientific basis as “evidence-based CAM.”

Acupressure is one type of CAM. Acupressure has been performed for many years; its therapeutic effect occurs through pressure on the

meridian points along meridian lines²⁾. In recent years acupressure has been used in nursing. For example, there have been studies of its use for improving constipation³⁾, mitigating the side effects of cancer chemotherapy⁴⁾, mitigating lymphedema after lymphadenectomy⁵⁾, influencing delivery time and alleviating labor pain⁶⁾. However, although acupressure is used for relief and relaxation in a number of unpleasant conditions, there has been insufficient verification of its effects. There are 361 meridian points in the body⁷⁾. Here, we studied those points that are stimulated in acupressure for treatment of cold intolerance; previous research has shown that more than half of Japanese women are sensitive to the cold⁸⁾.

The purpose of this research was to clarify the physical and subjective effects of using acupressure at two meridian points, *Yongquan* (KI1) and *Taixi* (KI3), that affect cold sensitivity.

Table 1. Measurement protocols

	physiological indices					subjective indices	
	blood pressure	pulse rate	skin surface temperature	deep skin temperature	blood flow volume	comfort sensation	thermal sensation
prepare	<ul style="list-style-type: none"> • Admission to laboratory • Change into hospital gown • Attachment of probes and bed rest for about 20 min 						
before intervention	○	○	○	○	○	○	○
intervention (for 5 minutes)	<ul style="list-style-type: none"> • Either acupressure at points KI1 and KI3 or bed rest alone 						
after intervention							
right after	○	○	○	○	○		
5 min		○	○	○	○		
10 min		○	○	○	○		
15 min		○	○	○	○		
20 min		○	○	○	○		
25 min		○	○	○	○		
30 min	○	○	○	○	○	○	○

“○” indicates that the parameter was measured at the point indicated.

2. Methods

2.1. Human subjects

The subjects were 11 adult female volunteers aged 21 to 34 years; mean \pm SD: 25.3 \pm 4.3). They were in good general health and had regular menstrual cycles.

2.2. Procedure

The study was performed from March to June 2010 in a university laboratory in which the temperature and humidity were maintained within fixed limits (room temperature, 25 to 26 degrees; humidity, 50% to 60%).

All 11 subjects were tested twice, on different days in random order. We compared the data from patients when they received acupressure with the data from the same patients when they did not receive it. To take into account diurnal changes in body temperature, all experiments were performed within the time range 13:00 to 17:00. All assessments were made during the low-temperature part of the menstrual cycle. Subjects were advised not to take much alcohol

on the day before the experiment and to make sure that they had had sufficient sleep the night before; they were also advised not to wear tight underwear on the day of the experiment and to avoid intense exercise.

The measurement protocol is shown in Table 1. Outcomes were measured according to objective indices (blood pressure, pulse rate, skin surface and deep temperatures, and blood flow volume) and subjective indices (feelings of comfort and warmth or cold in the feet). Over the period from before intervention to 30 min after, blood pressure was measured three times and the other physiological indices were measured eight times. Subjective indices were measured twice, before intervention and 30 min after acupressure. “Intervention” consisted of either 5 min of acupressure at the two points, or bed rest only, with no acupressure.

2.3. Method of acupressure

To standardized the acupressure technique only one researcher was used.

The two points, *Yongquan* (KI1) and *Taixi* (KI3), were chosen as stipulated by

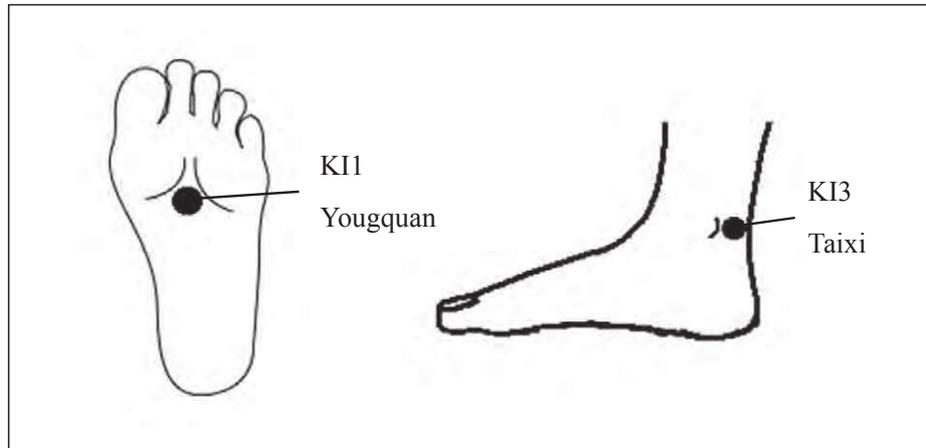


Figure 1 Positions of acupressure points

WHO/WPAO⁷⁾ (Figure 1). The intensity of acupressure was about 5 kg at KI1 and about 3 kg at KI3. Acupressure was performed for a total of 5 min at both points on both feet, at 10 s per stimulus.

2.4. Outcome measures

2.4.1. Physiological indices

Blood pressure was measured in the left arm with an electronic tonometer (ES-H55: TERUMO Corp.).

Pulse rate was measured in the index finger with a pulse transducer (MLT1010: ADInstruments Corp.) attached to the index finger of the right hand.

Skin surface temperature and deep skin temperature were measured on both soles with a temperature monitor (CoreTemp CTM205/210: TERUMO Corp.).

Blood flow volume was measured with a laser blood flow meter (ALF21RD: ADVANCE Corp.) by using probes attached to the central parts of both great toes.

Pulse rate and blood flow volume were analyzed by computing the average value for 1 min from the data recorded by the data acquisition system (ML870 PowerLab 8/30: ADInstruments Corp.).

Table 2. Subjective indices

	score
comfort sensation	
very comfortable	+2
slightly comfortable	+1
neutral	0
slightly uncomfortable	-1
uncomfortable	-2
thermal sensation	
very warm	+2
slightly warm	+1
neutral	0
slightly cold	-1
very cold	-2

2.4.2. Subjective indices

Outcome measures for subjective indices were the subjective feeling of comfort and the sensation of warmth in the feet.

For these two indices we used our own Likert scale graded into five levels (Table 2). Replies on these scales were scored -2 to +2 for analysis.

2.5. Data analysis

SPSS Statistics 17.0 (SPSS Japan) was used for the analysis. Normality was evaluated by the Shapiro-Wilk test. Temporal changes after acupuncture or bed rest alone were analyzed

Table 3. Changes of blood pressure

	systolic blood pressure				diastolic blood pressure			
	before	right after	30 min after	p-value ^a	before	right after	30 min after	p-value ^a
Acupressure	102.4 ± 9.7	100.4 ± 6.6	101.0 ± 7.3	n.s.	60.5 ± 6.4	61.8 ± 7.0	60.9 ± 6.1	n.s.
Bed rest only	104.1 ± 8.3	101.2 ± 7.5	101.3 ± 6.8	n.s.	61.4 ± 7.7	61.4 ± 6.6	61.6 ± 6.1	n.s.

^a multiple comparisons by Bonferroni method

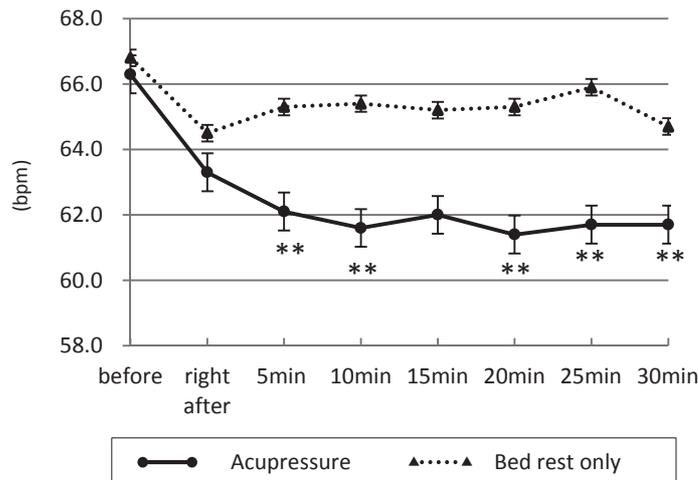


Figure 2 Temporal changes in pulse rate
 ** $p < 0.01$ vs "before" by multiple comparisons by Bonferroni method

in each subject. A paired *t*-test was used to compare temporal changes in the physiological indices, and the data were analyzed by using the significance level corrected by the Bonferroni inequality. A Wilcoxon signed rank test was used to compare the subjective indices. The significance level was set at 0.05 or 0.01.

2.6. Ethical considerations

The study was approved by the ethics committee of Hirosaki University Graduate School of Medicine, and informed consent was obtained from all subjects.

3. Results

3.1. Physiological indices

3.1.1. Blood pressure

There were no significant temporal changes

in systolic blood pressure and diastolic blood pressure between the acupressure and bed rest treatments (Table 3).

3.1.2. Pulse rate

There were no significant temporal changes in pulse rate after bed rest alone (Figure 2). However, the pulse rate 10, 15, 20, 25, and 30 min after acupressure fell significantly compared with before acupressure.

3.1.3. Skin surface temperature of both soles

Skin surface temperature at 20, 25, and 30 min on the right side and 25 and 30 min on the left side was significantly greater after acupressure than before acupressure (Figure 3A). There were no significant differences with bed rest alone. Thirty minutes after the end of acupressure, the foot temperature had risen by

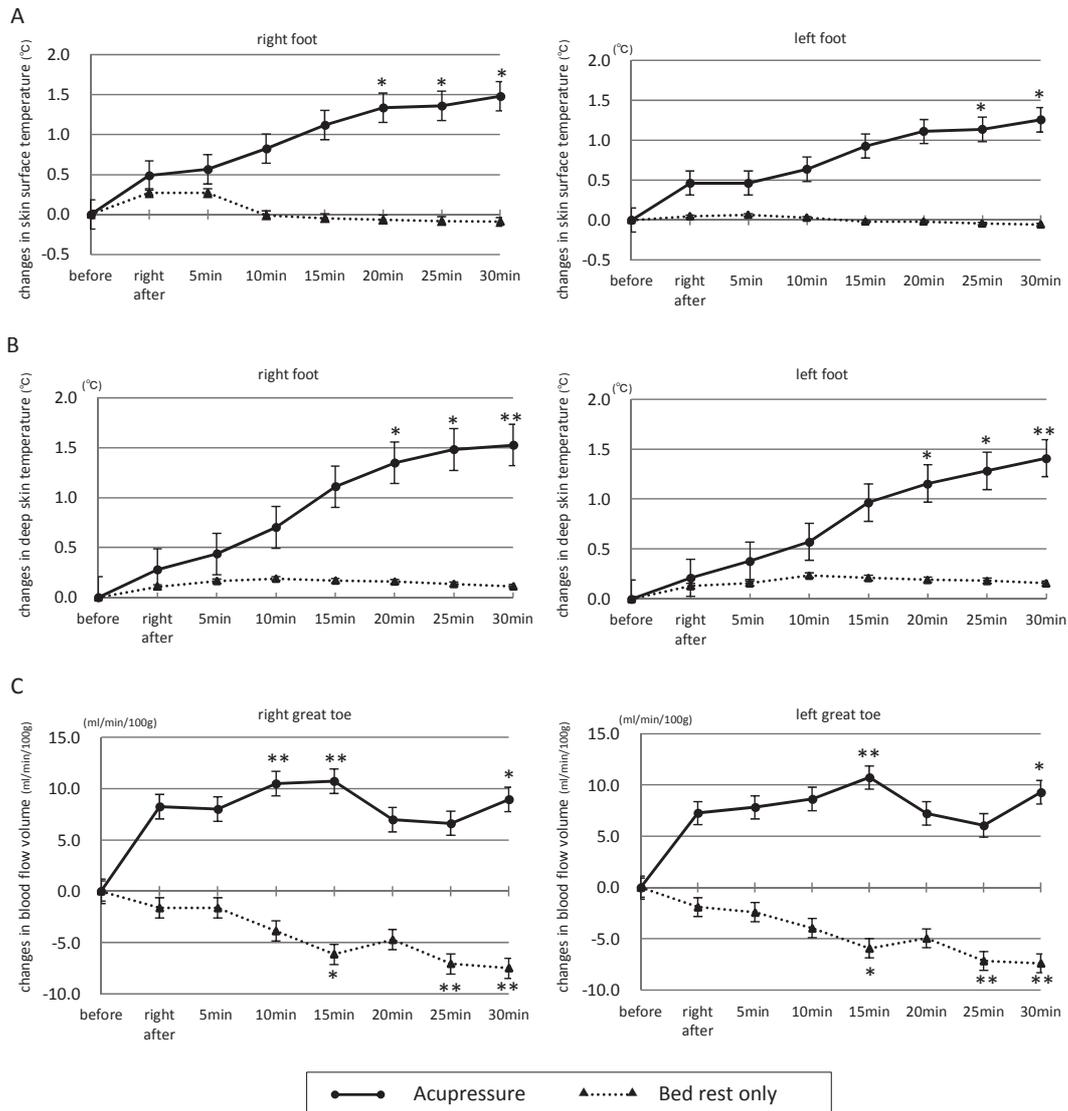


Figure 3 Temporal changes in skin surface temperature, deep skin temperature, and blood flow volume *p<0.05, ** p<0.01 vs “before” by multiple comparisons by Bonferroni method

Table 4. Changes in subjective indices

	comfort sensation			thermal sensation		
	before	30min after	p-value ^a	before	30min after	p-value ^a
Acupressure	0.3	1.4	p<0.05	-0.3	0.9	p<0.05
Bed rest only	0.2	0.4	n.s.	0.1	0.2	n.s.

^a Wilcoxon signed ranks test

1.3 to 1.5 degrees.

3.1.4. Deep skin temperature

Deep skin temperature showed changes similar to those of skin surface temperature

(Figure 3B). At 20, 25, and 30 min after the end of acupressure it was significantly greater than before. At 30 min after acupressure, the foot temperature had risen by 1.4 to 1.5 degrees. There were no significant changes with bed

rest alone.

3.1.5. Blood flow volume

Blood flow volume increased after acupressure; there were significant increases on the right side 10, 15, and 30 min after acupressure and on the left side at 15 and 20 min. In contrast, with bed rest alone, the blood flow volume had decreased significantly by 15, 25, and 30 min (Figure 3C).

3.2. Subjective indices

3.2.1. Comfort sensation

The comfort score 30 min after the end of acupressure was significantly greater than before acupressure; there were no changes with bed rest alone (Table 4).

3.2.2. Thermal sensation

The thermal sensation score was significantly greater after acupressure than before; there were no changes with bed rest alone (Table 4).

4. Discussion

4.1. Physiological effects of acupressure

With both acupressure and bed rest, pulse rate decreased right after intervention. In patients with bed rest alone, the decrease may have been due to the effect of lying down. Significant reductions in pulse rate occurred 5 to 30 min after the end of acupressure. This was likely because, in addition to the state of quietness, parasympathetic nervous system stimulation would have predominated as a result of the acupressure.

However, our results did not include a clear demonstration of the autonomic nerve activity that occurs under acupressure. Sugawara⁹⁾ investigated autonomic nervous system activity and electroencephalogram tracings during acupressure of the sole of the foot; it showed that pulse wave transmission time increased and heart rate decreased during acupressure

and that these changes were due to relaxation. Our results support these findings.

The skin surface and deep skin temperatures of both feet rose significantly after acupressure but not after bed rest alone. Moreover, blood flow volume in both great toes increased significantly after acupressure. The significant rise in temperature of the foot was likely brought about by the increase in blood flow volume resulting from acupressure stimulation.

The effects of acupressure can be explained by two mechanisms. One is the effect on the nervous system, and the other is a direct action on the circulatory system, including the blood and lymph vessels¹⁰⁾. The skin venous plexus and arteriovenous anastomosis play a role in the regulation of body temperature¹¹⁾. Sympathetic nerve activity falls with rising body temperature; the arteriovenous anastomosis then relaxes and arterial blood flows rapidly into the venous plexus, thus increasing the cutaneous blood flow volume. Skin stimulation from the acupressure brings physical and mental relaxation through spinal reflex action or the action of the autonomic nervous system, and blood flow increases through the promotion of blood and lymph mobility; this mechanism would therefore have led to the rise in skin surface temperature and deep skin temperature in the feet.

Although local blood flow was promoted by acupressure, significant temporal changes in blood pressure were not seen with either acupressure or bed rest alone. This result suggests that acupressure does not affect the dynamic state of circulation in the whole body. Serizawa¹²⁾ also states that massage of the extremities of the body, such as the upper limbs and legs, places no burden on the heart, although it promotes local circulation.

4.2. Subjective effects of acupressure

The scores on the two subjective scales increased only when the subjects received

acupressure. The skin surface and deep skin temperatures had risen by about 1.3 to 1.5 degrees by 30 min after the end of acupressure, and this rise was enough to cause a sensation of increased warmth in the foot. Comfort scores were also increased by acupressure, even though the acupressure was given on only two points and for only 5 min. This effect may have been due not only to the technique of acupressure but also to the warming of the foot.

4.3. Usefulness of acupressure for cold sensitivity

Our data showed that the acupressure had both physiological and subjective beneficial effects. Simple acupressure at the two meridian points was effective in combating foot coldness and easing cold-associated discomfort.

4.4. Limits of this research, and future agenda

There were three limitations to this research. First was the verification of the temporal duration of the effect of acupressure. We collected data for 30 min after the intervention, but the temperature and blood flow volume were still changing at 30 min, and it is unknown for how long this state would have continued.

Second is the verification of autonomic nerve activity. We considered that parasympathetic nervous system activity predominated after the acupressure, but an analysis of autonomic nerve activity was beyond the range of this research. To elucidate this activity we would need to use other measurement methods, such as analysis of changes in cardiac beat.

The final limitation was the influence of sleep. Despite being cautioned, some subjects—especially when they had received acupressure—slept during the data gathering. This may have been a natural reaction, because acupressure at KII promotes sleep, but it may still have influenced the results.

The effects of acupressure have still not been sufficiently verified; there is still a need to

verify its safety and efficacy on a demonstrated scientific basis and to then apply it in nursing practice.

Conclusion

Acupressure at points KII and KI3 led to an increase in blood flow volume and a rise in foot temperature. The increased temperature was sufficient to cause an increase in the subjective sensation of warmth. The pulse rate decreased, and the increase in the feeling of comfort was accompanied by a relaxation effect. Because there was no change in blood pressure, we considered that the acupressure did not affect the dynamic state of circulation throughout the body. However, acupressure on the two meridian points was safe and effective to warm up the feet.

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Conflict of interest statement

None.

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