

# THE EFFECT OF EARTHING ON HUMAN PHYSIOLOGY PART 2: ELECTRODERMAL MEASUREMENTS

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## ABSTRACT

The human body evolved while living in direct electrical contact (electrically grounded) with the earth. The question that arises is: Does loss of electrical contact with the earth affect human physiology? This double-blind study was designed to address this question by measuring several electrophysiological parameters of the body. Subjects were assigned to an experimental group that was grounded to the earth after a 28-minute baseline recording. Grounding the body (earthing) was achieved by placing electrode patches on the soles of the feet and connecting them to a conductive cable that was attached to a metal rod planted in the earth. The total recording time was 56 minutes. The control group was not grounded but "sham grounded." Part 1 of this study presented results from measurements taken with clinical biofeedback equipment. This paper presents results obtained on Jing-Well points using the SSVP (Single Square Voltage Pulse) method. With the SSVP method we were able to corroborate results presented in our first paper with the biofeedback system. The SSVP method results are that grounding the body produces a reduction in tension (relaxation) of the internal organs and a reduction in inflammation. We also postulated that the body was developed to take advantage of the contact with the earth through the feet by developing a system of distribution of electrons through the kidney meridian at K11. The present findings are consistent with the results of our previous study which concluded that grounded subjects experienced a reduction in stress and a normalization of the functioning of the autonomic nervous system after earthing.<sup>6</sup>

**KEYWORDS:** Acupuncture, meridians, Single Square Voltage Pulse method, SSVP, grounding, earthing, electrophysiology, acupuncture points.

## INTRODUCTION

### BACKGROUND

In recent times, and in most developed countries, humans live almost 100% of the time electrically insulated from contact with the earth. This insulation is principally due to 1) modern buildings and homes made from wood and other insulating materials, 2) the modern-day use of insulated footwear and 3) the low conductivity of the atmosphere. This has not been how the human body evolved over millions of years. So a question arises as to whether this lack of contact with the earth may pose a health risk.

It is well established that the Earth maintains a negative electrical potential on its surface.<sup>1-2</sup> When the human body is insulated from the earth, its electrical potential becomes more positive because of the progressively higher electrical potential existing above the ground. This electrical potential, which is around 200,000 Volts between the ground and the clouds in clear weather, can be millions of Volts during thunderstorms, causing electrical discharges (lightning).

In this paper, we use the term "earthing" to mean connecting a person to the ground with a wire and conductive patches. This is to differentiate this process from "grounding" to protect the body from high electrical voltages as it is done in the electrical power industry and the electrostatic discharge industry, for example.

When earthed, the earth's electrons are

conducted into the human body, maintaining the body at the same electrical potential as the earth.<sup>3,4</sup> This has been the natural bioelectrical environment of the human body during its evolution. There is mounting evidence that earthing has important benefits for human health. For example a report by Ghaly and Teplitz has shown that earthing the human body during sleep normalized circadian secretion levels of cortisol (the stress hormone), reduced pain and inflammation and improved sleep.<sup>5</sup> In a previous double-blind study, we documented the effects of earthing on 58 subjects using standard biofeedback equipment.<sup>6</sup> The observed physiological changes indicated a reduction in overall stress, and a normalization of the functioning of the autonomic nervous system. Good review articles on the subject of earthing have been published by Oschman.<sup>7,8</sup>

### PURPOSE

The present report is the second and last paper on a double-blind study about earthing conducted at the California Institute for Human Science (Encinitas, California) in 2003. The first paper reported results of electrophysiological measures obtained from a commercially available biofeedback system.<sup>6</sup> For the present report we analyzed data that was collected in the same double-blind study by the SSVP (Single Square Voltage Pulse) method using the AMI (Apparatus for Meridian Identification, to be described later). We looked for statistically significant differences in the recordings of each of the three parameters measured by this instru-

ment (termed BP, AP, and IQ) before and after earthing. We also compared earthed subjects with controls.

## HYPOTHESES

From our previous study, we developed the overall hypothesis that earthing relaxes the body and normalizes the autonomic nervous system functions. The present study also evaluates some of the anti-inflammatory aspects of earthing. The specific hypotheses we tested with the AMI are:

HO: There will be no difference before and after measurements of BP, AP, or IQ.

H1: There will be a statistically significant difference ( $p < 0.05$ ) in earthed subjects' mean BP values when comparing a 14-minute recording taken immediately before earthing with a 14-minute recording taken immediately after earthing.

H2: There will be a statistically significant difference ( $p < 0.05$ ) in mean BP values when comparing a 14-minute recording taken immediately after subjects were earthed with a 14-minute recording taken immediately after controls were "sham earthed".

H3: There will be a statistically significant difference ( $p < 0.05$ ) in earthed subjects' mean AP values when comparing a 14-minute recording taken immediately before earthing with a 14-minute recording taken immediately after earthing.

H4: There will be a statistically significant difference ( $p < 0.05$ ) in mean AP values when comparing a 14-minute recording

taken immediately after subjects were earthed with a 14-minute recording taken immediately after controls were "sham earthed".

H5: There will be a statistically significant difference ( $p < 0.05$ ) in earthed subjects' mean IQ values when comparing a 14-minute recording taken immediately before earthing with a 14-minute recording taken immediately after earthing.

H6: There will be a statistically significant difference ( $p < 0.05$ ) in mean IQ values when comparing a 14-minute recording taken immediately after subjects were earthed with a 14-minute recording taken immediately after controls were "sham earthed".

## MATERIALS & METHODS

### SUBJECTS

**S**ubject s' exclusion criteria during screening included the following: below the age of 18 or above 75; pregnancy; taking pain or anti-inflammatory medication, sedatives or prescription sleeping medication less than 5 days prior to testing; taking psychotropic drugs or diagnosed with mental disorder; recent surgery (less than 1 year); documented life threatening disease (such as cancer, AIDS, etc.); consumption of alcohol within 48 hours of participation; use of recreational drugs. The health status of prospective subjects was ascertained using a standard medical questionnaire (Past Medical Inventory or

PMI).<sup>6</sup> Informed consent was obtained for selected subjects prior to their participation.

Of 65 subjects selected and tested, 58 (30 controls and 28 earthed subjects) had data sets complete enough to be used in this double-blind study. Twenty-two earthed subjects had data sets suitable for the statistical analyses presented in this paper. Basic information on subjects is summarized in Table 1.

Subjects:	Females	Males	Total	Mean Age	SD
Earthed	19	9	28	51.12	12.46
Controls	21	9	30	49.69	12.43
Total	40	18	58		
Mean Age	50.89	49.18			
SD	12.66	11.92			

Table 1. Basic information on subjects

The ratio of female to male subjects was F/M = 2.22. The mean age and standard deviation for each gender were similar, and the mean age and standard deviation were also similar between the earthed (experimental) and the "sham earthed" (control) subjects. The 22 earthed subjects with suitable data for the statistical analyses presented in this paper had very similar age and gender distributions as well as similar means and standard deviations.

## EQUIPMENT

### Measuring Instrument

The measuring instrument utilized for this project was the Continuous AMI (CAMI).

Parameters measured included:

- a) BP (Before Polarization, a measure of meridian electrical conductivity)
- b) AP (After Polarization, a measure of autonomic nervous system function)
- c) IQ (Integral Q = electrical charge, a measure of immune activity)

The principle of functioning of the AMI and the parameters it measures have been described in detail elsewhere.<sup>7</sup> The CAMI is an AMI with the measuring stylus replaced by an electronic switching device having 28 cables connecting it to each of the 28 Jing-well points normally used with the AMI. This setup allows the CAMI to acquire data in a quasi-continuous manner in that data are acquired every second for 1 millisecond moving continuously from one Jing-well point to the next in the same sequential order normally used by the AMI.<sup>9,10</sup> Once data on a series of 28 Jing-well points (or acupoints) are acquired, the system goes back to the first acupoint and starts measuring the same sequence of 28 acupoints again. The experimenter has the ability to determine how many series of 28 acupoints are to be measured before the CAMI stops. A period of 14 minutes of data acquisition time is necessary to get good statistics for each acupoint (30 measurements for each of the 28 acupoints). It takes 28 seconds to complete one series of measurements on the 28 acupoints. For good statistics we wanted to have 30 measurements for every acupoint: 30 series of measurements x 28 seconds/series = 840 seconds or 14 minutes.

### Earthing System

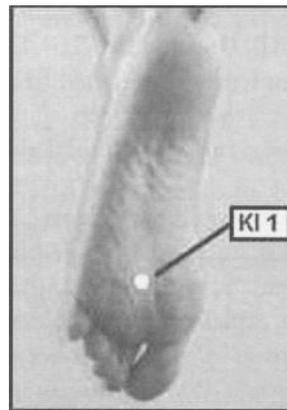
The earthing system used in this study consisted of two EKG (electrocardiograph) type adhesive electrode patches, one placed on the sole of each foot. The patches were big enough to cover completely the kidney acupoint (KI1, Figure 1) and a region of at least 1 inch around it.<sup>11</sup> A standard electrostatic discharge type ground system was snap attached to the electrode patches.

The earthing system consisted of a 50 foot long (15.24m) ground cord containing a snap attachment on one end to fasten to the electrode patches and the other end was attached to a 12-inch (30.48cm) stainless steel rod (diameter 0.25 inch or 0.635cm) planted in the earth outdoors. There was a switching box in between both ends of the grounding cord to cut or establish the connection with the earth. This box was necessary to implement the research design (see the Earthing Intervention section). The ground cord contained a UL approved 10 milliamp fuse. Details of the earthing system are presented in Figure 2.

The purpose of using this type earthing system for this study was to replicate a person standing barefoot directly on the earth while residing in a controlled environment as described in the next paragraph.

There was a concern that the ground wire could act as an antenna for electric fields, particularly when the lead was disconnected from the earth during control periods. There were also concerns that the electric wiring in the walls of the lab could induce electric fields on and in the body. To avoid

Figure 1. Location of KI1 acupoint.



these problems, care was taken to choose a room with modern well-grounded electrical outlets (all wiring was clad in grounded electrical conduits). Absence of electric field-induced body voltages, such as from the 60 Hz wiring, was confirmed by using a voltmeter with a separate dedicated ground system (a rod driven into the earth, identical to the body earthing system used in the experiment). The voltmeter had a large (approximately 1/2 inch diameter) metal contact attached to the ungrounded terminal. Subjects were asked to place their thumb on this contact to measure induced body voltage with respect to the earth. The meter had an accuracy of about 0.3% and readings on the body were typically less than 5 mV. Thus the subjects, patches, and wires did not have appreciable induced body voltages that could interfere with the AMI measurements.

### PROCEDURES & PROTOCOL

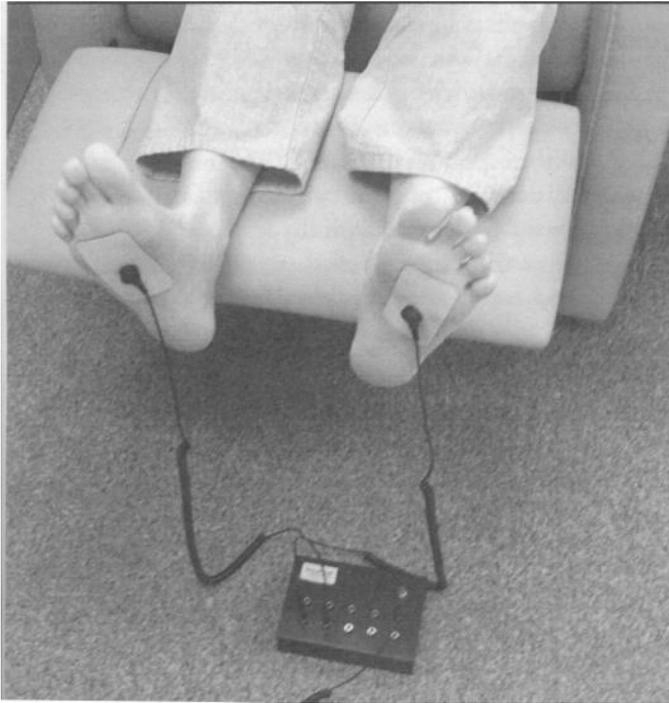
The protocol and informed consent form used in this study were approved by the Biomedical Research Institute of America,

an independent Institutional Review Board (IRB) located in San Diego, California. Consent was obtained from all subjects after they were informed of the nature of the study and its potential risks.

#### Earthing Intervention

This study was double-blind in that experimenters, assistants (with one exception to be explained below) and subjects did not know in which group each subject was placed. Prior to measurement, each subject (subjects were tested one at a time) was seated in a comfortable reclining chair and a conductive adhesive patch was placed on the sole of each foot on top of the MI acupoint (Figure 2). Patches were connected to a conductive cord that was attached to a dedicated ground rod driven into the earth outdoors. An inline switching box placed about 4 feet from subjects completed or had no effect on the completion of the earthing connection for

experimental and control subjects, respectively. The fuse in the ground cord was replaced by a similarly-shaped plastic object for control subjects. Hence flipping the on/off switch on the switching box did not complete the earthing connection for the control group ("sham earthing"). This procedure prevented the subjects, the experimenters and the assistants helping in the lab to know in which group each subject was placed. At the moment of earthing (28 minutes after the beginning of the recording period which lasted for a total of 56 minutes) the experimental group experienced the active earthed/grounded device and the control group the inactive device ("sham earthing"). Experimental vs. control subjects were randomly selected by an assistant before subject's arrival. This assistant was the only person knowing into which group each subject was placed and he was in charge of secretly changing the fuse before the arrival of each subject. This



*Figure 2. Earthing system including patches (1.75" x 3.75" each or 4.45cm x 9.53cm) placed at the bottom of each foot, inline switching box with an on/off switch and 50 feet (15.24m) cord (bottom of the picture) going out to a 12-inch (30.48cm) rod planted in the earth outdoors. The switching box splits the earthing cable into two or more connections which can be snapped to multiple patches.*



assistant was not allowed to be in contact with subjects and could not come in the testing lab until the subject had left. An experimenter (Mori) was in charge of flipping the switch at the appropriate time regardless of the subject's assigned group. Records of each subject's group assignment were kept by the assistant at a secret location and remained confidential until all data were obtained. Each subject's assigned group was revealed to the researchers only at the time of analysis.

**Measurement Protocol**

The testing protocol included 5 phases: Buffering, Baseline 1 (B1), Baseline 2 (B2), Intervention 1 (I1) and Intervention 2 (I2). Each phase lasted 14 minutes, except for the Buffering phase which varied depending on the time needed to prepare each subject.

The Buffering phase was a resting, pre-baseline preparation period (electrodes placement, no monitoring). B1 and B2 were periods with monitoring, however subjects were not earthed nor "sham earthed." I1 and I2 were periods with monitoring after earthing or "sham earthing," depending on the subject's group. At the beginning of I1, the experimenter flipped the switch which resulted in experimental subjects being earthed and control subjects being "sham earthed," as explained

previously. Table 2 illustrates the sequence of phases.

A total of sixty-five (65) subjects were measured. Sixty-two were measured within a 14-day period and three had to be rescheduled a few weeks later. Each subject's participation lasted approximately 1 hour and 10 minutes.

**DATA ANALYSIS**

Each subject was recorded for a total of 56 minutes. The data sets for statistical comparisons of pre- and post- earthing (or pre- and post "sham earthing") were taken from the last 14-minute period before earthing (B2) and the first 14-minute period after earthing (**I1**), respectively. The data sets for statistical comparisons between earthed (experimental) subjects and control ("sham earthed") subjects after earthing were taken from the first 14-minute period after earthing or "sham earthing" (I1) for experimental subjects and controls, respectively. Thirty (30) data sets for controls and twenty-two (22) data sets for experimental subjects were suitable for the statistical analyses performed for this paper.

Statistical tests used in this study included Student's t-test of differences between means, F-test of differences between variances and Chi Square for frequency testing.

*Table 2. Sequence of phases*

<b>Time</b>	Variable	14 minutes	14 minutes	14 minutes	14 minutes
<b>Phase Name</b>	Buffering	Baseline 1 (B1)	Baseline 2 (B2)	Intervention 1 (I1)	Intervention 2 (I2)
<b>CAM</b>	Preparation	Monitoring	Monitoring	Monitoring	Monitoring
Earthing period starts					

## RESULTS

### BEFORE POLARIZATION (BP) PARAMETER

As explained elsewhere in greater details, the BP parameter is a high frequency current measurement and is consequently the equivalent to measuring the pure electrical resistance (or conductivity) between the measured acupoint and the ground electrode located on the wrist. considered the parameter of electrical

The inventor of the AMI (Motoyama) claims that the high-frequency path between the acupoint and the ground electrode is along the corresponding meridian, as described in classical texts of Traditional Chinese Medicine (TCM), and thus BP is

conductivity of the meridian.<sup>1,12</sup> Major factors contributing to the value of this parameter are: 1) the water content along the path of the measured meridian (i.e. inflammation increases the value of BP while dehydrated subjects show low BP values) and 2) the health condition of the corresponding internal organ (the more energetic or healthy the organ, the higher the BP value, on the condition that there is no inflammation).

First, we compared the mean BP values (mean of 22 values for experimental subjects and 30 values for the control group, for each entry in Table 3) for the last 14-minute period before earthing (B2) with the mean<sup>9,10,12</sup>

Table 3. Summary of t-test results for mean BP values per meridian

Meridian	B1 E (PA)	C (PA)	B2 E (pA)	C (PA)	11 E (pA)	C (pA)	12 E (PA)	C (NA)	B21 E (pA)	t-test p-level	11.11 E-C (PA)	t-test p-level	B21 C (pA)	t-test p-Level	5% Level (pA)	1% Level (pA)
L LU	2224	2267	2291	2357	1818	2390	1826	2424	473	am	-34	ns	-33	ns	204	306
L LI	1793	1743	1819	1817	1433	1847	1438	1872	386	0.01	-25	ns	-30	ns	154	231
L HC	1768	1747	1793	1815	1413	1839	1418	1858	380	0.01	-19	is	-24	ns	140	210
L DI	1821	1788	1841	1851	1450	1869	1452	1883	391	0.01	-14	is	-18	ns	156	234
L TH	1744	1719	1760	1768	1382	1783	1384	1794	378	0.01	-11	ns	-15	is	146	219
L HT	1793	1767	1808	1821	1420	1836	1422	1850	388	0.01	-14	is	-15	ns	147	220.5
L SI	1742	1711	1752	1753	1371	1761	1373	1771	381	0.01	-10	ns	-8	is	147	220.5
R LU	2214	2203	2256	2319	1775	2352	1785	2387	481	0.01	-35	ns	-33	ns	192	288
R LI	1765	1753	1808	1839	1415	1862	1422	1890	393	0.01	-28	ns	-23	ns	160	240
R HC	1671	1667	1717	1743	1344	1769	1355	1800	373	0.01	-31	is	-26	ns	150	225
R DI	1795	1734	1830	1809	1433	1832	1436	1859	397	0.01	-27	ns	-23	ns	147	220.5
R TH	1715	1686	1738	1757	1351	1781	1351	1803	387	0.01	-22	ns	-24	os	144	216
R HT	1815	1731	1841	1797	1433	1815	1437	1834	408	0.01	-19	as	-18	is	151	226.5
R SI	1686	1646	1702	1713	1314	1727	1318	1746	388	0.01	-19	ns	-14	ns	141	211.5
L SP	1916	1986	1943	2035	827	2013	827	2018	1116	0.01	-5	ns	22	ns	150	225
L LV	1671	1660	1715	1743	1344	1769	1355	1800	371	0.01	-31			ns	150	225
L ST	1681	1709	1706	1750	700	1725	699	1733	1006	0.01	-8	is	25	ns	141	211.5
L SB	1772	1784	1800	1629	749	1806	749	1816	1051	0.01	-10	rt5	23	ns	144	216
L GB	1724	1801	1745	1846	717	1825	715	1634	1028	0.01	-9	ns	21	ns	136	204
L KI	1785	1826	1805	1867	742	1842	739	1849	1063	0.01	-7	ns	25	ns	151	226.5
L UB	1574	1672	1593	1711	634	1685	636	1692	959	0.01	-7	ns	26	is	156	234
R SP	1983	2023	2013	2080	862	2061	867	2069	1151	0.01		ns	19	ns	157	235.5
R LV	1937	1974	1975	2031	839	2013	836	2019	1136	0.01	.6	ns	18	ns	171	256.5
R ST	1662	1688	1685	1731	686	1711	684	1718	999	0.01	-7	ns	20	ns	129	1935
R SB	1736	1746	1759	1789	728	1765	724	1773	1031	0.01	-8	ns	24	ns	147	220.5
R GB	1706	1690	1753	1794	719	1770	718	1776	1034	0.01	-6	ns	24	ns	137	205.5

R KI	1713	1807	1738	1848	707	1831	705	1835	1031	001	-4	ns	17	ns	155	232.57
RUB	1571	1612	1600	1652	639	1632	640	1640	961	0.01	-8	ns	20	is	166	249

(L = left R = right; LU = lung; U = large intestine; HC = Heart Constrictor, DI = diaphragm; TH = Triple Heater HT = heart; SI = small intestine; SP = spleen; LV = liver, ST = stomach; SB = stomach branch; GB = gall bladder KI = kidney; UB = urinary bladder; E = earthed; C = controls; ns = not significant)



BP values for the first 14-minute period after earthing (II). The highly significant result ( $p < 0.01$ ) for each meridian on each side of the body is presented in Table 3, column **ttest plevel** just after the column **B2.I1 E**. This result implies that there was a significant decrease in mean BP values after earthing for every meridian on each side of the body for the experimental group. No such result was found for the control group (column **ttest plevel** just after the column **B2.I1 C**). Also no significant result was found when comparing the first 14-minute period after earthing with the first 14-minute period after "sham earthing" (**I-1**; column **ttest plevel** just after the column **I1.I1 E.C**).

Meridian	132-11 E (pA)	82-11 C (pA)	F-Ratio Inter (pA)	p-level	5% Conf Level (pA)
L LU	473	-33	9.14	0.01	204
L L1	388	-30	10.92	0.01	154
L HC	380	-24	12.16	0.01	140
L DI	391	-18	10.03	0.01	156
L TH	378	-15	10.22	0.01	146
L HT	388	-15	10.77	0.01	147
L SI	381	-8	9.84	0.01	147
R LU	481	-33	11.09	0.01	192
R U	393	-23	10.02	0.01	160
R HC	373	-26	10.15	0.01	150
R DI	397	-23	12.16	0.01	147
R TH	387	-24	12.21	0.01	144
R HT	408	-18	11.53	0.01	151
R SI	388	-14	12.25	0.01	141
L SP	1116	22	62.65	0.001	150
L LV	371	-26	10.15	0.01	150
L ST	1006	25	63.07	0.001	141
L SB	1051	23	66.22	0.001	144
L GB	1028	21	71.5	0.001	136
L KI	1063	25	61.85	0.001	151
L UB	959	26	46.63	0.001	156
R SP	1151	19	67.56	0.001	157
R LV	1136	18	55.14	0.001	171
R ST	999	20	75.55	0.001	129
R SB	1031	24	61.54	0.001	147
R GB	1034	24	74.08	0.001	137
R KI	1031	17	51.39	0.001	155
RUB	961	20	41.92	0.001	166

Table 4. Summary of F-test results for mean BP values

Next, we looked at the same data using a different method of statistical analysis: the F-test of differences in variance. This test compares the differences in variance within groups with the between groups variance of B2-I1 for the earthed subjects and the "sham earthed" (control) subjects. The results are presented in Table 4. Again, highly significant results were obtained, meaning that the decrease in mean BP values after earthing resulted in a significantly larger between group variance than the within group variances. Even though the meridians of the upper body show highly significant results with  $p < 0.01$ , the meridians of the lower body show an even higher degree of significance with  $p < 0.001$ . This higher level of confidence for the meridians of the lower body may be due to the placement of the patches on the soles of the feet at the KI1 acupoint (see discussion section for an elaboration on this

point). With these levels of significance there is little possibility that these results are chance occurrences.

Next, we looked at the same data in yet another way. In Table 3, we noticed that all BP mean values for **B2.I1 E** were positive while all BP mean values for **B2-**

**C** were negative. Since 28 acupoints were measured, one would expect by chance alone that about 14 BP mean values would be positive and 14 negative. The fact that all BP mean values for **B2.I1 E** are going in the same direction must have some statistical significance. The same applies for **B2-I1 C**. To check for the statistical significance of these results, we used a Chi Square test (Table 5 A) which is appropriate since all expected frequencies are above 5. As

A) 02-11 E-C CHI Square Analysis:									
0	Pos	Neg	EX		10-EX1-0.5		(10-EX)-0.5)/VEX		
B2-11 E	28	0	14	14	13.5	13.5	13.02	13.02	26.04
82-11 C	0	28	14	14	13.5	13.5	13.02	13.02	26.04
Chi Square:									
=									52.07 p<0.001
B) 11-11 ECG Chi Square Analysis:									
0	Pos	Neg	EX		10-EX1-0.5		(10-EX)-0.5)/EX		
11-11 EC	0	28	14	14	13.5	13.5	13.02	13.02	26.04
Chi Square:									
=									26.04 P<0.001

0 = Observed frequency; EX= Expected frequency

Table 5: Chi Square Analysis of BP

expected we obtained a highly significant result ( $p < 0.001$ ). This means that the fact that all BP values went down after earthing for the experimental group while they went up for the control group is not a chance occurrence. We will explore the meaning of these results in the discussion section.

Notice in Table 3 that all of the **II-II E-C** values were negative. A Chi Square test confirmed the statistical significance of this situation (Table 5 B). This result means that all the BP mean values after earthing were lower than the corresponding BP mean values after "sham earthing". Again this highly significant result ( $p < 0.001$ ) supports the result of Table 5 A) that the BP values went down after earthing but not after "sham earthing."

#### AFTER POLARIZATION (AP) PARAMETER

The AP parameter is the low frequency counterpart to BP.<sup>9,10,12</sup> It is equivalent to

a skin conductance (SC) or electrodermal resistance (EDR) measurement on an acupoint. Motoyama explains that AP is a measure of the stress on the organ corresponding to the measured acupoint according to TCM.<sup>12</sup> In support of this point, a Ph.D. dissertation was done at the California Institute for Human Science which showed no correlation between AP average values or individual meridian values and cortisol levels measured on 31 subjects.<sup>13</sup> Cortisol measurements are known to correlate with general, non-specific levels of stress (the flight or fight response). So if we assume that each AP value correlates with the corresponding internal organ stress level (a specific stress response), then there should be no or little correlation with non-specific stress levels as measured by cortisol.

Contrary to BP mean values for experimental subjects, t-tests on AP mean values of B2-I1 for both experimental and control subjects did not show any significant result (Table 6).

Meridian	81 E (PA)	C (PA)	B2 (PA)	EC (PA)	11 E (PA)	C (PA)	12 E (PA)	C (PA)	121 E (PA)	t-test p-level	11-11 E- (PA)	t-test p-level	121 C (PA)	t-test p-Level	5% Level (PA)
L LU	1566	1550	1582	1566	1522	1579	1534	1567	60	rts	-57	ns	-13	ns	184
L LI	1426	1492	1567	1560	1508	1560	1524	1578	59	ns	-52	ns	0	rs	163
L HC	1455	1513	1597	1534	1552	1549	1566	1560	45	no	3	ns	-15	ns	181
L DI	1555	1530	1709	1540	1640	1540	1655	1546	69	ns	100	ns	0	ns	175
L TH	1497	1507	1637	1507	1574	1509	1587	1517	63	ns	65	ns	-2	ns	179
L HT	1442	1486	1588	1484	1527	1490	1541	1500	61	ns	37	ns	-6	ns	171
L SI	1414	1449	1530	1447	1467	1434	1475	1437	63	ns	33	ns	13	ns	184
R LU	1568	1580	1570	1644	1500	1668	1507	1638	70	ns	-168	ns	-24	ns	225
R U	1541	1561	1586	1623	1537	1642	1546	1668	49	ns	-105	ns	-19	ns	161
R HC	1511	1482	1536	1528	1481	1553	1500	1523	55	ns	-72	ns	-25	ns	142
R DI	1538	1489	1641	1517	1595	1520	1584	1477	46	ns	75	as	-3	ns	170
R TH	1526	1465	1555	1490	1498	1484	1507	1503	57	ns	14	ns	6	ns	53
R HT	1617	1487	1632	1513	1562	1530	1574	1497	70	ns	32	ns	-17	ns	177
R SI	1412	1382	1414	1416	1347	1432	1359	1407	67	ns	-85	ns	-16	ns	154
L SP	1519	1571	1530	1587	1440	1590	1446	1553	90	ns	-150	ns	-3	ns	166
L LV	1573	1574	1638	1606	1548	1570	1596	1571	90	as	-22	ns	36		194
L ST	1480	1509	1490	1529	1393	1533	1404	1510	97	ns	-140	ns		ns	186
L SB	1577	1477	1624	1494	1487	1450	1567	1449	137	ns	37	ns	44	ns	154
L GB	1444	1476	1449	1479	1359	1484	1373	1456	90	ns	-125	ns	-5	ns	134
L K1	1436	1485	1443	1495	1344	1497	1350	1471	99	its	-153	ns	-2	ns	163
L UB	1230	1261	1259	1254	1183	1254	1187	1239	76	ns	-71	ns	0	ns	119
R SP	1558	1526	1598	1549	1519	1526	1552	1527	79	ns	-7	ns	23	ns	151
R LV	1598	1557	1606	1590	1531	1597	1552	1561	75	ns	-66	ns	-7	ns	199
R Sr	1570	1537	1507	1575	1500	1551	1551	1543	7	ns	-51	ns	24	ns	154
R SB	1440	1447	1478	1492	1448	1434	1387	1439	30	ns	14	ns	58	no	154
R GB	1445	1413	1497	1434	1452	1449	1466	1460	45	ns	3	ns	-15	ns	175
R ic	1517	1587	1560	1562	1530	1560	1574	1597	30	ns	-30	ns	2	ns	181
R UB	1330	1361	1259	1254	1234	1240	1287	1239	25	ns	-6	ns	14	ns	184

Table 6 Summary of t-test results for mean AP values

From Table 7, F-test analyses showed that only 2 meridians have statistically significant results for AP: the left Heart Constrictor (L HC) and the left Diaphragm (L DI). The Diaphragm meridian does not exist in TCM. From his research, Motoyama claims that DI reflects the function of the diaphragm muscle, the lower part of the esophagus and the upper part of the stomach.<sup>12</sup> The level of confidence on these 2 meridians is 1% and so for 28 measurements we should expect less than 1 false positive result (28 x 0.01 = 0.28 false positives), yet we have 2 positive (statistically significant) results. Still, since significance is showing up on only 2 meridians and on one side of the body only,

we do not see that result as strong evidence of a real effect due to earthing. Since patches were placed symmetrically on both sides of the body, there is no explanation why one side of the body should be giving statistically significant results and not the other side.

Next, Chi Square tests were performed in a similar manner as with BP. This is presented in Table 8. **B2-11 E-C** is the only test with significant results (Table 8 A). The meaning of this result is different than it was for BP. Here all meridians of the experimental group show that there was a decrease in AP mean values after earthing while there was no significant decrease or

Med-Plan	B2-11 E (pA)	B2-11 C (NA)	F-Ratio Inter (pA)	p-level	5% Conf Level (pa)
L LU	60	-13	0.14	ns	184
L LI	59	0	0.26	ns	163
L HC	45	-15	0.28	0.01	181
L DI	69	0	0.43	0.01	175
L TH	63	-2	0.39	ns	179
L HT	61	-6	0.47	ns	171
L SI	63	13	0.26	ns	184
R LU	70	-24	0.35	ns	225
R U	49	-19	0.35	ns	161
R HC	55	-25	0.36	ns	142
R DI	46	-3	0.05	ns	170
R TH	57	6	0.15	ns	53
R HT	70	-17	0.23	ns	177
R SI	67	-16	0.41	ns	154
L SP	90	-3	0.29	ns	166
L LV	90	36	0.05	ns	194
L ST	97	4	0.31	ns	186
L SB	137	44	0.25	ns	154
L GB	90	-5	0.45	ns	134
L KI	99	-2	0.38	ns	163
L UB	76	0	0.21	ns	119
R SP	79	23	0.08	ns	151
R LV	75	-7	0.21	ns	199
R ST	7	24	0.27	ns	154
R SB	30	58	0.41	flu	154
R GB			0.43	ns	175
R KI	30	2	0.28	ns	181
R UB	25	14	0.14	ns	184

ns = not significant

Table 7. Summary of F-test results for mean AP values

increase for the control group AP mean values after "sham earthing" (9 showed a decrease and 16 showed an increase, not significant). This result means that the experimental group and the control group had very different behaviors after earthing (experimental group) or "sham earthing" (control group). This result means that the experimental group had a relaxation of all their internal organs while the control group had no significant change.

Chi Square comparisons between the experimental and control groups for the first 14-minute period after earthing and "sham earthing," respectively, did not show any significant result (Table 8 B).

### INTEGRAL ELECTRICAL CHARGE (IQ) PARAMETER

Electrophysiologically, the integral electrical charge (IQ) parameter is a measure of the electrical charge that accumulated at the acupoint during the process of the SSVP measurement (values are in picocoulombs or

Table 8. Chi Square Analysis of AP

A) B2-11 E-C Chi Square Analysis:										
O	Pos	Neg	EX	10-EX	0.5	(10-EX -0.5)/EX				
B2-11 E	28	0	19.55	8.45	7.95	7.95	3.24	7.48		10.72
B2-11 C	9	16	17.45	7.55	7.95	7.95	3.62	8.38		12.00
B) 11-11 E-C Chi Square Analysis:										
O	Pos	Neg	EX	10-EX	0.5	(10-EX -0.5)/EX				
11-11 E-C	11	17	14	14	2.5	2.5	0.45	0.45		0.89
Chi Square: 22.72 p<0.001										
Chi Square: 0.89 ns										

0 = Observed frequency; EX= Expected frequency

Med- dian	81 E (PC)	C (PC)	B2 E (PC)	C (PC)	11 E (PC)	C (PC)	12 E (PC)	C (PC)	B2-11 E (PC)	Meet p- level	11-11 ENE (p)	West p- level	B2-11 C (PC)	West p- Level	5% Level (PA)
LLU	1565	1550	1580	1563	1520	1579	1534	1567	60	ns	-59	ns	-16	ns	184
LLI	1538	1499	1550	1546	1499	1573	1513	1554	51	ns	-74	ns	-27	ns	157
LHC	1444	1476	1449	1479	1359	1484	1373	1456	90	ns	-125	ns	-5	ns	134
LDI	1559	1530	1578	1558	1525	1580	1536	1549	53	ns	-55	ns	-22	ns	176
LTI-1	1603	1533	1609	1542	1534	1553	1545	1517	75	ns	-19	ns	-11	ns	175
LI-1T	1542	1519	1549	1526	1481	1540	1492	1506	68	ns	-59	ns	-14	ns	167
LSI	1516	1463	1517	1460	1451	1452	1459	1418	66	ns	-1	ns	8	ns	178
RLU	1568	1580	1570	1644	1500	1668	1507	1638	70	ns	-168	ns	-24	ns	225
RU	1552	1566	1579	1627	1518	1653	1535	1623	61	ns	-135	ns	-26	ns	169
RHC	1511	1482	1536	1528	1481	1553	1500	1523	55	ns	-72	ns	-25	ns	142
RDI	1582	1519	1602	1554	1534	1571	1545	1541	68	ns	-37	ns	-17	no	176
RTH	1528	1484	1534	1505	1464	1523	1474	1488	70	ns	-59	ns	-18	ns	160
RIT-1T	1617	1487	1632	1513	1562	1530	1574	1497	70	ns	32	ns	-17	ns	177
RSI	1412	1382	1414	1416	1340	1432	1359	1407	74	ns	-92	ns	-16	ns	154
LSP	1519	1571	1530	1587	1440	1590	1446	1553	90	ns	-150	ns	-3	ns	166
LLV	1573	1619	1573	1658	1468	1667	1485	1629	105	ns	-199	005	-9	ns	199
LST	1480	1509	1490	1529	1393	1533	1404	1510	97	ns	-140	ns	-4	ns	186
LSB	1577	1499	1585	1524	1474	1529	1486	1497	111	ns	-55	ns	-5	ns	166
LGB	1444	1476	1449	1479	1359	1484	1373	1456	90	ns	-125	ns	-5	ns	134
LKI	1436	1485	1443	1495	1344	1497	1350	1471	99	ns	-153	ns	-2	ns	163
LUB	1222	1272	1240	1266	1154	1265	1161	1242	86	ns	-111	ns	1	ns	124
RSP	1558	1551	1558	1581	1460	1584	1485	1552	98	ns	-124	ns	-3	ns	158
RLV	1598	1557	1606	1590	1531	1597	1552	1561	75	ns	-66	ns	-7	ns	199
RST	1485	1495	1495	1504	1400	1506	1408	1473	95	ns	-106	ns	-2	ns	225
RSB	1558	1507	1566	1521	1462	1527	1473	1492	104	ns	-65	ns	-6	ns	177
RGB	1493	1453	1516	1473	1446	1478	1460	1437	70	ns	-32	ns	-5	ns	219
RKI	1391	1544	1408	1556	1348	1561	1361	1531	60	ns	-213	005	-5	ns	184
RUB	1253	1236	1265	1227	1215	1234	1224	1213	50	ns	-19	ns	-7	ns	146

ns=nots rnf~ni

Table 9. Summary of ttest results for mean IQ values

pC). According to Motoyama, this parameter reflects the homeostatic function of the body particularly regarding the function of the immune system related to the corresponding internal organs according to TCM.<sup>12</sup>

T-tests on IQ mean values of **B2-I1** for both the experimental and the control subjects did not show any significant result (Table 9). For **'141 E-C** two meridians presented a statistically significant mean difference at the 5% level. These are left liver (L LV) and right kidney (R KI). However we do not see this result as very significant since we would expect 1/20 false positive or 1.4 in 28 t-tests at this level of confidence. So

we attribute these statistically significant results to chance occurrences only.

Next, just as for BP and AP, we looked at F-tests to find if there are any significant differences between variances. The results are presented in Table 10. Again we see no significant difference comparing within group variances with the between groups variance of **B2-I1 E** and **B2-I1 C**, in agreement with the negative results of the t-tests. This result also supports our previous conclusion that the 2 statistically significant t-test results were false positives.

Chi Square analyses for IQ provided interesting results. The Chi Square analysis

Meridian	132-11 E (pC)	132-11 C (pC)	F-Ratio Inter (pC)	p-level	5% Conf Level (pC)
LLU	60	-16	0.15	ns	184
LLI	51	-27	0.37	ns	157
LHC	90	-5	0.45	ns	134
L DI	53	-22	0.17	ns	176
L TH	75	-11	0.21	ns	175
L HT	68	-14	0.21	ns	167
L SI	66	8	0.08	ns	178
R LU	70	-24	0.35	ns	225
R LI	61	-26	0.36	ns	169
R HC	55	-25	0.36	ns	142
R DI	68	-17	0.24	ns	176
R TH	70	-18	0.32	ns	160
R HT	70	-17	0.23	ns	177
R SI	74	-16	0.41	ns	154
L SP	90	-3	0.29	ns	166
L LV	105	-9	0.42	ns	199
L ST	97	-4	0.31	ns	186
L SB	111	-5	0.51	ns	166
L GB	90	-5	0.45	ns	134
L KI	99	-2	0.38	ns	163
L UB	86	1	0.33	ns	124
R SP	98	-3	0.49	ns	158
R LV	75	-7	0.21	ns	199
R ST	95	-2	0.27	ns	225
R SB	104	-6	0.37	ns	177
R GB	70	-5	0.16	ns	219
R KI	60	-5	0.11	ns	184
R UB	50		0.09	ns	146

ns = not significant

Table 10. Summary of F-test results for IQ (E = earthed; NE = not earthed)

of **B2I1 E** and **B2I1 C** shows a very statistically significant result (Table 11 A). The experimental group has all positive results, meaning all the values of IQ decreased after earthing, while the opposite is true for the control group (except for 2 meridians: the left small intestine (L SI) and the left urinary bladder (L UB)).

Next looking at **I1I1 E C** all values (except for the right Heart (R HT)) are lower for the experimental group compared to the control group (Table 11 B). This very significant result means that all but one IQ mean values after earthing were lower than IQ mean values after "sham earthing." We will explore the meaning of that result in the discussion section.

## DISCUSSION

As explained previously, the BP parameter is the initial (or high frequency) current that is measured between an acupoint and a ground electrode located

Table 11. Chi Square Analysis of IQ

A) B2-11 E-C Chi Square Analysis:									
O	Pos	Neg	EX		O-EX +0.5		( O-EX -0.5)/EX		
82-11 E	28		14	14	13.5	13.5	13.02	13.02	26.04
B2-11 C	2	26	14	14	11.5	11.5	9.45	9.45	18.89
Chi Square									=
									43.93 p<0.1101
B) I1-11 E-C Chi									
O	Pos	Neg	EX		O-EX +0.5		( O-EX -0.5)/EX		
I1-11 E	1	27	14	14	12.5	12.5	11.16	11.16	22.32
Chi Square									=
									22.32 p<0.0001
O = Observed frequency; EX = Expected									

on the wrist of the subject measured. According to Motoyama, BP reflects the water content of the body part in the path of the meridian and also the energetic state of the corresponding internal organ according to TCM.

The results presented in Table 3 showed some very significant results. The column **ttest plevel**, just after the column **B2I1 E**, presented significant results for the experimental group with a significance level better than 1%. This result implies that there was a significant decrease in mean BP value after earthing for every meridian on each side of the body (experimental group). No such significant result was found for the control group (column **ttest plevel** after the column **B2I1 C**). According to Motoyama's interpretation of the meaning of the BP parameter, this result would mean a decrease in water content of almost all of the body (since all meridians show a decrease) or a decrease in inflammation or a decrease in corresponding internal organ function. In light of other results published on the effect of earthing on inflammation,<sup>8</sup> this result can be interpreted as a decrease in inflammation along all the meridians paths, which means a decrease in inflammation for most of the body since all the meridians showed this decrease in BP values. Also no significant result was found when comparing the first 14-minute period after earthing and after "sham earthing" (I-1) between the experimental and control groups, respectively (column **ttest plevel** just after the column **I1I1 EC**). So there was not a significant difference between the experimental and the control groups after

earthing or "sham earthing" intervention, respectively.

The F-ratio for differences between BP variances showed even more statistically significant results when comparing the variance between and within **B2I1 E and B2I1 C** (Table 4). For all the meridians of the upper body the significance level is better than 1% while for all meridians of the lower body (except the left liver (L LV)) the significance level is better than 0.1%. This 10 times higher level of significance for the lower part of the body is probably due to the location of the patches at KI1. This result supports the previous result with t-tests showing that the decrease in BP values after earthing was not a chance occurrence.

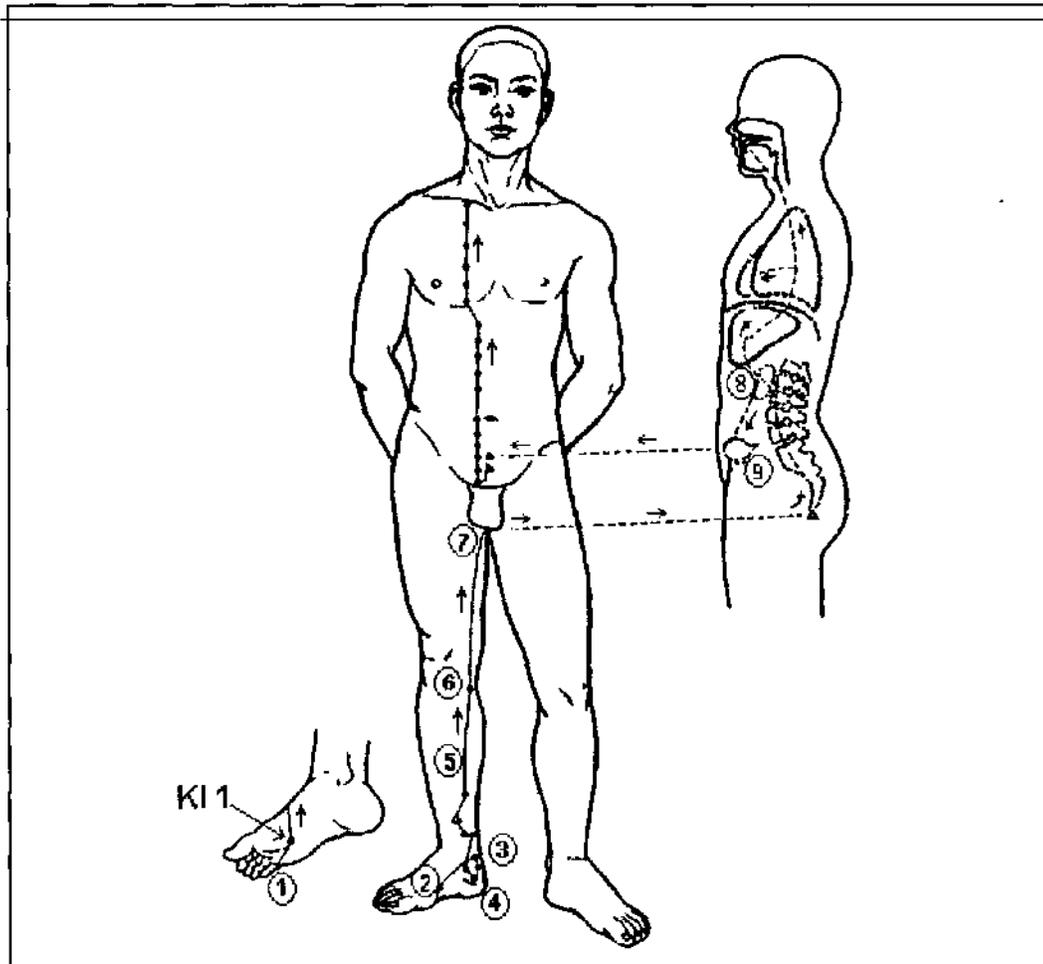
According to TCM, the KI meridian connects to the Urinary Bladder (UB) meridian with which it is internally-externally related (forming an especially close relationship in that if one meridian gets depleted in energy it will first try to draw energy from its internally-externally connected partner)." The way these meridians are internally connected is through an internal branch of the KI meridian reaching the bladder (Figure 3) and the UB meridian reaching the kidneys through another internal branch (Figure 4). The Kidney meridian starts from the inside side of the little toe (Figure 3, number 1) and runs obliquely toward the sole through KI1. Emerging from the lower aspect of the tuberosity of the navicular bone (2) and running behind the medial malleolus (3), it enters the heel (4). Then it ascends along

the medial side of the leg (5) to the medial side of the popliteal fossa (6) and goes further upward along the postero-medial aspect of the thigh (7). It enters the vertebral column through the coccyx (tailbone). Moving upward it leaves the spine to enter the kidney, its pertaining organ (8), and connects with the bladder (9). Reemerging from the kidney, it passes through the liver and the diaphragm, it enters the lung, runs along the throat and terminates at the root of the tongue. A

branch springs from the lung, joins the heart and runs into the chest to link with the Heart Constrictor (HC, also called Pericardium) meridian." Thus it can be seen that this meridian connects with many of the major organs.

The UB meridian starts from the inner canthus (Figure 4, BL1), between the eye and the nose. Ascending to the forehead, it reaches the vertex (1) where a branch arises, running to the temple (2). From the

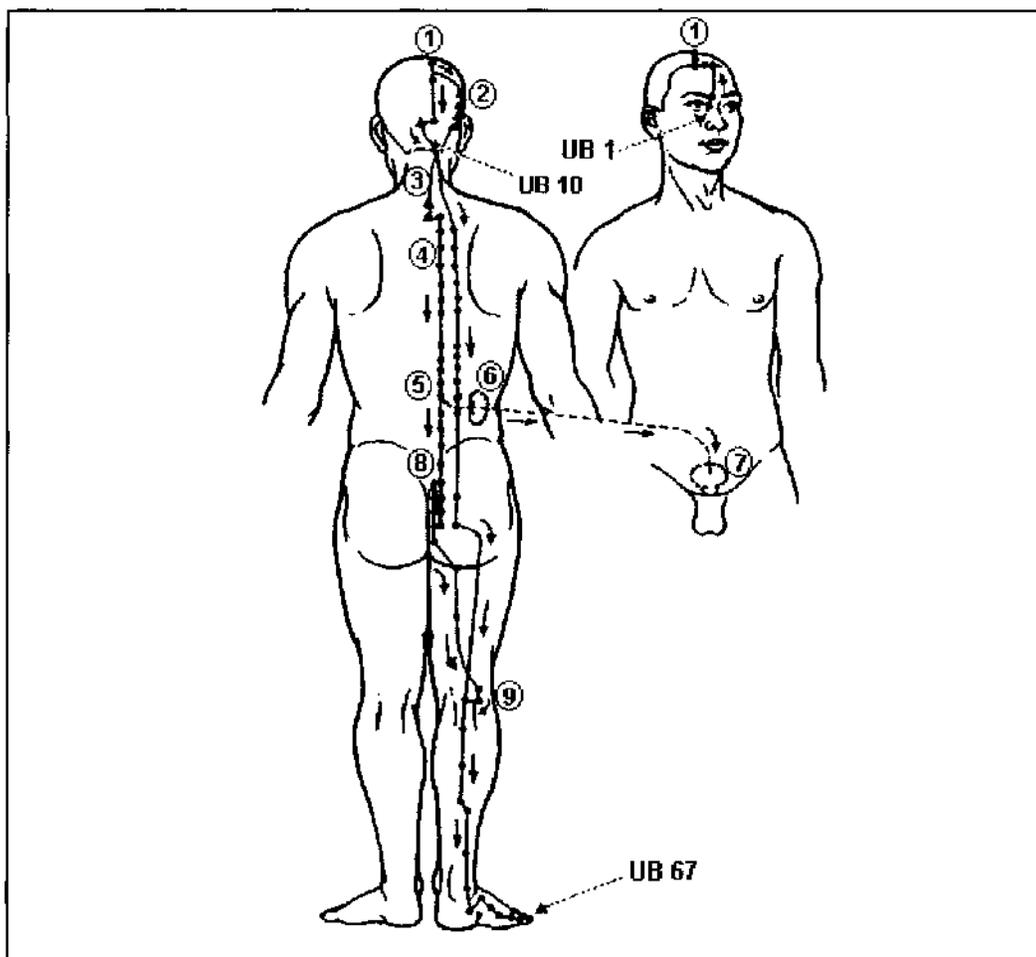
*Figure 3: KI meridian showing an internal branch starting from the kidney (8) connecting it internally to the urinary bladder (9) and the UB meridian (adapted from ref 11).*



vertex, it enters the skull and communicates with the brain. It then emerges and bifurcates to reach UB10 where it splits into a medial branch and a lateral branch, both running down parallel to the vertebral column. The medial branch descends along the posterior aspect of the neck (3). Running downward alongside the medial aspect of the scapula region and parallel to the vertebral column (4), it reaches the lumbar region (5), where it enters the body cavity via the paravertebral muscle to

connect with the kidney (6) and joins its pertaining organ, the bladder (7). The branch of the lumbar region descends through the gluteal region (8) and ends in the popliteal fossa (9). The lateral branch runs straight down from the posterior aspect of the neck along the medial border of the scapula. Passing through the gluteal region downward along the lateral aspect of the thigh, it meets the preceding branch descending from the lumbar region in the popliteal fossa. From there it descends along

Figure 4. UB meridian showing an internal branch connecting it internally to the kidneys (6). It is externally connected to the KI meridian at UB67 (adapted from reference 11).



the back of the leg and further to the posterior aspect of the external malleolus. Then, running along the tuberosity of the fifth metatarsal bone, it reaches the lateral side of the tip of the little toe (UB67), where it links with the KI meridian.<sup>11</sup>

The way these meridians are externally connected is through acupoints called Luo-Connecting points.<sup>11</sup> Each of the twelve regular meridians has, on the limbs, a Luo-Connecting point to link externally the internally-externally connected meridians. For example, a small lateral branch (called a Luo meridian) leaves the KI meridian at KI4 (located posterior and inferior to the medial malleolus) and connects it to the UB meridian at UB58 (located on the calf muscle).<sup>11,14</sup> The reason why this is called an "external" connection is because the region of the body where the twelve regular meridians connect at the limbs through Luo meridians lie in the superficial fascia close to the surface of the body in contrast to the

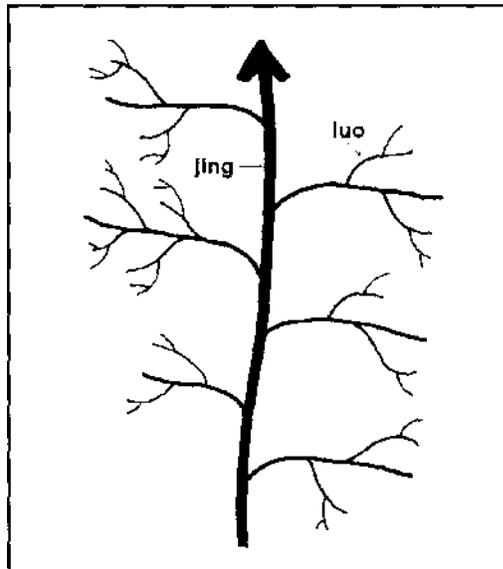


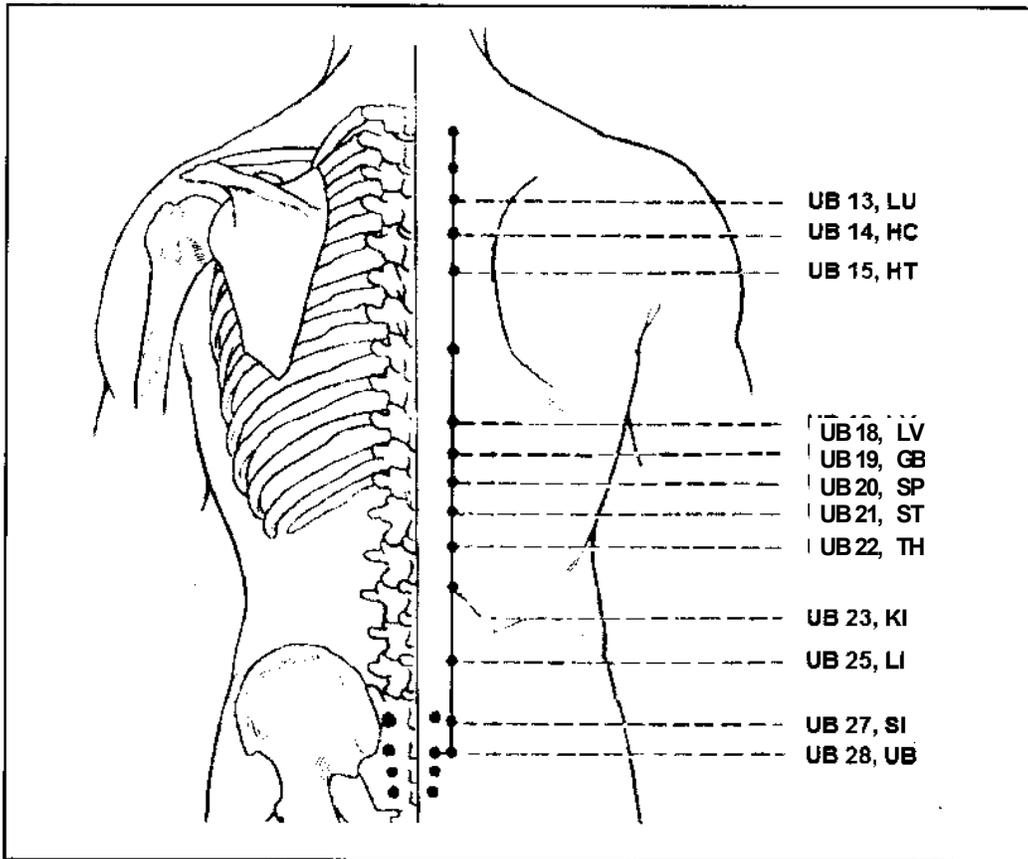
Figure 5. A regular meridian (Ding) and its branches (Luo meridians)<sup>14</sup>

internal connections which lie deep inside the body.<sup>14</sup> TCM postulates that every meridian has several Luo meridians branching out laterally (Figure 5) and that these Luo meridians traverse the whole body, "spirally wrap" the corresponding internal organs by traversing through their facial envelopes.<sup>14</sup> This system of Luo meridians can be understood as a means by which electrons can be transported from the KI meridian to a site of injury anywhere inside or at the surface of the body.

The KI meridian main functions are presented in Table 12. In TCM essence is the material base of the human body and many of its functional activities, one part is inherited from the parents and controls the aging process, the other part is acquired during life.<sup>11</sup> Qi is the fundamental substance or energy constituting the

Table 12. Major Functions of the ICI Meridian<sup>1L12</sup>

1) Stores essence
2) Dominates human reproduction
3) Dominates human development
4) Dominates water metabolism
5) Dominates the reception of Qi
6) Produces marrow
7) Dominates bone
8) Manufactures blood
9) Manifests in the hair
10) Opens into the ears
11) Dominates anterior and posterior orifices



*Figure 6 Portion of the UB meridian showing the Back-Shu points. Next to the point's name is the name of the meridian with which each Back-Shu point is related."*

universe, circulating through the meridian channels and supporting the functional activities of the internal organs and body tissues.<sup>11-12</sup>

As far as this research is concerned, the two most important features of the KI meridian are: 1) its internal-external relationship with the UB meridian and 2) its domination over water metabolism. It appears that the evolutionary process linked the water metabolism control process in the body

directly to the earth's electrons via the KI meridian. This would be a very effective and direct way of getting electrons into the body, i.e. through the water control pathway. Another way that the electrons can be effectively transported and distributed to the whole body through the KI meridian is because of its internal-external relationship to the UB meridian. In effect the UB meridian connects to all 12 regular meridians through special points in the back called Back-Shu points (Figure 6).<sup>11</sup>

The transport system for earth's electrons can now be seen this way: electrons enter the body through the KI meridian (in this experiment through a conductive patch and when one walks barefoot on the earth) reach the UB meridian through their internal-external connections, are distributed to internal organs through the Back-Shu points and through the whole body through the Luo meridians.

Another way of looking at the same BP data is to check for an increase or decrease in BP mean values immediately after earthing or "sham earthing" with a test that will determine if the number of BP mean values going up or down is significant. For example one would expect that if all 28 meridian BP mean values go down, that is probably not a chance occurrence. The Chi Square is exactly designed for that type of testing. Table 5 A shows that all the BP mean values after earthing decreased while all BP mean values after "sham earthing" increased. The Chi Square reveals that this is not a chance occurrence. It is the experience of one of the authors (Chevalier) that, when people relax, the tendency of BP values in general is to go up very slowly for several hours. So the increase in BP values after "sham earthing" is consistent with that observation. The fact that mean BP values go down after earthing is opposite to that observation and indicates that a real phenomenon is occurring. This is further support for the results of the t-test and the F-ratio.

The combined results of these 3 statistical tests lead us to conclude that the BP mean

values of the experimental group after the earthing intervention were significantly reduced and that the probable explanation for this reduction is a decrease in inflammation.

According to Motoyama, the AP parameter gives information on the stress level of the internal organs corresponding to the meridian under test as established in TCM. The t-test results for AP did not show any significant change for AP when comparing the experimental group before and after earthing (Table 6). The F-ratio (Table 7) supports that conclusion even though two meridians show significant results at the 1% level (left Heart Constrictor or Pericardium and left Diaphragm). By chance alone one would expect 0.28 (or 1) false positive result. We have two. Still this does not constitute a strong effect since there is no apparent reason why this would happen in the left side of these meridians but not the right side. We view these positive results as weak and we would need more reasons to believe that there is something special happening on the left side of these meridians compared to their right side.

The Chi Square results showed that all AP mean values decreased after earthing for the experimental group while there is no clear tendency for the control group after "sham earthing" (Table 8 A). This is a strong result that showed that subjects in the experimental group relaxed (or at least their internal organs did) more than the subjects in the control group despite the fact that the BP mean values of the control group show an increase. Comparing AP mean values after earthing and "sham earthing"

did not provide any significant result (Table 8 B). This means that the AP mean values after earthing were not significantly different from the AP mean values after "sham earthing".

The fact that the difference between the mean AP values before and after earthing for the experimental group was not statistically significant (Tables 6 and 7), combined with the fact that the Chi Square tests showed AP mean values for the experimental group to decrease but not the control group (Table 8 A) and that AP mean values after earthing and "sham earthing" were not statistically significant (Table 8 B) leads us to conclude that there was a decrease in AP mean values after earthing but it was small. So the organ relaxation was measurable but small overall.

Next looking at results for IQ, we find no significant difference in **B2I1** for the experimental group and for the control group (Table 9). This means that there was no significant increase or decrease in IQ mean values after earthing or "sham earthing". The F-ratio results of Table 10 corroborate this conclusion. When comparing the IQ mean values after earthing with after "sham earthing" we found no significant differences except for two meridians, left liver (L LV) and right kidney (R **KI**; Table 9 column **ttest p-level** after **I1I1 E.C**). The significance level is 5% and so we would expect about 1.4 false positives and the 2 positive results we obtained can easily be explained by chance occurrence. Hence the t-tests do not appear to show any significant result for

IQ. The F-ratio supports that conclusion of no difference before earthing or "sham earthing" (Table 10).

Chi Square test results for IQ showed that there is a decrease in IQ mean values after earthing for all meridians and an increase in all but two meridians after "sham earthing" (Table 11 A). This opposite behavior between the two groups is very significant (at the 0.1% level) and means that there is a decrease in immune activity after earthing but an increase after "sham earthing." Just as is the case with BP, it is usual to see a slow and gradual increase in IQ values over time.<sup>15</sup> Comparing the differences in IQ mean values after earthing with after "sham earthing" one finds that all but one of the meridian IQ mean values is negative (Table 11 B). This result is very significant ( $p < 0.001$ ). All but one IQ mean values for the experimental group is lower than for the control group. This result again supports a significant decrease in IQ mean values after earthing, meaning a significant decrease in immune function, which is a normal occurrence when inflammation decreases.

## CONCLUSION

Overall, the results support a decrease in inflammation after earthing and a shift toward parasympathetic function of internal organs. The results confirm our previous study which concluded that earthing reduces stress and normalizes the functioning of the autonomic nervous system. <sup>6</sup> To be specific, this study showed that:

- 1) There was a significant decrease in mean BP values after earthing for every meridian on each side of the body for the experimental group as measured with t-tests. This supports our hypothesis H1 and means that there was a significant decrease in inflammation.
- 2) The F-ratio for differences between BP variances showed even more statistically significant results. For all the meridians of the upper body the significance level is better than 1% while for all meridians of the lower body (except one) the significance level is better than 0.1%. This supports the previous result of a decrease in inflammation.
- 3) We found that all the BP mean values after earthing decrease while all BP mean values after "sham earthing" increased. A Chi Square test confirmed that this is not a chance occurrence ( $p < 0.001$ ). It is the experience of one of the authors (Chevalier) that when people relax the tendency of BP values is to go up very slowly for several hours. The increase in BP mean values after "sham earthing" is consistent with that observation. The fact that BP mean values go down after earthing indicates that a real phenomenon is occurring. So this is further support for the results of the t-test and the F-ratio of a decrease in inflammation.
- 4) H2 was partly validated. While there was no statistically significant difference when comparing before earthing mean BP values with after earthing mean BP values (Table 3 and 4), the Chi square showed that all BP mean values were lower after earthing than after "sham earthing" (Table 5 B).
- 5) H3 was partially validated. Just as for BP, there was no statistically significant result when comparing mean BP values before and after earthing (Table 6). However, all meridians' mean BP values decrease after earthing (Table 8 A).
- 6) H4 was not supported by the statistical tests performed in this paper.
- 7) Chi Square results showed that all AP mean values decreased after earthing for the experimental group while there was no clear tendency for the control group after "sham earthing." This result showed that subjects in the experimental group relaxed (or at least their internal organs shifted toward parasympathetic activation) more than the subjects in the control group.
- 8) H5 and H6 were partially supported. While t-tests and F-ratios for IQ did not show any significant mean differences before and after earthing or after comparing earthing with after "sham earthing" (Tables 9 and 10), the Chi Squares showed that IQ mean values went down after earthing and were lower than their "sham earthing" counterparts (Table 11).
- 9) Chi Square results for IQ showed that there is a decrease in IQ mean values after earthing for all meridians and an increase in IQ mean values for all but two meridians after "sham earthing." This opposite behavior between the two groups is very significant (at the 0.1% level) and means that there is a decrease in immune activity after earthing but an increase after "sham earthing." This decrease in immune system

activity is consistent with a decrease in inflammation.

10) Comparing the differences in IQ mean values after earthing with after "sham earthing" one finds that all but one of the meridian IQ mean values are negative. This means that all but one IQ mean value for the experimental group are lower than for the control group. This result again supports a significant decrease in IQ mean values after earthing and a decrease in immune function which is a normal occurrence when inflammation decreases.

Again, the results support a decrease in inflammation after earthing and an increase in parasympathetic activity in their internal organs. The results confirm our previous study which concluded that earthing reduces stress and normalizes the functioning of the autonomic nervous system.<sup>6</sup>

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