



ULTIMATE LONGEVITY  
CONSCIOUS SCIENCE IN SERVICE TO  
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## GROUNDING RESEARCH: STUDY SUMMARIES

**Over 20 peer-reviewed research studies** have been published on the extensive health benefits of grounding (also referred to as "earthing").

**These studies have shown impressive improvements in...**

*inflammation, pain, stiffness, circulation, blood pressure, blood viscosity, HRV, vagal tone, cortisol, stress, depression, anxiety, tiredness, fatigue, energy, mood, blood glucose, immunity, sleep, thyroid function, metabolism, serum electrolytes, wound healing, athletic performance and recovery, and more.*

Note: All studies were conducted using [indoor grounding devices](#).

Below, you'll find summaries of the results of 12 of the over 20 peer-reviewed research studies that have been conducted on the health benefits of grounding.

To target down to a specific section or study, just click on the section or study link in the list below:

### **Section 1: Stress Reduction + Nervous System + Improved HRV + Improved Sleep + Reduced Pain**

[Initial Grounding Experiment Conducted by Clint Ober: Improved Sleep & Reduced Pain](#)

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[Emotional Stress, Heart Rate Variability, Grounding, and Improved Autonomic Tone: Clinical Applications](#)

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### **Section 2: Hormonal Balancing + Physiological Changes**

[Earthing the Human Body Influences Physiologic Processes](#)

[Changes in Pulse Rate, Respiratory Rate, Blood Oxygenation, Perfusion Index, Skin Conductance, and Their Variability Induced During and After Grounding Human Subjects for 40 Minutes](#)

[The Effect Of Earthing On Human Physiology - Part 1](#)

[The Effect Of Earthing On Human Physiology - Part 2](#)

#### **Section 4: Athletic Performance & Recovery**

[NEW 2019 STUDY: Effectiveness of Grounded Sleeping on Recovery After Intensive Eccentric Muscle Loading](#)

[Pilot Study on the Effect of Grounding on Delayed-Onset Muscle Soreness](#)

[Differences in Blood Urea and Creatinine Concentrations in Earthed and Unearthed Subjects during Cycling Exercise and Recovery](#)

[Grounding After Moderate Eccentric Contractions Reduces Muscle Damage](#)

#### **Section 5: Links to Grounding Studies That Have Not Been Summarized**

**SECTION 1:  
STRESS REDUCTION + NERVOUS SYSTEM + IMPROVED HRV +  
IMPROVED SLEEP + REDUCED PAIN**

**1.1 Initial Grounding Experiment Conducted by Clint Ober: Improved Sleep & Reduced Pain**

Clint Ober's first published experiment to validate the benefits of grounding was conducted in 2000 and published in the journal ESD, an online journal specializing in news and technical papers about electrostatics. 60 volunteers with chronic sleep and pain issues were either grounded or sham-grounded while they slept by means of a conductive pad connected to a ground rod outside their bedroom windows. For the sham-grounded control, a spacer was used to block the connection to the Earth.

<b>Number of Participants Who Improved in Grounded vs. Sham-Grounded Groups</b>					
	<b>Time To Fall Asleep</b>	<b>Sleep Quality</b>	<b>Wake Feeling Rested</b>	<b>Muscle Stiffness and Pain</b>	<b>Chronic Back or Joint Pain</b>
<b>Grounded</b>	85% (23/4)	93% (25/2)	100% (27/0)	82% (22/5)	74% (20/7)
<b>Sham-Grounded</b>	13% (3/20)	13% (3/20)	13% (3/20)	0% (0/23)	0% (0/23)

**1.2 Electrical Grounding Improves Vagal Tone in Preterm Infants**

From October 2012 to January 2014, researchers at the Neonatal Intensive Care Unit at PennState Health Hershey Medical Center investigated the effect of grounding on premature babies. Their questions were:

1. How strong are the electric fields that premature infants are exposed to in the NICU?
2. Does grounding reduce skin potential in infants in the NICU as it does in adults?
3. Does reducing skin potential in infants in the NICU improve vagal tone as it does in adults?

Vagal tone is important because a high vagal tone indicates resilience, while in premature babies a low vagal tone is associated with an increased risk of necrotizing enterocolitis. Necrotizing enterocolitis is a disease in infants in which bowel tissue dies, and it is fatal in 20 to 30 percent of cases. This relationship may be causal, as vagal tone has an anti-inflammatory effect.

First, the researchers found that while the background magnetic flux density in the NICU was about 0.5 mG, within closed incubators, the magnetic flux density was between 1.5 and 12.7 mG. Open cribs warmed by a radiant warmer had a lower exposure than the closed incubators, between 0.8 and 1.7 mG. Other studies have shown that when pregnant mothers are exposed to a magnetic flux density of 2 mG, their children have an increased risk of asthma and obesity, and that exposure after birth to 4 mG or higher doubles the risk of childhood leukemia. As expected, all infants had a skin potential that oscillated at 60 Hz caused by the magnetic field exposure.

Then, the researchers grounded the infants using an electrode patch. The skin potential immediately decreased by about 95%. Vagal tone was measured as the high frequency power of heart rate variability. Before grounding, vagal tone was lowest in infants with the highest skin potential. During grounding, the

skin potential was massively reduced, and vagal tone increased by 67%. When grounding was discontinued, however, vagal tone fell to the pre-grounding level.

Sources:

HTML Version: <https://www.karger.com/Article/FullText/475744>

PDF Version: <https://www.karger.com/Article/Pdf/475744>

Summary: <https://www.earthinginstitute.net/wp-content/uploads/2018/03/groundingprematurebabiesposter.pdf>

### 1.3 Emotional Stress, Heart Rate Variability, Grounding, and Improved Autonomic Tone: Clinical Applications

A 2011 study investigated the effect of grounding on heart rate variability (HRV). HRV refers to a periodic change in heart rate that occurs in healthy people but is reduced by excess sympathetic nervous system activity (fight or flight), including stress. HRV, then, can be used as a measure of parasympathetic nervous system (rest and digest) function. It can also be used as a predictor of survival after a heart attack, with higher HRV being better.

The researchers used two sessions, each two hours long, to investigate the effects of grounding on HRV in 14 men and 14 women. In each session, the subjects rested in a comfortable reclining chair, and were ungrounded for 40 minutes, then either grounded or sham-grounded for 40 minutes, and then ungrounded again for 40 minutes. Each subject had one grounded session and one sham-grounded session so they could serve as their own controls.

Increase in HRV Measurements After 40 Minutes Grounding or Sham-Grounding		
	Grounded	Sham-Grounded
HRV SDRR (SDNN)	50%	20%
HRV HF	63%	33%
HRV LF	68%	28%

At the end of the grounding or sham-grounding period, PNS function had increased by about twice as much in subjects when they had been grounded for 40 minutes compared to those who were sham-grounded, showing that grounding had an effect on top of that of simple relaxation.

Stressful states, including anxiety, panic, depression, and anger are associated with reduced HRV. Therefore, grounding may be helpful for reducing stress because it can increase HRV.

Source: <https://www.ultimatelongevity.com/docs/Emotional-Stress-HRV-Improved-Autonomic-Tone.pdf>

### 1.4 The Biologic Effects of Grounding the Human Body During Sleep as Measured by Cortisol Levels and Subjective Reporting of Sleep, Pain, and Stress

High cortisol levels are associated with stress, inflammation, and sleep dysfunction. Chronically high cortisol also disrupts the circadian rhythm, which can contribute to sleep problems, high blood pressure

and cardiovascular disease, stroke, a decrease in bone density, reduced immunity, mood problems, abnormal blood glucose, and autoimmune disease.

A 2004 study published in *The Journal of Alternative and Complementary Medicine* investigated the following questions:

1. Does grounding reduce body voltage?
2. Can grounding restore a more normal circadian cortisol profile?
3. Can grounding improve subjective reports of sleep, pain, and stress?

12 participants with complaints of sleep dysfunction, pain, and stress were grounded for eight weeks via conductive pads placed under their fitted sheets. The pads, which were conductive due to carbon fibers, were connected to a stainless steel ground rod outside of participants' bedroom windows.

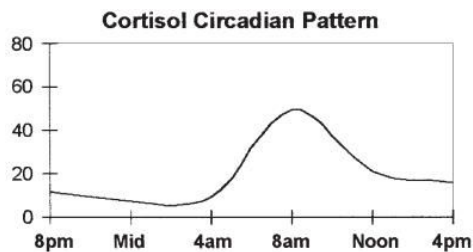
### Body Voltage

The average body voltage of study subjects in their beds at home prior to grounding was 3.27 volts. With the conductive grounding pad, body voltage was reduced to 7 millivolts.

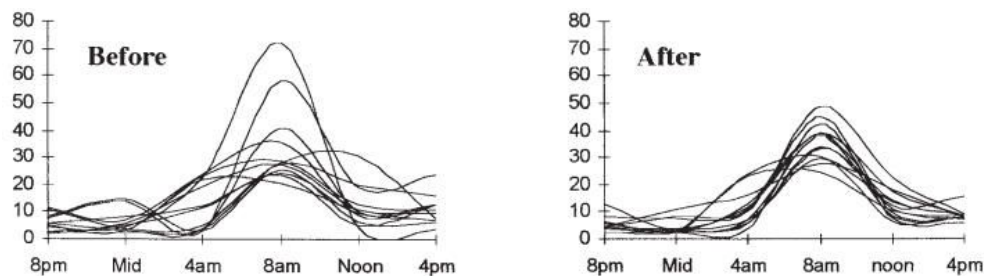
### Cortisol

Cortisol was tested every four hours for 24 hours, once before grounding and once after grounding for six weeks to establish a baseline cortisol profile and another after grounding.

A normal cortisol pattern looks like the image below. Cortisol is highest around 8:00 AM and is higher during the day than at night to allow for activity. At night, cortisol should be lower, being lowest from about midnight to 4:00 AM.



Below is a graphical representation showing the cortisol profiles of study participants before grounding and after six weeks of grounding.



Subjects' cortisol profiles moved toward the normal circadian pattern, with daytime levels improved and nighttime levels reduced. 8 of 12 subjects had a reduction in midnight cortisol levels, and 10 of 12 had an increase in 8:00 AM cortisol levels, the two exceptions having had exceptionally high morning cortisol

levels prior to grounding, which were reduced toward normal levels. 10 of 12 subjects had a cortisol profile that was closer to normal after six weeks of grounding, and one subject had a cortisol profile that was already normal prior to grounding.

#### Sleep

Subjective sleep data was collected daily for a week before grounding and during the eight weeks of grounding. The table below shows the improvement.

	Number of Subjects Who Improved When Grounded
Less Time to Fall Asleep	11 of 12
*Waking Fewer Times at Night	12 of 12
Reduced Fatigue	9 of 12
Increased Daytime Energy	9 of 12

\*Before grounding, the average was 2.5 times. After grounding, it was 1.4.

#### Pain, Stress, and Specific Conditions

Number of Participants with Improvement in Pain, Stress, or Other Specific Conditions	
Nighttime Pain Reduced	10 of 12
Pain Interfering with General Activity Reduced	7 of 11
*Emotional Stress Reduction	9 of 12
GI Disorders Improved	6 of 7
Premenstrual Syndrome or Hot Flashes Improved	5 of 6
TMJ Improved	3 of 3

\*Includes anxiety, depression, and irritability.

#### Conclusion

Grounding reduced subjects' body voltage, improved their circadian cortisol profiles and sleep, and reduced stress and pain.

Source: <https://www.ultimatelongevity.com/docs/Cortisol-Study.pdf>

### 1.5 The Effects of Grounding (Earthing) on Bodyworkers' Pain and Overall Quality of Life: A Randomized Controlled Trial

Massage therapists often develop injuries that lead to inflammatory pain, including tendonitis, carpal tunnel syndrome, and painful fingers, hands, wrists, elbows, and shoulders. These conditions can lead to early retirement.

A double blind study published in 2019 investigated the effect of grounding on massage therapists while working on clients and while sleeping at home. 16 massage therapists divided into two cohorts participated for six weeks. During the first and last week of participation, they were sham grounded, while from week two through week five, they were truly grounded. They filled out questionnaires at the beginning of the study, during the course of the study, and after the study to subjectively measure things such as sleep, stress, anxiety, depression, fatigue, energy, and pain.

Cohort A had significantly increased physical function and energy and significantly decreased fatigue and pain.

Cohort B had significantly decreased anxiety, depression, and sleep disturbance. Also, Cohort B's emotional stress was lower during the weeks when grounded than during the weeks when sham-grounded.

Differences between the response of the two cohorts to grounding may have been due to when the cohorts participated in the study, Cohort A participating during the holiday season and Cohort B at the beginning of the new year, as well as the slightly higher pain level of Cohort B.

Source: <https://www.sciencedirect.com/science/article/pii/S1550830718302519>

## **1.6 The Effect of Grounding the Human Body on Mood**

A study published in 2015 examined the effect of grounding for one hour on mood. 40 participants were either grounded or sham-grounded for one hour, and their mood was assessed using the Brief Mood Introspection Scale. Pleasant and positive moods increased significantly in grounded subjects, but not sham-grounded subjects, showing that an hour of grounded relaxation improves mood more than relaxation alone.

Source: <https://journals.sagepub.com/doi/10.2466/06.PR0.116k21w5>

## **SECTION 2: INFLAMMATION REDUCTION + IMPROVED CIRCULATION & BLOOD FLOW**

### **2.1 Earthing (Grounding) the Human Body Reduces Blood Viscosity**

High blood viscosity and clumping of red blood cells are both problems found in cardiovascular disease and high blood pressure. The risk of major cardiovascular events, such as heart attacks, increases with higher blood viscosity. The Edinburgh Artery Study found that the 20% of men with the highest blood viscosity had 3.2 times greater risk of adverse cardiac events than the 20% of men with the lowest blood viscosity.

In order to reduce blood viscosity and clumping of red blood cells, the surface of each red blood cell naturally has a negative charge, called a zeta potential. Because like charges repel, red blood cells with a high zeta potential repel each other more strongly than those with a weak zeta potential, meaning high zeta potentials equal lower blood viscosity and less clumping of red blood cells. In fact, it was found that patients with occlusive arterial disease had lower zeta potentials than healthy controls, meaning that their red blood cells did not repel each other as well as they should.

A 2013 study in *The Journal of Alternative and Complementary Medicine* investigated whether grounding could increase zeta potential and reduce blood viscosity and red blood cell clumping. 10 healthy adult subjects were grounded using electrode patches applied to the soles of their feet and palms of their hands for two hours.

When compared with before grounding, all subjects had increased zeta potentials and reduced blood viscosity. Zeta potentials increased by a factor of 1.27 to 5.63, with an average increase of a factor of 2.7. Interestingly, zeta potential increased more in those with poorer health. The sizes of red blood cell clusters were also dramatically reduced by grounding. As an added benefit, the three study subjects who reported pain prior to grounding had reduced pain. Two said they were pain free after the grounding session, and the third said her pain was nearly gone.

Together, these results indicate that grounding could increase zeta potential, reduce blood viscosity, and reduce clumping of red blood cells, which could have application in cardiovascular diseases.

Source:

Summary: <https://www.earthinginstitute.net/how-grounding-affects-blood-viscosity/>

PDF Full Text: <https://www.liebertpub.com/doi/pdfplus/10.1089/acm.2011.0820>

## **2.2 Grounding Patients With Hypertension Improves Blood Pressure: A Case History Series Study**

After three months of consistent grounding (each patient grounded for at least 10 hours per day, most of which was done at night while sleeping), systolic blood pressure decreased by an average of 14.3%.

Source: [http://alternative-therapies.com/openaccess/26-6\\_Elkin.pdf](http://alternative-therapies.com/openaccess/26-6_Elkin.pdf)

## **2.3 Thermography Inflammation Study: 20 Medical Thermography Case Studies on Grounding**

Medical thermography (infrared imaging) is used by doctors and scientists to photograph inflammation and poor circulation in the body. The 20 medical thermography case studies documented in this clinical research study provide before and after thermography images showing the elimination of inflammation and return of normal circulation after grounding. Each case study also includes a summary of each patient's original issues and the life-changing improvements they received after grounding.

This paper is best reviewed in its full form in order to see all of the thermography images and the specific details of each case study.

Below you'll find two links. The first link provides easy-to-read summaries of each of the 20 medical thermography case studies, along with the corresponding medical thermography images for each case study. The second link leads to the full medical thermography study.

Easy-to-Read Summaries of All 20 Medical Thermography Case Studies on Grounding  
<https://www.ultimatelongevity.com/earthing-grounding/thermography/thermography.shtml>

Full Study Paper:



<https://www.ultimatelongevity.com/docs/grounding-medical-thermographics.pdf>

## **2.4 Grounding the Human Body Improves Facial Blood Flow Regulation: Results of a Randomized, Placebo Controlled Pilot Study**

Many dermatological treatments focus on increasing blood circulation to facial skin, which may increase skin healing and repair by delivering more oxygen, nutrition, and providing better resistance to oxidative damage. Current emitting devices, massage, ultrasound, lasers, acupuncture, certain creams, chemical peels, and dermabrasion all aim to increase facial blood flow, but some of these may have serious side effects.

A double blind study published in 2014 in the *Journal of Cosmetics, Dermatological Sciences and Applications* investigated whether grounding would improve facial blood flow. 40 subjects with an average age of 55 years were either grounded or sham-grounded for 1 hour, and facial blood flow was recorded before and during grounding or sham-grounding using a Laser Speckle Contrast Imaging camera.

In grounded subjects, facial blood flow showed either an increase or a rhythmic fluctuation after grounding had started and subjects had fully relaxed. On the other hand, sham-grounded subjects did not have a rhythmic fluctuation in facial blood flow and either had a steady, low value or a gradual decrease during sham-grounding.

The study author suggested a few hypotheses for how grounding could have improved facial blood flow as seen in this study. These include improving how the autonomic nervous system regulates blood flow, reducing blood viscosity, and reducing inflammation via the vagus nerve, which mediates the inflammatory reflex.

Sources:

HTML Version: [http://www.scirp.org/html/1-1050269\\_51326.htm](http://www.scirp.org/html/1-1050269_51326.htm)

PDF Version: [http://www.scirp.org/pdf/JCDSA\\_2014111211461709.pdf](http://www.scirp.org/pdf/JCDSA_2014111211461709.pdf)

## **2.5 One-Hour Contact with the Earth's Surface (Grounding) Improves Inflammation and Blood Flow — A Randomized, Double-Blind, Pilot Study**

A 2015 publication in the journal *Health* reported the effect of grounding on circulation in the face, neck, and torso as measured by a thermal imaging camera, which allows clinicians to evaluate blood and lymphatic circulation in different parts of the body by looking at skin temperature. Thermal imaging can be used to examine breast cancer tumors, arterial disease, neck and back problems, soft tissue injuries, and many other conditions. In this study, thermal images were taken before and after grounding or sham-grounding, and the procedure was double blind.

Relaxation decreased the temperature of facial skin in both groups, but the grounded group had a much smaller decrease, meaning they had more facial blood circulation. Abdominal temperature increased in the grounded group, while it decreased in the sham-grounded group. In addition, the thermal images for both the face and abdomen became more symmetrical in the grounded group, while they became less symmetrical in the sham-grounded group. The temperature across the whole abdomen became more uniform in grounded subjects, opposite to the sham-grounded group. In grounded subjects, abdominal

heat patterns changed in a way that indicated improved circulation, but this was not seen in the sham-grounded subjects.

These changes show that grounding improved circulation in both the torso and face, while sham-grounding did not. This could be due to improved autonomic nervous system regulation of circulation, reduced blood viscosity, or both.

Sources:

HTML Version: [http://www.scirp.org/html/14-8203393\\_58836.htm](http://www.scirp.org/html/14-8203393_58836.htm)

PDF Version: [http://www.scirp.org/pdf/Health\\_2015081716010615.pdf](http://www.scirp.org/pdf/Health_2015081716010615.pdf)

## **2.6 Grounding the Human Body during Yoga Exercise with a Grounded Yoga Mat Reduces Blood Viscosity**

High blood viscosity means that blood is thick and doesn't flow through blood vessels as well as it should. It's associated with a number of disease conditions, including cardiovascular disease, diabetes, metabolic syndrome/obesity, hypertension, and even dementia. High viscosity blood may also be abrasive to vessel walls, leading to injuries that trigger plaque formation.

Many things affect blood viscosity, including the hematocrit (ratio of red blood cell volume to total blood volume), red blood cell clumping, dehydration, the flexibility of red blood cells, etc. Blood viscosity also changes as the heart pumps, being much lower during systole than it is during diastole. Blood is more viscous in narrower vessels. Inflammation also increases blood viscosity, because the increased free radical production reduces the negative charge on the surface of red blood cells that is supposed to keep the red blood cells adequately separated from each other.

In a double blind study published in the *Open Journal of Preventive Medicine* in 2015, state of the art equipment was used to measure both systolic and diastolic blood viscosity after a one hour session of gentle yoga exercises while grounded or sham-grounded. Normally, exercise causes a short term increase in inflammation, and that increases blood viscosity. It was found that the sham-grounded subjects had a slight but insignificant increase in blood viscosity after the yoga session, but grounded subjects actually had a significant decrease in both systolic and diastolic blood viscosity despite the hour of yoga exercise.

Source:

HTML Version: [http://www.scirp.org/html/2-1340431\\_55445.htm](http://www.scirp.org/html/2-1340431_55445.htm)

PDF Version: [http://www.scirp.org/pdf/OJPM\\_2015040915172304.pdf](http://www.scirp.org/pdf/OJPM_2015040915172304.pdf)

## **2.7 Effects of Grounding (Earthing) on Massage Therapists: An Exploratory Study**

A double blind, randomized controlled trial published in the journal *Health* in 2018 found that massage therapists had a decrease in blood viscosity when grounded for four weeks that persisted even a week after grounding was discontinued.

Sources:

HTML Version: [http://www.scirp.org/html/6-8204248\\_82706.htm](http://www.scirp.org/html/6-8204248_82706.htm)

## SECTION 3: HORMONAL BALANCING + PHYSIOLOGICAL CHANGES

### 3.1 Earthing the Human Body Influences Physiologic Processes

A 2011 paper detailed the results of five experiments showing diverse and substantial effects that grounding has on human physiology.

#### Experiment 1: Grounding and Calcium and Phosphate Homeostasis

In this double blind experiment using grounding or sham-grounding on sleeping participants, it was found that a night's rest while grounded significantly reduced the amount of calcium and inorganic phosphorus in blood serum, and also reduced the amount excreted in the urine. This is opposite to what happens to astronauts in zero gravity, and since calcium and phosphorus were reduced in both the blood and urine, the minerals were instead stored in the bone.

#### Experiment 2: Grounding and Serum Concentrations of Electrolytes

In this double blind experiment, it was found that seven hours of grounding at night significantly reduced levels of sodium, potassium, and magnesium in blood serum, and that an hour after grounding was discontinued, sodium, chloride, and magnesium levels significantly increased. This suggests that grounding changes the electrical environment in the body and how these electrolytes are absorbed, excreted, stored, and transmitted into and out of cells.

#### Experiment 3: Grounding and Thyroid Function

In this experiment on healthy participants, it was found that grounding during nighttime sleep increased levels of free T4 and thyroid stimulating hormone while reducing levels of free T3. This suggests increased use of T3 and an increase in basal metabolic rate with grounding during sleep.

#### Experiment 4: Grounding and Glucose Concentration in Non-Insulin Dependent Diabetic Patients

This double blind experiment was conducted with 12 diabetic patients whose glucose had formerly been well-controlled on a medication called glibenclamide for at least six months, but by the time of the study had unsatisfactory glucose control despite diet and exercise advice and glibenclamide, with fasting glucose levels of greater than 10 mmol/L. Subjects were given an isocaloric diet of 25% fat, 29% protein, and 55% carbohydrates and grounded continuously for 72 hours. In the grounded group, glibenclamide and ACE inhibitors, for those patients taking the latter, were both discontinued after 24 hours. Fasting glucose concentrations were significantly reduced in the grounded group, from an average of 10.6 to 7.4 mmol/L. Thus, grounding during rest and activity increases glucose consumption by cells in patients with non-insulin dependent diabetes. [The reduced fasting glucose levels also could have been caused by an increase in insulin sensitivity.]

#### Experiment 5: Immune Response to Vaccine and Toxoid

In this double blind experiment, the effect of grounding versus sham-grounding on the immune response to a dose of typhoid vaccine and tetanus toxoid was investigated. On the third night, participants were either grounded or sham-grounded. Sleeping while grounded lowered serum iron, total protein, and albumins, while it increased transferrin, ferritin, and globulins  $\alpha_1$ ,  $\alpha_2$ ,  $\beta$ , and  $\gamma$ . An hour after grounding was discontinued, ferritin and globulin  $\alpha_1$  were decreased, and iron, total protein, and globulins  $\alpha_2$ ,  $\beta$ , and  $\gamma$  were increased. The increase in  $\gamma$ -globulins indicates that the immune response to vaccines and toxoids

can be increased by grounding the body, and that grounding has an affect on the regulation of the immune system.

In the words of the authors, "It [grounding the body] may be the primary factor regulating the endocrine and nervous systems."

Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3154031/>

### **3.2 Changes in Pulse Rate, Respiratory Rate, Blood Oxygenation, Perfusion Index, Skin Conductance, and Their Variability Induced During and After Grounding Human Subjects for 40 Minutes**

A 2010 study found that, when compared with sham grounding, grounding immediately decreased skin conductance by about 10% within 0.5 to 4 seconds, depending on the subject. Skin conductance is an accepted measure of autonomic nervous system activity, with a reduced skin conductance indicating a higher parasympathetic activity to sympathetic activity ratio. This means that reduced skin conductance suggests a lowered stress response in the body.

Additionally, changes in respiratory rate and blood oxygenation suggest that grounding may induce a healing effect that increases the body's metabolic rate within the first 40 minutes of grounding and for at least 40 minutes afterward.

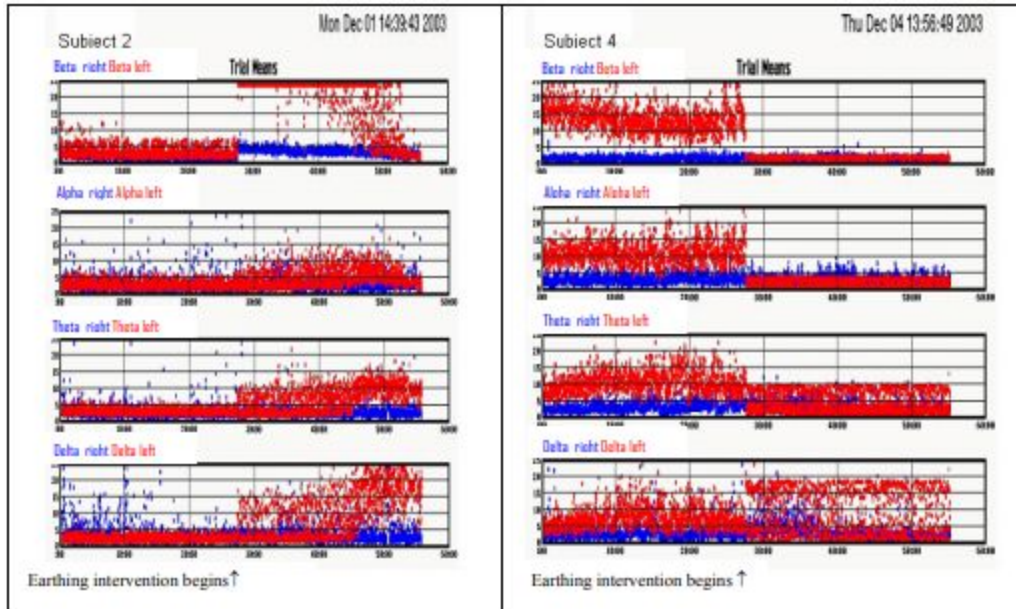
Source: <https://www.ultimatelongevity.com/docs/Changes-in-Pulse-Rate-Study.pdf>

### **3.3 The Effect Of Earthing On Human Physiology - Part 1**

A study published in *European Biology and Bioelectromagnetics* in 2006 investigated whether grounding would alter human electrophysiology. 58 subjects rested in a recliner for 56 minutes, and were either grounded or sham-grounded according to a double blind procedure for the second half of that time. Significant changes were found in EEG and SEMG recordings and in blood volume pulse in grounded subjects.

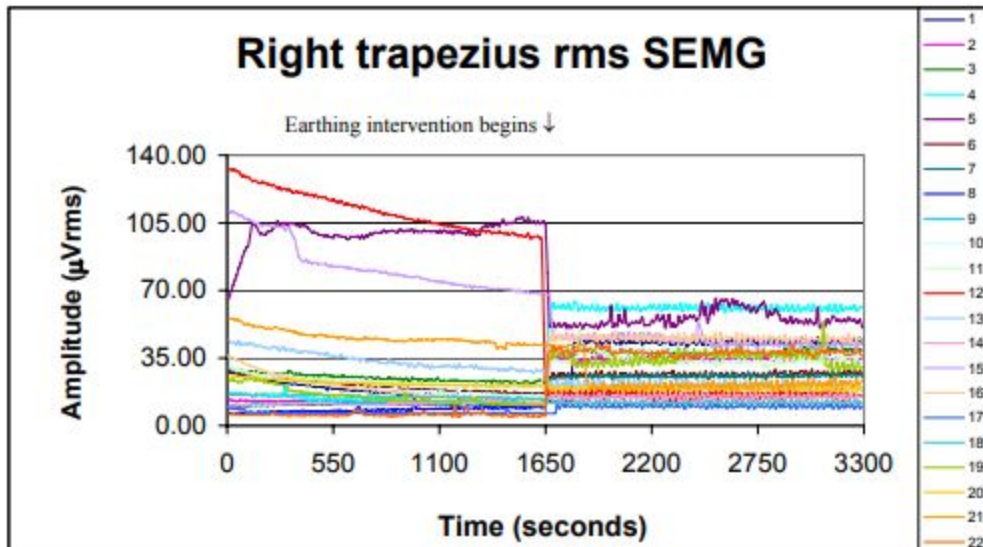
The EEG recordings were taken of the left and right frontal lobes of the brain. Half of the grounded subjects had significant changes, either up or down, in the RMS values of their EEGs on their left hemispheres almost immediately upon grounding, but no subjects had a change on their right hemispheres.

Figure 1: EEG recordings from two grounded subjects. Red represents the left hemisphere EEG and blue is for the right hemisphere. At the bottom, an arrow indicates where grounding was initiated.



SEMG recordings of the upper trapezius muscle were used to measure muscular activity and tension. When subjects were grounded, they all had significant and immediate changes, which were either increases or decreases that generally brought subjects closer to normal values, IE, high RMS values of SEMGs decreased, and low values increased. Additionally, once grounded, the RMS values of the SEMGs showed a low frequency oscillation that was not present before grounding or in sham-grounded subjects.

Figure 2a: SEMG recordings from the right trapezius muscles of grounded subjects. The arrow at the top indicates when grounding was started for the subjects.



Blood volume pulse decreased in 86.4% of grounded subjects, while it actually increased in 64% of sham-grounded subjects, which was statistically significant.

These results showed clear changes in electrophysiology as a result of grounding, and suggest that autonomic balance was improved and stress and tension were reduced.

Source:

<https://www.ultimatelongevity.com/docs/Effects-of-Earthing-on-Human-Physiology-Part-1.pdf>

### 3.4 The Effect Of Earthing On Human Physiology - Part 2

In Part 2 of *The Effect of Earthing on Human Physiology*, the researchers published additional results from the same experiment, this time regarding the effect of grounding on Jing-Well acupoints measured using the Apparatus for Meridian Identification and the Single Square Voltage Pulse method. They specifically measured before polarization, after polarization, and integral Q.

Before polarization (BP) is a measure of the electrical conductivity of a meridian. The grounded subjects had a highly significant decrease in BP for all meridians, while sham-grounding did not have a significant result. The decrease in BP suggests reduced inflammation throughout the entire body since it affected all meridians.

After polarization (AP) is a measurement of skin conductance on an acupoint and therefore the stress load of a corresponding organ. Interestingly, all meridians showed a decrease in AP in the grounded subjects, while there was no trend in the sham-grounded group. This indicates that organs had a reduction in stress.

Integral Q (IQ) is a measure of the charge accumulated at an acupoint during an SSVP measurement. IQ is connected to immune system function in the organ that corresponds to that acupoint. In grounded subjects, all meridians had a decreased IQ, while in sham-grounded subjects, all but 2 of the 28 meridians tested had an increased IQ, which occurs normally as a result of relaxation. This implies a slight decrease in immune system activity in the grounded subjects connected with the reduction in inflammation; IE, reduced inflammation means reduced immune activity.

These results are suggestive of a reduction in inflammation and increased relaxation of internal organs.

Source: <http://journals.sfu.ca/seemj/index.php/seemj/article/view/9/7>

## SECTION 4: ATHLETIC PERFORMANCE & RECOVERY

### 4.1 **NEW 2019 STUDY:** Effectiveness of Grounded Sleeping on Recovery After Intensive Eccentric Muscle Loading

Key Points:

- Triple-blind, placebo controlled study by the University of Salzburg, Austria
- Grounded sleeping after intensive eccentric exercise provided the following benefits...
  - Faster recovery
  - Decreased levels of markers of muscle damage and inflammation

- Significantly less pronounced decrease in performance (measured by maximum voluntary isometric contraction and by counter movement jump) [Figure 2 and 3](#)
- Significantly less of an increase in creatine kinase (CK) blood levels. CK is used to measure delayed onset muscle soreness associated with muscle damage (i.e. lower CK = less muscle damage). [Figure 4](#)
- Recovery process modulated by...
  - Maintenance of a constant hemoconcentration (as represented by the number of erythrocytes and the hemoglobin/hematocrit values)
  - Reduction of muscle damage-associated inflammation markers such as IP-10, MIP-1 $\alpha$ , and sP-Selectin

Summary:

Triple-blind, placebo controlled study conducted by the University of Salzburg, Austria. Grounded sleeping was shown to result in faster recovery and decreased levels of markers of muscle damage and inflammation after intensive eccentric exercise.

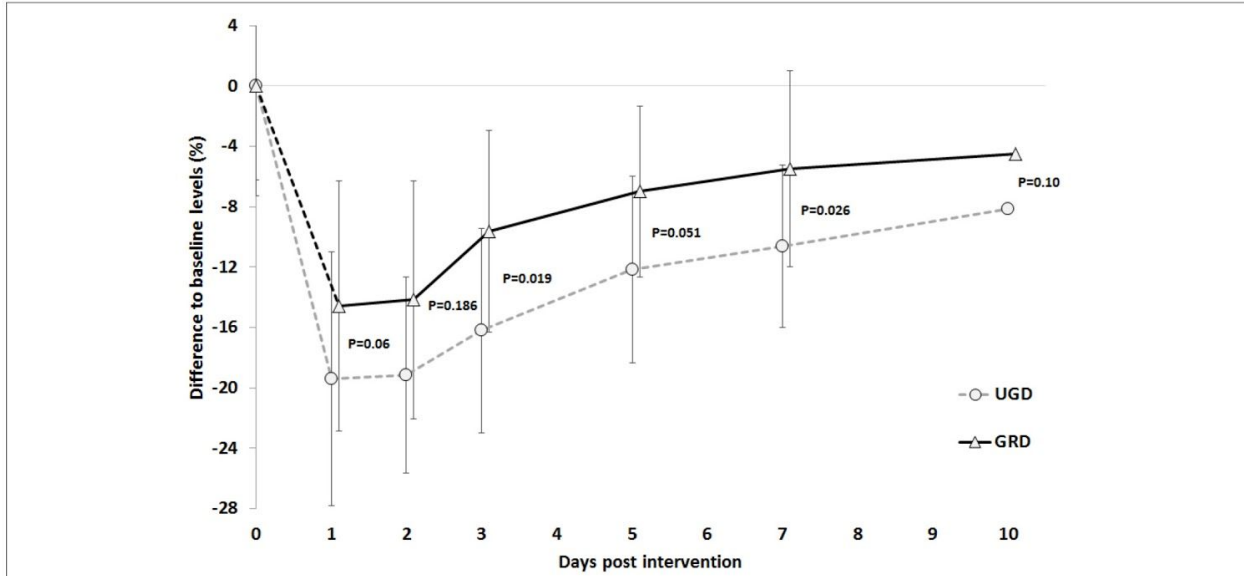
Additionally, participants in the grounded group experienced less pronounced decrease in performance (measured by maximum voluntary isometric contraction and by counter movement jump) and significantly less of an increase in creatine kinase (CK) blood levels versus participants in the sham-grounded control group (all  $P < 0.05$ ). All  $P < 0.05$  is the medical value that must be attained to validate that a result is statistically significant. CK is used to measure delayed onset muscle soreness associated with muscle damage (i.e. lower CK = less muscle damage). [Figure 4](#)

Detailed blood analysis demonstrated that grounded sleeping modulates the recovery process by (a) keeping a constant hemoconcentration, as represented by the number of erythrocytes and the hemoglobin/hematocrit values; and (b) by the reduction of muscle damage-associated inflammation markers such as IP-10, MIP-1 $\alpha$ , and sP-Selectin.

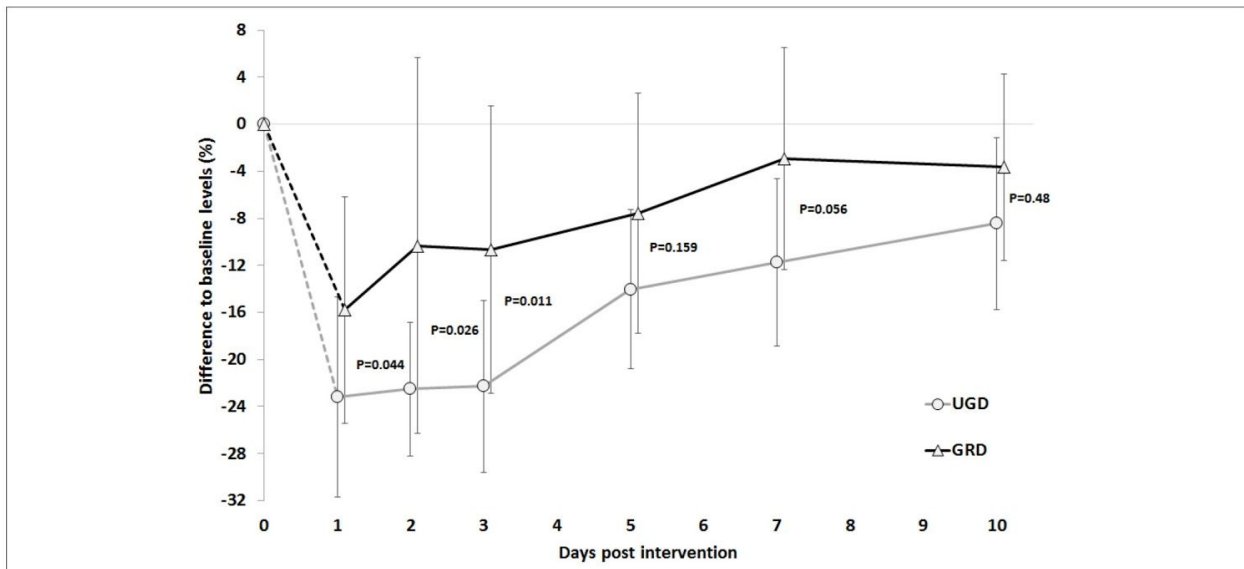
Figure 2 & Figure 3

Figure 2 (see below): Counter movement jump % reductions with respect to baseline during the 10 day period following intensive eccentric exercise. UGD = sham-grounded group; GRD = grounded group

Figure 3 (see below): Isometric maximal strength (for the dominant leg) % reductions with respect to baseline during the 10 day period following intensive eccentric exercise. UGD = sham-grounded group; GRD = grounded group



**FIGURE 2 |** Time course of the % reductions with respect to baseline levels in the counter movement jump (CMJ) across the 10 days post intervention period. UGD, sham-grounded sleeping group; GRD, grounded sleeping group (mean ± SD).



**FIGURE 3 |** Time course of the % reductions with respect to baseline levels in the isometric maximal strength for the dominant leg across the 10 days post intervention period. UGD, sham-grounded sleeping group; GRD, grounded sleeping group (mean ± SD).



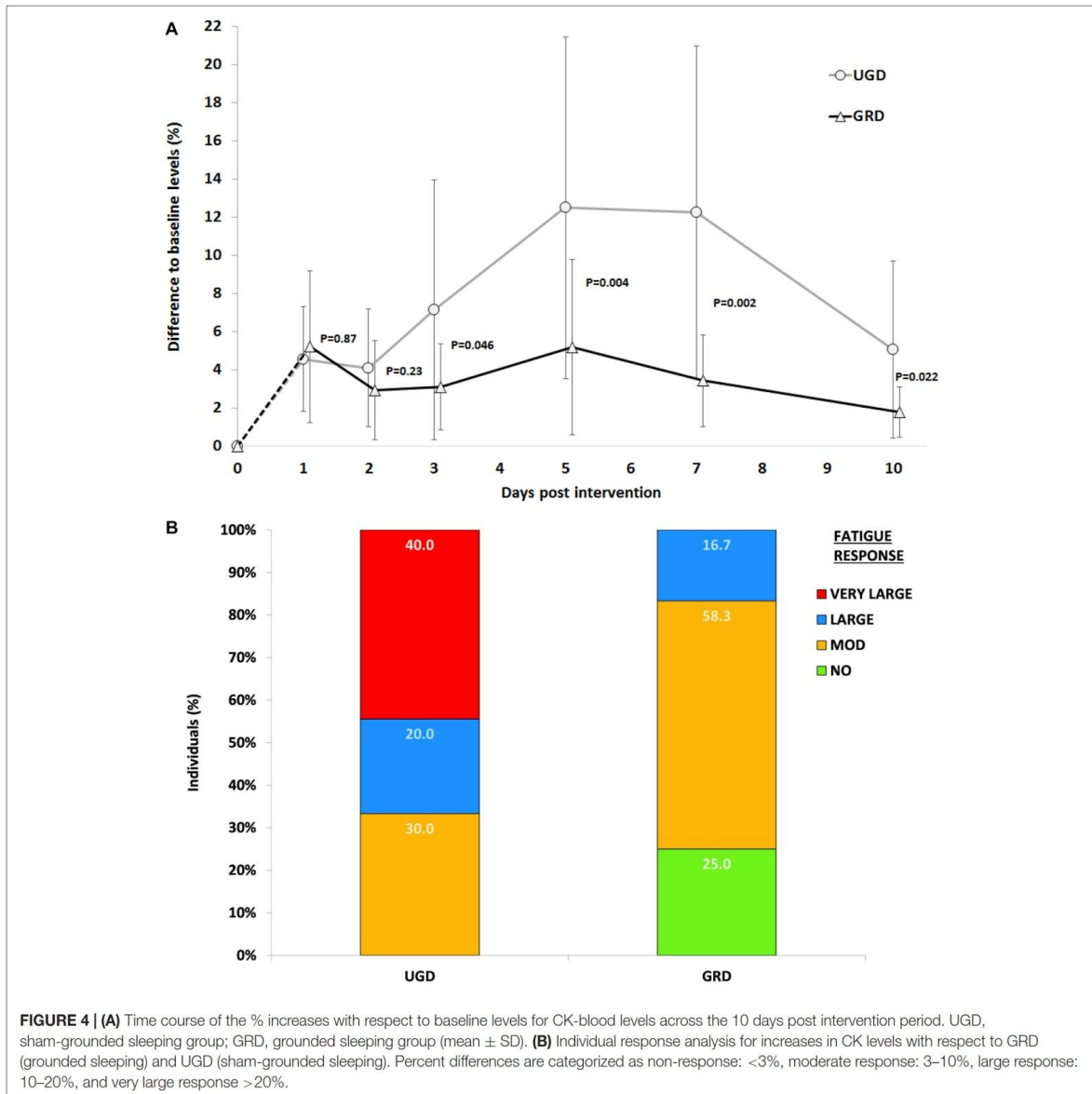
Figure 4

Creatine Kinase Blood Levels Following Intensive Eccentric Exercise

Figure 4A (see below): Creatine kinase (CK) blood level % increase with respect to baseline during the 10 day period following intensive eccentric exercise. UGD = sham-grounded group; GRD = grounded group

Figure 4B (see below): Level of fatigue (based on CK blood level % increase) following intensive eccentric exercise. Categorized as:

- No fatigue response = individuals with less than 3% increase in CK blood level
- Moderate response = individuals with 3% - 10% increase in CK blood level
- Large response = individuals with 10% - 20% increase in CK blood level
- Very large response = individuals with >20% increase in CK blood level



Source: <https://www.frontiersin.org/articles/10.3389/fphys.2019.00035/full>

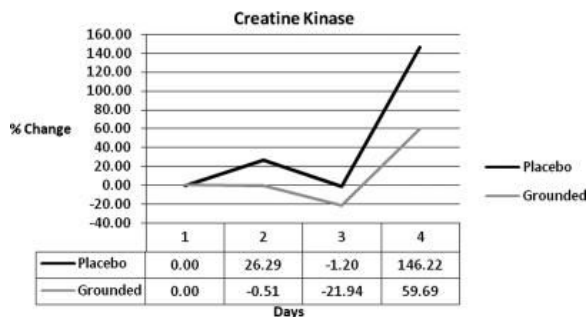
## 4.2 Pilot Study on the Effect of Grounding on Delayed-Onset Muscle Soreness

A study published in 2010 in *The Journal of Alternative and Complementary Medicine* investigated whether grounding would change markers of delayed-onset muscle soreness after eccentric exercise. Eight healthy males, age 20 to 23, were selected. The study was double blind, and rigorous control methods were used. Subjects stayed in a hotel room for the duration of the study. Samples for tests were collected at the exact same time each day. They were given the same food and quantity of food at the same times of day. They did not leave the hotel rooms except for certain tests they were driven to. And they went to bed and got up at the same time each day.

After baseline measurements were taken, each subject performed eccentric toe raises while holding a barbell equal to one third of his bodyweight. The toes were on a platform raised two inches above the heels, and the subject fully extended his foot, held the position for 10 seconds, then returned to the ground, repeating the movement 20 times before a two minute break and then 20 more repetitions. This exercise was designed to produce soreness in the gastrocnemius muscle of each leg. After the exercise, they were either grounded or sham-grounded for the remainder of the study using both electrode patches and full body grounding.

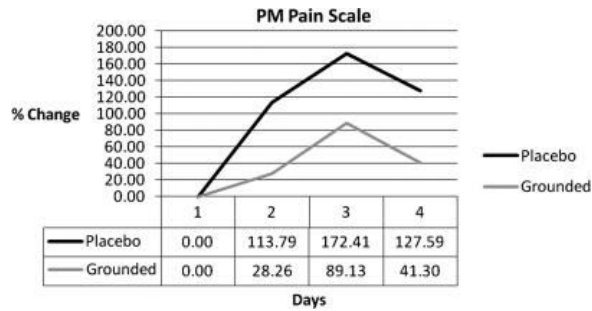
### Creatine Kinase

Creatine kinase is a marker of muscle damage from exercise. The sham-grounded group always had higher levels of creatine kinase than the grounded group, by 27%, 21%, and 87% on days two, three, and four, respectively.

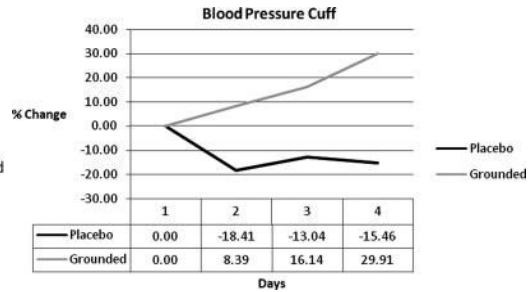


### Pain

Pain was measured using a subjective scale, the Visual Analogue Pain Scale, and an objective method in which the gastrocnemius muscle was put under pressure with a blood pressure cuff until subjects asked for the pressure to stop increasing due to acute pain. The sham-grounded group had higher subjective pain each day, by 86%, 83%, and 86% on days two, three, and four, respectively. The grounded group was able to tolerate greater pressure on the gastrocnemius muscle from the blood pressure cuff due to decreased pain, by 26%, 29%, and 45%, respectively.



PM Pain Scale = Visual Analogue Pain Scale



### White Blood Cells

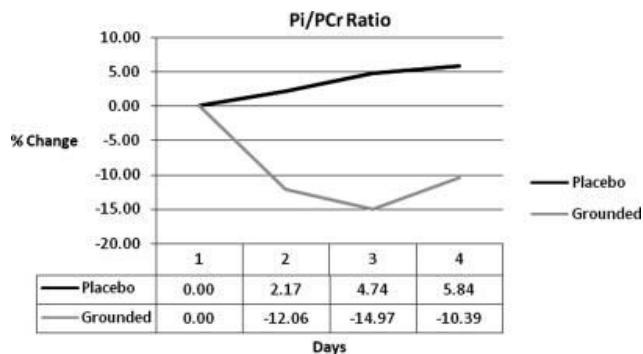
Total white blood cells, neutrophils, and lymphocytes were all lower in the grounded subjects compared to the sham-grounded subjects, suggesting that fewer of these cells were required for healing.

### Bilirubin

Both groups had a drop in bilirubin levels, but the drop was much smaller in the grounded subjects, by 27%, 26%, and 26% on days two, three, and four, respectively. Bilirubin can be used to neutralize free radicals, and so grounding may have reduced the amount of bilirubin that was used up for that purpose in the grounded subjects.

### Inorganic Phosphorus/Phosphocreatine Ratio

The Pi/PCr ratio is used as a measure of cell damage and metabolic rate. During energy conversion, inorganic phosphorus is separated from phosphocreatine, increasing the Pi/PCr ratio. The sham-grounded group had higher levels of inorganic phosphorus, while the grounded group had higher levels of phosphocreatine, suggesting a reduced requirement for energy production because the muscle tissue was already closer to homeostasis in the grounded group. The difference in the Pi/PCr ratio in the two groups was 13%, 20%, and 16% on days two, three, and four, respectively.



### Glycerolphosphorylcholine and Phosphorylcholine

Glycerolphosphorylcholine (GPC) and phosphorylcholine (PC) levels were both higher in grounded subjects compared to sham-grounded subjects.

GPC has numerous important functions in the body:

- Choline donor
- Increases acetylcholine levels in motor units

- Essential in phospholipids, which are a major part of all cellular membranes
- Plays an important role in the release of human growth hormone
- Aids in sarcoplasmic reticulum transport of  $Ca^{2+}$
- Supplementation with GPC delayed cognitive impairment in one study

In a different study, PC reduced the number of foam cells, which are a result of inflammation.

The results of this study show that grounding is a promising modality for speeding up recovery from delayed-onset muscle soreness after exercise.

Source:

<https://www.ultimatelongevity.com/docs/Grounding-Delayed-Onset-Muscle-Soreness.pdf>

#### **4.3 Differences in Blood Urea and Creatinine Concentrations in Earthed and Unearthed Subjects during Cycling Exercise and Recovery**

A 2013 double blind study published in *Evidence Based Complementary and Alternative Medicine* found that when subjects were grounded during a 30 minute cycling session and for 40 minutes afterward, they had significantly lower blood urea levels. This suggests that grounding either reduces the breakdown of protein in the liver during exercise, or that it increases the rate at which the kidneys are able to eliminate urea. If grounding does reduce the breakdown of protein in the liver and in other tissues, it could help athletes to maintain or increase lean muscle mass.

Sources:

HTML Version: <https://www.hindawi.com/journals/ecam/2013/382643/>

PDF Version: <http://downloads.hindawi.com/journals/ecam/2013/382643.pdf>

#### **4.4 Grounding After Moderate Eccentric Contractions Reduces Muscle Damage**

A 2015 study published in the *Open Access Journal of Sports Medicine* investigated the effect of grounding on recovery after moderate eccentric exercise. All the subjects performed 200 half-knee bends (squats) in 10 minutes, holding each knee bend for two seconds. Subjects were either grounded or sham-grounded for four hours immediately after the exercise and four hours on the following day. The experiment was double blind.

On the second day, the sham-grounded group had a significant increase in blood levels of creatine kinase, while the grounded group did not. Creatine kinase in the blood comes from muscle cells, where it leaks out because of weakened cell membrane integrity and mechanical damage. The more intense the exercise and thus the more injured the muscle tissue is, the higher the level of creatine kinase will be. Therefore, since grounding reduced blood levels of creatine kinase after eccentric exercise, it was protective of the muscle tissue.

Source:

<https://www.dovepress.com/grounding-after-moderate-eccentric-contractions-reduces-muscle-damage-peer-reviewed-fulltext-article-OAJSM>

## SECTION 5: LINKS TO GROUNDING STUDIES THAT HAVE NOT BEEN SUMMARIZED

### 5.1 The Neuromodulative Role of Earthing

<https://www.sciencedirect.com/science/article/abs/pii/S0306987711003641>

### 5.2 Earthing the Human Organism Influences Bioelectrical Processes

<https://www.ultimatelongevity.com/docs/Earthing-Bioelectric-Processes.pdf>

### 5.3 Effects of Grounding on Body Voltage and Current in the Presence of Electromagnetic Fields

<https://www.ultimatelongevity.com/docs/Earthing-Body-Voltage-Electromagnetic-Fields.pdf>

### 5.4 Effect of a Conductive Patch & Bed Pad in Reducing Human Body Voltage

<https://www.ultimatelongevity.com/docs/Earthing-Body-Voltage-Reduction.pdf>