THE EFFECTS OF GROUNDING (EARTHING) ON BODYWORKERS' PAIN AND OVERALL QUALITY OF LIFE: A RANDOMIZED CONTROLLED TRIAL

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Background: It is well known that massage therapists routinely develop a number of health problems related to their profession.

Purpose: To determine the effects of grounding on massage therapists' quality of life and pain. Grounding, refers to being in direct body contact with the ground, such as walking barefoot on humid soil or on grass.

Setting: The Chopra Center for Well-Being in Carlsbad, California, USA.

Participants: Sixteen massage therapists (mean age 42.8 years).

Research design and intervention: A stepped wedge cluster design was incorporated into a 6-week double-blind Randomized Controlled Trial (RCT) procedure with massage therapists assigned randomly into one of two cohorts. Therapists were not grounded for the first week, were grounded while working on clients and at home while sleeping for the next four weeks, and then ungrounded for the last week.

Outcome measures: Prior to, during, and immediately following the intervention, participants completed standardized questionnaires reporting on pain, physical function, anxiety, depression, fatigue/tiredness, sleep disturbance and number of hours of sleep, number of clients worked on per working day, energy, and emotional and mental stress.

Results: As a group, therapists experienced significant increases in physical function and energy and significant decreases in fatigue, depressed mood, tiredness and pain while grounded as compared to not being grounded. At one-month following the study, physical function was also increased and depressed mood and fatigue were decreased.

Conclusions: We observed consistent beneficial effects of grounding in domains highly relevant to massage therapists, namely pain, physical function, and mood. These findings, combined with prior results from this trial indicating improvements in inflammatory biomarkers, blood viscosity and heart rate variability (HRV), suggest that grounding is beneficial to massage therapists in multiple domains relevant to their occupation, supporting overall health and quality of life.

Keywords: Grounding, Earthing, Bodyworkers, Massage therapists, Pain, Sleep disorders

INTRODUCTION

Bodyworkers' burnout

It is well documented that massage therapists develop a number of health problems if they do not adopt appropriate self-care techniques.[1–3] Bodyworkers, for example, are prone to develop tendonitis, painful fingers, hands, wrists, elbows and shoulders, carpal tunnel syndrome, and a host of other work-related injuries.[4] Each of these problems produce inflammation-related pain.[5–7] These realities of daily work life, and the lack of effective relief, prompt many massage therapists to prematurely retire from the profession they love; they "burnout".[8–9]

Grounding (earthing)

Grounding refers to being in direct body contact with the ground (earth). Grounding includes walking barefoot on humid soil or grass, swimming in the ocean, or using grounding equipment such as grounding mats and sheets indoors which are designed to connect the body to the earth.[10–12] Methods of grounding utilizing products include plugging the equipment into the grounding system of a building or connecting to a rod planted in the ground outside.

Previously reported benefits from grounding include reduced inflammation (both chronic and acute), improved sleep, normalization of cortisol levels, decreased stress (both physiological as well as psychological), decreased blood viscosity, faster recovery from muscle damage during exercise, improved blood circulation, wellness and positive mood.[10–12]

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Bodyworkers and grounding

Prior unpublished anecdotal evidence provided by massage therapists indicated that being grounded while they work helps alleviate the pain and stress associated with their profession. This randomized double-blind study was designed to systematically evaluate these existing anecdotal reports. Specifically, the aim of this current study was to examine the effectiveness of being grounded on pain and quality of life experienced by massage therapists. Physiological findings from this intervention trial have been previously published.[13]

MATERIAL AND METHODS

Subjects

The study was conducted at the Chopra Center for Wellbeing in Carlsbad, California, U.S.A., under the supervision of BioMed IRB of San Diego, California (http://biomedirb.com/). Sixteen (16) healthy massage therapists with at least one year of experience were recruited. All of the routinely used massage techniques at the Chopra Center were included in this project, including traditional Ayurvedic treatments utilizing herbalized oils, classical Ayurvedic massage strokes and energy points. The massage protocols themselves were individualized for each person and included a combination of the following treatments: Odyssey (a combination of various Ayurvedic massage techniques), Gandharva, Oshadhi, Shirodhara, Swedana, Shiro-Abhyanga-Nasya, Netra, Marma and Srota.

Grounding methods and equipment

Grounding at the Chopra Center was accomplished using two grounding mats: a grounding mat that was placed directly under a massage table sheet and a larger separate grounding mat that was placed on the floor around the massage table. Both grounding mats were bound together and connected to the grounding hole of one of the massage room's power outlet using a single grounding cord, after checking that the power outlet ground was working properly. Grounding at the therapist's home during sleep was accomplished with a grounding tummy band or a grounding sleeping mat (www.earthing.com, Thousand Palms, CA) connected to the ground hole of a power outlet in the bedroom by a grounding cord, after checking that the room's power outlet ground was working properly. The trial period was 6 weeks. Subjects were blinded to grounding by receiving different "grounding" cords at the start of each week of the study. On weeks 1 and 6, they received number coded "inactive" grounding cords that did not ground them (control), while during weeks 2–5 they received number coded "active" grounding cords that did ground them.

Questionnaires

1. Chopra Center Eligibility/Health History Form
   The Chopra Center Eligibility/Health History Form (CCEHH) was developed by medical doctors at the Chopra Center for Wellbeing. The form included questions regarding past medical history, medications, family history and social history.
2. McGill Pain Questionnaire
   The McGill Pain Questionnaire (MPQ) is a classic test for pain measurement. It was developed in 1975 by Melzack at McGill University, Montréal, Canada.[14] The Short Form was used in this study.[15] The MPQ has numerous adjectives describing different aspects of pain, from mild to extremely severe. The MPQ has three pain rating scores: (a) a pain rating index (PRI) score based on the rank values of the words; (b) a score based on the number of words chosen (NWC); and (c) a score describing the present pain intensity (PPI).
3. PROMIS -29
   The PROMIS-29, which was developed with funding from the National Institutes of Health, assesses wellbeing, including domains of depression, anxiety, physical function, pain, fatigue, sleep, and social roles and activities (http://www.healthmeasures.net/explore-measurement-systems/promis).
4. Daily Wellbeing Log Form
   After each day of work, massage therapists answered 6 questions from a log form that was developed by the authors in collaboration with the Director of Massage Services at the Chopra Center. The questions were: (1) how many clients did you work on today compared to the usual; (2) how well did you recover between clients compared to the usual; (3) how tired did you feel at the end of the day compared to the usual; (4) how much energy did you have at the end of the day compared to the usual; (5) how much emotional stress did you experience at the end of the day compared to the usual; and (6) how much mental stress did you experience compared to the usual. Their choices of answer for each question were: 1 = much less; 2 = a bit less; 3 = as usual; 4 = a bit more; and 5 = a lot more. There was a seventh question asking how many hours they slept the previous night.

Study procedures and design

After providing written informed consent, subjects completed the CCEHH, MPQ and the PROMIS-29. Subjects again completed the PROMIS-29 at the end of week 5 and week 6, and one month after the end of their participation. The MPQ and the Daily Log Form were completed at the end of each work day. Subjects were instructed how to use the grounding equipment and received two number coded cords, one to be used at home and the other to be used in the massage rooms.

At the end of the first week, a study staff member collected the completed MPQ and Daily Log forms, took back the two cords and gave subjects two new cords coded with different numbers. The process of exchanging cords with new cords coded with different numbers was repeated every week. This process was used to maintain the double-blind nature of the study. At the end of the study, comments from the massage therapists related to their participation were noted.

A stepped wedge cluster design was incorporated into the double-blind Randomized Controlled Trial (RCT) procedure developed for this study. In a stepped wedge design, an intervention is rolled-out sequentially to the trial subjects (either as individuals or clusters of individuals) over a number of time periods.[16,17] The order in which the individuals or clusters receive the intervention is determined at random and, by the end of the random allocation, all individuals or groups will have received the intervention. This design incorporates data collection at each point where a new group (step) receives the intervention. The stepped wedge design is often used: (1) when it is anticipated from previous research that the intervention will produce rapid results, (2) when there is a high likelihood the intervention will do more good than harm (making a design where participants do not receive the intervention unethical), and (3) because the design benefits recruitment since all study participants receive the active intervention. In addition, for this particular study, for logistical reasons, it was not possible to deliver the intervention to all 16 massage therapists simultaneously. The multi-week design also offered the opportunity to model the effects of time on the effectiveness of grounding.[16,17] Subjects were randomly assigned to one of two clusters, or cohorts (A or B). The duration of each cohort's participation was 6 weeks and was divided as follows (Fig. 1):

- First week of participation subjects were not grounded.
- The next 4-week period they were grounded.
- The last week they were not grounded.

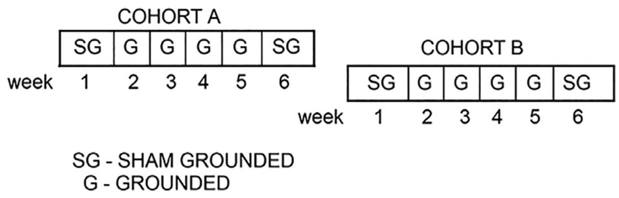

Fig. 1. Intervention sequences for each cohort.

Cohort B participation started after Cohort A ended their participation. This project had two interventions, grounding and sham-grounding; each intervention was identified by a number coded band placed around the cord. The intervention the number code represented was not known to the massage therapists, study staff and researchers; the code was known only to the person who prepared the cords, who was off-site. All cords looked alike, except for the number on the coding band. The intervention represented by the numbers on the coding bands was revealed only after the last cohort had completed their participation and after all the forms were received by the principal investigator (PI).

Data analysis

Data analysis was performed using NCSS/PASS 2000 edition licensed with Dawson's book: Basic and Clinical Biostatistics, Third Edition, McGraw-Hill, New York, 2001. For each variable, descriptive statistics (average (Ave) and standard deviation (SD)) were calculated. Chi-square was used to determine significance between cohorts' gender distribution. Parametric mean comparisons were performed using *t*-test for differences in means or Aspin-Welch Unequal-Variance test. When the assumption of a normal distribution did not hold, non-parametric statistical tests were used including: Wilcoxon Signed-Rank Test for difference in means, Quantile (Sign) Test, and Wilcoxon Rank-Sum Test for difference in means. Correlations were calculated using Pearson's correlation coefficient adjusted for sample size. In this paper, the threshold for statistical significance is 0.05. Even though results with $p < 0.10$ are not statistically significant, they are included for potential interest to researchers planning to replicate this study.

RESULTS

Anthropometric information, including age, gender and body mass index (BMI), are presented in Table 1. The average age between genders was similar. The age range for females was 30−55 years and for males 34−54 years. Female massage therapists represented 69% of the subjects. Despite the randomization process, Cohort B had only one male subject while Cohort A had an even number of female and male subjects. However, there was not a significant gender difference between the two cohorts as indicated by Chi-square analysis. Also, there was not a significant difference in age between the two Cohorts. BMI was significantly lower for females.

The average number of massages per day for every week and each cohort is presented in Table 2. Notice that on week 2 massage therapists of Cohort A and B performed only one massage and 1.76 massages per day, their respective lowest number of massages per day of all weeks.

PROMIS -29

Physical function

Physical function was increased significantly one month after the end of participation for both cohorts combined. Cohort A physical function increased significantly at the end of week 5 (End W5) compared to before the beginning of their participation (Start W1) and also one month after the end of their participation (> 1 month) (Table 3).

Anxiety

Anxiety decreased significantly at the end of week 5 for Cohort B; this was true also for both cohorts combined.

Depression

Both cohorts combined (A+B) were significantly less depressed at week 5, week 6 and one month later compared to the beginning of their participation. Cohort B was significantly less depressed at the end of week 5 and one month after the end of their participation compared to before their participation.

Fatigue

Both cohorts combined showed significantly less fatigue at week 5 and one month after the end of the study. It can also be

Table 1. Age, gender and BMI characteristics of the participants

A+B *Gender*	*N*	%	A *Gender*	*N*	%	B *Gender*	*N*	%
Female	11	68.8%	Female	4	25.0%	Female	7	43.8%
Male	5	31.3%	Male	4	25.0%	Male	1	6.3%
Total	16	100.0%	Total	8	50.0%	Total	8	50.0%
Age	***Years***	**BMI (kg/m^2)**	***Age***	***Years***	**BMI (kg/m^2)**	***Age***	***Years***	**BMI (kg/m^2)**
Female			***Female***			***Female***		
Ave (SD):	42.5 (8.0)	20.7 (1.5)	Ave (SD):	39.8 (2.2)	20.3 (1.7)	Ave (SD):	44.1 (9.7)	20.8 (1.4)
Male			***Male***			***Male***		
Ave (SD):	43.4 (7.5)	24.8 (3.0)	Ave (SD):	42.5 (8.3)	24.8 (3.5)	Ave (SD):	47 (N/A)	25.1 (N/A)
Combined			***Combined***			***Combined***		
Ave (SD):	42.8 (7.6)	22.0 (2.8)	Ave (SD):	41.1 (5.8)	22.6 (3.5)	Ave (SD):	44.5 (9.1)	21.4 (2.0)

Table 2. Average number of massages per day for every week

Number of massages		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	All Weeks
Cohort A	***Average:***	3.21	1.00	3.40	2.58	3.16	1.94	2.55
	SD:	0.37	0.00	0.45	0.76	0.62	0.82	0.50
Cohort B	***Average:***	3.34	1.76	3.10	3.06	2.09	3.25	2.77
	SD:	0.64	0.34	0.62	0.42	0.48	0.79	0.55
Cohort A+B	***Average:***	3.27	1.38	3.25	2.82	2.62	2.59	2.66
	SD:	0.51	0.46	0.55	0.64	0.77	1.03	0.66

Table 3. Within cohort PROMIS-29 results

		Averages (SD)				Probabilities[a]		
Domain	Cohort	Start W1	End W5	End W6	> 1 month	End W5	End W6	> 1 month
Physical function	**A**	52.1 (6.8)	56.9 (0.0)	54.1 (5.4)	53.0 (8.3)	**0.004**	**0.055**	**0.035**
	B	51.4 (6.0)	52.1 (5.1)	48.3 (10.2)	52.0 (5.5)	**0.273**	**0.250**	**0.145**
	A+B	51.8 (6.2)	54.5 (4.3)	51.2 (8.4)	52.5 (6.8)	**0.070**	**0.377**	**0.011**
Anxiety	**A**	55.8 (8.6)	56.7 (3.2)	57.3 (4.7)	54.2 (6.8)	**0.363**	**0.219**	**0.305**
	B	56.4 (7.0)	48.6 (8.2)	53.1 (4.0)	52.5 (7.1)	**0.018**	**0.134**	**0.076**
	A+B	56.1 (7.6)	52.7 (7.3)	55.2 (4.7)	53.4 (6.8)	**0.038**	**0.315**	**0.080**
Depression	**A**	53.1 (6.0)	50.8 (7.0)	50.3 (6.9)	47.9 (8.5)	**0.213**	**0.209**	**0.057**
	B	50.7 (7.8)	45.0 (5.7)	45.3 (6.1)	46.5 (6.6)	**0.003**	**0.061**	**0.045**
	A+B	51.9 (6.8)	47.9 (6.9)	47.8 (6.8)	47.2 (7.4)	**0.010**	**0.040**	**0.006**
Fatigue	**A**	55.5 (4.9)	50.4 (4.2)	51.5 (6.8)	50.0 (5.2)	**0.012**	**0.035**	**0.004**
	B	54.4 (5.4)	52.4 (6.3)	50.8 (9.5)	52.8 (7.7)	**0.180**	**0.221**	**0.325**
	A+B	55.0 (5.0)	51.4 (5.3)	51.2 (8.0)	51.4 (6.5)	**0.012**	**0.062**	**0.018**
Sleep disturbance	**A**	50.0 (7.3)	47.7 (5.4)	48.5 (7.6)	46.9 (6.2)	**0.232**	**0.081**	**0.156**
	B	52.7 (7.1)	47.2 (7.1)	49.3 (8.9)	49.5 (6.4)	**0.015**	**0.191**	**0.131**
	A+B	51.3 (7.1)	47.5 (6.1)	48.9 (8.0)	48.2 (6.3)	**0.023**	**0.060**	**0.054**
Satisf with social role	**A**	49.1 (6.9)	50.6 (5.9)	50.2 (5.5)	53.9 (9.6)	**0.273**	**0.331**	**0.050**
	B	46.6 (9.7)	47.4 (6.7)	49.9 (12.7)	49.5 (8.1)	**0.379**	**0.156**	**0.212**
	A+B	47.9 (8.2)	49.0 (6.3)	50.1 (9.4)	51.7 (8.9)	**0.263**	**0.135**	**0.041**
Pain interference	**A**	49.1 (7.2)	50.1 (5.6)	50.0 (7.8)	48.7 (7.8)	**0.310**	**0.369**	**0.363**
	B	53.6 (6.0)	51.8 (9.7)	56.8 (11.7)	50.4 (7.6)	**0.348**	**0.260**	**0.143**
	A+B	51.3 (6.9)	51.0 (7.7)	53.4 (10.2)	49.5 (7.5)	**0.440**	**0.223**	**0.163**
Pain intensity	**A**	2.5 (2.3)	2.0 (1.1)	1.8 (1.2)	1.9 (1.6)	**0.358**	**0.122**	**0.194**
	B	2.5 (1.9)	2.8 (2.0)	3.9 (3.2)	2.5 (1.3)	**0.335**	**0.126**	**0.442**
	A+B	2.5 (2.0)	2.4 (1.6)	2.8 (2.6)	2.2 (1.4)	**0.403**	**0.322**	**0.194**

Start W1 = domain values at the beginning of week 1, End W5 = domain values at the end of week 5, End W6 = domain values at the end of week 6, > 1 month = domain values one month after the end of the study, A+B = both cohorts combined values.

[a]All probabilities are calculated against **Start W1.**

observed that Cohort A was less fatigued at week 5, week 6, and one month later than at the beginning of their participation.

Sleep disturbance

Sleep disturbance decreased significantly at week 5 for Cohort B and both cohorts combined.

Satisfaction with social role

Cohort A and both cohorts combined show a significant increase in satisfaction with social role one month following completion of the study.

Looking next at comparisons between cohorts (Table 4), it can be observed that both cohorts had similar average scores at the beginning of their participation for all eight domains measured by PROMIS-29 (depression, fatigue, sleep disturbances, and satisfaction with social role were omitted from Table 4 because there was no significant result; probabilities are presented in the rows entitled *AvsB (p)*). It can be observed that both physical function and anxiety were significantly higher for Cohort A compared to Cohort B at the end of week 5. Anxiety was also significantly higher for Cohort A when comparing the combined average score results of week 1, week 5, week 6 and one month after the end of their participation (column labeled "All" in Table 4). When combining the results of all weeks and one month later, pain interference was significantly higher for Cohort B compared to Cohort A.

Table 4. Between cohort PROMIS-29 results

Domain	Cohort	Averages (SD)				
		Start W1	End W5	End W6	> 1 month	All
Physical function	**A**	52.1 (6.8)	56.9 (0.0)	54.1 (5.4)	53.0 (8.3)	54.2 (5.9)
	B	51.4 (6.0)	52.1 (5.1)	48.3 (10.2)	52.0 (5.5)	51.7 (6.5)
	AvsB (p)	**0.908**	**0.032**	**0.205**	**0.465**	**0.057**
Anxiety	**A**	55.8 (8.6)	56.7 (3.2)	57.3 (4.7)	54.3 (6.8)	55.1 (7.0)
	B	56.4 (7.0)	48.6 (8.2)	53.1 (4.0)	52.5 (7.1)	52.9 (7.3)
	AvsB (p)	**0.833**	**0.027**	**0.078**	**0.460**	**0.046**
Pain interference	**A**	49.1 (7.2)	50.1 (5.6)	50.0 (7.8)	48.7 (7.8)	49.1 (6.8)
	B	53.6 (6.0)	51.8 (9.7)	56.8 (11.7)	50.4 (7.6)	52.6 (8.8)
	AvsB (p)	**0.164**	**0.679**	**0.192**	**0.680**	**0.048**
Pain intensity	**A**	2.5 (2.3)	2.0 (1.1)	1.8 (1.2)	1.9 (1.6)	2.1 (1.5)
	B	2.5 (1.9)	2.8 (2.0)	3.9 (3.2)	2.5 (1.3)	2.9 (2.1)
	AvsB (p)	**0.957**	**0.510**	**0.114**	**0.303**	**0.076**

MCGILL PAIN QUESTIONNAIRE (MPQ)

Daily MPQ values for each subject and for each of the 3 pain scales were averaged every week and their average values compared to the average values at week 1 (W1; Table 5).

PRI (pain rating index)

It can be observed that Cohort A PRI average score at week 5 (W5) and week 6 (W6) were significantly lower compared to W1. This was the case also for both cohorts combined (A+B) at W5.

NWC (number of pain adjectives chosen)

Similar results were obtained with the number of pain adjectives chosen (NWC) where Cohort A NWC average score at W5 and W6 were significantly lower compared to W1. This was the case also for both cohorts combined (A+B) at W2 and W5.

PPI (present pain intensity)

Both Cohort A and A+B had lower average pain scores at W5, respectively.

Next, comparing average pain scores between cohorts (Table 6) leads to the conclusion that Cohort B experienced significantly higher pain levels for all weeks combined (column entitled “All Ws”) and for all three pain scores. Additionally, PPI at W3 was significantly higher for Cohort B compared to the PPI average value for Cohort A. Except at W4 for PRI and NWC, when females reported to experience more pain than males, there was no statistical difference in pain between females and males.

DAILY LOG FORM

Table 7 presents within cohorts average score results for each of the seven questions subjects answered at the end of each day of work. These results were obtained by averaging daily scores and compiling them into a weekly average for each subject and each question. Since weeks 2–5 were grounded weeks, these weeks were combined into a week 2–5 (W2–5) average score for each question. From their answers to question 1 (Q1), it can be seen that each cohort worked on significantly fewer clients on average at W2–5 compared to W1 and this was true for both cohorts combined. Cohort A worked on a significantly lower number of clients at W6 compared to W1 and this was also true for both cohorts combined. Interestingly, Cohort A worked on a significantly lower number of clients on W6 compared to W2–5 while Cohort B worked on significantly more clients comparing the same periods.

Table 5. Pain Score results within cohorts

Pain score	Cohort	Averages (SD)						Probabilities[a]				
		W1	W2	W3	W4	W5	W6	W2	W3	W4	W5	W6
PRI	**A**	6.5 (4.6)	5.0 (3.5)	6.8 (8.8)	5.6 (7.6)	3.5 (3.4)	2.8 (2.6)	**0.166**	**0.363**	**0.145**	**0.012**	**0.025**
	B	10.0 (10.3)	7.5 (4.9)	11.1 (5.7)	7.6 (3.9)	8.2 (8.6)	11.7 (11.5)	**0.214**	**0.273**	**0.261**	**0.259**	**0.308**
	A+B	8.2 (7.9)	6.2 (4.3)	9.0 (7.5)	6.6 (5.9)	5.8 (6.8)	7.2 (9.3)	**0.202**	**0.365**	**0.227**	**0.049**	**0.122**
NWC	**A**	3.2 (2.2)	2.2 (1.6)	2.8 (3.5)	2.9 (3.5)	1.8 (1.5)	1.6 (1.2)	**0.074**	**0.145**	**0.145**	**0.004**	**0.019**
	B	5.0 (4.3)	3.9 (2.8)	5.5 (3.2)	4.4 (2.1)	4.3 (3.8)	5.2 (4.5)	**0.153**	**0.371**	**0.325**	**0.255**	**0.461**
	A+B	4.1 (3.4)	3.1 (2.4)	4.1 (3.5)	3.7 (2.9)	3.1 (3.1)	3.4 (3.7)	**0.042**	**0.227**	**0.258**	**0.032**	**0.077**
PPI	**A**	1.3 (0.6)	0.9 (0.8)	1.2 (0.7)	1.1 (0.7)	0.8 (0.5)	1.0 (0.8)	**0.107**	**0.344**	**0.258**	**0.012**	**0.131**
	B	1.6 (0.8)	1.6 (0.6)	1.9 (0.5)	1.6 (0.4)	1.4 (0.8)	1.8 (0.8)	**0.436**	**0.124**	**0.391**	**0.244**	**0.213**
	A+B	1.4 (0.7)	1.3 (0.7)	1.6 (0.7)	1.4 (0.6)	1.1 (0.7)	1.4 (0.9)	**0.171**	**0.233**	**0.378**	**0.008**	**0.397**

[a]All probabilities are calculated against **W1.**

Table 6. Pain score results between cohorts

Pain score	Cohort	Averages (SD)						
		W1	W2	W3	W4	W5	W6	All Ws
PRI	**A**	6.5 (4.6)	5.0 (3.5)	6.8 (8.8)	5.6 (7.6)	3.5 (3.4)	2.8 (2.6)	5.0 (5.5)
	B	10.0 (10.3)	7.5 (4.9)	11.1 (5.7)	7.6 (3.9)	8.2 (8.6)	11.7 (11.5)	9.3 (7.7)
	AvsB (p)	**0.798**	**0.188**	**0.083**	**0.141**	**0.183**	**0.058**	**0.0009**
NWC	**A**	3.2 (2.2)	2.2 (1.6)	2.8 (3.5)	2.9 (3.5)	1.8 (1.5)	1.6 (1.2)	2.4 (2.4)
	B	5.0 (4.3)	3.9 (2.8)	5.5 (3.2)	4.4 (2.1)	4.3 (3.8)	5.2 (4.5)	4.7 (3.4)
	AvsB (p)	**0.307**	**0.157**	**0.058**	**0.066**	**0.114**	**0.059**	**0.00005**
PPI	**A**	1.3 (0.6)	0.9 (0.8)	1.2 (0.7)	1.1 (0.7)	0.8 (0.5)	1.0 (0.8)	1.1 (0.7)
	B	1.6 (0.8)	1.6 (0.6)	1.9 (0.5)	1.6 (0.4)	1.4 (0.8)	1.8 (0.8)	1.7 (0.7)
	AvsB (p)	**0.711**	**0.076**	**0.028**	**0.102**	**0.090**	**0.051**	**0.00003**

Table 7. Average score results within cohorts for each question

Question	Week	Cohort A			Cohort B			Cohort A+B		
		W1	W2–5	W6	W1	W2–5	W6	W1	W2–5	W6
Q1		3.23 (0.65)	2.71 (1.11)	1.38 (0.72)	3.26 (1.15)	2.56 (1.07)	3.61 (0.85)	3.25 (0.95)	2.63 (1.09)	2.60 (1.38)
	W1		**0.027**	< **0.000001**		**0.002**	**0.142**		**0.0002**	**0.011**
	W2–5			**0.000013**			**0.00009**			**0.376**
Q2		3.08 (0.89)	3.34 (0.85)	3.38 (0.81)	3.23 (0.70)	3.19 (0.86)	2.78 (1.06)	3.21 (0.80)	3.26 (0.86)	3.06 (0.98)
	W1		**0.082**	**0.136**		**0.146**	**0.018**		**0.343**	**0.212**
	W2–5			**0.419**			**0.115**			**0.110**
Q3		2.81 (0.98)	2.32 (1.03)	3.00 (1.10)	2.90 (0.94)	2.86 (1.07)	2.83 (1.10)	2.86 (0.95)	2.61 (1.08)	2.91 (1.08)
	W1		**0.015**	**0.275**		**0.426**	**0.355**		**0.055**	**0.443**
	W2–5			**0.011**			**0.375**			**0.082**
Q4		3.12 (0.86)	3.57 (0.99)	3.19 (1.22)	3.00 (0.89)	3.00 (1.02)	3.00 (1.14)	3.05 (0.87)	3.27 (1.04)	3.09 (1.16)
	W1		**0.018**	**0.452**		**0.460**	**0.478**		**0.066**	**0.456**
	W2–5			**0.083**			**0.493**			**0.170**
Q5		2.65 (0.94)	2.83 (1.01)	2.44 (0.81)	2.77 (0.88)	2.64 (0.78)	2.89 (1.02)	2.72 (0.90)	2.52 (0.90)	2.68 (0.94)
	W1		**0.077**	**0.218**		**0.245**	**0.328**		**0.071**	**0.415**
	W2–5			**0.339**			**0.136**			**0.180**
Q6		2.54 (0.91)	2.39 (0.91)	2.31 (0.95)	2.77 (0.92)	2.66 (0.83)	3.06 (1.00)	2.67 (0.91)	2.54 (0.88)	2.71 (1.03)
	W1		**0.236**	**0.222**		**0.263**	**0.161**		**0.166**	**0.406**
	W2–5			**0.371**			**0.051**			**0.157**
Q7		8.50 (0.00)	7.71 (0.84)	7.28 (1.64)	7.34 (1.25)	7.52 (1.08)	8.00 (1.32)	7.38 (1.25)	7.61 (0.97)	7.66 (1.50)
	W1		**0.094**	**0.125**		**0.292**	**0.044**		**0.255**	**0.202**
	W2–5			**0.270**			**0.135**			**0.362**

Regarding recovery (question 2 or Q2), there was not much change between weeks except for Cohort B claiming to recover significantly less between clients at W6 comparing to W1. Cohort A reported being significantly less tired at W2–5 compared to W1 (question 3 or Q3) and significantly more tired at W6 compared to W2–5. Regarding energy (question 4 or Q4), Cohort A reported having more energy at W2–5 than W1. Both Cohorts did not report any significant change in emotional stress (question 5 or Q5) or mental stress (question 6 or Q6) during the entire time of their participation. Finally, Cohort B reported sleeping significantly more hours at W6 compared to W1 (Q7).

Table 8 presents results between Cohorts for each question. It can be seen from this table that both cohorts started at W1 with similar average scores for each question. The average scores being quite close to 3 (for questions 1–6) confirm that their perception of the situation described by each question at W1 was "as usual". The table shows that at W6, Cohort B worked on a significantly higher number of clients than Cohort A (Q1). Recovery was similar between cohorts for all weeks (Q2). Cohort A was significantly less tired and had significantly more energy at W2–5 compared to Cohort B (Q3 and Q4) and this was also true when combining results of all weeks (column "All"). Interestingly, Cohort A experienced significantly more emotional stress (Q5) but less mental stress (Q6) at W2–5 than Cohort B. The situation for emotional stress reversed with Cohort B experiencing significantly more emotional stress if one looks at all weeks combined. Cohort B also experienced significantly more mental stress for all weeks combined. Additionally, Cohort

Table 8. Average score results between cohorts for each question

Question	Cohort	W1	W2−5	W6	All
Q1	**A**	3.23 (0.65)	2.71 (1.11)	1.38 (0.72)	2.65 (1.12)
	B	3.26 (1.15)	2.56 (1.07)	3.61 (0.85)	2.82 (1.13)
	AvsB (p)	**0.939**	**0.235**	**0.000002**	**0.335**
Q2	**A**	3.08 (0.89)	3.34 (0.85)	3.38 (0.81)	3.29 (0.85)
	B	3.23 (0.70)	3.19 (0.86)	2.78 (1.06)	3.17 (0.86)
	AvsB (p)	**0.249**	**0.077**	**0.072**	**0.109**
Q3	**A**	2.81 (0.98)	2.32 (1.03)	3.00 (1.10)	2.49 (1.05)
	B	2.90 (0.94)	2.86 (1.07)	2.83 (1.10)	2.87 (1.04)
	AvsB (p)	**0.666**	**0.0003**	**0.602**	**0.002**
Q4	**A**	3.12 (0.86)	3.57 (0.99)	3.19 (1.22)	3.44 (1.01)
	B	3.00 (0.89)	3.00 (1.02)	3.00 (1.14)	3.00 (1.00)
	AvsB (p)	**0.576**	**0.00008**	**0.646**	**0.0003**
Q5	**A**	2.65 (0.94)	2.83 (1.01)	2.44 (0.81)	2.44 (0.97)
	B	2.77 (0.88)	2.64 (0.78)	2.89 (1.02)	2.70 (0.83)
	AvsB (p)	**0.543**	**0.007**	**0.156**	**0.003**
Q6	**A**	2.54 (0.91)	2.39 (0.91)	2.31 (0.95)	2.41 (0.91)
	B	2.77 (0.92)	2.66 (0.83)	3.06 (1.00)	2.73 (0.88)
	AvsB (p)	**0.195**	**0.010**	**0.033**	**0.0007**
Q7	**A**	8.50 (0.00)	7.71 (0.84)	7.28 (1.64)	7.66 (0.99)
	B	7.34 (1.25)	7.52 (1.08)	8.00 (1.32)	7.54 (1.15)
	AvsB (p)	**0.349**	**0.363**	**0.349**	**0.415**

A reported experiencing significantly less mental stress at W6 compared to Cohort B. There was no significant difference in the number of hours of sleep between cohorts during the entire time of their participation.

Correlation analysis

To determine the level of correlation among the variables used in this study, Pearson correlation coefficient corrected for small number of subjects (r_{adj}) was used. The correlation was performed by averaging over all weeks and for all subjects. The results are presented in Table 9. The strongest positive correlations ($p < 0.001$) are between Fatigue and Sleep Disturbance ($r_{adj} = 0.76$), the pain variables (Pain Interference, Pain Intensity, PRI, NWC and PPI, r_{adj} between 0.70 and 0.98), and Q5 and Q6 ($r_{adj} = 0.98$). The strongest negative correlations ($p < 0.001$) are between Physical Function and Pain Interference ($r_{adj} = -0.78$), Q2 and Q3 ($r_{adj} = -0.82$), and Q3 and Q4 ($r_{adj} = -0.94$).

DISCUSSION

Physical function increased significantly at the end of week 5 (End W5) for Cohort A, as well as one month after the end of their participation, compared to before the start of their participation (Start W1); physical function increased enough at the end of W5 to become significantly higher for Cohort A compared to Cohort B (Table 4). Also, fatigue decreased significantly at the end of W5 for Cohort A and this lower level of fatigue was maintained at the end of W6 (End W6) and one month later. Satisfaction with social role also improved over time for Cohort A, improving significantly one month after the end of their participation. On the other hand, Cohort B had a significant decrease in anxiety, sleep disturbance and depression at the end W5 with depression staying significantly low one month later. Also, anxiety was significantly lower at the end of W5 for Cohort B compared to Cohort A who showed a slight increase in anxiety levels that was not statistically significant at W5 compared to W1. These results suggest that both cohorts responded very differently to being grounded for four weeks.

Next, we examine pain as reported through the MPQ (Table 5). Cohort A reported significantly lower levels of pain at W5 and W6 compared to W1 according to PRI and NWC pain scores and at W5 only according to the PPI pain score. Cohort B did not report any significant change in pain level during their participation. However, when combining all weeks ("All Ws" column of Table 6) all 3 pains scores are significantly higher for Cohort B compared to Cohort A. The fact that there was no significant difference in pain at each week when looked at separately for all 3 pain scoring methods (except for the PPI score being significantly higher for Cohort B on W3) indicates that the pain experienced by Cohort B was only slightly but systematically higher than that of Cohort A. It is interesting to note that pain interference was also higher for Cohort B considering all weeks combined (Table 4), re-enforcing the conclusion that Cohort B was slightly but systematically and constantly operating at a higher pain level than Cohort A and that their pain was causing some interference with their normal level of functioning. We know, from Table 9, that there is a very strong negative correlation between physical function and pain interference ($r_{adj} = -0.78$). This observation may well explain why Cohort B did not experience a significant increase in physical function at W5 as Cohort A did (Table 3). Also, there is a very good positive correlation between fatigue and pain interference ($r_{adj} = 0.65$), this correlation could explain why Cohort B did not experience a significant decrease in fatigue as Cohort A did (Table 3).

Table 9. Correlations

r_{adj}	PF	Anx	Dep	Fatig	S Dir	SSR	P Inter	P Inten	PRI	NWC	PPI	Q1	Q2	Q3	Q4	Q5	Q6	Q7
PF		0.13	− 0.13	− 0.34	− 0.50	0.54	− 0.78	− 0.63	− 0.61	− 0.56	− 0.45	− 0.41	0.22	− 0.30	0.22	− 0.06	− 0.14	− 0.37
Anx			0.58	0.33	0.27	0.10	0.09	− 0.11	0.20	0.24	− 0.22	− 0.24	0.22	− 0.03	0.07	− 0.07	0.00	− 0.53
Dep				0.57	0.40	− 0.22	0.47	0.32	0.26	0.20	0.17	0.05	− 0.02	− 0.04	0.22	− 0.21	− 0.18	0.00
Fatig					0.76	− 0.67	0.65	0.69	0.55	0.47	0.38	0.42	− 0.38	0.35	− 0.27	0.24	0.26	− 0.09
S Dir						− 0.57	0.59	0.63	0.45	0.39	0.29	0.26	− 0.19	0.13	− 0.01	0.12	0.16	− 0.21
SSR							− 0.49	− 0.66	− 0.32	− 0.24	− 0.15	− 0.45	0.32	− 0.27	0.21	− 0.01	− 0.06	− 0.43
P Inter								0.86	0.81	0.78	0.78	0.40	− 0.48	0.50	− 0.33	0.26	0.27	0.13
P Inten									0.78	0.74	0.74	0.58	− 0.54	0.44	− 0.26	0.32	0.29	0.09
PRI										0.98	0.70	0.43	− 0.52	0.64	− 0.56	0.43	0.43	− 0.29
NWC											0.71	0.40	− 0.49	0.64	− 0.55	0.45	0.45	− 0.32
PPI												0.40	− 0.64	0.64	− 0.48	0.31	0.26	0.01
Q1													− 0.02	− 0.02	− 0.03	− 0.24	− 0.24	0.16
Q2														− 0.82	0.69	− 0.54	− 0.49	− 0.12
Q3															− 0.94	0.55	0.54	− 0.07
Q4																− 0.49	− 0.48	0.12
Q5																	0.98	− 0.35
Q6																		− 0.33
Q7																		

PF = physical function, Anx = anxiety, Dep = depression, Fatig = fatigue, S Dir = sleep disturbance, SSR = satisfaction with social role, P Inter = pain interference, P Inten = Pain pain Intensity intensity.

Looking now at the results from the seven questions that every subject was required to answer at the end of every day of work (Tables 7 and 8), the first observation is that at W1 both cohorts' answers were in the normal range (i.e. close to 3 for questions 1−6, Table 8). This result indicates a normal condition at the beginning of their participation. The first question was about how many clients they worked on compared to the usual. Both Cohorts worked on a significantly lower number of clients at W2−5 (grounded weeks) compared to W1. The fact that both cohorts worked on their lowest number of clients on W2 certainly contributed to lowering the average number of clients worked on during W2−5 (Table 2). Cohort A worked on a significantly lower number of clients at W6 compared to W1 and W2−5 while Cohort B worked on more clients at W6 compared to W2−5 (but not W1). The number of clients Cohort B worked on during W6 was significantly higher than the number of clients Cohort A worked on during the same week (Table 8) which may explain why Cohort B felt significantly more pain interference at W6 (Table 4). Since pain intensity (P Inten in Table 9) is correlated with Q1 ($r_{adj} = 0.58$), and highly correlated with PRI and NWC ($r_{adj} = 0.81$ and 0.78, respectively), one possible explanation for why Cohort A had less pain at W6 (PRI and NWC, Table 5) is that they worked on a smaller number of clients during that week compared to Cohort B. We do not know if that is the case also at W5 since the data for weeks 2−5 are combined in Table 7, but that would make sense.

Going now to Q2, how well they recovered between clients compared to the usual, the only significant result is for Cohort B reporting significantly lower recovery between clients at W6 (Table 7). This result could be due to the fact that this cohort worked on a larger than usual number of clients during that week as reported in their answer to Q1 and that they also experienced some level of pain interference (Table 4). Regarding how tired they were at the end of the day compared to the usual (Q3), Cohort A reported being significantly less tired at W2−5 vs. W1 and significantly more tired at W6 compared to W2−5. This is an interesting result in the light that Cohort A worked on a much smaller number of clients during W6 (as reported in their answers to Q1). What was causing them to report being more tired at W6 than W2−5 (and even W1 but not significantly)? According to their comments, it is because Cohort A W6 ended on 12/22/2016, just a few days before Christmas and they were stressed about preparations for Christmas. Regarding Q4, how much energy did they experience at the end of the day compared to the usual, Cohort A reported having significantly more energy at W2−5 than at W1. This is not surprising as Q3 and Q4 are highly (negatively) correlated ($r_{adj} = -0.94$), which make sense (i.e. the more one has energy, the less tired that person is). Both the decrease in tiredness and increase in energy for Cohort A at W2−5 was not observed for Cohort B. As already explained the main cause for this situation is likely to be pain interference.

Q5 is about how much emotional stress they experienced and Q6 about how much mental stress they experience at the end of the day compared to the usual. According to Table 9, these 2 questions are extremely well correlated ($r_{adj} = 0.98$). We observed no significant change in the answers to Q5 and Q6 for any of the two cohorts (Table 7). However, Table 8 reveals that while Cohort A showed a slight, non-significant increase in emotional stress at W2−5, Cohort B showed a slight decrease for the same time period, resulting in Cohort A experiencing a significantly higher level of emotional stress compared to Cohort B during W2−5. Interestingly, the situation reverses for all weeks combined in which case Cohort B experienced a significantly higher level of emotional stress than Cohort A. Basically this means that during the weeks that they were not grounded (W1 + W6), the emotional stress experienced by Cohort B was significantly higher than that for Cohort A. The conclusion is that grounding was much more effective at relieving emotional stress for Cohort B than for Cohort A, showing again how different these 2 cohorts were. The situation is different for Q6 (mental stress). Except at W1, mental stress was always significantly higher for Cohort B than Cohort A. Maybe Cohort B worried about their pain? Regarding hours of sleep (Q7) both cohorts slept a similar number of hours during all the time of their participation. The only significant result is that Cohort B slept significantly more hours at W6 compared to W1 (Table 7). This is an interesting result in the light that Cohort B reported significantly more mental stress at W6 than Cohort A, suggesting that their mental stress did not interfere with their relaxation and decrease in emotional stress and depression. However, the small number of participants still implies that this result (as all results presented here) needs replication with larger cohorts (and a larger number of cohorts too).

It is instructive to recap in what ways the two cohorts showed up differently in this study. During their 4-week period of grounding, Cohort A experienced a significant increase in physical function, a significant decrease in fatigue, tiredness and pain (at W5 only for pain), a significant increase in energy and they worked on a smaller number of clients than usual (more so at W6). On the other hand, during grounding, Cohort B experienced a significant decrease in anxiety, depression, sleep disturbance (they slept significantly more hours at W6), they also worked on a smaller number of clients at W5 but they worked on more clients at W6. Furthermore, a direct comparison of the average scores of the two cohorts reveals that by the end of W5 Cohort A had a significantly higher physical function and higher anxiety level than Cohort B, that Cohort B had a slight, systematic but significant higher level of pain during the entire time of their participation, and that during W2−5, Cohort B felt significantly more tired, less energetic, less depressed, less emotionally stressed, but more stressed mentally than Cohort A. Taking into account that both cohorts looked similar on all variables at the beginning of their participation and before being grounded, we can conclude that Cohort A became much more active and emotionally stressed than Cohort B which became more relaxed, less depressed and more mentally stressed after a 4-week grounding period. One possible explanation for these differences between cohorts is related to time of the year. As already mentioned in a previous study, [13] Cohort A started their participation on 11/14/2016, 10 days before Thanksgiving, and ended on 12/22/2016, a few days before Christmas. This explains the lower number of massages Cohort A performed on W2, it was the week of

Thanksgiving. On the other end, Cohort B participation started on 1/4/2017 and ended on 2/15/2017. They started just after the Holidays vacation and were ready to go to work. The lower number of clients they worked on at W2 is possibly because of Martin Luther King Jr. Day on 1/16/2017. However, no other holidays interfered with their work. Other possibilities to explain the difference between cohorts are gender and BMI. Unfortunately, it is not possible to separate gender from BMI since males had a higher BMI than females. These differences between cohorts might help enlighten how massage therapists differently reacted to grounding, depending on their conditions.

Limitations of this study include the modest number of subjects per cohort and the proximity with major holidays, resulting in one cohort experiencing more stress than the other. A larger number of subjects would also allow better randomization based on gender and BMI, more cohorts spaced in time, and better determination of massage therapists' capacity to do more massages per day with an explanation why, if it is the case.

CONCLUSION

Grounding helped therapists who were experiencing higher stress to cope with those stressful situations by providing them with extra energy. Grounding also helped those therapists who were experiencing higher levels of pain to become more relaxed, with less anxiety and depression and improved sleep. These findings, combined with the results of a prior study indicating improvements in inflammatory biomarkers, blood viscosity and heart rate variability (HRV), [13] suggest that grounding is beneficial for massage therapists in multiple domains relevant to their occupation, improving overall health and quality of life.

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CONFLICTS OF INTEREST

P.J.M. is director of research at the Chopra Foundation. S.P. is employed by the Chopra Center and L.W. is an employee of the Chopra Foundation. D.C. is a co-founder and a co-owner of the Chopra Center. G.C. is a consultant for Earth FX.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.explore.2018.10.001.

REFERENCES

1. Lyons N. 3 things you should know before becoming a massage therapist. Massage Therapy Schools Information. http://www.massagetherapyschoolsinformation.com/becoming-a-massage-therapist/ Accessed 12 June 2018.
2. Oschman J.L. Earthing: a new perspective on the cause and prevention of therapist burnout. Massage & Bodywork, 2016; 74−81. https://www.abmp.com/textonlymags/article.php?article=1481.
3. Blau G, Monos C, Boyer E, et al. Correlates of injury-forced work reduction for massage therapists and bodywork practitioners. *Int J Ther Massage Bodywork*. 2013;6(3):6–13.
4. Zucker M. Goodbye pain and inflammation: massage table grounding pad relieves therapist's overuse injuries. *Dermascope*. 2016;108–109. http://www.dermascope.com/scope-this/goodbye-pain-and-inflammation-massage-table-grounding-pad-relieves-therapist-s-overuse-injuries?print=1&tmpl=component#.WdZxQjBryUk.
5. Louati K, Berenbaum F. Fatigue in chronic inflammation − a link to pain pathways. *Arthritis Res Ther*. 2015;17:1–10.
6. Omoigui S. The biochemical origin of pain − proposing a new law of pain: the origin of all pain is inflammation and the inflammatory response. Part 1 of 3 − a unifying law of pain. *Med Hypotheses*. 2015;69:70–82.
7. Omoigui S. The biochemical origin of pain: the origin of all pain is inflammation and the inflammatory response. Part 2 of 3 − inflammatory profile of pain syndromes. *Med Hypotheses*. 2015;69:1169–1178.
8. La Plante C. How to avoid professional burnout; *Massage Ther J*. 2013; https://www.amtamassage.org/articles/3/MTJ/detail/2852/how-to-avoid-professional-burnout. Accessed June 12, 2018.
9. Bianchi R, Schonfeld IS, Laurent E. Is it time to consider the "burnout syndrome" a distinct illness? *Front Public Health*. 2015;3:158.
10. Chevalier G, Sinatra ST, Oschman JL, Sokal K, Sokal P. Earthing: health implications of reconnecting the human body to the Earth's surface electrons. *J Environ Public Health*. 2012. http://dx.doi.org/10.1155/2012/291541. (8 pages). Article ID 291541.
11. Oschman JL, Chevalier G, Ober AC. Biophysics of Earthing (grounding) the human body. In: Rosch PJ, ed. *Bioelectromagnetic and Subtle Energy Medicine*. 2nd ed. New York, NY: CRC Press; 2015:427–448.
12. Oschman JL, Chevalier G, Brown R. The effects of grounding (Earthing) on inflammation, the immune response, wound healing, and prevention and treatment of chronic inflammatory and autoimmune diseases. *J Inflamm Res*. 2015;8:83–96.
13. Chevalier G, Patel S, Weiss L, et al. Effects of grounding (Earthing) on massage therapists: an exploratory study. *Health*. 2018;10:228–250.
14. Melzack R. The McGill pain questionnaire: major properties and scoring methods. *Pain*. 1975;1(3):277–299.
15. Melzack R. The short-form McGill pain questionnaire. *Pain*. 1987;30(2):191–197.
16. Brown CA, Lilford RJ. The stepped wedge trial design: a systematic review. *BMC Med Res Methodol*. 2006;8:6–54.
17. Hussey MA, Hughes JP. Design and analysis of Stepped wedge cluster randomized trials. *Contemp Clin Trials*. 2007;28:182–191.