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Immediate Effects of Reiki on Heart Rate Variability, Cortisol Levels, and Body Temperature in Health Care Professionals With Burnout

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Abstract

Burnout is a work-related mental health impairment comprising three dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment. Reiki aims to help replenish and rebalance the body's energetic system, thus stimulating the healing process. The objective of this placebo-controlled, repeated measures, crossover, single-blind, randomized trial was to analyze the immediate effects of Reiki on heart rate variability (HRV), body temperature, and salivary flow rate and cortisol level in health care professionals with burnout syndrome (BS). Participants included 21 health care professionals with BS, who were asked to complete two visits to the laboratory with a 1-week interval between sessions. They were randomly assigned the order in which they would receive a Reiki session applied by an experienced therapist and a placebo treatment applied by a therapist with no knowledge of Reiki, who mimicked the Reiki treatment. Temperature, Holter ECG recordings (standard deviation of the normal-to-normal interval [SDNN], square root of mean squared differences of successive NN intervals [RMSSD], HRV index, low frequency component [LF], and high frequency component [HF]), salivary flow rate and cortisol levels were measured at baseline and postintervention by an assessor blinded to allocation group. SDNN and body temperature were significantly higher after the Reiki treatment than after the placebo. LF was significantly lower after the Reiki treatment. The decrease in the LF domain was associated with the increase in body temperature. These results suggest that Reiki has an effect on the parasympathetic nervous system when applied to health care professionals with BS.

Keywords

burnout, Reiki, heart rate variability, cortisol, body temperature

Burnout is a work-related mental health impairment comprising three dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment. The frequency of burnout in health care professionals has been estimated to be 14.9% in Spain (Grau-Martín, Flichtentrei, Suñer, Prats, & Braga, 2009), but some studies report up to 40% in nursing professionals (Irving, Dobkin, & Park, 2009). Nurses are at risk for this condition because their occupation has a high workload that includes stressful and emotional interaction with others (Bakker, Killmer, Siegrist, & Schaufeli, 2000). Burnout is usually associated with decreased job performance and commitment and predicts stress-related health problems and low career satisfaction. It is also associated with lower patient satisfaction with their care (Vahey, Aiken, Sloane, Clarke, & Vargas, 2004).

Several cognitive methods have been studied to promote the well-being of health care professionals with the aim of reducing the deleterious body–mind effects of burnout (Awa, Plaumann, & Walter, 2010; Irving et al., 2009). Alternative therapies, as integral interventions, may be beneficial for restoring balance in cases of body–mind alterations associated with burnout in health care professionals. Reiki is an energy

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medicine, specifically a biofield therapy developed in Japan in the mid-19th century (National Center for Complementary and Alternative Medicine, n.d.). It aims to help replenish and rebalance the body's natural energetic system, thus stimulating the natural healing process (Mackay, Hansen, & McFarlane, 2004). Reiki is used around the world for a number of conditions (Lee, Pittler, & Ernst, 2008) and is recommended for different health services as a treatment approach (Nield-Anderson & Ameling, 2000). However, authors of a recent systematic review concluded that current evidence is insufficient to suggest that Reiki is an effective treatment (Lee et al., 2008). Further, studies investigating the physiologic effects of Reiki have had several methodological flaws that must be addressed in any new studies.

Previous studies have shown an apparent connection between Reiki and the autonomic nervous system (ANS), since Reiki seems to reduce stress (Ramnarine-Singh, 1999; Wardell & Engebretson, 2001). Heart rate variability (HRV) is a noninvasive measure of the autonomic influence on heart rate that has been successfully used to estimate modulation of autonomic tone (Task Force, 1996). Different hands-on healing techniques have demonstrated effects on HRV by restoring ANS to balance in athletes (Arroyo-Morales et al., 2008) and patients with tension-type headache (Toro-Velasco, Arroyo-Morales, Fernández-de-las-Peñas, Cleland, & Barrero-Hernández, 2009). Since Reiki is considered to be a hands-off (no contact) therapy, we do not know if it has similar effects on HRV. In the current study, we hypothesized that the influence of the sympathetic nervous system on heart rate would be reduced after a Reiki session. The expected changes included an increase in HRV and either a decrease in the low-frequency (LF) component or an increase in the high-frequency (HF) component.

A number of salivary markers, such as cortisol and salivary flow, have been used as markers of the biological response associated with stress (Wardell & Engebretson, 2001). It seems that anxiety-induced somatic changes (Benjamins, Asscheman, & Schuur, 1992) and job stress in nurses are related to increased levels of cortisol (Fukuda et al., 2008). In addition, a variety of studies support the use of salivary cortisol levels as a measure of the glucocorticoid response to stress (Benjamins et al., 1992; Davis et al., 2004; Stupnick & Obminski, 1992). Therefore, if Reiki is effective in reducing stress, it would also be expected to reduce cortisol levels. However, the effect of Reiki on cortisol level is controversial. For instance, Bowden, Goddard, and Gruzelier (2010) did not find significant changes in cortisol levels after the application of Reiki in healthy psychology undergraduates whose attention was absorbed in one of three tasks involving self-hypnosis or relaxation. In contrast, Woods, Beck, and Sinha (2009) reported significant differences in morning cortisol variability after a therapeutic touch session in patients with dementia. In the current study, we hypothesized that a parasympathetic response would occur after Reiki as indicated by an increase in salivary flow rate and a decrease in salivary cortisol levels.

To the best of our knowledge, no study has previously investigated the biological changes following the application of Reiki in health care professionals with burnout. Therefore, the main objective of the current study was to investigate the immediate effects of a Reiki session on HRV, body temperature, salivary flow rate, and salivary cortisol levels in that population. A secondary aim of the study was to analyze the relationships among HRV, body temperature, and salivary changes.

Materials and Method

We conducted a randomized, single-blind, placebo-controlled, crossover study to compare the immediate effects of Reiki versus sham Reiki (placebo) in health care professionals with burnout.

Setting and Selection of Participants

Using word of mouth, we recruited 21 female health care professionals experiencing burnout from the Emergency Services unit of the University Hospital San Cecilio (Granada, Spain; $M \pm SD$ age: 44 ± 6 years) between January and May 2009 to participate in the study. Participants were diagnosed with BS by a psychologist experienced in the management of patients with BS according to criteria established by Maslach, Jackson, and Leiter (1996). The psychologist collected data on burnout features, hospital department, work history, and medications. To be eligible to participate, individuals had to report all the features typical of BS: depersonalization, emotional exhaustion, and low sense of personal accomplishment leading to decreased work effectiveness (Maslach & Goldberg, 1998). The local Hospital Ethics Committee granted consent. We obtained written informed consent from all subjects and conducted all procedures in accordance with the Declaration of Helsinki.

Data Collection

HRV. HRV was assessed following the standard criteria of the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (Task Force, 1996). We obtained short-term HRV in time (standard deviation of the normal-to-normal interval [SDNN], square root of the mean squared differences of successive NN intervals [RMSSD], HRV index [number of all NN intervals/maximum of all NN intervals]) and frequency domains (low frequency component [LF], 0.04–0.15 Hz or high frequency component [HF], 0.15–0.40 Hz) using a three-channel (1: right manubrial border of sternum—left anterior auxiliary line of the sixth rib; 2: left manubrial border of sternum—1 inch to right of xiphoid process; 3: center of manubrium—left midclavicular line of the sixth rib) electrocardiogram (ECG; Norav Holter NH 300, Braemar, Brunsville, Minnesota, USA). We took 5-min recordings with participants at rest in the supine position and no external stimulation at baseline and postintervention. The spectral analysis was calculated with Norav software (v.2.70) using fast

Fourier transform algorithms. The sampling rate was 1,024 samples per s and the frequency filter was set at 0.05–60 Hz.

Salivary flow rate and cortisol. We collected stimulated saliva for 3 min at each assessment time (baseline and postintervention), calculated the volume of each sample (to nearest 0.1 ml) and stored them at −70°C until analysis. We measured concentrations of cortisol in thawed samples using a commercial luminescence immune assay (Salimetrics, State College, USA), reading the luminescence units with an automatic luminometer (Beckmann, Germany). We analyzed all samples in triplicate in a single batch to eliminate interassay variance. We obtained adequate intra-assay accuracy with a coefficient of variance < 6.5%.

Body temperature. We measured body temperature using the OMRON GentleTemp 510, an infrared thermometry device (MC-510-E2, Kyoto, Japan). The temperature of the room ranged between 23 and 26°C.

Procedures

Participants presented to the examination and treatment laboratory at the same time of day on two separate occasions 1 week apart. All sessions took place between 9 and 12 a.m. to avoid circadian rhythm–induced variations (Van Ravenswaaij-Arts, Kolle, Hopman, Stoelinga, & Van Geijn, 1993). We instructed participants not to take any anxiolytic or analgesic drugs for approximately 72 hr prior to the experimental session. Further, we requested that they abstain from caffeine, alcohol, food, and exercise for 2 hr prior to assessment to reduce the influence of these variables on cortisol levels (Lovallo, Farag, Vincent, Thomas, & Wilson, 2006). In the first session, we obtained baseline Holter recording, body temperature, and saliva sample measurements after a 20-min rest period with participants in a supine position. After we collected these pre-intervention data, participants received the randomly assigned treatment (either Reiki session or placebo nonintentional Reiki), as determined via a coin flip. Following the intervention, we obtained posttreatment measures of Holter ECG, temperature, and saliva. Data collection procedures were the same for the second session, but each participant received the alternate treatment from that of her first session. All outcome measures were collected by an assessor blinded to the treatment allocation of the participants.

Interventions

Reiki sessions were administered by a therapist with more than 15 years of clinical experience in the Reiki approach (Level 3 of training). The placebo intervention was administered by a nurse with no previous experience in Reiki using the same hand positions of the Reiki practitioner but without any therapeutic intention. The nurse focused attention on neutral stimulus with no healing intentions during the session. Mansour, Beuche, Laing, Leis, and Nurse (1999) reported this procedure to be successful for blinding participants to the receipt of Reiki.

Table 1. Characteristics of Participants Who Completed Study ($n = 21$)

Characteristic	*N* (%)
Hospital unit	
Emergency	16 (76.2)
Intensive care	5 (23.8)
Profession	
Nurse	19 (90.5)
Physician	2 (9.5)
Work experience	
0–5 years	6 (28.6)
6–10 years	7 (33.3)
≥ 11 years	8 (38.1)
Married	10 (47.6)
	M (range)
Dependent children	1.3 (1–2)

The Reiki treatment consisted of the practitioner placing hands over various parts of the participant's body, over clothing and not touching, for approximately 5 min at each site, including areas around the head, eyes, ears, and chest. The Reiki protocol followed was the traditional lineage of the Usui system of natural healing (Rieben, 2006). Both the experimental and the placebo sessions lasted approximately 30 min.

Statistical Analysis

We conducted data analysis with the R software (version 2.9.2, R Foundation for Statistical Computing, Auckland), calculating means, standard deviations, and 95% confidence intervals of the values for each variable. The Kolmogorov-Smirnov test showed a normal distribution of the data ($p > .05$). We compared pre-intervention values using independent t tests for continuous data and used a two-way repeated-measures analysis of variance (ANOVA) with session (control vs. experimental) and time (pre–post) as within-subjects variables to examine the effects of Reiki. The hypothesis of interest was the Session × Time interaction. When necessary, we log transformed data to achieve homogeneity of variance. Finally, we used the Pearson correlation test (r) to analyze the association between HRV parameters and body temperature. p values less than .05 were considered statistically significant.

Results

Participants comprised 21 female health care professionals (mean weight = 61 ± 8 kg, 95% CI 56–64 kg; mean height = 161 ± 4 cm, 95% CI 158–163 cm; and mean body mass index = 23.4 ± 3 kg/m^2, 95% CI 22–25). Table 1 presents additional demographic data. Pre-intervention measures were not significantly different between sessions: SDNN ($p = .4$), RMSSD ($p = .8$), HRV index ($p = .2$), LF ($p = .7$), HF ($p = .8$), body temperature ($p = .6$), salivary flow rate ($p = .8$), and salivary cortisol concentration ($p = .3$).

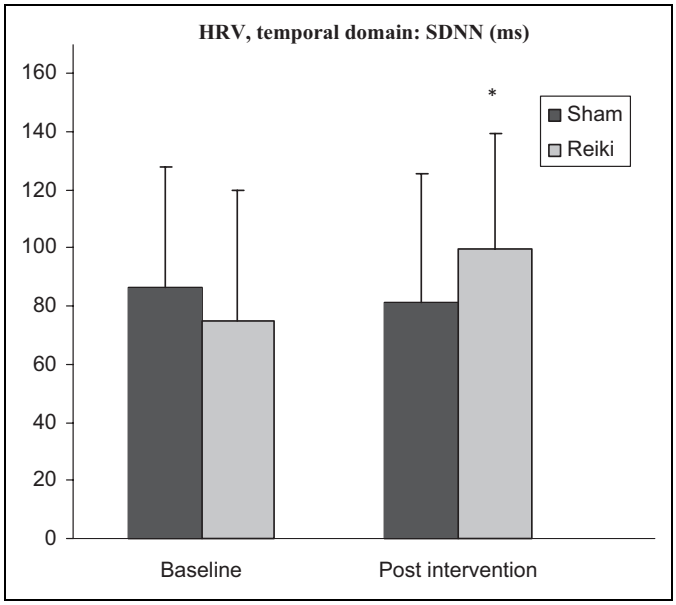

Figure 1. Mean standard deviation of the normal-to-normal interval (SDDN) in milliseconds (ms) of heart rate variability (HRV) at baseline and postintervention for Reiki and sham sessions. $N = 21$. *$p < .05$.

HRV

The ANOVA test showed a significant Session × Time interaction for the SDNN ($F = 4.9$; $p < .04$), LF ($F = 4.2$; $p < .05$), and the ratio LF/HF ($F = 6.2$; $p = .02$) but not for the RMSSD ($F = 4.0$; $p = .06$), HRV index ($F = 0.3$; $p = .8$), and HF ($F = 1.3$; $p = .2$) domains. After the Reiki session, subjects showed an increase in SDNN ($p = .03$) and a decrease in LF ($p < .05$), with no changes in the LF/HF ratio ($p = .3$). We found no changes after placebo treatment in SDNN ($p = .6$; Figure 1) or LF ($p = .9$). We did, however, find an increase in the LF/HF ratio ($p < .05$) with the placebo treatment. Table 2 presents pre–post intervention and change scores for each HRV domain after each session.

Salivary Flow Rate and Cortisol and Body Temperature

The ANOVA did not reveal a Session × Time interaction for salivary cortisol concentration ($F = 4.8$; $p = .08$) or flow rate ($F = 3.8$; $p = .10$; Table 3). The ANOVA did, however, reveal a significant Session × Time interaction for body temperature ($F = 7.01$; $p = .02$). We found an increase in body temperature ($p < .001$) after the Reiki session but no significant changes after the placebo treatment ($p = .9$; Figure. 2). Table 3 shows pre- and postintervention and change scores for salivary flow rate, salivary cortisol levels, and body temperature.

Correlations Between Change Scores of Body Temperature and HRV Parameters

We found a significant negative correlation between the increase in body temperature and the decrease in the LF domain after Reiki treatment ($r = -.5$; $p = .02$). The remaining parameters of HRV did not exhibit significant relationships with either body temperature or salivary measures.

Table 2. Baseline, Postintervention, and Change Scores for Heart Rate Variability (HRV) in Placebo and Reiki Sessions

HRV Measure	Placebo Session [95% CI]	Reiki Session [95% CI]
SDNN (ms)		
Baseline	86.7 ± 41.0 [66.9, 106.4]	75.1 ± 45.0 [53.4, 96.8]
Postintervention	81.2 ± 44.3 [59.7, 102.5]	99.8 ± 39.4 [66.3, 133.2]
Pre–post change	−5.5 [−27.4, 16.3]	24.6 [3.0, 46.3]*
RMSSD (ms)		
Baseline	72.2 ± 49.5 [48.4, 96.1]	70.4 ± 55.5 [43.7, 97.1]
Postintervention	70.2 ± 55.7 [43.0, 97.1]	99.6 ± 41.0 [55.7, 143.4]
Pre–post change	−2 [−25.8, 21.8]	29.2 [4.6, 53.6]
HRV index		
Baseline	9.2 ± 4.3 [7.2, 11.2]	7.9 ± 3.3 [6.3, 9.5]
Postintervention	9.1 ± 4.4 [6.8, 10.9]	7.8 ± 2.3 [6.7, 8.9]
Pre–post change	0.1 [−1.6, 1.5]	0.1 [−2.0, 1.8]
LF (ms^2)		
Baseline	161.8 ± 55.1 [135.9, 187.6]	159.8 ± 58.9 [132.0, 187.7]
Postintervention	161.3 ± 45.5 [131.8, 191.9]	131.3 ±45.5 [110.4, 153.1]
Pre–post change	−0.5 [−40.7, 23.1]	−28.5 [−56.8, −7.6]*
HF (ms^2)		
Baseline	167.8 ± 47.6 [144.1, 191.5]	174.7 ± 55.8 [147.8, 201.6]
Postintervention	140.7 ± 66.1 [107.7, 173.6]	171.1 ± 83.5 [130.8, 211.3]
Pre–post change	−27.1 [−73.9, 5.9]	3.6 [−39.9, 47.4]
LF/HF		
Baseline	1.1 ± 0.4 [0.8, 1.2]	1.1 ± 0.5 [0.8, 1.3]
Postintervention	1.3 ± 0.6 [1.0, 1.6]	0.9 ± 0.5 [0.7, 1.2]
Pre–post change	0.2 [0, 0.6]*	−0.2 [−0.4, −0.1]

Note. HF = high frequency; LF = low frequency; RMSSD = square root of the mean squared differences of successive NN intervals; SDNN = standard deviation of the normal-to-normal interval. Values are expressed as $M \pm SD$ (95% confidence interval) for baseline and postintervention data and as mean (95% confidence interval) for pre–post change. $N = 21$.
*Statistically significant ($p < .05$).

Table 3. Pre-Intervention, Postintervention, and Change Scores for Salivary Markers and Body Temperature for Placebo and Reiki Sessions

Measures	Placebo Session [95% CI]	Reiki Session [95% CI]
Salivary flow rate (ml/min)		
Baseline	1.2 ± 0.5 [1.05, 1.60]	1.2 ± 0.6 [0.86, 1.45]
Postintervention	1.3 ± 0.6 [0.98, 1.59]	1.1 ± 0.6 [1.00, 1.56]
Pre–post change	0.1 [−0.2, 0.6]	−0.1 [−0.4, 0.1]
Cortisol (μg/ml)		
Baseline	0.26 ± 0.30 [0.11, 0.40]	0.34 ± 0.41 [0.10, 0.58]
Postintervention	0.11 ± 0.06 [46.0, 120.6]	0.12 ± 0.08 [0.07, 0.15]
Pre–post change	−0.15 [−0.27, 0.01]	−0.22 [−0.43, −0.01]
Body temperature (°C)		
Baseline	35.8 ± 0.4 [35.6, 36.0]	35.7 ± 0.3 [35.5, 35.9]
Postintervention	35.8 ± 0.4 [35.6, 36.0]	36.0 ± 0.3 [35.8, 36.1]
Pre–post change	0 [−0.2/0.2]	0.3 [0.2, 0.4]*

Notes. Values are expressed as $M \pm SD$ (95% confidence interval) for baseline and postintervention data and as mean (95% confidence interval) for pre–post change. $N = 21$.
*Statistically significant ($p < .01$).

Discussion

Our results show that a single session of Reiki increased HRV (increase in SDNN, decrease in LF, and no change in LF/HF)

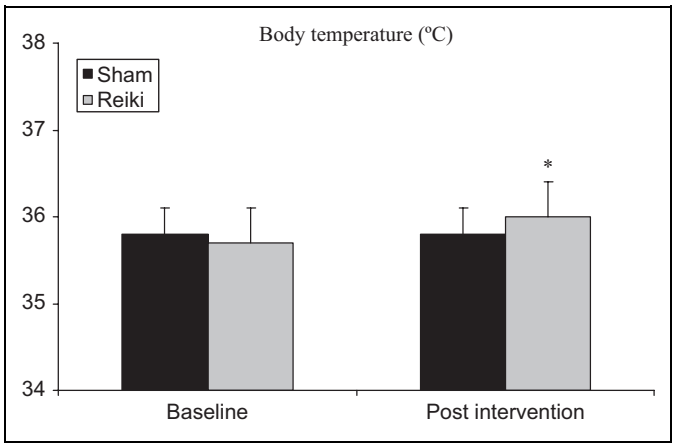

Figure 2. Mean body temperature (°C) at baseline and postintervention for Reiki and sham sessions. $N = 21$. *($p < .05$).

and body temperature but not salivary cortisol levels in female health care professionals with burnout. Further, the decrease in the LF HRV domain was associated with the increase in body temperature. The placebo Reiki session did not exert changes in body temperature but did produce an increase in the LF/HF ratio. These results support the hypothesis that Reiki has an effect on the parasympathetic nervous system when applied to health care professionals with BS.

It has been hypothesized that the physiologic system sensitive to energy-based therapies is the ANS because this system is involved in the physiological response to stress (Rosch, 2009). Researchers have previously investigated the effects of Reiki on the ANS in healthy subjects (Mackay et al., 2004; Mansour et al., 1999; Sneed, Olson, Bubolz, & Finch, 2001) and animals (Baldwin, Wagers, & Schwartz, 2008) and have found decreases in heart rate after the application of Reiki. Results of the current study suggest that Reiki shifts the autonomic balance toward parasympathetic predominance. We found an improvement in cardiac balance after the Reiki session, reflected as an increase in SDNN concomitant with a decrease in LF and no change in the LF/HF ratio (Task Force, 1996). These results indicate that Reiki may promote relaxation by reducing sympathetic activity in health care professionals with BS.

Heart rate is determined by the equilibrium of sympathetic and parasympathetic inputs to the heart. The reduction of the LF compound of HRV supports the hypothesis that Reiki reduces systemic sympathetic activity (Mackay et al., 2004). Our findings are similar to those of Mackay and colleagues who showed decreased heart rate with increased cardial vagal tone and cardiac sensitivity to baroreflex after the application of Reiki in healthy subjects. Current and previous findings showing decreased sympathetic and increased parasympathetic tone activity would explain the cardiovascular and relaxation effects of Reiki. Further, anxiety in healthy humans is associated with loss of vagal control of the heart (Watkins, Grossman, Krishman, & Sherwood, 1998). It is also possible that the maintenance of vagal tone induced by Reiki can reduce the mental health impairment associated to BS. However, we did not evaluate mental health impairments in the participants in the current study.

Body temperature is also associated with the energy system. We found that Reiki induced an increase in body temperature, which was associated with the decrease found in the LF component of HRV. Body temperature is, to a certain extent, dependent on the amount of environmental and internal disturbances. Burnout reflects an overactive state in the ANS, which could be accompanied by internal disturbances. Reiki led to a slow reduction of metabolic activity through an increase in body temperature in association with a decrease the LF component of HRV (a decrease of sympathetic activity). Other body–mind interventions such as progressive muscle relaxation training have shown similar effects on body temperature (Atsberger, 1995; Chen et al., 2009). Further, homeostatic control of the ANS has been associated with changes in body temperature (Elenkov, Wilder, Chrousos, & Vizi, 2000). Therefore, it seems that Reiki may have a homeostatic effect in subjects with BS, which supports the findings of Baldwin and colleagues' previous study conducted in animals (2008).

Neither salivary flow rate nor salivary cortisol concentrations showed significant differences between the Reiki and placebo sessions. Nevertheless, cortisol concentration levels showed a tendency to decrease after the Reiki session. Our results are similar to those previously reported for studies involving hands-on procedures (Laidlaw et al., 2006; Woods & Diamond, 2002; Woods et al., 2009). Findings from previous studies as well as the current study suggest that a single session of Reiki is unable to immediately reduce salivary cortisol levels. However, for the current study, we do not know whether there was a change in salivary cortisol concentrations 2, 6, or 24 hr postintervention.

The main strength of our study was that the design controlled for expectations by keeping participants blinded with respect to treatment. We asked participants whether they could identify the order in which they experienced the treatments. Only 19% of participants identified the target treatment received at each session correctly, so blinding was successful. In addition, the crossover design that we used can reduce variability in subject responses, reducing the loss of power associated with small sample sizes.

There were also some limitations to consider. First, only one experienced therapist applied the Reiki protocol, which may limit the generalizability of results. Effective Reiki requires a trained and experienced therapist; therefore, results should be extrapolated to other situations with caution. Second, we analyzed the immediate effect of Reiki with short-term HRV measurement, which may have limited clinical significance. Nevertheless, Reiki might clinically improve the ANS imbalance usually associated with BS. Investigators should consider using 24-hr Holter measurement in future studies to detect any long-term changes in the ANS. Third, the small sample size might have been a factor in our failure to find an effect in cortisol levels. Also, it is possible that subsequent sessions would have greater and longer lasting effects on the outcome

measures. Future studies with long-term follow-up periods that take into consideration the patients' expectations or beliefs in the outcomes are needed in order to elucidate the clinical relevance of the current findings.

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