Eliciting the Relaxation Response With the Help of Flotation–REST (Restricted Environmental Stimulation Technique) in Patients With Stress-Related Ailments

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This study aimed to investigate long-term effects of the flotation–REST (restricted environmental stimulation technique) 4 months after treatment. Seventy patients, 54 women and 16 men, participated, diagnosed as having stress-related pain. Twenty-six participants had also the diagnosis of burnout depression. Participants were randomly assigned in equal numbers to either a control group or a flotation–REST group and participated in a total of 12 flotation–REST or control sessions. Results indicated that pain areas, stress, anxiety, and depression decreased, whereas sleep quality, optimism, and prolactin increased. Positive effects generally maintained 4 months after treatment, but prolactin returned to initial levels. It was concluded that

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flotation tank therapy is an effective method for the treatment of stress-related pain.

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Current achievement-based, demanding, and high-tempo societies have incurred increased risks and vulnerability for stress-related chronic pain and other illnesses for their people (Lundberg, 2003; Lundberg & Melin, 2002). Increased muscle tension facilitates the development of chronic pain (Linton, 1994), and its induction of negative effects on concentration, self-confidence, learning, and memory has been observed (Levi, 2002, 2004). The brain and central nervous system undergo constant bombardment with information. Relaxation exercises offer a means to reduce the physiological and psychologic reactions to stress (Hoffman, Benson, Arns, Stainbrook, Landsberg, Young, & Gill, 1982; Sandlund & Norlander, 2000). Different relaxation techniques often lead to specific psychologic and physiological changes labeled the "relaxation response" (Benson, 1975). The relaxation response (RR) is identified as the physiological counterpart of the stress or "fight-or-flight response" (Esch, Fricchione, & Stefano, 2003).

The RR is associated with instantly occurring physiological changes that include reduced sympathetic nervous system activity, reduced metabolism, and lowered heart rate, blood pressure, and respiratory rate (Bleich & Boro, 1977; Hoffman et al., 1982). At the psychologic level, individuals typically experience RR techniques as genuine rest, recovery, better sleep quality, less need for alcohol and psychoactive medication, as well as an increased sense of control and efficacy in stressful situations (Setterlind, 1990). For a relaxation technique successfully to elicit the RR, at least two main factors are necessary according to Ben-Menachem (1977), that is, reduced sensory input and reduced bodily movements. A problem is that it has been found that the individuals in most need of relaxation techniques are often those who find it most difficult to initiate the relaxation exercises that are necessary for eliciting the RR (Maslach, 1998; Norlander, 1997). In the present study, a floating tank was to induce the RR. Flotation–REST (restricted environmental stimulation technique) is a method in which an individual is placed in a horizontally floating posture and immersed in highly concentrated salt water, in an environment (the floating tank) where all incoming stimuli are reduced to the barest minimum during a short period. The salt water in the floating tank is maintained at skin temperature, ear plugs are used to minimize sounds, and when the tank is closed, complete darkness ensues. Flotation–REST is a cost-effective and secure method with minimal or complete absence of adverse effects (Borrie, 1993; Suedfeld, 1983). Several studies have shown the incidence of positive effects such as increased well-being (Mahoney, 1990), mild euphoria (Schulz & Kaspar, 1994), increased origi-

nality (Forgays & Forgays, 1992; Norlander, Bergman, & Archer, 1998; Norlander, Kjellgren, & Archer, 2003; Sandlund, Linnarud, & Norlander, 2001; Suedfeld, Metcalfe, & Bluck,1987), improved sleep (Ballard, 1993), reduced stress (Kjellgren, Sundequist, Norlander, & Archer, 2001), reduced tension and anxiety (Fine, & Turner, 1982; Schulz & Kaspar, 1994; Suedfeld, 1983), reduced blood pressure (Fine & Turner, 1982; Turner, Fine, Ewy, & Sershon, 1989), less muscle tension (Norlander, Bergman, & Archer, 1999) as well as indications that the technique is a suitable complement to psychotherapy (Jessen,1990; Mahoney, 1990).

Several studies have been performed that apply flotation–REST as a method to alleviate different types of pain conditions (Kjellgren, 2003; Kjellgren, Sundeqvist, Norlander, & Archer, 2001; Turner & Fine, 1984). Patients experiencing chronic headaches experienced significant improvements after flotation–REST treatment, and these improvements were maintained during follow up 6 months later (Wallbaum, Rzewnicki, Steele, & Suedfeld, 1992). Notable improvements in patients with rheumatic aches were observed by Mereday, Leham, and Borrie (1990). Alleviation of premenstrual pain was noted by Goldstein and Jessen (1990). Other studies indicating analgesic effects associated with flotation–REST have been reported by Fine and Turner (1985) and Norlander, Kjellgren, and Archer (2001). Certain attempts have been made to identify the physiological markers for the subjectively experienced pain alleviation so often reported with flotation–REST. Thus, significant reductions of ACTH and plasma cortisol levels have been found after REST treatment (Turner & Fine, 1983, 1990). One study (Turner, Fine, Ewy, & Sershon, 1989) showed that REST as a treatment method in a series of eight sessions was followed by a decrease in plasma cortisol and a reduction in arterial blood pressure compared with the initial treatment occasion, although Schulz and Kaspar (1994) did not find any changes in plasma cortisol and other endogenous substances 60 minutes after floating compared with lying on a mattress for an equivalent interval. In a former study from the Human Performance Group in Karlstad (Kjellgren, Sundeqvist, Norlander, & Archer, 2001) measuring the catecholamine metabolite 3-metoxy-4-hydroxyphenyletyleneglucol (MHPG) and β-endorphin in serum of floatation–REST-treated patients with muscle tension pain in neck and shoulders, we have found a significant decrease in MHPG levels but no effects on levels of the measured opioid peptide. Still, the patients reported a significant reduction of pain.

There is evidence for effects of body temperature in exercise-induced prolactin changes (Melin, Cure, Pequignot, & Bittel, 1988). The plasma prolactin–norepinephrine relationship in the same report suggests that these changes may depend on central changes in noradrenergic activity. When continuing our effort at explaining the effects of floatation–REST, we decided to measure some further biologic markers, including prolactin, in

patients with widespread pain and chronic fatigue. We directed our attention at prolactin owing to our previous findings on decrease in MHPG at flotation–REST and the report of a connection between adrenergic block and elevated prolactin levels, and because of the reported possible influence of body temperature on prolactin levels.

The present study had two main purposes: (a) to investigate whether it was possible to replicate earlier findings of increased wellness after flotation tank therapy and (b) to investigate whether or not those improvements were maintained during a follow up 4 months later. There have only been a few studies dedicated to the long-term effects of flotation–REST (e.g., Wallbaum, Rzewnicki, Steele, & Sudefeld, 1992).

METHODS

Participants

Seventy patients, 54 women and 16 men, recruited from the waiting list at the Human Performance Laboratory at Karlstad University, participated in the study. They had been diagnosed by a physician as having stress-related pain of a muscle tension type. Among the patients, 26 of them also had received the diagnosis of "burnout depression"; in Sweden, there is now some consensus among professionals that this diagnosis includes symptoms such as fatigue, less energy, problems with organizing daily life, problems with memory and processing new information, problems with sleep, ailments that do not get relieved by rest, and feelings of lowspiritedness). Patients in the present study reported having had pain for 12.1 years (standard deviation [*SD*] = 8.67) and 29.4% stated that they experienced the pain day and night, 35.3% every day, 25% weekly, 5.9% monthly, and 4.4% reported rare pain. Participants were randomly assigned in equal numbers (35 participants) to one of two experimental groups: a control group and a flotation–REST group (see the sections "Design" and "Procedure"). Analyses (chi-square, goodness-of-fit, .05 level) did not show any significant differences with regard to participation in the control group or the flotation–REST group among men, women, patients with no diagnosis of burnout depression, and patients with such a diagnosis. The average age of the patients was 49.1 years (*SD* = 9.81). Statistical analyses using independent samples *t* test yielded no significant age differences between groups regarding experimental groups, gender, or burnout depression ($p > .05$).

Design

The current study in a first step used a three-way split-plot design, in which *time* with assessments before and after the treatments constituted the within-subjects factor and where *group* (control, flotation–REST) and *diagnosis* (nonburnout patients with stress-related pain, burnout patients with stress-related pain) constituted the between-subjects factors. Participants were randomly assigned to the control (20 nonburnout patients, 15 burnout patients) or flotation (24 nonburnout patients, 11 burnout patients) groups. All participants, irrespective of condition, visited the laboratory for a period of 7 weeks. The period consisted of two visits per week for 3 weeks, followed by a week without treatment, and then another 3 weeks of treatments. The reason for having two 3-week treatment periods was so that female subjects participating could plan the timing of their flotation treatments from the incidence of each menstrual cycle. Participants in the flotation–REST group were involved in a total of 12 flotation–REST treatments (two times per week during 6 weeks). Each flotation treatment lasted 45 minutes, resulting in a total of 315 hours of treatment. The control group received the same treatment as the flotation group before and during the experiment, but instead of floating, they sat in an armchair for 45 minutes and were allowed to read magazines that were laid out for them. In a second step, a two-way split-plot design was used on the flotation–REST group, in which the within-subjects factor now also included a 4-month follow up for the flotation group (*treatment* condition) and where diagnosis was maintained as the between-subjects factor.

Measures

Flotation Tank

A flotation tank (Delfi, www.kikre.com, Varberg, Sweden) measuring 2700 mm $\times$ 1500 mm $\times$ 1300 mm was used. The depth of fluid (salt water) varied between 200 and 300 mm. The flotation tank was insulated to maintain constant air and water temperature and to reduce incoming light and noise. The water temperature was maintained at 34.7°C and was saturated with magnesium sulfate (density: 1.3 g/cm^3). The tank was equipped with a horizontal entrance that was easy to open and close (from inside and out) by the subject. Between flotations, a hydrogen peroxide solution was regularly poured in, and after this, the salt water was filtered and sterilized with ultraviolet light.

Questionnaire 1

Before the treatment (floating in the tank), a questionnaire was provided that estimated each subject's self-assessed pain: intensity, frequency, duration, onset, sleep quality, treatment as well as experiences/symptoms of other types of complaints. Each subject's own descriptions of "sleep quality" were estimated on visual analog scales (0–100).

Questionnaire 2

At a final meeting directly after the 7 weeks of the experimental flotation procedure, the same questions were presented as in questionnaire 1.

Blood Measures

In the present study, blood samples were taken for cortisol and prolactin between 10 o'clock AM and 2 o'clock PM. According to laboratory standard procedures, cortisol was measured in nanomoles per liter blood serum (nmol/L) and prolactin was measured in micrograms per liter blood serum (μg/L). Normal range for cortisol 10 o'clock is 125 to 625 nmol/L. Normal range for prolactin concerning men is 3.5 to 18 μg/L and for women 4.5 to 25 μg/L.

Pain Area Inventory

The pain area inventory (PAI) test (Bood, Sundequist, Kjellgren, Nordström, & Norlander, in press) consists of two anatomical images of a human being, one frontal and one dorsal. The task of the participants was to indicate with a color pen their areas of pain and color them in. A transparent, plastic film was then placed over the colored areas on both figures. Each figure was divided into 833 equal-sized squares (total 1666), and the number of colored squares was calculated. The test was validated (Bood, Sundequist, Kjellgren, Nordström, & Norlander, in press) through comparisons with other instruments measuring total number of pain types, number of connected pain areas, most severe pain intensity, normal pain intensity, and pain frequency, which yielded acceptable values (standardized item $\alpha = .84$, $R = 0.70$). Test–retest reliability was examined through using a group of pain patients who completed the pain area inventory on two occasions 7 weeks apart ($r = .92$).

Stress and Energy

The stress and energy (SE) instrument is a self-estimation instrument concerning individuals' energy and stress experiences (Kjellberg & Iwanowski, 1989). It consists of two subscales that elucidate the mood levels of the subjects on the dimensions: "experienced stress" and "experienced energy." Response alternatives were arranged on six-grade scales, extending from 0 = not at all to 5 = very much. The instrument has been validated by analyses from studies focused on occupational burdens and pressures (Kjellberg & Bohlin, 1974; Kjellberg & Iwanowski, 1989). The SE scale was constructed and based on an early and much used checklist, the Mood Adjective Check-List, constructed by Nowlis and Green (1965) and modified further and translated into Swedish by Kjellberg and Bohlin (1974). Kjellberg and Iwanowski (1989) reduced the list to 12 adjectives on two dimensions. It is currently the latest version of the SE scale (with test–retest scores of 0.73 to 0.78) and was used in the present study. The test did not have a time limit.

Hospital Anxiety Depression Scale

The Hospital Anxiety Depression scale (HAD) is a rating scale concerning degree of anxiety and depression using various published materials. It was constructed by Zigmond and Snaith (1983) for use with physically ill people. It has since been revised to be used as a rating scale for anxiety and depression. Its validity and reliability were examined by Herrmann (1997). The instrument consists of 14 statements with four response alternatives (0–3), ranging from positive to negative or vice versa, and there are seven statements regarding anxiety and seven regarding depression.

Life Orientation Test

This test (Scheier & Carver, 1985) consists of eight items plus four filler items. The task of each participant is to decide whether or not one is in agreement with each of the items described, on a scale of 0–4, in which 0 indicates "strongly disagree" and 4 indicates "strongly agree." The test measures dispositional optimism, defined in terms of generalized outcome expectancies. Parallel test reliability is reported to be 0.76 and internal consistency to be 0.76 (Scheier & Carver, 1985), Test–retest reliability is 0.75 (Norlander, Bergman, & Archer, 2002). The Life Orientation Test (LOT) is also regarded as having an adequate level of convergent and

discriminant validity (Scheier & Carver, 1985), as demonstrated by correlation statistics and by using LISREL VI ($r = .64$).

Positive Affect and Negative Affect Scales

The Positive Affect and Negative Affect Scales (PANAS) instrument (Bood, Archer, & Norlander, 2004; Norlander, Bood, & Archer, 2002; Watson, Clark, & Tellegen, 1988) assesses the degree of affect, both negative (NA) and positive (PA). The instrument consists of 10 adjectives for the NA dimension and 10 adjectives for the PA dimension. In the test manual (Watson, Clark, & Tellegen, 1988), it is postulated that the adjectives describe feelings and mood. The participants were asked to estimate how they had been feeling during the last week. Response alternatives are presented on 5-degree scales ranging from 0 = "not at all" to 5 = "very much." The PANAS scale has been validated through studies focused on several different routinely used scales within psychopathology (Huebner & Dew, 1995). Cronbach's alpha for PA was 0.73 and for NA 0.76 in the present study.

Experienced Deviation From Normal State

An instrument modified for use with flotation–REST (Kjellgren, Sundeqvist, Norlander, & Archer, 2001) uses the internationally applied psychometric instruments, APZ questionnaire, and OAVAV (Dittrich, 1998) for obtaining judgments of altered states of consciousness and the relaxation response. Several studies indicate strong connections between altered states of consciousness and different RR techniques such as Qigong (Jones, 2001), Tai Chi (Yocum, Castro, & Cornett, 2000), and muscle relaxation training (Stenstrom, Arge, & Sundbom, 1996). In total, the experienced deviation from normal state (EDN) instrument consists of 29 questions whereby each is responded on a visual analog scale (0–100). A complete "index of experience" was constructed from the points obtained from all 29 questions and were averaged to provide a "sum of experience." These values reflect the total experience of deviation from normal states. Cronbach's alpha for EDN was 0.93 in the present study. Typical EDN values after an individual's first experience of flotation–REST is around 30 EDN points, which should be compared with the first experience of chamber REST (15 points) (Kjellgren, Sundequist, Sundholm, Norlander, & Archer, 2004).

Procedure

The participants were recruited by asking patients on the waiting list for participation in the flotation–REST experiment at the Human Performance laboratory, Karlstad University, Sweden. They were either originally referred by their physicians or had responded to announcements for individuals with localized muscle tension pain in the neck and shoulder area, with or without temporal headache, associated with myofascial tender points or trigger points.

Each participant's first contact with the project was an interview with a pain specialist at the initial medical examination where they were informed about the project, screened for suitability through questionnaire 1, and underwent a medical examination (including a blood sample for later analysis of cortisol and prolactin), plus a careful pain analysis, including palpation of muscle tone and a neurologic examination. Among the exclusion criteria were listed pregnancy or ongoing breast feeding, somatic problems/illnesses requiring other types of treatment, open wounds, manifest psychiatric symptoms, neurologic disturbances, whiplash-related disorders, manifest posttraumatic stress disorder, as well as regular treatment with heavy opiate analgesics, signs of anxiety/fear, or discomfort being in a restricted environment.

During this interview, each participant's degree of anxiety–depression was assessed using HAD, whereupon the other personality tests and other psychologic tests were completed. Every participant received a leaflet with patient-oriented information about flotation–REST, in which (in addition to the purely practical details associated with treatment) they were also informed that driving was not recommended shortly after treatment (as a result of increased risk of transient tiredness). During this initial contact, each subject was shown around the floatarium. The information was restricted (no mentioning of possible changes in consciousness), and the participants were only informed that most people experience the floating as relaxing.

After this, participants were randomly assigned to either the control group or to the flotation–REST group. The participants belonging to the control group sat in an easy chair reading their own literature or literature provided, for 45 minutes, twice per week, first for 3 weeks, then 1 week with no treatment, followed by another 3 weeks with the armchair condition. The participants belonging to the flotation–REST group were given flotation treatment during the forthcoming 3 weeks (with two visits per week), whereby each floating session was of 45 minutes' duration. After that, the participants had 1 week with no treatment followed by another 3-week period. The number and duration of treatments—12 over a 7-week period (two 3-week treatment periods with a nontreatment week in between)—was chosen from similarly sized schedules described in the literature and from our own experiences.

A "spontaneous-randomization" process consisting of a "first come, first assigned" method was applied. When the participant was using the flotation tank at the very first session, he or she was informed of the flotation technique, shown the bathroom and shower, and thoroughly reminded of complete freedom to terminate the session if necessary. After visits to the bathroom and shower and the insertion of earplugs, each participant was allowed to immerse himself or herself in the water of the tank and close the lid unaided following instructions to relax. Treatment was terminated after 45 minutes when the experimenter gently knocked on the exterior of the tank. Directly after the first session in the flotation tank, the participant was allowed to complete the EDN. They also had to complete the EDN directly after the last session (i.e., after 12 flotations) in the flotation tank.

With regard to the second between-subjects factor of the study (diagnosis), experience was already available suggesting that approximately half of the patients with stress-related pain from muscular tension who seek treatment are also diagnosed with burnout depression. Thus, no further groupings of patients were carried out.

Three days (or 72 hours) after the final control or flotation session, participants attended a final consultation and follow-up discussion with a nurse, at which time they completed questionnaire 2 and the personality tests, and a new blood sample was taken. All the patients described in the present study completed the whole course of treatment (12 control or flotation sessions over 6 weeks).

Four months after the final consultation, all patients in the flotation–REST group were invited to participate in a follow-up study at the Human Performance laboratory. The information was also given that if they accepted the invitation they would receive a lottery ticket valued at $10 U.S. Twenty-eight of the participants in the flotation group participated in the follow-up consultation in which they once more completed the questionnaire, the personality tests, and also had a new blood sample taken.

RESULTS

Step 1: Comparisons Between the Control Group and the Flotation–REST Group With Regard to Time and Diagnosis

A three-way mixed Pillais' multivariate analysis of variance was carried out with time (before, after) as the within-subjects factor and group (control, flotation–REST) plus diagnosis (nonburnout patients, burnout patients) as between-subjects factors, and with prolactin, cortisol, pain area (PAI), sleep quality, dispositional optimism (LOT), stress (SE), energy (SE), anxiety

Table 1. Means and (Standard Deviations) for Prolactin, Cortisol, and Pain Area Inventory (PAI) Before and After Control or Flotation Treatment (Time 1–2) With Regard to Group (Control, Flotation–REST) and Diagnosis (Nondepressed, Depressed)

	Control		Flotation–REST		Time
Variable	Nondepressed	Depressed	Nondepressed	Depressed	Before & After
Prolactin 1	13.33 (5.34)	17.93 (9.07)	13.18 (5.01)	12.7 (6.15)	14.13 (6.46)
Prolactin 2	11.58 (4.04)	15.57 (6.85)	14.12 (5.42)#	24.31 (30.29)#	15.28 (13.19)
Cortisol 1	248.00 (107.00)	280.79 (89.33)	248.79 (100.99)	171.73 (50.21)	242.69 (98.25)
Cortisol 2	247.35 (86.01)	280.43 (106.23)	221.92 (79.61)	234.18 (37.16)	242.81 (83.85)
PAI 1	143.72 (111.97)	149.14 (155.78)	101.61 (108.96)	203.18 (181.89)	140.11 (135.87)
PAI 2	120.88 (81.84)	135.14 (135.87)	60.42 (66.33)#	101.25 (97.56)#	101.81 (97.99)*

Note. Significant effects for Time ($p < .05$) are indicated in the After conditions with *. Significant interaction effect for Time × Group ($p < .05$) is indicated in the Flotation–REST and After conditions with #.

Table 2. Means and (Standard Deviations) for Sleep Quality (Sleep) and Dispositional Optimism (Optimism) Before and After Control or Flotation Treatment (Time 1–2) With Regard to Group (Control, Flotation–REST) and Diagnosis (Nondepressed, Depressed)

	Control		Flotation–REST		Time
Variable	Nondepressed	Depressed	Nondepressed	Depressed	Before & After
Sleep 1	51.89 (26.27)	61.27 (16.88)	46.71 (24.23)	34.00 (15.92)	49.28 (23.47)
Sleep 2	56.53 (22.79)	55.53 (21.43)	59.04 (22.65)#	42.82 (30.7)#	55.00 (23.86)
Optimism 1	21.89 (4.05)	23.07 (4.53)	20.63 (3.97)	16.73 (5.53)	20.88 (4.75)
Optimism 2	22.42 (4.54)	22.13 (4.36)	21.88 (4.12)#	19.09 (5.03)#	21.64 (4.49)

Note. Significant interaction effect for Time × Group ($p < .05$) is indicated in the Flotation–REST and After conditions with #.

(HAD), depression (HAD), positive affectivity (PANAS), and negative affectivity (PANAS) as the dependent variables. This analysis yielded significant effects for time ($p = .003$, $Eta^2 = 0.48$, power > 0.97), group ($p = .018$, $Eta^2 = 0.41$, power $= 0.91$), and diagnosis ($p = .003$, $Eta^2 = 0.48$, power $= 0.98$), and there was also a significant time × group interaction effect ($p = .005$, $Eta^2 = 0.46$, power $= 0.96$). There were no other significant effects ($p > .05$). The results from the univariate F tests concerning time × group interaction, group and diagnosis, are given subsequently. A three-way mixed multivariate analysis of covariance controlling for the difference between control and flotation groups regarding cortisol concentrations before treatments yielded no other significant effects. For means and standard deviations, see Tables 1 through 4.

The analysis indicated direct flotation–REST effects (time × group interaction effects) for prolactin ($F[1, 49] = 8.81$, $p = .00$), pain area inventory ($F[1, 49] = 10.25$, $p = .00$), sleep quality ($F[1, 49] = 4.82$, $p = .03$), dispositional optimism ($F[1, 49] = 6.62$, $p = .01$), stress ($F[1, 49] =$

Table 3. Means and (Standard Deviations) for Stress, Energy, Anxiety, Depression Before and After Control or Flotation Treatment (Time 1–2) With Regard to Group (Control, Flotation–REST) and Diagnosis (Nondepressed, Depressed)

	Control		Flotation–REST		Time
Variable	Nondepressed	Depressed	Nondepressed	Depressed	Before & After
Stress 1	2.04 (0.87)	2.14 (1.10)	2.19 (1.01)	2.83 (0.85)	2.24 (0.98)
Stress 2	1.94 (0.95)	2.03 (0.71)	1.51 (0.99)#	1.95 (1.15)#	1.80 (0.97)*
Energy 1	3.30 (1.02)	3.12 (1.20)	3.11 (0.81)	2.77 (0.96)	3.11 (0.98)
Energy 2	3.11 (0.99)	3.23 (0.87)	3.15 (0.78)	2.83 (0.64)	3.10 (0.83)
Anxiety 1	7.74 (3.48)	6.80 (2.98)	7.00 (3.62)	10.91 (3.65)	7.78 (3.67)
Anxiety 2	7.26 (4.20)	8.73 (7.52)	5.48 (3.27)#	7.18 (3.63)#	6.93 (4.82)
Depress 1	3.79 (3.34)	5.13 (3.16)	4.08 (2.89)	10.09 (4.99)	5.19 (4.04)
Depress 2	3.47 (3.01)	5.47 (4.84)	3.24 (2.67)#	6.18 (3.43)#	4.24 (3.57)*

Note. Significant effects for Time ($p < .05$) are indicated in the After conditions with *. Significant interaction effect for Time × Group ($p < 0.05$) is indicated in the Flotation–REST and After conditions with #.

Table 4. Means and (Standard Deviations) for Positive Affectivity (PA), and Negative Affectivity (NA) Before and After control or Flotation Treatment (Time 1–2) With Regard to Group (Control, Flotation–REST) and Diagnosis (Nondepressed, Depressed)

	Control		Flotation–REST		Time
Variable	Nondepressed	Depressed	Nondepressed	Depressed	Before & After
PA 1	34.37 (7.32)	31.93 (10.22)	31.75 (7.36)	28.09 (8.56)	31.93 (8.29)
PA 2	35.11 (5.56)	31.53 (9.65)	35.08 (5.76)	32.91 (6.77)	33.99 (6.89)*
NA 1	18.42 (6.07)	21.4 (9.32)	16.58 (3.98)	24.91 (6.92)	19.46 (6.99)
NA 2	18.32 (5.08)	16.47 (8.41)	15.48 (4.07)	20.00 (12.33)	17.17 (7.19)*

Note. Significant effects for Time ($p < .05$) are indicated in the After conditions with *.

7.54, $p = .01$), anxiety ($F[1, 49] = 6.06$, $p = .02$), and depression ($F[1, 49] = 7.40$, $p = .01$). The analysis indicated no significant time × group interaction effects for energy, positive affectivity, negative affectivity, and for cortisol ($p > .05$). Concerning differences regarding groups, there were no significant results between experimental groups ($p > .05$) except for cortisol ($F[1, 49] = 4.61$, $p = .04$), in which participants in the control group had higher concentrations of cortisol as compared with the participants in the flotation group. Finally, concerning differences with regard to diagnosis, there were no significant results between groups ($ps > .05$) except for prolactin [$F(1, 49) = 4.68$, $p = .03$], Negative affectivity [$F(1, 49) = 5.26$, $p = .02$], and Depression ($F[1, 49] = 22.38$, $p < .00$), in which participants with burnout diagnosis had higher levels of prolactin, negative affectivity, and of depression.

Step 2: Analyses of the Flotation–REST Group 4 Months After Treatment With Regard to Treatment and Diagnosis

In the second step, the long-term effects of flotation–REST treatment were analyzed. Statistical analyses were carried out using two-way split-plot Bonferroni analyses of variance with treatment (before treatment, directly after treatment, 4 months after treatment) as the within-subjects factor and diagnosis (nonburnout patients, burnout patients) as the between-subjects factor. Only dependent variables, which in the first step exposed effects from the flotation–REST treatment, shown by time × group interaction effects, were used, including prolactin, pain area (PAI), sleep quality, dispositional optimism (LOT), stress (SE), anxiety (HAD), and depression (HAD). For means and standard deviations, see Tables 5 through 7.

Table 5. Means and (Standard Deviations) for Prolactin and Pain Area Inventory (PAI) Before Treatment, Directly After Treatment, and 4 Months After Treatment (1–3) With Regard to Diagnosis (Nondepressed, Depressed)

	Diagnosis		Treatment
Variable	Nondepressed	Depressed	Before, After, Follow-up
Prolactin 1	13.36 (5.04)	12.70 (6.15)	13.14 (5.34)
Prolactin 2	14.34 (5.40)	24.31 (30.29)	17.47 (17.65)*
Prolactin 3	13.04 (5.57)	13.30 (4.30)	13.13 (5.10)
PAI 1	102.23 (11.49)	203.18 (181.89)	135.88 (144.32)*
PAI 2	57.44 (66.94)	101.25 (97.56)	70.92 (78.34)
PAI 3	72.93 (70.41)	79.67 (51.53)	74.95 (64.04)

Note. Significant effects for Treatment ($p < .05$) are indicated with * in the condition which is significantly high or low as compared to the other two conditions.

Prolactin

The analyses yielded a significant difference for treatment ($F[2, 48] = 4.48$, $p = .024$), and further analysis showed (pair-samples t tests, 5% level) that the prolactin concentrations first increased from 13.14 ($SD = 5.34$) to 17.47 ($SD = 17.65$) directly after treatment and then decreased again 4 months after treatment to 13.13 ($SD = 5.10$) back to the original level. There were no other significant effects ($p > .05$).

Pain Area Inventory

The analyses yielded a significant difference for treatment ($F[2, 28] = 7.37$, $p = .004$), and further analysis showed (pair-samples t tests, 5% level) that pain as assessed with the PAI first decreased from 135.88 squares ($SD = 144.33$) to 70.92 squares ($SD = 78.34$) directly after treatment and then

Table 6. Means and (Standard Deviations) for Sleep Quality (Sleep) and Dispositional Optimism (Optimism) Before Treatment, Directly After Treatment, and 4 Months After Treatment (1–3) With Regard to Diagnosis (Nondepressed, Depressed)

	Diagnosis		Treatment
Variable	Nondepressed	Depressed	Before, After, Follow-up
Sleep 1	48.35 (23.38)	34.00 (15.92)	43.71 (22.08)*
Sleep 2	59.39 (23.10)	42.82 (30.07)	54.03 (26.30)
Sleep 3	50.53 (26.32)#	52.67 (21.86)#	51.21 (24.59)
Optimism 1	20.48 (3.99)	16.73 (5.53)	19.27 (4.80)*
Optimism 2	21.70 (4.12)	19.09 (5.03)	20.85 (4.53)
Optimism 3	22.42 (5.65)	18.78 (5.19)	21.25 (5.68)

Note. Significant effects for Treatment ($p < .05$) are indicated with * in the condition which is significantly high or low as compared to the other two conditions. Significant interaction effects for Treatment × Diagnosis ($p < .05$) are indicated with # in the follow-up condition.

Table 7. Means and (Standard Deviations) for Stress, Anxiety, and Depression Before Treatment, Directly After Treatment, and 4 Months After Treatment (1–3) With Regard to Diagnosis (Nondepressed, Depressed)

	Diagnosis		Treatment
Variable	Nondepressed	Depressed	Before, After, Follow-up
Stress 1	2.27 (0.96)	2.83 (0.85)	2.45 (0.95)*
Stress 2	1.56 (0.98)	1.95 (1.15)	1.69 (1.04)
Stress 3	1.89 (1.00)	1.93 (0.99)	1.90 (0.98)
Anxiety 1	7.22 (3.54)	10.91 (3.65)	8.41 (3.93)*
Anxiety 2	5.63 (3.25)	7.18 (3.63)	6.11 (3.40)
Anxiety 3	6.63 (3.89)#	7.67 (5.50)#	6.96 (4.39)
Depress 1	4.13 (2.94)	10.09 (4.99)	6.06 (4.62)*
Depress 2	3.21 (2.72)	6.18 (3.43)	4.14 (3.23)
Depress 3	4.05 (3.08)#	4.89 (4.54)#	4.32 (3.55)

Note. Significant effects for Treatment ($p < .05$) are indicated with * in the condition which is significantly high or low as compared to the other two conditions. Significant interaction effects for Treatment × Diagnosis ($p < .05$) are indicated with # in the follow-up condition.

maintained at the same level after 4 months after treatment (mean = 74.95, $SD = 64.04$). There were no other significant effects ($p > .05$).

Sleep Quality

The analyses yielded a significant difference for treatment ($F[2, 52] = 4.72$, $p = .019$), and further analysis showed (pair-samples t tests, 5% level) that the sleep quality first enhanced from 43.71 ($SD = 22.08$) to 54.03 ($SD = 26.30$) directly after treatment and then maintained at the same level after 4 months after treatment (mean = 52.21, $SD = 24.59$). In addition, there was a significant treatment × diagnosis interaction effect ($F[2, 52] = 3.85$, $p = .004$) indicating that patients who did not have a burnout diagnosis first improved their sleep quality directly after treatment and then decreased again 4 months after treatment back to the original level, whereas the patients with burnout diagnosis improved according to a trend test (Page, 5% level) both directly after treatment and 4 months after the treatment. There were no other significant effects ($p > .05$).

Dispositional Optimism

The analyses yielded a significant difference for treatment ($F[2, 52] = 10.72$, $p = .001$), and further analysis showed (pair-samples t tests, 5% level) that dispositional optimism first enhanced from 19.26 points ($SD = 4.80$) to 20.85 points ($SD = 4.53$) directly after treatment and then maintained at the same level 4 months after treatment (mean = 21.25, $SD = 5.68$). In addition,

there was a significant difference with regard to diagnosis ($F[1, 26] = 5.17$, $p = .043$) indicating that patients who did not have a burnout diagnosis were more optimistic as compared with the patients with a burnout diagnosis. There were no other significant effects ($p > .05$).

Stress

The analyses yielded a significant difference for treatment ($F[2, 50] = 12.35$, $p = .001$), and further analysis showed (pair-samples t tests, 5% level) that stress first decreased from 14.73 points ($SD = 5.71$) to 10.11 points ($SD = 6.23$) directly after treatment and then maintained at the same level after 4 months after treatment (mean = 11.43, $SD = 5.88$). There were no other significant effects ($p > .05$).

Anxiety

The analyses yielded a significant difference for treatment ($F[2, 52] = 15.69$, $p = .001$), and further analysis showed (pair-samples t tests, 5% level) that the anxiety first decreased from 8.41 points ($SD = 3.93$) to 6.11 ($SD = 3.40$) directly after treatment and then maintained at the same level after 4 months after treatment (mean = 6.96, $SD = 4.39$).

Depression

The analyses yielded a significant difference for treatment ($F[2, 52] = 14.67$, $p = .001$), and further analysis showed (pair-samples t tests, 5% level) that the depression first decreased from 6.06 points ($SD = 4.62$) to 4.14 points ($SD = 3.23$) directly after treatment and then maintained at the same level 4 months after treatment (mean = 4.32, $SD = 3.55$). There was also a significant difference with regard to diagnosis ($F[1, 26] = 12.28$, $p = .003$) indicating that patients with a burnout diagnosis were more depressive as compared with the patients who did not have a burnout diagnosis. In addition, there was a significant treatment $\times$ diagnosis interaction effect ($F[2, 52] = 13.80$, $p = .001$) indicating that patients who did not have a burnout diagnosis first decreased their levels of depression directly after treatment and then increased again 4 months after treatment back to the original level, whereas the patients with a burnout diagnosis lowered their depression levels, according to a trend test (5% level), both directly after treatment and 4 months after the treatment. There were no other significant effects ($p > .05$).

The Relaxation Response (RR)

To investigate a possible release of the RR, and whether or not the magnitude of the response increased during treatment, EDN was administered to participants in the flotation–REST group directly after the first session in the flotation tank and directly after the last (i.e., the 12th) session. A split-plot analysis of variance with session (i.e., first flotation session, last flotation session) as the within-subjects factor and diagnosis (nonburnout patients, burnout patients) as the between-subjects factor was used. The analyses yielded a significant difference for session ($F[1, 28] = 19.39$, $p < .001$), and further analysis showed (pair-samples t tests, 5% level) that the EDN level increased from 29.48 points ($SD = 16.01$) measured directly after the first session to 40.12 ($SD = 21.10$) directly after the last session. There were no other significant effects ($p > .05$).

DISCUSSION

The present study aimed to replicate earlier studies concerning several positive effects of flotation–REST on well-being for patients with stress-related pain, with or without burnout diagnosis, and also to study long-term effects of the method. Results indicated that flotation–REST treatment was beneficial for the patients: pain areas, stress, anxiety, and depression decreased compared with a control group, whereas sleep quality and optimism increased. Those results are in line with several other studies (e.g., Bood, Sundequist, Kjellgren, Nordström, & Norlander, in press; Kjellgren, Sundeqvist, Norlander, & Archer, 2001). Further it was noticed, as a novel result, that prolactin levels were enhanced after 12 sessions in the flotation tank.

Results also indicated that that the positive effects of the flotation–REST therapy were typically maintained 4 months after treatment. The patients' experienced pain areas decreased by 48% as a result of the treatment and maintained at the same level after the 4 months with no treatment. Sleep quality was enhanced by 23% and maintained at the same level after the 4 months. Dispositional optimism increased by 8.3% and maintained at the same level after the 4 months. Experienced stress decreased by 31.4% and kept the same level after the follow up. Anxiety decreased by 27.4% and maintained the same level after the follow up. Depression lowered 24.1% and maintained the same level. Prolactin levels, however, first increased by 33% and then, after the follow up, sank back to initial levels.

The conventional description of the physiological effects of prolactin is that its major target organ is the mammary gland with the purpose to stimulate mammary gland development and milk production (Grattan, Pi,

Andrews, et al., 2001). This is of course true to some extent and functional through puberty and in pregnancy, but it cannot explain the physiological purpose of prolactin rise, for example, during extensive physical exercise (Kiive, Maaroos, Shlik, Toru, & Harro, 2004). A possible speculation would be that prolactin may also be a marker for a vitality-enhancing effect for an organism under pressure which, despite this circumstance, manages to experience relaxation. That would shed some new light not only on the reports of increased levels of prolactin during extensive physical exercise (Kiive, Maaroos, Shlik, Toru, & Harro, 2004), but also on the fact that levels of prolactin rise with healing of wounds, reparation of tissue, and during sleep (Lindholm, 1996). Because increased levels of prolactin are not beneficial for the organism over long periods of time (Werner, Bengtsson, Petrus, et al., 1999), the levels of prolactin, after an intensive period of exercise or after the healing of wounds, eventually will decrease to initial levels.

A hypothesis is that the "booster-vitality" effect would be strengthened if patients with more severe complaints (e.g., not only stress-related pain, but also burnout depression) have the greatest rise of prolactin levels. Analyses, however, did not indicate that patients with burnout diagnosis peaked more on prolactin levels directly after the period of treatment. Analyses indicated that patients with burnout diagnosis, as compared with patients without such a diagnosis, benefited more from the treatment with regard to depression. A further notion was that patients with a burnout diagnosis experienced the same quality of the relaxation response, measured with the EDN, as the patients without such a diagnosis. Both groups of patients responded at the same EDN levels after the first flotation session and both groups experienced the same enhancement of EDN levels after the 12th session.

The study did have some limitations. One obvious one was that there was no follow up of the control cohort as a result of financial limitations on the project. Furthermore, the small number of cortisol and prolactin measurements may rightly be criticized, but considering that patients were involved in a relaxation program, frequent blood sampling might been very disturbing. Naturally, the few men in the study constitute a problem, but it should also be noted that their part in the sample is typical for the population. An analysis (Mann-Whitney, 5% level) showed that the prolactin values for the men did not significantly differ from women regarding measures taken before treatment or at the follow up 4 months later. The blood sample taken directly after treatment for the men, like for the women, was significantly higher as compared with the other two measurements, although the men did not peak as high as the women. Finally, flotation–REST experiments often maintain an armchair group or a couch group as the control group (Norlander, Bergman, & Archer, 1998). The question of which group one should prefer is not settled. The problem with the couch group is that participants may fall asleep, or they might experience the condition as more or less a chamber REST

condition (i.e., another form of REST rather than a control condition). The armchair condition is certainly a non-REST condition and despite problems such as a different body posture as compared with flotation–REST, it is the most used control condition in flotation experiments (Norlander, Bergman, & Archer, 1998). The important thing is that participants in both experimental conditions (i.e., control and flotation) get the same attention (Bood, Sundequist, Kjellgren, Nordström, & Norlander, in press).

All in all, the results suggest that flotation tank therapy is an effective and noninvasive method for the treatment of stress-related pain, with effects persisting for at least 4 months. The treatment of both burnout depression and pain related to muscle tension constitutes a major challenge for the patient as well as the care provider, an area where great gains can be made if the treatment is effective. An important aspect of such treatment is to find methods that involve rest and recovery and an increased ability to experience happiness and hope. Flotation tank therapy may constitute an integral part of such treatment. There is, however, a necessity for further research to find and understand connections among possible markers, stress, and the relaxation response.

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