

Effects of modified Restricted Environmental Stimulation Therapy on relaxation, heart rate, blood pressure and flexibility

ORIGINAL

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Abstract

Background: Restricted Environmental Stimulation Therapy (REST) promotes physiological and behavioral changes that reduce the deleterious effects of stress. However, it requires expensive equipment and is accessible to a limited number of professionals and patients. We aimed to evaluate the physiological and behavioral effects of modified REST (mREST) in healthy young women.

Method: Twenty-one healthy young women (20-25 yrs) participated. mREST consists of positioning the patient floating in the pool with 32°C for about 15 minutes, for twelve sessions, with blindfolded and wearing earplugs. The evaluation was performed before and after the intervention. The analysis of the state of relaxation was investigated by a questionnaire and the self-reports were categorized. Measures of heart rate and blood pressure were used as indicators of the cardiovascular response. Flexibility, measured by the finger-to-floor test, was used as an indicator of muscle relaxation.

Results: Heart rate and blood pressure significantly decreased while flexibility and relaxation increased after the sessions ($p < 0.001$ for all comparisons). Self-reports of relaxation were consistent with the blood pressure measures and indicated that the participants showed states of relaxation associated with the decrease of blood pressure and the increase of flexibility ($p < 0.001$ for all comparisons).

Conclusion: Healthy women undergoing mREST reported relaxation, with effects on muscular and cardiovascular systems. mREST is a simple, practical and affordable option for therapy in the aquatic environment.

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Keywords

Hydrotherapy, Relaxation, Sensory Deprivation, Women

Introduction

Actually there is a growing search for complementary therapies, whose goal is to induce relaxation. Physiological changes induced by relaxation can minimize the deleterious effects of stress, reducing the risk of diseases associated with this condition, such as autoimmune disorders, cardiovascular diseases, neurodegenerative and behavioral disorders [1,2,3].

Studies with relaxation techniques, e.g. yoga, tai chi and meditation, evaluated the induced physiological and psychological behavioral changes, known as relaxation response. This response is a protective mechanism against the deleterious effects of "fight or flight" reactions, triggered by stress. The relaxation response involves the reduction of autonomic and metabolic activity, and the decrease of heart rate and arterial blood pressure [1,3].

The Restricted Environmental Stimulation Therapy (REST) is performed with decreased stimulation by floatation in aquatic environment with controlled sensory conditions. This original version is based on the floatation for 40 minutes in a 34°C high salinity water chamber with reduced noise and light [4]. Benefits of this therapy have been demonstrated, such as the reduction of stress, anxiety, muscle fatigue and chronic pain and the gain on range of motion and sleep quality [5].

Cunha and Caromano (2006) proposed the adaptation of REST, called modified REST (mREST), to use in a regular swimming pool [6]. The patient in immersion was positioned with the head constantly out of water, with floatation equipment. Visual and auditory stimuli were restricted by using blindfold and earplugs, temperature was 34°C. The physiotherapist was next to the patient, who could stop the session if was necessary. The time of application was reduced from 40 to 15 minutes, with the aim of using this intervention as part of a hydrotherapy session.

REST and mREST aimed to promote physiological changes, caused by the physical properties of the

water, that can be immediate and/or delayed and diversify to the level of body immersion and characteristics of body composition [5,7].

The mREST did not require specific environment and was viable in any thermoneutral temperature pool. Therefore, it was relatively practical, inexpensive and accessible, compared to the original version of the technique. The presence of the therapist close to the patient offered control over the intervention and promoted safety for the patient.

Hydrostatic pressure can contribute to relaxation due to the pressure gradient, which facilitates venous and lymphatic return and minimizes the peripheral accumulation of fluid. The buoyancy decreases the discharge of body weight, reducing muscle tension. The effect of water temperature accentuates the feeling of well-being, optimizes circulation and may show analgesic effects [8].

Relaxation techniques are useful for physical trainers and therapists. Currently, a large number of clients and patients report high levels of stress, which can impair physical training and rehabilitation. Stressed individuals may benefit from interventions to promote relaxation. The ability to apply relaxation techniques can help the trainers/ therapists on decision making about the most appropriate resources, considering the needs of the clients/ patients. This study aimed to evaluate the effect of mREST on self-reported relaxation, arterial blood pressure, heart rate and flexibility in healthy women.

Methods

This study used a quasi-experimental design, with pre and post-intervention assessments of one group. It was conducted in the Laboratory of Physical Therapy and Behavior from the Physical Therapy Course in the Faculty of Medicine of University of São Paulo (Brazil), in cooperation with the Integrated Physical Therapy Clinic SIMMM. A 4.0 x 6.0 x 1.5 meters pool was used. Water temperature was

set at 32°C. The study was approved by the Ethics and Research Committee of the Institution.

Study population

Twenty-one healthy women, aged between 20 and 25 years, were eligible to participate in the program of intervention with 12 sessions of mREST. All of them had university degree. The inclusion criteria were young women, no complaints of vascular, neurological and orthopedic disorders.

Exclusion criteria

Exclusion criteria were subject who were smokers, or used sedation or sleeping pills.

Experimental protocol

To evaluate the relaxation pre and post intervention, was used a Likert scale [9], to respond verbally changes in feeding routine, sleeping habits, mood and bowel function.

Two open questions addressing how the participant felt during the sessions and about the effects of intervention were also included. The reports were transcribed, and the speeches analyzed and organized by categories.

Arterial blood pressure and heart rate were measured before and after intervention. The aimed of vital signs assessment were to investigate physiological adaptation in immersion and after the volunteer had been inside the pool for 5 minutes and at end of each session. It was used digital automatic pulse pressure GS200 equipment (G-Tech Corporation, USA).

Flexibility was measured by the fingertip-to-floor test, before and after the interventions. Participants stood with feet together, on a 40 x 40 cm platform, 20-cm high, without shoes. They were asked to bend forward as far as possible, while maintaining knees, arms, and fingers fully extended. Vertical distance between tip of middle finger and the platform was measured with a ruler. The distance was positive when the subject did not reach the

platform and negative when she could go further [10].

Intervention

The application of mREST occurred in twelve sessions of 15 minutes, twice a week, for six consecutive weeks. During the interventions, floaters were used, according to each participant. Subjects were blindfolded and wore hearing protectors, and they were kept without any verbal or tactile contact throughout intervention. The therapist remained in the pool about 50 cm from participant. It was previously clarified that the therapist would only intervene if asked by the participant.

Statistical analysis

The answers to the questionnaire were arranged in categories, and the frequency of the reports was described and compared by chi-square tests. The measures of heart rate, systolic and distolic arterial blood pressure, and flexibility pre- and post-interventions were compared by analyses of variance. Alfa was set at $p < 0.05$.

Results

Data referring to reported relaxation questionnaire are presented in categories with Chi-square tests comparing the frequencies of positive and negative reports for each category, on **Table 1**.

REST modified was effective in producing immediate acceptance in 95% of the participants ($n=20$, $p < 0.001$). It was observed that reports were consistent with feelings for both physical and mental relaxation. Relaxation came faster in subsequent sessions for 95% of the participants ($n=20$, $p < 0.001$) (**Table 1**).

All participants (100%, $n=21$) reported the sensation of not feeling body parts and sometimes not feeling the whole body during mREST ($p < 0.001$). Volunteers also mentioned improvement of sleep

Table 1. Reports of the subjects treated with mREST (n=21), organized by category and frequency. Chisquare tests compared positive vs. negative reports for each category (p<0.05)

Positive reports	Negative reports	Chi-square test
1. Acceptance of the technique		
Feelings of relaxation and comfort during all the sessions (n=20, 95%)	Difficulty relaxing, mainly in the first sessions, with many recurring thoughts (n=1, 5%)	P<0.001
2. Relaxation		
Relaxation, with a sensation of peace, calm and well being (n=17, 81%)	Thoughts of a series of issues to be resolved were frequent during the sessions (n=4, 19%)	P=0.001
3. General sensations and feelings		
Feeling that the problems had disappeared during the session (n=17, 81%)	Thoughts on their problems (n=4), although the resolution options seemed clearer (n=2, 10%)	P=0.001
Sensation of not feeling body parts and sometimes the whole body (n=21, 100%)	No negative reports (n=0)	P<0.001
Feeling of being between dream and reality (n=15, 71%)	No negative reports (n=0)	P=0.007
Feeling of protection or of being able to count on someone (n=5, 24%)	No negative reports (n=0)	Non-significant difference
4. Sensations at the end of each session		
Thoughts about what was really important in their lives and what should be modified (career, family, friends) (n=5, 24%)	No negative reports (n=0)	Non-significant difference
Thoughts about which behaviors they should change to be healthier (feeding and sleeping habits, relaxation routines, decreasing work overload) (n=18, 86%)	No negative reports (n=0)	P=0.001
5. Behaviors about how they felt with the evolution of the sessions		
Relaxation came faster with the evolution of the sessions (n=20, 95%)	One participant reported difficulty relaxing in all the sessions (n=1, 5%)	P<0.001
Improvement on sleep quality (n=16, 76%)	No negative reports (n=0)	P=0.003
Better feeding control (n=8, 38%)	No negative reports (n=0)	Non-significant difference
Mood improvement (n=20, 95%)	No negative reports (n=0)	P<0.001
Less incidence of musculoskeletal pain and the feeling of more body mobility (n=21, 100%)	No negative reports (n=0)	P<0.001

quality (76%, $n=16$, $p=0.003$), mood (95%, $n=20$, $p<0.001$), and perception of more body mobility (100%, $n=21$, $p<0.001$). After the sessions, participants reported having thoughts about which daily life behaviors should be modified to make them healthier (feeding and sleeping habits, implementing relaxation routines, decreasing work overload) (86%, $n=18$, $p=0.001$) (Table 1).

Analyses of variance compared the evolution of heart rate, systolic and diastolic arterial blood pressure, and fingertip-to-floor distance, comparing the measures pre- vs. post-intervention.

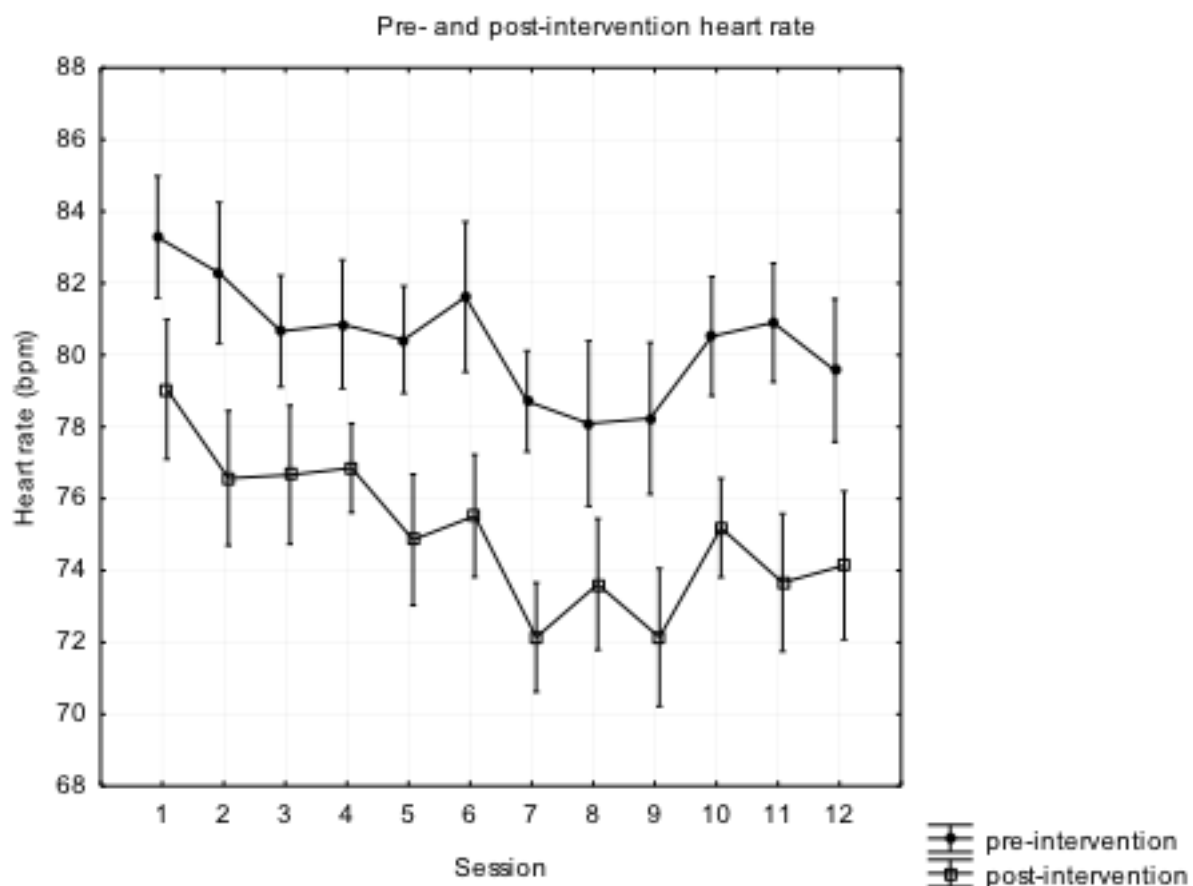
Heart rate

The analysis of variance showed difference between the assessments (comparing assessments

1 to 12) ($F_{11,220}=6.60$; $p<0.001$; $ES=0.248$) and between the moments pre- vs. post-intervention ($F_{1,20}=467.52$; $p<0.001$; $ES=0.959$). It also showed an interaction between assessment and moment ($F_{11,220}=2.51$; $p=0.005$; $ES=0.112$) (Figure 1).

Tukey *post hoc* tests showed that pre-intervention heart rates on assessments 3-5, 7-12 were significantly lower than pre-intervention heart rates on assessment 1. Tukey *post hoc* tests showed that post-intervention heart rates on assessments 2, 3, 5-12 were significantly lower than post-intervention heart rates on assessment 1. All post-intervention heart rates were significantly lower than the respective pre-intervention heart rates on all the sessions ($p<0.001$ for all comparisons) (Figure 1).

Figure 1: Pre- and post-intervention heart rates on the twelve sessions performed.



Systolic arterial blood pressure

The analysis of variance showed differences between assessments (comparing assessments 1 to 12) ($F_{11,220}=68.64$; $p<0.001$; $ES=0.774$) and between the moments pre- vs. post-intervention ($F_{1,20}=189.40$; $p<0.001$; $ES=0.904$). It also showed an interaction between assessment and moment ($F_{11,220}=2.13$; $p=0.019$; $ES=0.096$) (**Figure 2**).

Tukey *post hoc* tests showed that pre-intervention systolic arterial blood pressures on assessments 3-12 were significantly lower than the pre-intervention on assessment 1. Post-intervention systolic arterial blood pressure on assessments 3-12 were also significantly lower than the post-intervention on assessment 1. Post-intervention systolic blood pressures were lower than pre-intervention on all

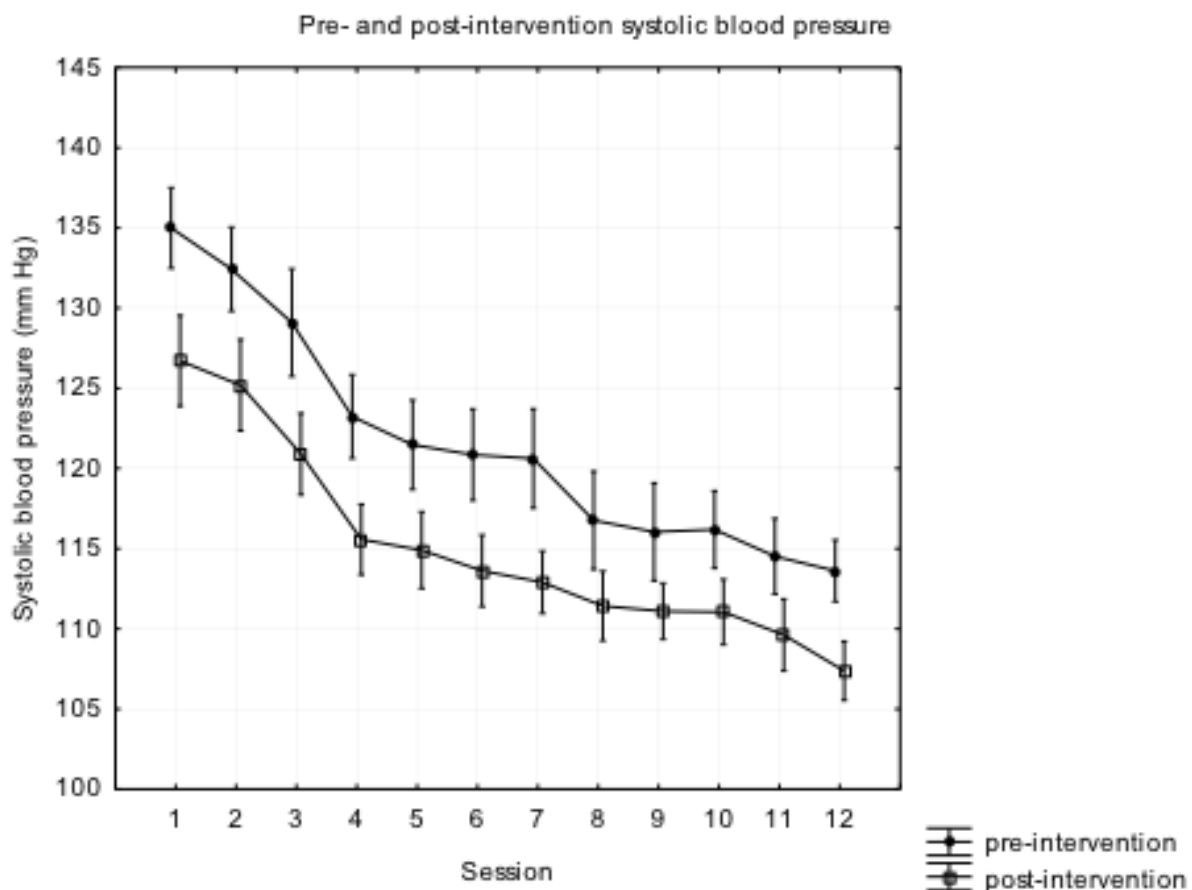
the sessions performed ($p<0.001$ for all comparisons) (**Figure 2**).

Diastolic arterial blood pressure

The analysis of variance showed a difference between assessments (comparing assessments 1 to 12) ($F_{11,220}=14.60$; $p<0.001$; $ES=0.422$) and between pre- vs. post-intervention moments ($F_{1,20}=209.38$; $p<0.001$; $ES=0.913$). It also showed an interaction between assessment and moment ($F_{11,220}=3.12$; $p<0.001$; $ES=0.135$) (**Figure 3**).

Tukey *post hoc* tests showed that pre-intervention diastolic arterial blood pressures on assessments 4-12 were significantly lower than pre-intervention on assessment 1 ($p<0.001$ for these comparisons). Post-intervention diastolic arterial blood pressures

Figure 2: Pre- and post-intervention systolic blood pressure on the twelve sessions performed.



on assessments 10-12 were significantly lower than post-intervention on assessment 1 ($p < 0.05$ for these comparisons). Post-intervention diastolic blood pressures were lower than pre-intervention on sessions 1-3, 5 and 11 ($p < 0.05$ for these comparisons) (**Figure 3**).

Flexibility

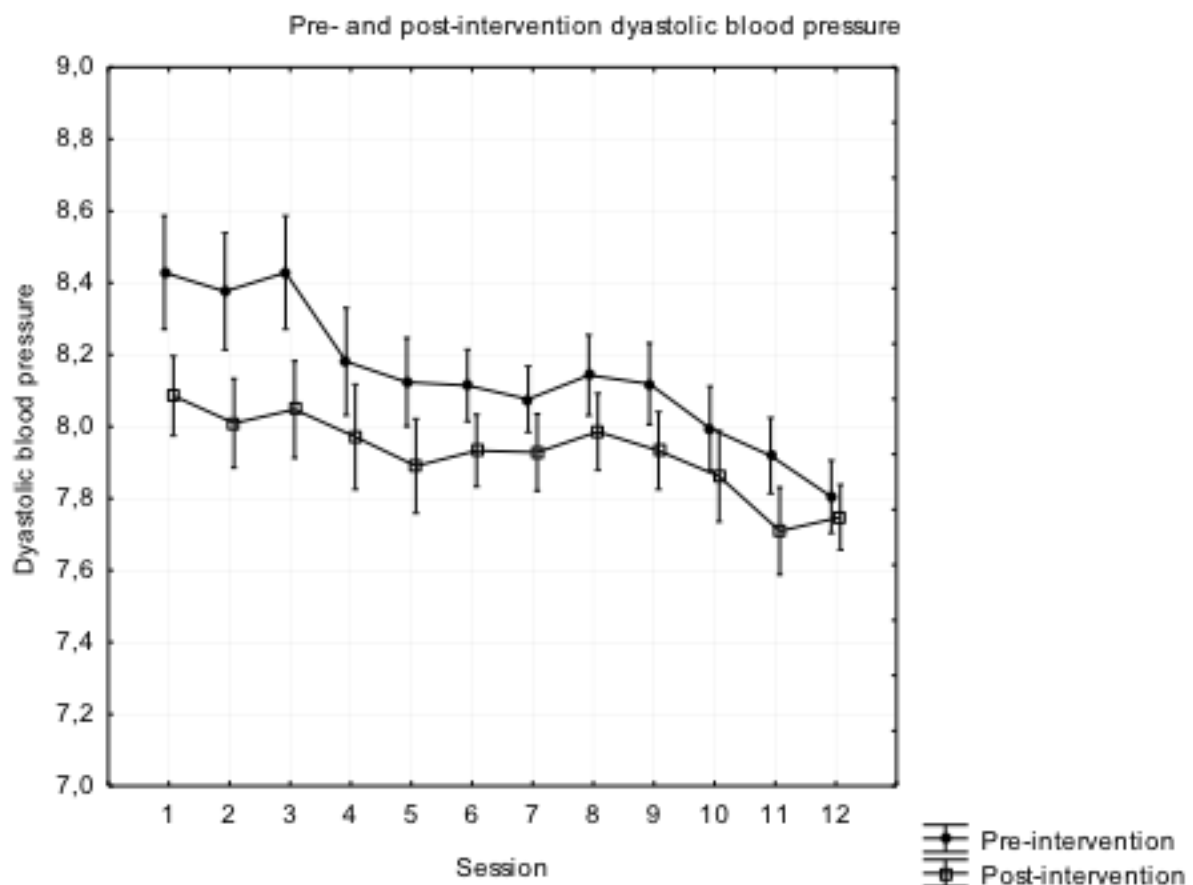
The flexibility, was assessed three times (on sessions 1, 7 and 12). The analysis of variance showed difference between assessments (comparing assessments 1, 7 and 12) ($F_{2,40} = 11.42$; $p < 0.001$; $ES = 0.364$) and moment (comparing pre- vs. post-intervention) ($F_{1,20} = 60.52$; $p < 0.001$; $ES = 0.752$). It also showed an interaction assessment vs. moment ($F_{2,40} = 4.74$; $p < 0.014$; $ES = 0.192$) (**Figure 4**).

Tukey *post hoc* tests showed that post-intervention flexibility on sessions 7 and 12 were significantly higher than post-intervention flexibility on session 1 ($p = 0.001$ and $p < 0.001$, respectively). Post-intervention flexibility was higher than pre-intervention flexibility on all performed assessments ($p < 0.001$ for all comparisons) (**Figure 4**).

Discussion

The present study showed that mREST produced physiological and behavioral changes. Feelings of relaxation and comfort have been reported by most participants, during sessions and after them (**Table 1**). Heart rate and arterial blood pressures

Figure 3: Pre- and post-intervention diastolic blood pressure on the twelve sessions performed.



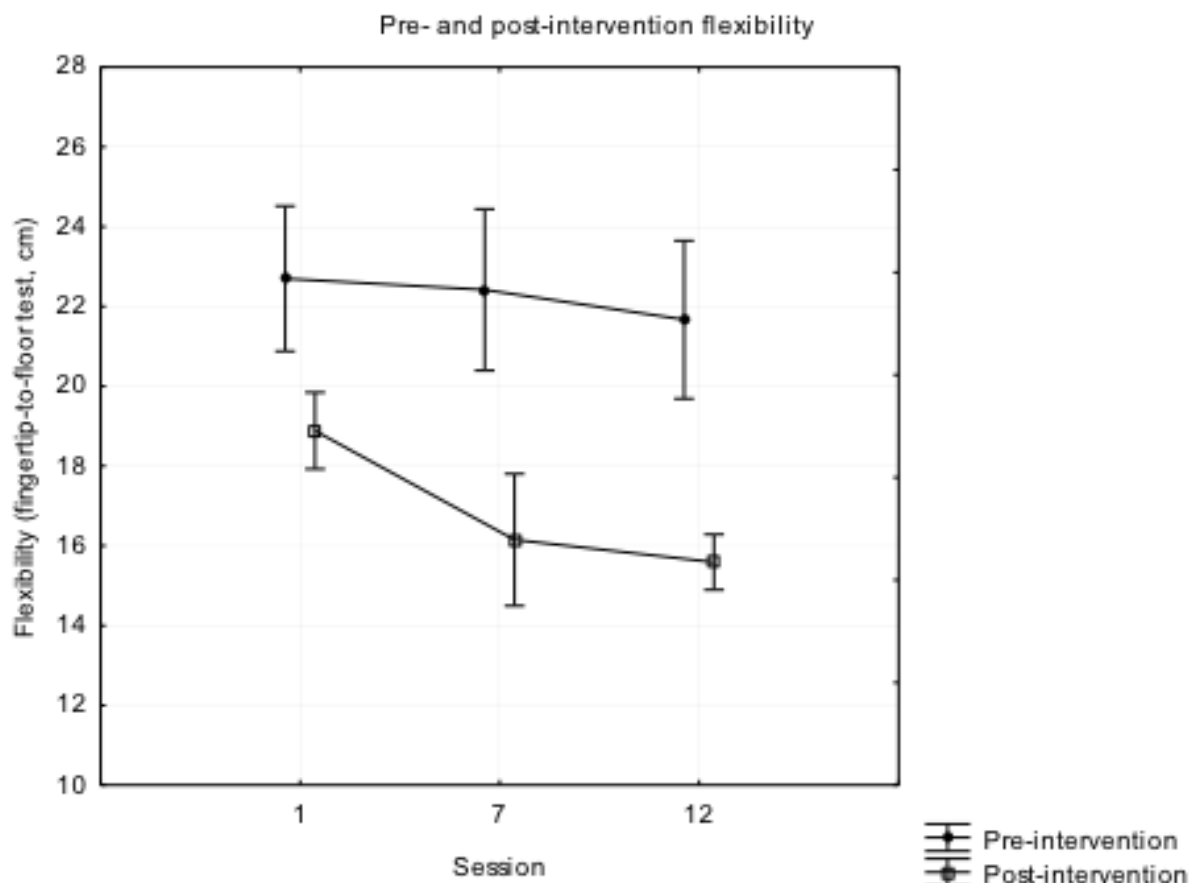
decreased after each session and such decrease showed accumulatory effect along the study period. Flexibility increased after the session and the increase was also accumulated along the sessions.

Previous studies with the traditional REST have also mentioned positive effects, e.g. reports of well-being, mild euphoria, increased feeling of originality, improved sleep, reduced stress and anxiety, reduced arterial blood pressure and reduced muscle tension [11]. Subjects submitted to REST also report the awareness of internal sensations during the relaxation session and higher awareness of external stimuli after sessions, they become more receptive and responsive to new information. Thus, the technique may facilitate relaxation and lifestyle changes when it is combined with appropriate inputs [12].

The results from the present study are consistent with other studies that assessed the perception of stress and relaxation using REST. One of these studies stated that REST produces relaxation with physiological and behavioral modifications, and reduces the perception of stress [13]. Such reports are important because currently most people report suffering with the exposure to different stressing stimuli. The classic "fight or flight" response is characterized primarily by neuroendocrine responses, e.g. the release of hormones that trigger a series of physiological changes in order to maintain life in difficult situations [2].

Bood et al. (2006) and Dierendonck & Nijenhuis (2005) investigated floatation as a stress-management tool [11,14]. The results showed that REST has

Figure 4: Pre- and post-intervention flexibility on the twelve sessions performed.



positive effects on physiological reactions. It reduces arterial blood pressure, and also the perception of pain, negative affectivity and depression. REST also improved sleep quality and mood significantly. Bood et al. reported that these results were significant in a 12-session program and they were maintained on second study with a 4 month follow-up [11,15].

The control of arterial blood pressure with the use of behavioral procedures was one of the earliest concerns of health psychology [12]. Positive effects on systolic and diastolic arterial blood pressure have been described, not only for REST, but also after slow breathing, in healthy people [16,17,18] or in people with cardiovascular dysfunction [19]. Such changes can be explained by a gradual reduction on sympathetic vasomotor control, as a result of parasympathetic activation during relaxation [20,21,22,23]. After some sessions, parasympathetic activity increases, leading to the maintenance of the results during longer periods [20], as observed in the present study, in which the reduction of heart rate and arterial blood pressure was maintained within the study period.

Forgays & Belinson (1986) found consistent relationship between heart rate and time on floatation environment [24]. Most subjects displayed higher heart rates on first sessions, which dropped reliably along the study period, and then increased a bit at the end of the intervention period. The authors discussed that this pattern made good logical and psychological sense. For the pre-within-post floating comparison, the heart rate of the typical subject decreases most during floatation and was lower after than before the session. Then, there was a steady decrease on heart rate, during the session, until the subject was apparently preparing to leave the tank, when an increase occurred, because, by this time, the novelty of the environment has worn off and a boredom factor was developing. This suggests that, in the present study, the heart rate and the arterial blood pressure may have been ever lower during mREST period.

The systolic and diastolic blood pressure were significantly reduced after each REST session and, as in the present study, a positive cumulative effect was observed comparing the first to the subsequent sessions, in a four month-follow up, reported reductions on blood pressure across and after floatation sessions [25]. However, another study, by Bood et al. (2007), showed that the diastolic blood pressure did not change significantly after 12 floatation sessions. The authors reported a significant reduction on diastolic arterial blood pressure only after a program of 33 sessions [15].

It is interesting to observe that, although the present study performed shorter sessions, it was able to detect significant positive diastolic arterial blood pressure modifications after 12 sessions. This can be explained because the present study included only healthy participants and the study of Bood et al. (2007) included a sample with both healthy subjects and Burnout syndrome patients, who may need longer relaxation programs to show significant physiological benefits [15].

The flexibility measurement was used as an indicator of muscle relaxation [26] and improved consistently after all sessions that were evaluated. Previous studies that used REST to promote relaxation corroborate these findings and showed satisfactory effects in reducing muscle tension and increasing flexibility [25,27].

Patients with physiological and behavioral consequences of psychomotor agitation or muscle tension, associated with pain, are commonly observed in clinical practice. As a result, it is necessary to employ relaxation techniques, with the objective of promoting systemic adaptations, that oppose to those activated during stressful situations. Patients submitted to relaxation techniques may adapt more easily to daily interurrences, and show higher quality of life.

REST modified technique is an adaptation from the original REST, with reduced costs and time. Moreover, a possibility to use this technique in thera-

peutic environment adequate to produce relaxation, associated with beneficial physiological and behavioral changes. Although the floatation-REST technique is not strongly influenced by expectancy-placebo [28] or by attention-placebo [11], future studies should include control groups, different populations and follow-up reassessments.

Conclusion

The effects of mREST technique were beneficial for decreased heart rate, systolic and diastolic arterial blood pressure. Improvement in self-relaxation with reports of reduced perceived stress and improvement on sleep quality, mood, body comfort. Therefore, it was adequate for the purpose of inducing relaxation.

Conflicts of interest

The authors declare no conflicts of interest.

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