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Flotation restricted environmental stimulation therapy and napping on mood state and muscle soreness in elite athletes: A novel recovery strategy?

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ABSTRACT

Relaxation techniques and napping are very popular strategies amongst elite athletes recovering from the psychophysiological demands of training and competition. The current study examined a novel relaxation technique using restricted environmental stimulation therapy in a flotation tank (FLOAT). FLOAT involves reducing the level of environmental stimulation while achieving a sense of near weightlessness through floating in an enclosed, warm, saline-dense water tank. Sixty elite, international-level athletes (28 male, 32 female) across a range of 9 sports, completed a ~45 min FLOAT session following exercise training for their sport. Pre and post FLOAT, athletes filled out a multidimensional mood-state questionnaire (MDMQ) containing 16 mood-state variables as well as a question on perceived muscle soreness. Group data were analysed for pre to post FLOAT for all measured variables. Further analyses were performed on all variables for athletes that napped during FLOAT ($n = 27$) and compared to those that did not nap ($n = 33$). A single FLOAT session significantly enhanced 15 of the 16 mood-state variables ($p < 0.05$) and also lowered perceived muscle soreness ($p < 0.01$). *Small* ($n = 3$) to *moderate* ($n = 6$) effect sizes in favour of napping for 9 of the 16 mood-state variables were found when compared to the no nap group. FLOAT may be an effective tool for both physical and psychological recovery following training in elite athletes. Furthermore, napping in combination with FLOAT may provide additional benefits to enhance certain mood-state variables. This study serves as a pilot study for future research into the performance recovery of elite athletes following FLOAT.

1. Introduction

Flotation-restricted environmental stimulation therapy (REST) involves lying supine in a dark, sound-reduced tank, while immersed in a saline solution, effectively increasing the density of the water which allows an individual to float (Van Dierendonck & Te Nijenhuis, 2005). This form of therapy has been used as a relaxation tool for stress-management (Van Dierendonck & Te Nijenhuis, 2005), for treatment of chronic pain (Fine & Turner, 1985), headaches (Rzewnicki, Wallbaum, Steele, & Suedfeld, 1990), hypertension (Kristeller, Schwartz, & Black, 1982), insomnia (Ballard, 1993), rheumatoid arthritis (Turner, DeLeon, Gibson, & Fine, 1993), behavioural problems (Suedfeld & Bow, 1999), and also to increase internal focus and primary-process orientation important for complex skill execution (Norlander, Bergman, & Archer, 1999). More recently, anecdotal reports and unpublished observations (Klockare, 2012) of athletes using flotation tanks to aid in their recovery from training and competition have yielded interest in this strategy. Indeed, the psychophysiological stress, coupled with inadequate recovery often experienced by elite athletes can lead to overtraining and under-performance (Budgett, 1998), hence the need for strategies that target both physiological and psychological recovery.

Flotation REST was developed in the 1960's by John Lilly as a method of sensory deprivation to treat various behavioural and health disorders (Lilly, 1977). Participants lay in a flotation tank containing water that is dense with Epsom salts (Mg_2SO_4). The Epsom salt solution allows participants to float supine, with the face and ventral portion of the body above the water line. This environment generally brings about an automatic relaxation response and can elicit the onset of sleep (Van Dierendonck & Te Nijenhuis, 2005). The relaxation response has been shown to alter a number of psy-

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chophysiological measures from pre to post flotation sessions on a wide range of stress-related measures. Changes in these measures include increases in EEG theta and alpha waves, decreases in plasma and urinary cortisol, ACTH, aldosterone, renin activity, epinephrine, heart rate and blood pressure following flotation sessions (Turner & Fine, 1990, 1993). Furthermore, self-reports using psychometric scales or open-ended questions, indicate deep relaxation for the vast majority of subjects following flotation REST (Forgays, Forgays, Pudvah, & Wright, 1991; Schulz & Kaspar, 1994). Alongside physical recovery strategies such as ice-baths, compression garments and massage, relaxation strategies have also become a popular method of recovery from exercise (Venter, Potgieter, & Barnard, 2010). Techniques such as progressive muscle relaxation (PMR) and meditation are commonly used by athletes to enhance performance and post-exercise recovery (Hashim, Hanafi, & Yusof, 2011; Venter et al., 2010). It is also widely accepted that sleep, including napping, is another key strategy for athletes recovering from exercise, through various psychophysiological pathways (Samuels, 2009). However, no research has been performed evaluating the use of flotation REST and napping for relaxation and recovery in an elite athlete setting.

The aforementioned previous research on flotation REST has mostly focused on the treatment of various health-related issues. To our knowledge, only one study has assessed the effect of flotation REST in an exercise-recovery setting. Morgan, Salacinski, & Stults-Kolehmainen, (2013) investigated the use of a 1-h flotation session following maximal eccentric muscle contractions of the knee extensors and flexors. Their results indicated that flotation REST had a significant impact ($p < 0.05$) on lowering blood lactate and perceived pain compared with a 1-h passive recovery session in 24 untrained healthy men. These significant results warrant further research into whether the same effect would be seen in a highly-trained athletic population. However, while not in an exercise-recovery setting, several studies evaluating sport performance in athletes have yielded positive results following flotation REST. In several studies, flotation REST has been combined with visual imagery training, or used as a pre-competition strategy and resulted in subsequent positive outcomes. Significant improvements to basketball free-throw shooting (Suedfeld & Bruno, 1990; Wagaman, Barabasz, & Barabasz, 1991), tennis first-serving percentage (McAleney, Barabasz, & Barabasz, 1990), archer accuracy (Norlander et al., 1999) and rifle marksmanship (Barabasz, Barabasz, & Bauman, 1993) have all been attributed to the benefits associated with the psychological and muscle relaxation attained during flotation REST.

In summary, positive effects, both physiological and psychological, have been demonstrated following flotation REST in numerous different populations ranging from healthy individuals to those with chronic diseases. While there are promising indications that flotation REST may be effective in an exercise-recovery setting (Morgan et al., 2013), there is a distinct lack of research investigating the use of flotation REST as a recovery strategy in an elite athlete population. Therefore, the aim of the current study was to assess the effect of a flotation REST session on mood-state variables and perceived muscle soreness following exercise in elite, international level athletes.

2. Method

2.1. Participants

Restricted environment stimulation therapy sessions in a flotation tank (FLOAT) were performed by 60 elite Australian athletes. All athletes volunteered to participate in the study and had not previously taken part in a FLOAT session. The study was completed by 28 male and 32 female athletes across a wide range of sports (athletics = 8; basketball = 8; boxing = 2; cycling = 10; football = 11; netball = 15; rowing = 2; rugby = 2; swimming = 2). All athletes represented their country at an international-level for their chosen sport and took part in the study during the in-season phase of training. As athletes were from a mix of summer and winter sports, the study took place over a 6-month period to ensure that athletes participated during their respective competition seasons. The study was approved by a institutions Human Research Ethics Committee.

2.2. Design

On a single occasion, athletes attended the institutions recovery centre for the FLOAT session. All athletes were to arrive at the session within 1–3 h of finishing their last training session for their sport (mean ± SD: 2.5 ± 1.0 h). Athletes filled out the questionnaires immediately pre and 10-min post FLOAT. Athletes were instructed to arrive at the FLOAT sessions in a hydrated state.

2.3. Methodology

FLOAT sessions involved athletes lying supine in a light-proof flotation tank (Apollo Float Tanks, Australia) in ~30 cm deep saline solution (Epson salts – Mg_2SO_4) warmed to ~35 °C. The float tank was insulated on the inside so as to maintain a constant temperature and to isolate the participant from sound and sight. Air temperature inside the float tank was also maintained at ~35 °C, to ensure that the sensation between air and water was minimized. Earplugs and an air cushion were provided for comfort and neck support and athletes donned their normal swimwear during FLOAT. Athletes were instructed to float for ~45 min (mean ± SD: 48 ± 15 min), as this is the recommended average duration from a previous meta-analysis (Van Dierendonck & Te Nijenhuis, 2005). Athletes reported whether or not they napped during the FLOAT session and if so, their estimated duration of the nap. In the current study, a nap was defined as "falling asleep" for any period of time during the FLOAT session.

The pre and post questionnaire was completed by all athletes that participated in the current study. Information relating to sport, level of competition and time of last training session was collected. In addition to the background information, immediately before and 10-min after FLOAT, a modified version of a validated multidimensional mood-state questionnaire (MDMQ) was completed to assess different mood dimensions including: pleasant–unpleasant, awake–sleepy, and calm–restless (Steyer, Schewenmezger, Notz, & Eid, 1994). The questionnaire contained a list of 16 mood-state descriptors (e.g exhausted, tense, fresh, sleepy), each with a 6-scale, Likert format response (definitely not, not, not really, a little, very much, extremely). The athletes also indicated on a 10 cm visual analogue scale their level of general muscle soreness (0 = not sore at all, 10 = maximal muscle soreness).

2.4. Statistical analysis

Descriptive statistics are shown as means ± between-subject standard deviations unless stated otherwise. Magnitudes of the standardised effects were calculated using Cohen's *d* and interpreted using thresholds of 0.2, 0.5, 0.8 for *small, moderate and large*, respectively (Cohen, 1988). An effect size of ±0.2 was considered the smallest worthwhile effect with an effect size of <0.2 considered to be *trivial*. The effect was deemed *unclear* if its 90% confidence interval overlapped the thresholds for *small* positive and negative effects (Batterham & Hopkins, 2006). Paired student t-tests were used to compare pre and post FLOAT in SPSS version 19 (New York, USA) and statistical significance was set at $p \leq 0.05$.