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STRESS REDUCING REGULATIVE EFFECTS OF INTEGRATED MENTAL TRAINING WITH SELF-HYPNOSIS ON THE SECRETION OF DEHYDROEPIANDROSTERONE SULFATE (DHEA-S) AND CORTISOL IN PLASMA: A PILOT STUDY

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Abstract

Early observations have shown that preventive educational efforts towards experience of stress entail advantages in terms of improved well-being, health and performance. We examined the influence in healthy subjects of self-hypnosis and mental training taught in group sessions, with individual training in between according to a standard protocol, and integrated in daily life and work for six months, on the alteration in plasma concentration of the stress hormone cortisol and the 'anti ageing' hormone dehydroepiandrosterone sulfate (DHEA-S). DHEA-S and cortisol were analysed in twelve healthy men and women, with six individuals randomly divided equally between experimental and control groups. In the experimental group DHEA-S was significantly increased by 16% ($P < 0.05$), whereas plasma DHEA-S in controls followed an expected age-related decline. Cortisol was reduced by 12.3% ($P < 0.05$) in the experimental group, but remained unchanged in the control group. The ratio between plasma concentrations of DHEA-S and cortisol that reflects stress-related alteration in the adrenal secretion between androgens and glucocorticoids, increased significantly by 27.8% ($P < 0.05$) in the experimental group with a reduction of 8,2% in controls. The increase in plasma DHEA-S under experimental conditions was equivalent to a range normally found in individuals 5 to 10 years younger. Copyright © 2006 British Society of Experimental & Clinical Hypnosis. Published by John Wiley & Sons, Ltd.

Key words: mental training, self-hypnosis, plasma, increased DHEA-S, decreased cortisol, anti-aging

Introduction

The concept of 'stress' is usually defined as the non-specific response of the body to any demand (Henry, 1997). Biologically, stress is any challenge to homeostasis, i.e. activation of mental, emotional, physiological and biochemical processes in the body as a response to the environment, adapting the organism to external load, and as an immediate and dynamic response to the intensity and duration of environmental stimuli (Parker, Eugene, Farber, Lifrak, Lai and Juler, 1985). The stress reaction, aside from somatic influences, also involves cognitive, emotional, and behavioural effects and is considered to be a crucial and central survival factor (Fava, Littman and Halperin, 1987). From an evolutionary perspective, the physiological reaction characterized by heightened systemic arousal, influencing all physiological processes, e.g. followed by increased secretion of stress hormones and increased heart rate, was in pre-history developed as a temporary response towards unexpected and immediate changes and threats in the surroundings.

On the other hand, in urban complex societies with continuous environmental changes and never ending multi-factor sensory stimulation, repetitive, cumulative and chronic effects of an antecedent stress reaction have been related to cardiac diseases, increased blood pressure, gastric ulcers, eczema, insomnia, loss of appetite and drug abuse, etc. (Endoh, Kristiansen, Casson, Buster and Hornsby, 1996).

The hypothalamus, pituitary and adrenal glands (HPA-axis) play a central role in the body's adaptation to stress-related responses (Faredin, Fazekas, Toth and Juslesz, 1969; Parker et al., 1985). Examples of such stress are physical and psychological strain, trauma and infections (Endoh et al., 1996). The most important and quantitative dominating stress hormone is the adrenal hormone cortisol (Parker et al., 1985). The secretion of cortisol as a response to stress activation, is regulated by the glucocorticotrope hormone (ACTH). In terms of survival and self-preservation, ACTH reflects an immediate hormonal connection to perceptual and cognitive experiences (Endoh et al., 1996). In the systemic circulation, dehydroepiandrosterone sulfate (DHEA-S), the most numerous androgen, is secreted in a counteracting balanced response to the level of cortisol (Orentreich, Brind, Rizer, Vogelman, 1984; Labrie, Bélanger, Cusan, Gomez and Candaz, 1997). DHEA-S is converted in various tissues to its primary active analogue, dehydroepiandrosterone (DHEA; Leowattana, 2001), and along local peripheral pathways to androstenediol (Berliner and Gallegos, 1967) and finally to androstenetriol (Regelson, Loria and Kalami, 1988). DHEA-S has been considered as a marker for biological ageing (Barrett-Conner, Khaw and Yen, 1986; Wisniewski, Hilton, Morse and Svec, 1993; Baulieu, 1996; Corrigan, 2002). The adrenal secretion and blood concentration follows a biphasic time course, reaching a peak in the age range of 20–30 years, followed by a slow decline, with the greatest fall by 50–60 years (Barrett-Conner, Khaw and Yen, 1986; Baulieu, 1996; Corrigan, 2002). The concentration in blood is slightly higher in men than in women, and the highest concentration appears later in men (Carlström, Brody, Lunell, Lagrelius, Möllerström, Pousette, Rannevik, Stege, von Schoultz, 1988; Wisniewski, Hilton, Morse and Svec, 1993; Sulcóva, Hill, Hampl, Stárka, 1997). At the age of 70 only about 10 to 20% of peak concentrations remain (Wisniewski, Hilton, Morse and Svec, 1993; Baulieu, 1996). The concentration in blood of DHEA-S and DHEA reflects the biological conditions of acute and chronic stress (Kroboth, Salek, Pittenger, Fabian and Frye, 1999; Boudarene, Legros, Timsit-Berthier, 2002). Falling concentrations have been observed in both mental and psychological stress and physical illness (Boudarene et al., 2002). Low concentrations in blood have been correlated with many age-related diseases, an important issue which has been reviewed recently (Luppa, Munker, Nagel, Weber and Engelhardt, 1991; Kroboth et al., 1999; Salek, Bigos and Kroboth, 2002). Increased plasma DHEA-S has been connected with a reduction in age-related diseases and alleviated chronic stress-load (Glaser, Brind, Vogelman, Eisner, Dillbeck, Walace, Chopra and Orentreich, 1992; Arlt, Callies, van Vlijmen, Koehler, Reinecke, Bidlingmaier, Huebler, Oettel, Ernst, Schulte and Allolio, 1999). In women, elevated concentrations of the active hormone DHEA, but not DHEA-S, have been significantly correlated with positive measures of well-being and sensation seeking behaviour (Cawood and Bancroft, 1996). Continous physical activity and training or systematic application of stress-reducing and relaxation activities also result in increased DHEA-S levels (Keiser, Kuipers, De Haan, Becers, Habets, 1987; Caciarri, Mazzanti, Tassinari, Bergamaschi, Magnani, Zapulla, Nanni, Copianchi, Ghini, Pini and Tani, 1990; Glaser et al., 1992). In institutional elderly people, social activities experienced as stimulating and motivational contribute to an increase in the production of DHEA (Arnetz, 1983). The pleiotropic effects of DHEA-S could, on recent observations, be considered partly based on perceptual and cognitive

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induced auto-regulation of different genes involved in physiological processes, regulating enzymes involved in the metabolism of DHEA-S and its active analogues, in relation to coping strategies and behaviours (Adams, 1985; Nijhout, 1990; Normile, 1998; Beishuizen, Thijs, Vermes, 2002).

Integrated mental training (IMT)

IMT, developed by Uneståhl in the early 1970s, is a systematic and long-term training of mental processes (thoughts, images, attitudes, emotions) aiming for peak performance and wellness. The training develops 'Alternative Systems of Control' by using 'Alternative States of Consciousness', mainly self-hypnosis (Uneståhl, 1973; Uneståhl, 1975; Uneståhl, 1999).

Investigations of sport and work competence revealed three basic factors for 'external success', self-image, goal-images and attitude. However, in order to achieve 'internal success' (feeling well, satisfaction, happiness) an emotional factor had to be added. The development and control of these four factors became the main part of the training programmes (Uneståhl, 2000). The programmes were developed, applied and tested on various national and Olympic teams during the 1970s (Uneståhl, 1985). The applications went from sport to schools and education (1975–1982), then to business, public administration and health and clinical areas in the 1980s. The biggest area from the beginning of the 1990s has been personal development together with team and leadership development (coaching) (Uneståhl, 2004).

Purpose

The purpose of this study was to examine the effects on health and stress, measured by an alteration in plasma cortisol and DHEA-S, in connection with proficiency after mental training, among healthy individuals in job involvement at the same work unit.

Method

Participants

Twelve healthy volunteers were recruited and participated in the study, with six individuals equally allocated to experimental and control groups. The experimental group (also referred to as the study group) consisted of two men and four women, with an average age of 38 years (32–47 years). The control group consisted of 5 women and one man with an average age of 32 years (25–44 years). The control group was informed about the basic purpose of the study, but did not participate in any other way, apart from giving blood samples. The course consisted of group meetings every other week for six months with individual mental training between the meetings.

Procedure

A programme for the development of personal competency was used. The programme is called MEA (MEW), which means motivation, effectiveness and work satisfaction. It consists of ten video lectures and a training programme in ten steps to be used during six months. The combination of video information and self-training by cassettes/CD makes it possible to run the course at home or at work, which according to the 'state bound learning' law enhances the transfer from knowledge to competence and the application of the training to work, relations and health.

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The content of the training used in this study was:

1. muscular relaxation (systematic and progressive relaxation);
2. self-hypnosis (operationally defined as the 'mental room' – MR);
3. self-suggestions and imagery (training of mental techniques);
4. self-image training (self-esteem and self-confidence);
5. goal-image training (goal settings translated into images);
6. motivation (goal programming, mission, meaning and energy);
7. creativity (spontaneous problem solving and cybernetic solution processes);
8. optimism and attitude training (positive interpretation of 'reality');
9. mental toughness training (decrease of fear, increase of courage);
10. emotional training (identification, selection and 'trigger' control of joy, happiness, etc.).

The training started with a basic mental training, providing the base for personal growth. The first part, systematic and progressive muscular relaxation, has two main purposes. The first is to decrease or remove the basic tension level, which leads to a 'relaxed effectiveness' model, which promotes health (improved rest and recovery) as well as performance (optimal tension in the synergist muscles and relaxation in the antagonist muscles). In learning relaxation the spontaneous relaxation effects of exhalation are used by developing so-called triggers, at the same time as the thought is captured by the relaxation's physiological meaning for an emotional experience of unison and total muscular relaxation. The systematic trained connection between desired goals and relaxation results in a well-trained person in immediate and total systemic muscular relaxation, irrespective of the situation the person is in. In this manner, trigger-mediated relaxation according to the MEA-model, offers increased personal control over situations that under other conditions trigger stress related reactions.

The second part, establishing an inner 'mental room' (MR) provides the basis for the rest of the training. MR involves a self-hypnotic state, in which alternative information pathways are used to develop and control thoughts, self- and goal-images, attitudes and emotions. Earlier studies (Uneståhl and Bundzen, 1996) have shown that MR is characterized by an increase of theta-activity and a levelling out of activity, making the brain work as a 'holistic unit'. The possibility of looking at this self-hypnotic state (MR) as a 'harmonious brain state' will be further investigated and music has been composed (Uneståhl, Kaså and Lord-Gunnarsson, 2005) in order to enhance the effects of the hypnotic and self-hypnotic inductions.

After having learned the basic relaxation and self-hypnosis techniques the training continues with:

- self-image training (especially self-confidence and self-esteem);
- goal-image training (vision-mission-goalsettings-goal-programming);
- attitude training (optimism, mental toughness);
- emotional training (everyday triggers for positive emotions).

Measures

The individual training frequency was registered after the ending of the course by using a subjective rating scale in five steps:

1. daily training;
2. many times a week;

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3 once a week;
4 less than once a week;
5 not at all.

Blood samples for measuring the concentration of DHEA-S and cortisol were taken before and post education. The samples were taken in the morning between 11.00 and 12.00. After centrifugation at standard conditions, plasma samples were stored frozen at –70°C until assayed. The concentration of cortisol and DHEA-S was quantified in duplicate using standard methods (Beishuizen, Thijs and Vermes, 2002); Normile, 1998)

Statistical analysis
SAS® (Statistic Analysing System) was used to calculate basic mean value statistics. The group variance for paired conditions was calculated according to conventional t-test for mean values with the level of significance set to $P < 0.05$.

Results

The frequency of the mental self-training during the MEA-course was rated by the practitioners after completion of the programme, and equals a mean score of two on the five step subjective rating scale (see Figure 1). Four of the practitioners were in training frequently several times a week, with periodic daily training. Two individuals were in training once a week only.

The mean plasma concentrations of DHEA-S and cortisol in experimental (study) and control groups are shown in Figures 2 and 3, respectively. The plasma concentration of DHEA-S followed a decline by 23.3% in the control group. This striking accentuated decrease should reasonably be considered to lie outside the normal age-related fall, and might be explained by the fact that the plasma concentration of DHEA-S in one of the control subjects was reduced by approximately 50% between measures. Among the other controls a normal decrease (1.5–2.0%) or unchanged concentration of DHEA-S was

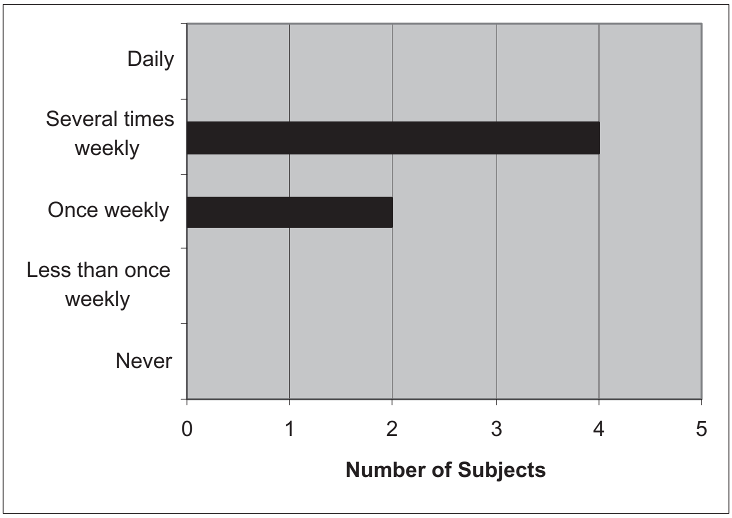

Figure 1. Training frequency (days).

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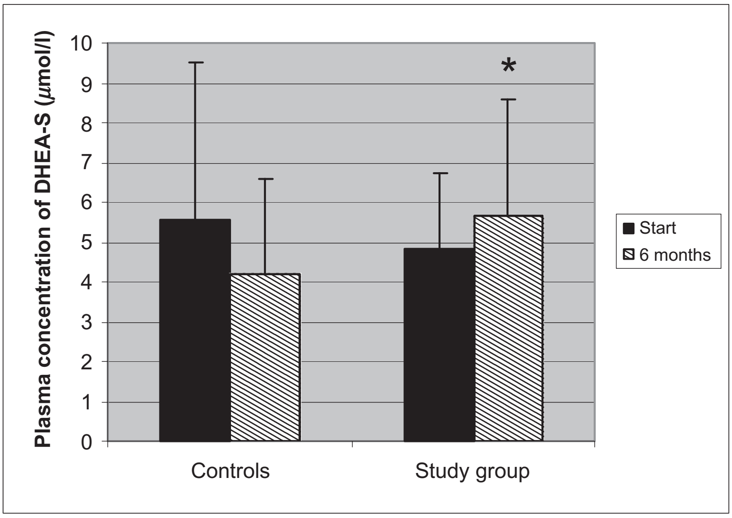

Figure 2. Plasma concentration of DHEA-S (Mean ± SD) in experimental group and controls, before and 6 months after start of study (*P < 0,05).

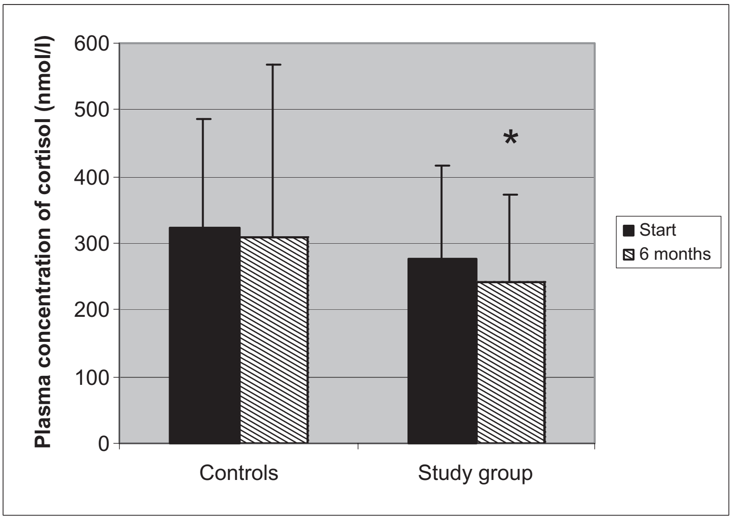

Figure 3. Plasma concentration of cortisol (Mean ± SD) in experimental group and controls, before and 6 months after start of study (*P < 0,05).

observed. In contrast, plasma DHEA-S was significantly increased by 16.0% ($P < 0.05$) in the experimental group. This increase in plasma DHEA-S corresponds to a concentration range normally observed in subjects 5 to 10 years younger. All participants in the experimental group showed a similar response as a consequence of the applied training procedure.

Mean plasma cortisol was found unchanged in the control group at both measures. On the other hand, a significant decrease by 12.3% ($P < 0.05$) in cortisol concentration was observed in the experimental group at the second measurement.

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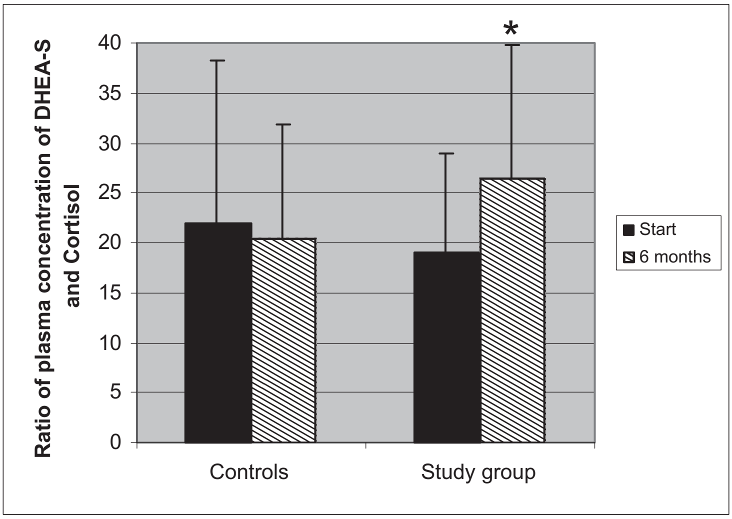

Figure 4. Ratio of plasma concentration of DHEA-S and cortisol (Mean ± SD) in experimental group and controls before and 6 months after start of study (*P < 0,05).

Figure 4 shows the ratio between plasma concentrations of DHEA-S and cortisol before and post training. The plasma ratio of DHEA-S and cortisol, showed a significant increase, 27.8% ($p < 0.05$) in the study group, while a decrease by 8.2% was observed in controls.

Discussion

Integrated mental training was taught in group sessions according to a standard protocol. The various parts of the mental training programme were frequently trained and integrated into daily life and work. Studying the role of anxiety, cortisol and DHEA-S in the stress response, regulated by the HPA-axis, has identified DHEA-S as an anti-stress hormone related to an antagonistic action towards cortisol (Boudarene et al., 2002), possibly conditioning an emotional state based on improved well-being. Results conclude that with sustained psychological stress, a state of anxiety was associated with loss of behavioural control, increased cortisol and low DHEA-S in plasma. Furthermore, a close negative correlation was observed between higher DHEA-S and increasing scores of state and trait anxiety. The results confirm that worrying, anxiety, rumination, uneasiness, emotional tension and negative anticipations were less important in subjects with higher plasma DHEA-S. The beneficial role of DHEA-S could be related a direct metabolic transformation into sexual hormones or indirectly by competition, opposing the action of cortisol.

The age-dependence of plasma DHEA-S and DHEA, and the proposed preventive and anti-ageing effects and possible application as biomarkers of physiological ageing has been debated and questioned in the scientific literature (Kroboth et al., 1999). Previous studies have shown that stress and serious disease are associated with increased ACTH secretion (Parker and Odell, 1980). Increased production of ACTH stimulates a shift from androgens towards glucocorticoidal secretion in the adrenal glands. This can mainly be seen as a pronounced increased level of cortisol and lower DHEA-S (Corrigan, 2002). Also, a decrease in the cortisol/DHEA ratio and low DHEA-S has been correlated with the suppression of cellular immunity and the severity of disease (Parker and Odell, 1985).

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Several studies have shown that DHEA supplementation boosts plasma levels of DHEA and DHEA-S with beneficial improvements in their ratios with cortisol, and a positive correlation with specific disease symptoms and overall assessment of the illness (Kroboth et al., 1999; Salek et al., 2002). Systemic treatment with DHEA or DHEA-S has normalizing and reversing effects on physiological and biochemical changes (Bundzen, Bendjucov and Kirushin, 1994), normally associated with low levels of DHEA-S, caused by adaptation to chronic stressors (Corrigan, 2002). Increased concentration of DHEA-S in subjects older than 80 was reported to be higher than in those up to 20 years younger, suggesting the hypothesis that people with higher DHEA-S have a longer lifespan (Baulieu, 1996). The increase in plasma DHEA-S observed in our study, corresponds to a concentration range observed subjects 5–10 years younger (Glaser et al., 1992; Baulieu, 1996).

The results of the present study suggest that frequent application of the mental training programme several days a week was successful in changing the adrenal secretion of DHEA-S and cortisol. The emotional, psychological and physiological changes previously identified to follow on self-induction of the changed mental state (Bundzen, Korotkov and Uneståhl, 2002a; Bundzen, Korotkov, Nazarov and Rogozin, 2002b), produced in the current study sustained and increased DHEA-S and lowered cortisol, and may suggest a previously unidentified relationship between an affective mental state, a shift in vagal modulation of HRV (McCraty, 2002; Bundzen et al., 2002b), and adaptation to external sensory stimuli of the hormones regulating activity in the HPA-axis. It might be suggested that increased HRV, depending on activation of afferent vagal input from the heart to prefrontal cortex, reduces plasma cortisol by inhibiting ACTH from the pituitary gland (Drinkhill and Mary, 1989), thus supporting a previous observation that a profound change in psychological states is associated with a corresponding change in mental-emotional and physiological states (McCraty, Barrios-Choplin, Rozman and Watkins, 1998). The data suggest that the adrenal neuroendocrine functional balance can be altered towards a more coherent environmental response by regular implementation of a favourable mental state, without need for supplementation with exogenous DHEA.

In conclusion and in agreement with other recent studies (Uneståhl and Bundzen, 1996; Uneståhl, Bundzen, Gavrilova and Isakov, 2004) the findings indicate that implementation of integrated mental training in every day life offers a practical tool having sustained impact on physiological and psychological well-being. By managing and conditioning changes in perception and emotional responses, a substantial affective balance in cortisol/DHEA-S ratio can be achieved with considerable effects on stress reduction, emotional stability, performance and health outcomes.

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