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Original Scientific Paper

Effects of yoga practice on neuroendocrinological changes

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Abstract: *Stressful experience may influence neuroendocrine, immune and cytokine functions of the biological systems. Academic Examination stress has been considered as a good model of naturally occurring psychological stress. It can be very potent stressors especially when the exam is perceived as important to the individual's future career objective. Thus stress management can be used to help the students filter out some of the stress and enhance their performance. Since Examination Stress modifies hormones like Cortisol, Prolactin (PRL) and Beta endorphin (β-EP), we conducted an investigation on the effect of yoga practice on these parameters. Blood samples of Engineering students were collected at four intervals Base Line (BL), Exam Stress (ES), 3 and 6 weeks practice of SK&P during ES and these hormones were measured. ES elevated cortisol, PRL and β-EP levels significantly ($p<0.001$, $p<0.05$, $p<0.01$ respectively). 3 and 6 weeks practice of SK&P reduced the elevated cortisol level significantly ($p<0.001$), and further elevated the level of PRL and β-EP ($p<0.05$). Our study indicates that students who participated yoga has the potential to overcome ES in students which is evident from the alterations in the levels of these hormones.*

Key words: *yoga, beta endorphin, cortisol, exam stress, prolactin, sudarshan yoga kriya*

Introduction

The neuroendocrine has long been thought to play an important role in causal pathway linking stress and ill health. Stress is a term often used by individuals in a variety of social, academic and employment settings. Academic examination in students has been considered as one of the most acute stresses experienced by students (Jemmott JB & Magloire K 1988). Engineering examiners frequently use examinations to assess students because they know of no other way to ensure that the students have sufficient knowledge and understanding to pass an exam without the risk that others have helped them excessively. However all examiners also know that examinations also cause serious stress to at least some proportion of students, probably to the extent that their performance is severely affected. Some degree of stress is however a normal part of the incentive to perform well, and is thus a good thing, but excess stress can be debilitating. Hence there is an urgent need for inexpensive and effective strategies to promote psychological well being in students and improve their mental and physical health status.

While modern medicine has focused on formulating ingenious chemical compounds to help us overcome toxic emotions and stress, traditional practices such as Yoga is an important and inexpensive method for training the mind. Yoga includes meditation, physical exercises and breathing exercises. Sudarshan Kriya and Pranayam (SK&P) is a rhythmic breathing technique which emphasizes breathing in 3 different rhythms. SK&P has been found to be useful for relieving depression (Brown, Gerber, 2005; Murthy et al

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1998), improving antioxidant defenses in the body (Sharma et al 2003), EEG studies (Bhatia et al 2003) revealed increased beta-activity during resting state (indicative of alertness) and increased alpha and beta-activity during the process of SK&P (indicative of relaxed alertness). Although many stress reduction techniques are well known, there is lack of research about their usefulness in reducing ES in students which thus may help in better performance by the students.

It was noticed that participants at the workshops where they practice yoga techniques have more enthusiasm, excellence and responsibility. By practicing the techniques taught in the YES+, there is a possibility in the realm of the mind to be both, Focused and Relaxed at the same time which is an art. The YES!+ course techniques help flush out this emotional stress as a result of which we are capable of taking better decision, experience more enthusiasm, creativity and joy. However there are no scientific studies to validate the claims. Numerous studies have been done previously on the level of stress among students of professional courses like medical, Dental, Nursing, Physiotherapy. Whereas, studies on engineering students is scarce and only few studies have been completed in engineering students on the physiological , biochemical and endocrine changes associated with exam stress in engineering students.

Thus the purpose of this study was to authenticate scientifically the above mentioned conviction. The present study was conducted in healthy populations among engineering students and volunteers from SRM University, Kanchipuram district, Tamilnadu, India. The present study is the first of its kind to document the effect of the short term yoga techniques practice on exam stress induced changes in stress hormones cortisol, PRL and also β-EP in engineering students.

Method

A Randomized controlled pilot study was conducted in SRM University, Kattankulathur, Tamilnadu, India among the Undergraduate Engineering Students. A convenience sampling was used. Students from same department of engineering college were selected for this study to avoid differences in stress levels. The total number of the class was 72, from which 45 students who met the inclusion criteria was enrolled for the study. 2 students did not consent to participate. Finally 43 students were involved in the study. Students who were non smokers, non alcoholics, without any history of depression, neurological disorders and who were not under any medications and those who do not practice any other kind of yoga were included. Before the study commenced, the nature of the study was explained to the participants individually and at the same time, their informed written consents were obtained. In addition each participant's personal history including medical history and lifestyle practice was also obtained. This study was approved by the institutional ethics committee (IEC) of SRM Medical College Hospital and Research Centre.

Experimental Design

In order to study the effect of short term structured yoga module in the stressful environment of university students, the 43 participants were randomly allocated into 2 groups. Control group consisted of 21 students who did not practice yoga and yoga group consisted of 22 students who practiced yoga. The assessments were done twice at pre-intervention and twice at post intervention in both the groups namely:

1. No exam period (Base Line- BL)
2. On the eve of Examination (ES)
3. After 3 weeks (During exam)
4. After 6 weeks (During exam)

The baseline data was measured few days after beginning of the academic year and the students did not have any exams or any academic burden during baseline investigations.

After performing ES assessments, the yoga group students underwent the structured yoga module (YES+) for 6 weeks daily, whereas control group did not practice yoga but were asked to sit in separate room for the timing when yoga training was given.

Interventional procedure

Youth empowerment and skill workshop is a one week course. It is composed of three modules: Healthy Body, Healthy Mind, and Healthy Lifestyle. The Healthy Body module consists of physical activity that includes yoga stretches, mindful eating processes, and interactive discussions about food and nutrition.
The Healthy Mind module includes stress management and relaxation techniques. Breathing exercises (e.g., Sudarshan Kriya) and mindfulness techniques are used to calm the mind, bringing awareness to the moment and enhancing concentration. Group processes promote personal responsibility, respect, honesty, and service to others. In the Healthy Lifestyle module, students learn strategies for handling challenging emotional and social situations, especially peer pressure. Mindful decision making and leadership skills are taught via interactive games. The following table shows the details of yoga component included in this course:

Table 1: Details of the structured yoga module

Yoga	
Asanas	Neck roll, Shoulder rotation, Peacock asana, Swing, Half moon stretch, Breath of joy, Cat Pose, Butterfly pose, Cradle pose, Wind relieving Pose, Boat pose, Surya Namsakar, Serpent posture, Locust posture, Mountain posture and Yoga nidra.
Pranayam	Three stage Pranayam with Ujjayi or "Victory Breath" Three sets of Bhastrika or "Bellow's Breath" Sudarshan Kriya or the healing breath technique.
Meditations	Guided meditation, Panchakosha meditation and Space meditation
Others	Thoughts which create positive thinking, increased self esteem

Blood was collected after 3 weeks and after 6 weeks of practice. Care was taken so that exams took place at the end of 3 and 6 weeks of SK&P practice in order to study the true effect of SK&P practice on ES. At all the 4 intervals fasting blood sample (5 ml) was collected between 8.00 am to 9.30 am by vein puncture. Serum was separated and used for the assays of Cortisol and PRL using ELISA (Adultis, Italy). β- EP was measured in plasma by ELISA (Phoenix Biosciences).

Statistical analysis

Data was analyzed using SPSS 16 version. One way ANOVA was performed in order to evaluate significant difference within the group between conditions.

Results

The results clearly indicated that exam in students elicited a significant increase ($p<0.001$) in serum cortisol levels. The significant fall ($p<0.001$) in serum cortisol levels after 3 and 6 weeks in yoga group (Fig 1) suggests that regular practice of yoga progressively develops greater levels of both relaxation and resilience to stress.

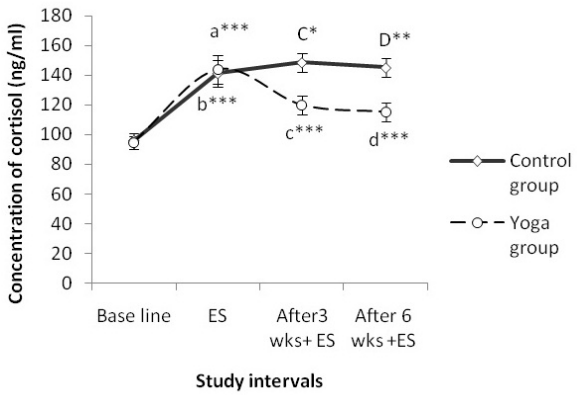

Figure 1. Fall in serum cortisol level in yoga group after 3 and 6 weeks

Figure 2 clearly shows that exam stress increased ($p<0.01$) the level of β- endorphin (β-EP) in both the groups. The level was further found to be increased ($p<0.05$) after 6 weeks in yoga group. No change was seen in control group. Exam stress elevated ($p<0.05$) PRL levels in both the groups when compared to their respective baseline levels. No significant change in PRL levels was noticed in yoga group after 3 weeks while an increase in PRL levels were observed only after 6 weeks. It is worth mentioning that, increase in PRL levels observed in yoga groups after 6 weeks, was different in the male ($p<0.01$) and female students ($p<0.05$) .

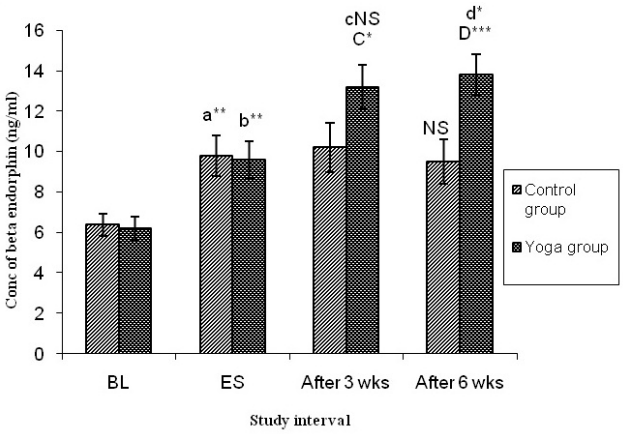

Figure 2. Effect of exam stress on β-EP in both groups

Discussion

Endocrine changes have been reported in individuals anticipating various types of challenge. In our study the level of cortisol was found to be increased during ES. Plasma cortisol concentrations and rates of excretion of cortisol and related metabolites may increase in students during periods of ES (Frankenhaeuser et al 1978, Bogdonoff et al 1960). The significant fall in serum cortisol levels after 3 and 6 weeks practice of SK&P (during exam) in test group suggests that regular practice of SK&P progressively develops greater levels of both relaxation and resilience to stress. Changes in brain waves and blood serum cortisol during exercise have been studied and increase in alpha waves and decrease in cortisol levels reported (Kamei et al 2000). EEG studies on SK&P revealed increased alpha activity during Yoga practice (Bhatia et al 2003). So decrease in cortisol levels in our study may be due to

increased alpha wave activation. In control group, all ES samples showed elevated cortisol level. Though elevated cortisol level comes back to normal within 72 hrs, but consecutive ES elevates its level.

Pituitary hormone like Prolactin was found to be increased in certain kind of stressor like oral examinations (Meyerhoff et al 1988). Prolactin released during stress have multiple effects in the periphery, including mobilization of energy reserves (Mason JW 1968) via gluconeogenesis and lipolysis (Shanker, Sharma, 1979; Richter et al 1987), as well as effects on the cardiovascular system, (Holaday 1983) and on electrolyte balance (Matsuoka et al 1980). Prolactin-secretory response to stress has an immunomodulatory function protecting the organism from the consequences of stress (Gala, 1990) and maintaining homeostatic balance affected by other stress hormones. A study conducted by Janakiramaiah et al in 2000 have shown that Yoga practice caused transient increase in PRL levels. Acute PRL release have shown to reduce fear and anxiety in animal models (Torner et al 1995). These results indicate that males and females behaves differently in prolactin secretion upon response to stress, which could be due to differences in prolactin regulatory secretions and interference of other hormones or peptides, like estradiol, to cause significant change in prolactin level especially in female students (Freeman et al 2000).

Similarly, psychological stress also increases beta endorphin level (Mason, 1968). Mediation and exercise has shown to increase the release of β-EP which may be associated with mood and emotions. Scientific evidence shows that meditation increases the level of β-EP (Ryu et al 1996). Thus increased β-EP in the student's yoga group indicates that they show high relaxation even during ES.

Earlier report suggest that PRL as well as β-EP are elevated during psychologically stressful situations, it is noteworthy that β-EP may facilitate PRL release (Vogit et al 1983). While the function of PRL release in response to stress is not understood, one possible physiological role for PRL might be stimulation of the immune system (Spangelo et al 1985). One mechanism by which endorphin could release PRL is by decreasing the release of dopamine into the portal circulation, possibly through activation of specific opiate receptors on tuberoinfundibular dopaminergic neurons (Gudelsky, Porter, 1979).
Scientific evidences illustrate that meditation and exercise has shown to increase the release of β-EP which may be associated with mood and emotions (Ryu et al 1996). Thus increased β-EP in the students who practiced yoga indicates that they were in relaxed state even during exam.

Conclusion

The findings of this study strengthen the fact that not only the nature of the stressor but also the state of the responder may be of greater importance in determining the responses to stress. Thus it is clear that, participants of structured yoga module, by improvement in coping skills and decrease in excitation during stressful period managed the level of anxiety which ultimately lead to reduction in cortsiol, increase in prolactin and beta endorphin levels and were able to withstand the stress arousal during ES. However further extensive and long term studies are need to be done to prove these findings to recognize and incorporate yoga's importance in the curriculum both for the physical and psychosocial development of the college students.

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