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EFFECTS OF YOGA ON BRAIN WAVE COHERENCE IN EXECUTIVES

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Abstract : Aim of this study was to assess the effect of Self Management of Excessive Tension (SMET), a yoga based stress management program on brain wave coherence. Brain wave recordings were taken with Brain Master 2 Channel EEG (version-2.0). The subjects for the study were 72 corporate executives, 48.75±3.86 years of mean age referred from Oil and Natural Gas Corporation Limited. EEG data was recorded on the first and sixth day of 5 days SMET program. A complete statistical and spectral analysis showed 19.31% increase (p=0.03) in delta, 5.04% increase (p=0.65) in theta, 15.40% increase (p=0.09) in alpha, 1.67% decrease (p=0.54) in beta and 18.68% increase (p=0.07) in gamma wave coherence between pre and post intervention measurements. Taken together, these results suggest that participation in a SMET program was associated with improvement in emotional stability and may have implications for 'Executive Efficiency'. Because before and after designs limit inferences about intervention effects, further research is warranted to explore the effects of SMET program for stress management using a larger, randomized controlled trial.

Key words : self management of excessive tension yoga brain wave coherence executives

INTRODUCTION

Business executives' lives have become a never-ending race against time, technology, and targets. This race creates tension, which leads to dissatisfaction and frustration and eventually manifests itself as psychological and physiological stress with mental and emotional drain. This modern lifestyle intensifies the stress leading to 'Excessive Tension' and consequent deterioration in 'Executive Efficiency'. Yoga offers a holistic and integrated stress management program called Self Management of Excessive Tension (SMET) to combat this modern lifestyle problem and thereby one can lead a holistic way of living in health, harmony and happiness (1). Previous work on stress management educational program, reported significant improvement in the subjective well being inventory (SUBI) scores of the 77 subjects within a period of 10 days as compared to controls. These observations suggest that a short lifestyle modification and stress management educational program can make an appreciable contribution to

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primary prevention as well as management of lifestyle diseases (2). Previous work on SMET, reported decrease in occupational stress levels and baseline autonomic arousal in managers, suggesting significant reduction in sympathetic activity (3) and better emotional well being in the managers (4). No previous investigation has directly evaluated the effect of SMET program on EEG. Hence, we have designed present study to assess the efficacy of five days SMET program, on corporate executives using EEG recordings. This study analyzes and discusses the neuro-physiological changes after SMET program.

MATERIALS AND METHODS

Subjects

The subjects for the study were 72 corporate executives (63 males and 9 females), 48.75±3.86 years of mean age referred from Oil and Natural Gas Corporation Limited. Routine clinical examinations showed all of them in normal health, none were using any other wellness strategy. All of them had high-fiber low-fat vegetarian diet and no caffeinated drinks, alcohol, or tobacco in any form during the five days residential SMET program. We got the participants' signed consent to participate in the study after explaining the variables we would record and the study design. The Institutional Review Board also had approved the project. We selected participants of the following inclusion and exclusion criteria to meet the study requirements fully.

Inclusion criteria: Age between 45- 60 years (males and females), physically and mentally fit.

Exclusion criteria: Taking any medications, using any other wellness strategy.

Design: A single group pre-post study

Intervention: All the subjects participated in SMET program (1) for 5 days.

Practical Session during SMET program: Cyclic Meditation (1, 5), a combination of

TABLE I: The schedule of the SMET program.

Time	*Activity*
05.00 AM	Ablution
05.30 AM	Prayer (Prathasmaran)
06.00 AM	Asanas/Special Yoga Technique
07.15 AM	Friendship Meet (Maitrimilan) Gita Sloka Chanting and Discourse (Satsanga)
08.00 AM	Breakfast
09.30 AM	SMET Lecture session 1
10.30 AM	SMET practice (Cyclic Meditation)
11.30 AM	Milk or Tea
12.05 PM	Special Yoga Techniques
01.00 PM	Lunch
02.00 PM	Library/Rest
03.00 PM	SMET Lecture session 2
04.00 PM	SMET practice (Cyclic Meditation)
05.00 PM	Tuning to Nature
06.00 PM	Devotional Session (Bhajan)
06.45 PM	MSRT (Mind Sound Resonance Technique)
07.30 PM	Dinner
08.30 PM	Happy Assembly/Cultural Program
09.15 PM	Group Discussion/Self Practice
10.00 PM	Lights Off

TABLE II: Lecture Session during SMET program.

Day	*Session 1*	*Session 2*
1	Concept of stress	Stress-induced problems and management
2	Stimulation-Relaxations	Stress and its management according to yoga
3	Stress levels and its release	Recognition of stress is half the solution
4	Executive growth	Depth of perception and awareness
5	Group awareness	Progress in tune with nature

stimulating and calming practices based on yoga was given to the subjects.

Assessments

Brain Wave Coherence Recording Condition: We collected EEG data using 2-channel electrode locations C3 and C4. We referenced these scalp locations to linked earlobes, with the ground at the forehead. We did all recordings in similar conditions using Brain Master 2 Channel EEG version 2.0 from Bio-Medical Instruments, Inc., Warren, Michigan. We chose Sampling Frequency Rate of 256 Hz. Protocol of Settings file was EEG Pro 2 Channel Alpha Synchrony. Run of Length was 10.0 Minutes. We kept the electrode impedances below 10 kΩ to ensure noise-free, accurate, and good EEG recordings (6, 7). We instructed the participants to sit on the chair in any comfortable posture with eyes-closed.

Brain wave coherence calculation and training: BrainMaster calculates and displays coherence for different components like delta, theta, alpha, beta, and gamma. In addition, we can set a threshold between 0.01 and 0.99 for training. The operator can select any or all of the components for sound feedback; hence coherence training was easy. In addition, we can show the coherence on the summary screen, and read it from the Excel spreadsheet containing the minute-by-minute statistics. Coherence between 0.0 and 0.4 in EEG is not significant, because random signals can have a small amount of coherence. However, coherence values above 0.5 and especially exceeding 0.6 are significant for EEG training (8).

Experimental paradigm: We studied EEG recordings of each of the subjects before and after SMET program for 5 days. The subject was resting on chair in Bio-energy lab of SVYASA University with eyes closed during EEG recording for 10 minutes. The formal names of recordings were Pre & Post respectively.

Analysis

SPSS version 16 was used for data analysis. The Kolmogorov-Smirnov Test showed that the data were not normally distributed. We used the Wilcoxon test to compare means before (Pre) and after (Post) the SMET program.

TABLE III: The analysis of the brain wave coherence.

Brain wave coherence	*Mean±Standard deviation*		*P*
	Before SMET (Pre)	*After SMET (Post)*	
Delta (δ) 1-3 Hz	47.08±28.17	56.17±25.59	0.03
Theta (θ) 4-7 Hz	52.90±28.96	55.57±26.51	0.65
Alpha (α) 8-12 Hz	42.69±27.15	49.26±27.69	0.09
Beta (β) 13-39 Hz	38.55±25.79	37.91±20.91	0.54
Gamma (γ) 40-45 Hz	31.81±31.81	37.77±20.79	0.07

RESULTS

A complete statistical and spectral analysis showed 19.31% increase (p=0.03) in delta, 5.04% increase (p=0.65) in theta, 15.40% increase (p=0.09) in alpha, 1.67% decrease (p=0.54) in beta and 18.68% increase (p=0.07) in gamma wave coherence between pre and post intervention measurements.

The results revealed significant increase in delta, moderate increase in theta, alpha and gamma and decreased trait in beta wave coherence.

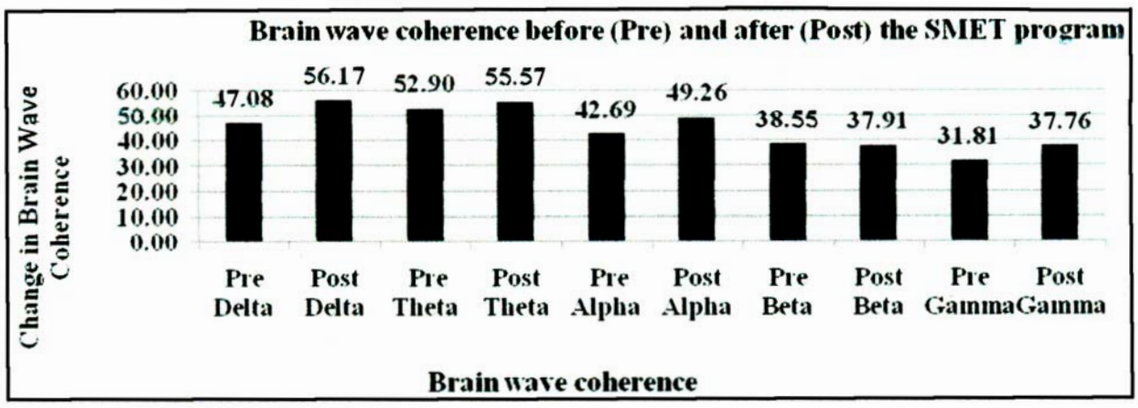

Fig. 1: Brain wave coherence before and after the practice of SMET program.

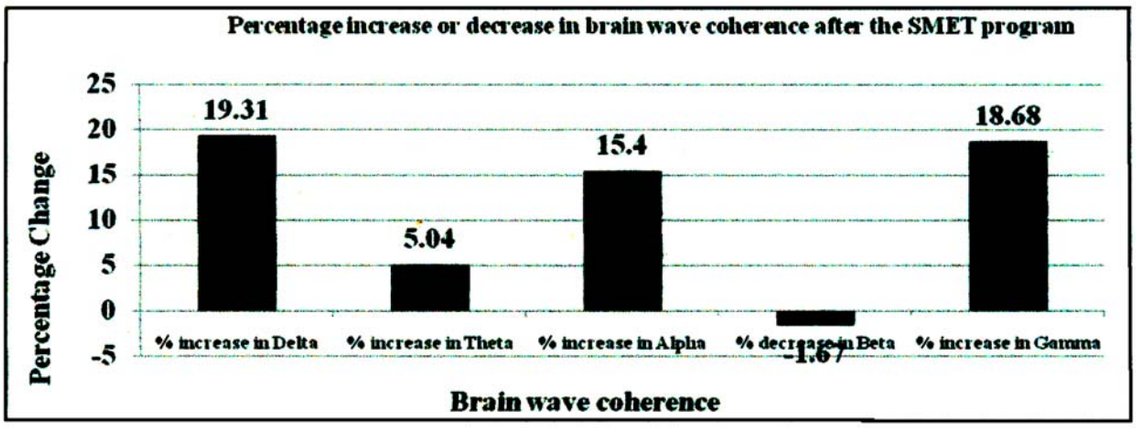

Fig. 2: Percentage change in brain wave coherence after the practice of the SMET program.

DISCUSSION

Significant increase in delta wave coherence in the present study may be associated with the higher states of consciousness (9). Moderate increase in alpha wave coherence in the present study may be related with wakefulness and vigilance (10-12) and is the essential requirement for 'Executive Efficiency' (13, 14). This outcome may also be related to the findings from earlier studies in which percentage of alpha waves were higher in persons performing meditation with good coherence suggesting good homogeneity, uniformity, and increased orderliness of brain functioning (15). Similarly, it was reported that Transcendental Meditation (TM) increases frontal alpha coherence, which reflects an enhancement of frontal lobe integration, as increased cognitive flexibility, intelligence, and emotional stability (16). However, implications for increase in theta and decrease in beta wave coherence in the present study were uncertain but may be correlated with thought-free respiratory suspension (17).

Furthermore, it was demonstrated that increased occipital gamma power was related with enhanced sensory awareness (18).

Taken together, the results from the present study suggest that participation in a SMET program was associated with improvement in emotional stability and may have implications for 'Executive Efficiency'. Because before and after designs limit inferences about intervention effects, further research is warranted to explore the effects of SMET program for stress management using a larger, randomized controlled trial.

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REFERENCES

1. Nagendra HR, Nagarathna R. New perspectives in stress management. Bangalore, India: Swami Vivekananda Yoga Publications; 2007.
2. Sharma R, Gupta N, Bijlani RL. Effect of yoga based lifestyle intervention on subjective well-being. *Indian J Physiol Pharmacol* 2008; 52: 123–31.
3. Vempati RP, Telles S. Baseline occupational stress levels and physiological responses to a two day stress management program. *J Indian Psychol* 2000; 18: 33–37.
4. Sony K, Nath NCB, Nagendra HR. Effectiveness of SMET program with respect to emotional well-being among managers- an empirical study. *XIMB Journal of Management (Vilakshan)* 2007; 4: 165–173.
5. Subramanya P, Telles S. A review of the scientific studies on cyclic meditation. *Int J Yoga* 2009; 2: 46–48.
6. Collura TF. History and evolution of electro-encephalographic instruments and techniques. *J Clin Neurophysiol* 1993; 10: 476–504.
7. Collura TF. Real-time filtering for the estimation of steady-state visual evoked brain potentials. *IEEE Tram Biomed Eng* 1990; 37: 650–652.
8. Collura TF. Conclusion: QEEG-guided neurofeedback in context and in practice. *Appl Psychophysiol Biofeedback* 2010; 35: 37–38.
9. Mason LI, Alexander CN, Travis FT, Marsh G, Orme-Johnson DW, Gackenbach J, Mason DC, Rainforth M, Walton KG. Electrophysiological correlates of higher states of consciousness during sleep in long-term practitioners of the Transcendental Meditation program. *Sleep* 1997; 20: 102–110.
10. Darrow CW. Psychological and psychophysiological significance of the electroencephalogram. *Psychol Rev* 1947; 54: 157–168.
11. Malmo RB. Activation: a neuropsychological dimension. *Psychol Rev* 1959; 66: 367–386.
12. Cantero JL, Atienza M, Salas RM, Gomez CM. Alpha EEG coherence in different brain states: an electrophysiological index of the arousal level in human subjects. *Neurosci Lett* 1999; 271: 167–170.
13. Feige B, Scheffler K, Esposito F, Di Salle F, Hennig J, Seifritz E. Cortical and subcortical correlates of electroencephalographic alpha rhythm modulation. *J Netwophysiol* 2005; 93: 2864–2872.
14. Sadato N, Nakamura S, Oohashi T, Nishina E, Fuwamoto Y, Waki A, Yonekura Y. Neural networks for generation and suppression of alpha rhythm: a PET study. *Neuroreport* 1998; 9: 893–897.
15. Khare KC, Nigam SK. A study of electro-encephalogram in meditators. *Indian J Physiol Pharmacol* 2000; 44: 173–178.
16. Cahn BR, Polich J. Meditation States and Traits: EEG, ERP and Neuroimaging Studies. *Psychol Bull* 2006; 132: 180–211.
17. Badawi K, Wallace RK, Orme-Johnson D, Rouzere AM. Electrophysiologic characteristics of respiratory suspension periods occurring during the practice of the Transcendental Meditation Program. *Psychosom Med* 1984; 46: 267–276.
18. B Rael Cahn, Arnaud Delorme, John Polich. Occipital gamma activation during Vipassana meditation. *Cogn Process* 2010; 11: 39–56.