Efficacy of yoga for mental performance in university students

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ABSTRACT

Background: With growing scientific evidence, yoga is emerging as an important health behavior-lifestyle modifying module to achieve holistic health at physical, mental, emotional, social and spiritual levels. Brain wave coherence (BWC) recordings from the surface of the skull are associated with different cognitive processes and plays both critical and useful roles in yoga with wide range of functional significance. The psycho-physiological changes that characterize the efficacy of yoga for better mental performance in university students have not been studied adequately.

Objective: The study was designed to assess the mental performance through BWC analysis in university students undergoing Integrated Yoga Module (IYM).

Materials and Methods: The IYM subjects (n=30) with 25.77±4.85 years of mean age participated in this single group pre-post study. The BWC data was collected before (pre) and after (post) the 21 days IYM using Brain Master (Model: 2E Part # 390-001), Michigan, USA.

Statistical Analysis: Means, standard deviations, Kolmogorov-Smirnov test and Wilcoxon signed rank test were used for analyzing data with the help of SPSS-16.

Results: A complete statistical and spectral analysis showed 43.24% increase \((P<0.001)\) in Delta, 9.13% increase \((P=0.289)\) in Theta, 57.85% increase \((P<0.001)\) in Alpha, 17.65% decrease \((P=0.136)\) in Beta and 9.19% increase \((P=0.586)\) in Gamma BWC between pre and post intervention measurements.

Conclusion: BWC study showed significant increase in both Delta and Alpha wave coherence suggesting that IYM can result in improvement of coherent and integrated brain functioning among students, thus paving the way for their better mental performance. Although this preliminary research is promising, more well-designed studies are needed before a strong recommendation can be made.

Key words: Brain wave coherence, mental performance, yoga

INTRODUCTION

Stress certainly seems to be an inescapable element of the modern life of a student. Stress management is required for students to decrease depression and anxiety, and to improve sensitivity toward themselves, peers, and parents. Brain wave coherence (BWC) is a measure of correlation or synchrony of the electroencephalograph (EEG) waves recorded at two points on the scalp. Mathematically, it is the absolute value of the cross-correlation function in the frequency domain of two electrical signals.\(^1\) Coherence reflects the number and strength of connections between two brain areas.\(^2\) Higher coherence indicates that these two points of the brain are working more closely together. Similarly, higher coherence is associated with more integrated and effective thinking and behavior, including greater intelligence, creativity, learning ability, emotional stability, ethical and moral reasoning, self-confidence, and reduced anxiety.\(^3\)
With growing scientific evidence, yoga is emerging as an important health behavior-modifying practice to achieve states of health, both at physical and mental levels. Previous study of yoga on BWC in managers reported significant increase in Delta BWC showing efficacy of yoga for managerial effectiveness. A study by Aftanas LI and Golocheikine SA on Sahaja Yoga Mediation reported that subjective scores of emotionally positive “blissful” experience significantly correlated with theta, whereas scores of internalized attention with both theta and alpha lower synchronization. Previous study of EEG coherence on Zen Mediation showed an increase in slow alpha interhemispheric EEG coherence in the frontal region induces meditation with a predominance of internalized attention. High degree of cardio respiratory synchronization during yoga was demonstrated by Cysarz and Bussing suggesting a state of restful alertness. The EEG alpha activity occurred predominantly in the anterior half, and occurred silently in the posterior half of the brain during Qi Gong meditation. Moreover, a study by Travis revealed that Transcendental Meditation practice was marked by significantly lower breath rate, higher respiratory sinus arrhythmia amplitudes, higher EEG alpha amplitude and higher alpha coherence. However, the psycho-physiological changes that characterize the efficacy of yoga for better mental performance have not been studied adequately. Hence, the present study was designed to assess the efficacy of Integrated Yoga Module (IYM) for mental performance in university students.

OBJECTIVE

The study was designed to assess the mental performance through BWC analysis in university students undergoing IYM.

MATERIALS AND METHODS

Subjects

Students of both sexes (n = 30) undergoing IYM at Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA) University, Bangalore between the ages of 18 and 37 years (mean ± SD = 25.77 ± 4.85 years) participated in this single group pre-post study. Students with serious medical conditions, those using any other form of wellness strategy as well as those using any form of prescribed or abused drugs were excluded. The BWC data was collected before (pre) and after (post) the IYM using Brain Master (Model: 2E Part # 390-001), Michigan, USA.

Consent

The study was approved by the IRB of S-VYASA University. An informed consent was obtained from all the participants.

Design was single group pre-post study.

Assessments

Intervention

All the subjects participated in the 21 days IYM which was based on Integrated Approach of Yoga Therapy (IAYT) designed and developed at S-VYASA University [Table 1].

Data collection

In this study we have used Brain Master two-Channel EEG version 2.0 from Bio-Medical Instruments, Inc., Warren, Michigan for BWC recording[11,12] which records the brain waves and through an inbuilt software gives the coherence values of Delta (δ), Theta (θ), Alpha (α), Beta (β) and Gamma (γ) waves. We collected BWC data using electrode locations C3 and C4 referenced to linked earlobes, with the ground at the forehead. We kept the electrode impedances below 10 KΩ to ensure noise-free, accurate, and good brain wave recordings.[11,12] The sampling frequency was 256 Hz. Protocol of setting file was brain wave Pro 2 Channel Alpha Synchrony. Run of length was 10.0 minutes. We studied BWC for same subject at the same time of the day for pre and post data. During BWC recording, each subject was resting on the chair with the eyes closed for 10 minutes in Bio-Field Energy Laboratory of S-VYASA University in a silent room.

Data scoring

Brain Master calculates and displays coherence for different components as 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.

| Time   | Activity                              | Time   | Activity                              |
|--------|---------------------------------------|--------|---------------------------------------|
| 05.00 AM | Ablution                              | 03.00 PM | Lecture session 2                      |
| 05.30 AM | Prayer (Prathasmaran)                 | 04.00 PM | Cyclic meditation                      |
| 06.00 AM | Asana/special yoga technique          |        |                                       |
| 07.15 AM | Friendship meet (Maitri Milan)-Gita sloka chanting and discourse (Satsanga) | 05.00 PM | Tuning to nature                       |
| 08.00 AM | Breakfast                             | 06.00 PM | Devotional session (Bhajan)            |
| 09.30 AM | Karma Yoga                            | 06.45 PM | Lecture session 3/Trataka              |
| 10.30 AM | Lecture session 1                     | 07.30 PM | Dinner                                |
| 11.30 AM | Milk or ayurvedic tea (Malt)          | 08.30 PM | Happy assembly (yoga game session)/cultural program |
| 12.05 PM | Special yoga techniques               | 09.15 PM | Group discussion/self practice         |
| 01.00 PM | Lunch and rest                        | 10.00 PM | Lights off                             |

IYM – Integrated yoga module
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 brain wave is not significant, because random signals can have a small amount of coherence. However, coherent values above 0.5 and especially exceeding 0.6 are significant for brain wave training.13

Data analysis

All statistical analysis was carried out using the version 16.0 of the Statistical Package for Social Sciences (SPSS) software. The Kolmogorov-Smirnov test showed that the data was not normally distributed. We therefore used Wilcoxon signed rank test to compare means of the data.

RESULTS

A complete statistical and spectral analysis of the data showed 43.24% increase ($P < 0.001$) in Delta, 9.13% increase ($P = 0.289$) in Theta, 57.85% increase ($P < 0.001$) in Alpha, 17.65% decrease ($P = 0.136$) in Beta and 9.19% increase ($P = 0.586$) in Gamma BWC between pre and post intervention measurements [Table 2].

DISCUSSION

Everything good about the brain depends on its coherent, orderly functioning. Recent studies in neuroscience have found that world-class athletes have higher EEG coherence than controls, and higher-performing CEO’s display greater coherence than other executives.14 During ordinary waking consciousness, EEG patterns are generally scattered, disorderly, and rapidly changing.15 By contrast, as the mind settles into the practice of yoga, brainwaves tend to become rhythmic and orderly.10

In the present study it was observed that twenty one days of IYM significantly increase Delta and Alpha BWC and a high level of coherence between two EEG signals indicates a co-activation of neuronal populations and provides information on functional coupling between these areas.17 Significant increase in Delta EEG coherence may be associated with heightened efficiency of brain functioning and may improve mental performance and overall health.18 Similarly, significant increase in Alpha EEG coherence is associated with wakefulness and vigilance and is the essential requirement for ‘student efficiency’.19-23 Findings from earlier studies suggest that percentage of Alpha waves were higher in persons performing meditation with good coherence which suggests good homogeneity, uniformity, and increased orderliness of brain functioning.24 Arambula et al., have reported that subjects who practiced Kundalini Yoga Meditation could achieve balance in lateralization of cerebral functions with an increase in alpha EEG activity.25 Similarly, Cahn et al., have shown that TM increases frontal alpha coherence, which reflects an enhancement of frontal lobe integration, as increased cognitive flexibility, intelligence, and emotional stability.26 Furthermore, activation in Alpha wave coherence can produce a state of well-poised readiness, and deep relaxation. It may be associated with improved creativity, sense of well-being, and ability to perform effectively.11,12

The mechanism by which IYM may improve mental performance in university students, while increasing Delta and Alpha EEG coherence, may be related to the notion that during IYM, the ordinary thinking process settles down. This settling down is due to integration and synchronization of the left hemisphere (logical capacity) and the right hemisphere (intuitive capacity) of the brain. In addition, students gain a distinctive psycho-physiological state of ‘restful alertness’.

The factors that indicate the ‘restful alertness’ and may be the mechanisms of improved mental performance and overall health are: decreased respiration, decreased skin conductance, decreased plasma lactate and cortisol, increased cerebral blood flow, faster H-reflex recovery, shorter latency of auditory-evoked potentials, decrease in autonomic arousal (sympathetic activation), psychological factors and mind and body integration.11,27,30

CONCLUSION

The present study showed significant increase in both Delta and Alpha wave coherence suggesting that IYM can result in improvement of coherent and integrated brain functioning among students, thus paving the way for their better mental performance. Additional well-designed studies are needed before a strong recommendation can be made.

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