

Effects of Yoga to Brainwave Activities and Stress Reduction

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Abstract

The purpose of this research was to study the effects of yoga on reducing stress and changing brainwaves activities. The study was conducted with healthy volunteers aged between 25-40 years. There were 30 samples, divided into 2 groups: The first group comprised 15 people who had never practiced yoga, and the second group comprised 15 people who had previously practiced yoga. Both groups were studied to compare the effects before and after practicing yoga by using the 14-channels Electroencephalogram (EEG) to measure brainwaves activities and the Thai Stress Test (TST) to assess the stress level. The result showed that stress level could be changed through the practice of yoga. In practiced yoga group, delta, theta, alpha and beta brainwaves had been increased with statistically significance level of 0.05 ($p \leq 0.05$). In non-practiced yoga, there had been increasing delta and theta brainwaves with statistically significance level of 0.05 ($p \leq 0.05$).

Keywords: Yoga / Stress / Brain / Brain waves

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1. Introduction

All humans must have ever felt stressed. Stress can happen to every person, gender, age, profession as long as there are still needs and the purpose of struggle to continue living. The reason is because everything all is changing and developing rapidly in today's society. The occurrence of stress causes spasmodic contraction of muscles in various parts of the body, agitated and restless mind. Therefore, stress reduction mainly focuses on relaxing muscles and calming the mind. In doing so, there is a variety of methods such as sitting back and practice of contracting and relaxing muscles, practicing deep breathing, and initial practice of meditation, playing music, listening to music, drawing pictures, growing plants or exercise. These methods can be chosen for use when being faced with stress. However, this depends on the extent to which such ways are effective for reducing stress. The current trend reveals that there are more and more enthusiasts of yoga for health. Yoga is a way of creating the balance of body, mind and spirit by combination to be oneness. Yoga practice comprises 3 main parts, including exercise or practicing yoga postures, breathing or breath, meditation practice. Practicing yoga postures will stimulate various organs and glands in the body to function better. According to the hypotheses of the researcher, the practice to meditate, develop consciousness causes the ability to control

emotions, which is the creating of relaxation. It is one way to enable the prevention of diseases. Yoga and meditation practice is the approach to health care which encompasses the physical, mental, spiritual dimensions. People in Europe and the United States have turned to practicing yoga and meditation increasingly. This is an Alternative lifestyle. Medically, there are more studies on bringing yoga and meditation practice for use in providing care for patients.

There are numerous studies and researches on the relationships between yoga and stress, yoga and electroencephalogram (EEG) and meditation practice of various forms to modify stress. For example, the study on the brain functioning after practicing 2-hour Kriya reveals that there are more alpha and theta waves in the Parietal lobe area with an average increase of up to 40%. The alterations in alpha and theta waves indicate that the brain relaxes while practicing Kriya yoga. Also, another example is the study on effectiveness of practicing Taichi and Yoga in relation to anxiety, heartbeat rate, EEG. The findings of such study are the following: theta electrocardiogram in the Frontal lobe area increases; the heartbeat rate mounts and anxiety can be reduced by using STAT (State anxiety Inventory) as well.

2. Objectives

1. To investigate the effectiveness of yoga for enabling stress reduction
2. To study the effectiveness of yoga for enabling the changes in EEG (Electroencephalography)

3. Materials and Method

3.1 Subjects

Male and female volunteers aged 25-45 years who were healthy, with no history of illness, no neurological diseases, cardiovascular disease and pulmonary disease, no history of undergoing brain surgery, no drugs or hormones consumption with effect on EEG. Acknowledgement of information and consent to participation in the research

3.2 Tools and Equipment Used in Research

3.2.1 Recording personal information, namely age, gender, nationality, history of illness and record of yoga.

3.2.2 Thai Stress Test (TST): Questionnaires comprise two parts of contents. Part 1 (Questions no. 1-12) indicates negative scores. Part 2 (Questions no. 13-24) indicates positive scores. Each question includes the sequence of choices in the manner of Rating Scale in 3 levels with scoring criteria as range of 0, 1, 3, namely: 0 means never feeling stressed at all, 1 means feeling stressed occasionally, and 3 means feeling stressed often. Criteria for scoring: By combining the score of each aspect for comparison with the metric tables as follows: Scores of questions no. 1-12 indicate negative scores and scores of questions no. 13-24 indicate positive scores (Phattharayuttawat, S., 2012).

Negative Scales score (Sum of Item 1-12)	Positive Scales score (Sum of Item 13-24)				
	12-36	9-11	6-8	3-5	0-2
0-1	1	2	3	4	5
2-3	2	3	4	5	6
4-5	3	4	5	6	7
6-7	4	5	6	7	8
8-36	5	6	7	8	9

Table: 1 Criteria for classifying the scores of Thai stress test by comparing with the metric tables.

As to interpretation of the results of Thai stress test, the researcher applied the criteria for interpreting the results of Thai stress test.

Scoring Group	Stress indicator
1	Excellent mental health (if not faking)
2, 3, 4	Normal mental health
5, 6	Mild stress
7, 8, 9	Stressful

Table 2: Interpretation of the results of Thai stress test.

2.3 Electroencephalography-EEG:

The electroencephalography is registered in the name of Software Development Kit (SDK). It is considered to be the most ultramodern development of neurotechnology with high effectiveness, display of many output channels. The neuroheadset is of wireless type with the ability to display the output, analyze and record EEG (Electroencephalogram) in 14 channels. The principles of analytical check are based on the 10-20 system or International 10-20 system by displaying the EEG output according to the following positions: AF3, F7, F3, FC5, T7, P7, O1, O2, P8, T8, FC6, F4, F8, AF4. It is not used for the purposes of being a medical tool or diagnosis, including treatment and prevention of diseases in any way. It is a tool that can be used in the research safely without medical complications or side effects.

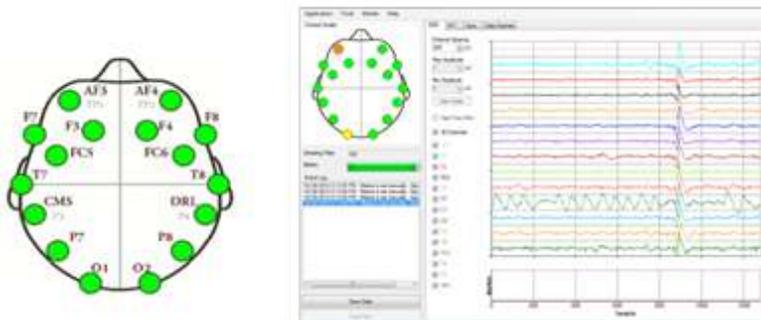


Figure 1: Electroencephalography (EEG) 14 channels. Middle picture shows the positions: AF3, F7, F3, FC5, T7, P7, O1, O2, P8, T8, FC6, F4, F8, AF4

2.4 Video Clips of Predefined Basic Yoga Asana

Posture 1: Posture for controlling the breath Posture
bones and (Pranayama)



Posture 2: Posture for exercising
neck muscles



Posture 3: Posture for exercising shoulders spinal elbows, wrists and finger tips



Posture 4: Posture for exercising bones, back muscles and flanks



3. Methodology

The total representative samples comprised 30 people. Each person underwent the brainwave measurement and answered questionnaires of the Thai Stress Test (TST). The data obtained compared pre- yoga and post- yoga experiment by examining comparatively all three sets of experimental results, namely EEG data comparison between pre-yoga practice and post- yoga practice of the two representative samples. Comparing the data on total score of questionnaires: negative scores and questionnaires: positive scores. Calculation of stress levels before practicing yoga and after practicing yoga of both representative samples. The data collected was brought for analysis with package program. Basic data (Demographic data) of volunteers was analyzed by using descriptive statistics. Comparison of EEG results before and after yoga practice was analyzed by using statistical paired t -test at reliability level of 95 percent ($p < 0.05$).

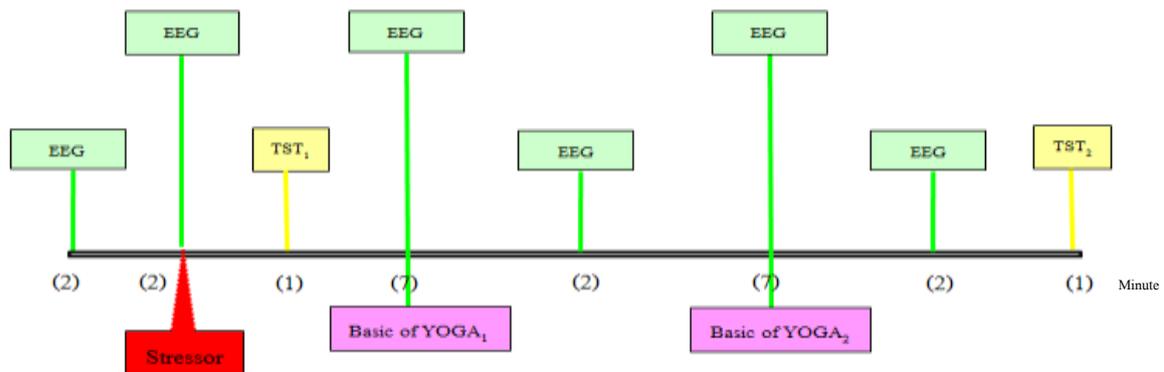


Figure 2: Experimental paradigm

4. Results

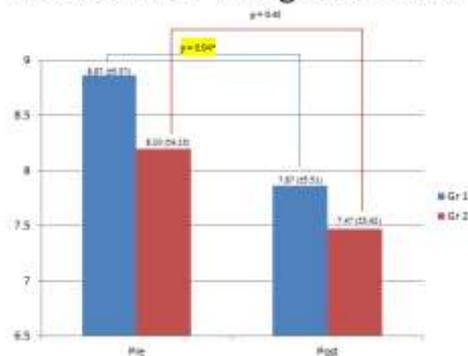
Overview of the representative samples: Total project participants were 30 cases which were qualified in accordance with the study criteria. They were divided into 2 groups; group 1 has never practiced yoga, accounting for 15 cases: 2 male persons, 13 female persons, and group 2 ever practiced yoga before, equaling 15 cases: 1 male person, 14 female persons. History of practice yoga of Group 2: 46.67 Percent for more than 10 hours per month; 40.00 percent for 6-10 hours per month and 13.33 percent for 1-5 hours per month.

Results of Analyzing Stress Levels before and after Practicing Yoga . Concerning the results of measuring the stress levels by comparison between pre-yoga practice and post-yoga practice of 30-person representative samples, the majority had the stress levels that changed after practicing yoga. Regarding the group that has never practiced yoga (group 1): Before yoga practice: 9 persons felt slightly stressed; 5 persons felt normal and 1 person felt very good. After yoga practice: 7 persons felt slightly stressed; 7 persons felt normal and 1 person felt very good. As for the group that had ever practiced yoga (group 2): Before yoga: 8 persons felt slightly stressed and 7 people felt normal. After yoga: 8 persons felt slightly stressed; 6 persons felt normal and 1 person felt very good.

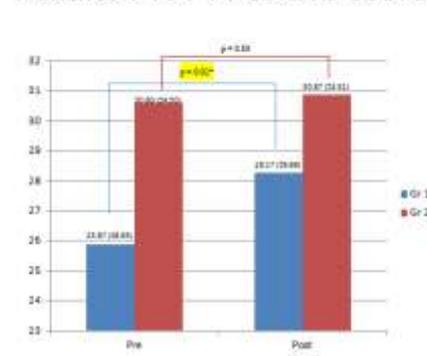
Levels of Negative Scores: Group 1: There were changes in a statistically significant way at 0.05 level (p-value = 0.04). The average before practicing yoga was 8.87 (\pm 5.57) score and the average after practicing yoga was 7.87 (\pm 5.51) score. Group 2: There was no change in a statistically significant manner at 0.05 level (p-value = 0.48). The average before practicing yoga was 8.20 (\pm 4.13) score and the average after practicing yoga was 7.47 (\pm 3.42) score.

Levels of Positive Scores: Group 1: There were changes in a statistically significant way at 0.05 level (p-value = 0.02). The average before practicing yoga was 25.87 (\pm 8.65) score and the average after practicing yoga was 28.27 (\pm 6.68) score. Group 2: There was no change in a statistically significant way at 0.05 level (p-value = 0.80). The average before practicing yoga was 30.60 (\pm 4.50) score and the average after practicing yoga was 30.87 (\pm 4.52) score.

Results : TST : Negative Score



Results : TST : Positive score



Results of Comparative Study on brainwaves before and after Practicing Yoga:

Delta Wave: Group 1: There were statistically significant changes at the level of 0.05 (p-value = 0.05). The average increased from 3.14 (\pm 0.61) microvolts to 4.27 (\pm 0.34) microvolts. Group 2: There were statistically significant changes at the level of 0.05 (p-value = 0.05). The average increased from 3.43 (\pm 0.17) microvolts to 5.82 (\pm 0.23) microvolts. As to results of changes in delta waves before and after practicing yoga of both volunteer groups, it was found that there were changes to increasing levels in a statistically significant way at 0.05 level. The alterations were also found in the frontal lobe area of delta waves as shown in Figure 3

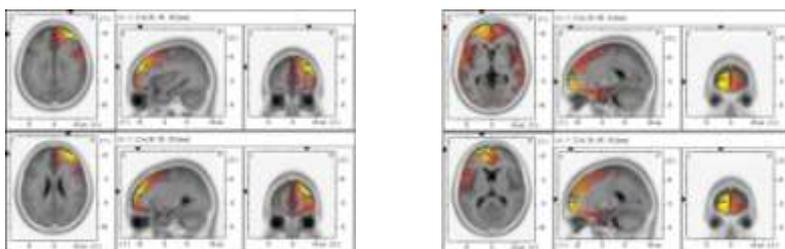


Figure 3: Inverse solution problem; left picture - the volunteer group no. 1 (picture at the top), the frontal lobe area of delta waves before (3.14 \pm 0.61 microvolts) and after (4.27 \pm 0.34 microvolts) practicing yoga (lower picture); right picture – the volunteer group no. 2 (picture at the top), the frontal lobe area of delta waves before (3.43 \pm 0.17 microvolts) and after (5.82 \pm 0.23 microvolts) practicing yoga (lower picture)

Theta wave: Group 1: There were statistically significant changes at the level of 0.05 (p-value = 0.05). The average increased from 3.03 (\pm 0.21) microvolts to 4.94 (\pm 0.62) microvolts. Group 2: There were statistically significant changes at the level of 0.05 (p-value = 0.05). The average increased from 4.31 (\pm 0.71) microvolts to 5.64 (\pm 0.32) microvolts. Regarding the results of changes in theta waves before and after practicing yoga of both volunteer groups, it was found that there were changes to increasing levels in a statistically significant way at 0.05 level. Besides, the alterations were found in the frontal lobe area of theta waves as shown in Figure 4.

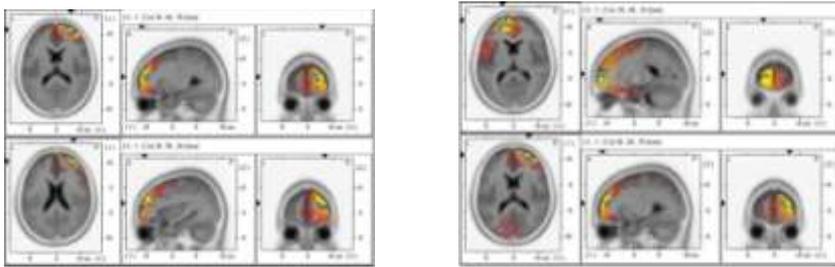


Figure 4: Inverse solution problem; left picture - the volunteer group no.1 (picture at the top), the frontal lobe area of theta waves before (3.03 ± 0.21 microvolts) and after (4.94 ± 0.62 microvolts) practicing yoga (lower picture); right picture – the volunteer group no. 2 (picture at the top), the frontal lobe area of theta waves before (4.31 ± 0.71 microvolts) and after (5.64 ± 0.32 microvolts) practicing yoga (lower picture)

Alpha wave: Group 1: There was no change in a statistically significant way at 0.05 level (p-value = 0.25). The average increased from $11.45 (\pm 0.23)$ microvolts to $11.83 (\pm 0.74)$ microvolts. Group 2: There were changes in a statistically significant way at 0.05 level (p-value = 0.05). The average increased from $11.45 (\pm 0.23)$ microvolts to $13.83 (\pm 0.74)$ microvolts. As to results of changes in alpha waves before and after practicing yoga of the volunteer group no. 1, there was no change in a statistically significant way at 0.05 level. However, the volunteer group no. 2 had changes to increasing levels in a statistically significant way at 0.05 level. The alterations were also found in the occipital lobe area of alpha waves as shown in Figure 5.

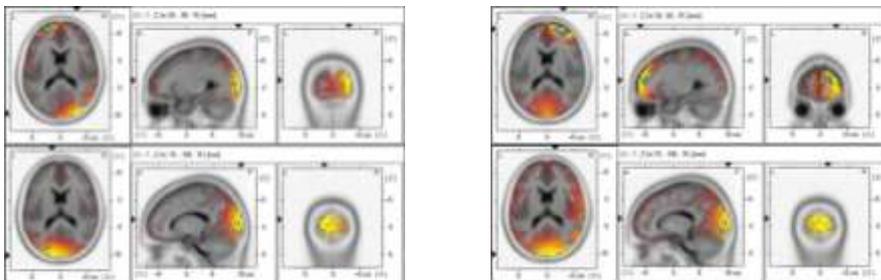


Figure 5: Inverse solution problem; left picture- the volunteer group no. 1 (picture at the top), the occipital lobe area of alpha waves before (11.45 ± 0.23 microvolts) and after (11.83 ± 0.74 microvolts) practicing yoga (lower picture); right picture, the volunteer group no. 2 (picture at the top), the occipital lobe area of alpha waves before (11.45 ± 0.23 microvolts) and after (13.83 ± 0.74 microvolts) practicing yoga (lower picture).

Beta wave: Group 1: There was no change in a statistically significant way at 0.05 level (p-value = 0.37). The average increased from 6.32 ± 0.32 microvolts to 6.97 ± 0.62 microvolts. Group 2 There were changes in a statistically significant way at 0.05 level (p-value = 0.05). The average increased from 6.32 ± 0.32 microvolts to 8.97 ± 0.62 microvolts. The results of comparing changes in beta waves before and after yoga practice are the following. There was no change in a statistically significant manner at 0.05 level of volunteer group no. 1. However, there were changes to increasing levels in a statistically significant manner at 0.05 level of volunteer group no. 2. Also, the alterations were found in the frontal lobe area of beta waves as shown in Figure 6.

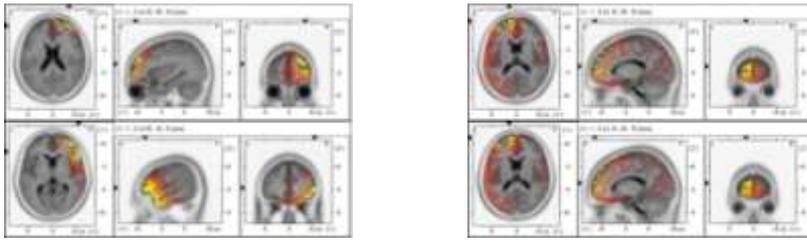


Figure 6: Inverse solution problem; left picture- the volunteer group no. 1 (picture at the top), the frontal lobe area of beta waves before (6.32 ± 0.32 microvolts) and after (6.97 ± 0.62 microvolts) practicing yoga (lower picture); right picture, the volunteer group no. 2 (picture at the top), the frontal lobe area of beta waves before (6.32 ± 0.32 microvolts) and after (8.97 ± 0.62 microvolts) practicing yoga (lower picture)

Conclusion

The purpose of this research was to study the effects of yoga on reducing stress and changing brainwaves activities. The result showed that stress level could be changed through the practice of yoga. In practiced yoga group, delta, theta, alpha and beta brainwaves had been increased whereas in non-practiced yoga, there had been increasing delta and theta brainwaves, respectively.

5. Discussion

According to hypothesis test of study, yoga affects the changes in brain functioning and reduces stress. The findings can be discussed as follows:

5.1 Stress Levels before and after Yoga Practice

Considering the results of investigation, it was found that the stress levels mostly decreased after practicing yoga. The group that has never practiced yoga before had the reduced levels of negative feelings in a statistically significant way and the increased levels of positive feelings with statistical significance. Concerning the group that previously practiced yoga, it was found that the levels of negative feelings decreased, but there was no statistical significance. Likewise, the levels of positive feelings increased, but without statistical significance. This is probably because, subsequent to yoga practice, the group that has never practiced yoga had more power of concentration and peace of mind than before practicing. However, the group that ever practiced yoga has already had peace of mind and power of concentration as original asset, thus not causing any significant change.

5.2 Results of EEG Changes Analysis before and after Yoga Practice

Considering the comparison of EEG changes in different levels before and after yoga practice, the findings are as follows:

EEG	Group No.1	Group No.2	Location
Delta	↑	↑	Frontal lobe
Theta	↑	↑	Frontal lobe
Alpha	X (↓)	↑	Occipital lobe
Beta	X (↓)	↑	Frontal lobe
Gamma	X (↓)	X (↓)	Occipital lobe

Table 3: shows the results of comparing EEG in different levels before and after yoga practice and the positions of the brain where changes were found in volunteers of group no. 1 and group no. 2.

The research findings reveal that yoga practice can reduce stress by decreasing the levels of negative feelings, increasing the levels of positive feelings and modifying EEG in all levels to increase. According to the findings, the group that ever practiced yoga before had increased delta waves, theta waves, alpha waves, beta waves in a statistically significant way. The group that practiced yoga for the first time, meanwhile, had increased delta waves, theta waves in a statistically significant way, whereas the alpha waves and beta waves increased, but there was no statistical significance. This is consistent with the study of Travis and Shear 28. According to the findings of such study, people who practice continuously like Tibetan monks have increased beta waves and gamma waves in a statistically significant way.

Suggestions

This study may have some room for correction and improvement. Further studies should increase the duration of practicing yoga, modify yoga postures to reduce the movement of various postures. Also, it is advisable to add warm-up postures before practicing yoga and set the exact timing of the experiment.

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