Impact of Preksha Meditation on Alpha Waves in EEG

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Abstract

Aims: The present study aims at demonstrating changes in alpha wave frequency on electroencephalograph (EEG) at two and four months of Preksha meditation (PM) training in young novice students.

Subjects and Methods: Participants included 52 girls between the 17 to 21 years of age from a local college selected using a convenience sampling technique. They were then randomly divided into experimental (n = 29) and control (n = 26) groups. Study duration was 4 months during which experimental group was administered a supervised PM training for 4 months. During this period control group continued their normal activities without mediation practice. EEG was recorded, analyzed for alpha waves and compared at base line, at 2 months and at 4 months.

Results: The mean value of alpha wave frequency (%) in control group at beginning was 49.65 ±21.598 which increased to 52.58±18.005 at 2 months. In experimental group, it was 49.52 ±18.169 which increased to 54.31±22.490 at 2 months. However, this increment was not statistically significant in both groups. A statistically significant increment in alpha waves percentage to 66.59±9.493 was observed in experimental group after four months of PM practice which was significant at the level of $p<0.01$. Conversely the changes in control group after 4 months were not significant rather the mean value decreased slightly to 48.88±17.653.

Conclusions: A significant increase in alpha waves was observed at 4 months of PM practice in young novice students. This increase was observed at 4 months and not at 2 months suggesting that longer practice of meditation is needed to bring out significant improvement. No such changes were observed in control group.

Keywords: Preksha meditation, EEG, Alpha waves

Introduction

Meditation is an ancient eastern tradition and its different forms are being practiced in most of the world's religions e.g. Hindu, Jain, Christian and Buddhist etc.[1,2] It is considered as a mean of self-realization and soul (consciousness) purification. Meditation reverses the roles of the sympathetic and parasympathetic nervous systems so that the normally dominant sympathetic nervous system takes a back seat to the parasympathetic nervous system.[1] Studies have documented the benefits of meditation in promoting health as well as in treatment of many diseases e.g. psychosomatic disorders, anxiety, depression, mood disorders, addiction, dementia, heart diseases, diabetes and sleep disorders etc.[1,3-7]

There are many kinds of meditation and even within a given meditation tradition there are different methods.[8] Basically there are two types of meditation i.e. open mindness and concentration and most meditation techniques are varying combination of these two. Open mindness also known as nondirective meditation yields more marked changes in electrical brain wave activity than concentration meditation.[9] Its use in promoting health as well as in prevention and treatment of various diseases is on increase throughout the globe.[10] Preksha meditation (PM) is one of the world prevailed technique of meditation. It has been developed as a simple and comprehensive method for betterment of life by Acharya Mahaprajana in 2004.[11] Several investigations have been made on PM. The result acquired with these studies reveals that PM has optimistic impact on human body and mind. Positive benefits have been recorded for cardiac and respiratory variables, cardiovascular functions and blood profile, various aspects of emotional and mental health.[12] PM have also shown to have therapeutic benefits on many diseases such as stress, diabetes, hypertension, coronary heart diseases, adolescent, asthma etc.[1,13,14]

Meditation is an internal subjective experience and an elaborate technique is needed to quantify it.[15] Till recently, demonstration of effectiveness of meditation was left to the teaching of religious gurus and belief of their disciples. Lack of physical evidences is responsible for its decreased acceptance and popularity both amongst scientific community and general public. Scientific research is now trying to resolve many facts and doubts associated with meditation.[16] Various modalities adopted to investigate meditation are psychosocial evidences (through questionnaire), biochemical and hormonal assays, imaging techniques (computed tomography, functional magnetic resonance imaging and positron emission tomography etc), electrophysiological studies (electroencephalography, evoked potentials and galvanic skin resistance etc), autonomic function studies, and epigenetic studies.[6,17,18] All these techniques have their merits and limitations.

Electroencephalogram (EEG) has the advantages of simple recording procedure, good sensitivity and wide spread availability. However, spatial resolution is poor

compared to advanced techniques. It is most widely used investigation to study effects of meditation. There are many wave patterns observed on EEG i.e. alpha (8-12 Hz), beta (13-30 Hz), theta (4-8 Hz), delta (0.5-4 Hz) and gamma brain waves (>30 Hz). Alpha wave is the most chosen wave pattern for studies with meditation as it occurs when brain's thinking is slower, body calms down and mind is relaxed.

While alpha power increases (but theta power decreases) from early childhood to adulthood, opposite holds true for the late part of the lifespan.[19] It is characteristic of wakeful rest and often associated with what is known as "super learning"—the ability to learn, process, store and recall large amounts of information quickly and efficiently.[9] Its other benefits are creativeness, relaxation and anti-stress, natural antidepressant, positive thinking, positive emotions, reductions of fear and anxiety, improved immune system and healing.[7,20] Stress, tension, anxiety and feelings of being nervous diminish alpha occurrence. Meditation is a significant tool for improving alpha waves in brain. Many studies reveal that during meditation, alpha waves increase.[21-23] It may correlate with good homogeneity, uniformity and increased orderliness of brain. However, most of these studies are either observation on small numbers of subjects or with poor scientific methodology. In view of popularity and effectiveness of meditation as a means of promoting good health, there is a pressing need for a rigorous investigation of how it affects brain function.[9] Present study aims at demonstrating changes in alpha waves frequency in young novice students at 2 months and 4 months of meditation practice.

Subjects and Method

In present study, normal healthy female students between 17 to 21 years of age were taken as subjects. They were all from Acharya Kalu Kanya Mahavidhyalaya attached to Jain Vishva Bharati Institute, Ladnun, Rajasthan. Experimental paradigm was explained fully to all participants and informed written consent was obtained from each of them. They were informed that their brain activity will be recorded with EEG. The institutional ethics committee approved the study protocol. Exclusion Criteria: (i) previous experience of yoga or meditation training, (ii) history of neurological or psychiatric disorders or of any major medical illness in the past (iii) history of major surgery in the recent past. They were divided randomly in two groups as below:

Experimental group: They were subjected to undergo Preksha meditation training in addition to normal routine activities. All subjects in this group were explained the process of meditation and a standardized PM module as explained below was administered to them as a group meditation at a calm and quiet meditation hall of the institute. It was administered between 8 AM and 9 AM of the day for 5 days per week. They practiced 30 minutes PM module under the supervision of one of the author (SSP) of the present study. The total duration of intervention was for four months.

Control group: They were not administered any meditation training and were doing their normal routine as before.

Preksha Meditation module: Subjects were instructed to sit comfortably with erect posture and crossed leg. PM was administered to each participant in experimental group consisted of:[11]

Mahapran Dhavani	5 min
Kayotsarga	5 min
Long breathing	5 min
Leshya meditation	15 min

Mahapran Dhvani: It is a subtle type of sound practice. In this participants were instructed to inhale long and then exhale and while exhaling they had to produce a sound like buzzing bee. While producing sound, subjects were instructed to concentrate on their head and try to feel vibrations there. This sound was repeated for nine to eleven times in 5 minutes.

Relaxation (Kayotsarga): Bodily movements, speech and mental functions are threefold activities of organism. Kayotsarga implies reduction or total cessation of each of these activities. Subjects were instructed to practice relaxation for five minutes. They were instructed to relax each part of their body one by one from toe to the upper part of their head and then suggested to experience the whole body got relaxed.

Long breathing: Long breathing is slow and complete exhalation and deep inhalation. Subjects were instructed to inhale and exhale deeply for 5 minutes. The concentration was completely on breathing. While inhaling they had to concentrate on the expandation of their abdomen and while exhaling they had to concentrate on the contraction of their abdomen.

Leshya-Dhyan (Color Meditation): It is a component of PM in which practitioner meditates with perception of different colors. In this study, we have selected green color perception. For the facilitation of perception of color, meditation room was flooded with light green illumination. Subjects were suggested to visualize this color around them including in the environment. After that they were instructed to perceive it to diffuse into brain. After visualizing the green color in brain they were instructed to recite mentally that their brain has calmed down.

The session of meditation was concluded with recitation of Mahapran Dhvani as above three times and subjects were instructed to leave the room quietly.

EEG Recording: All the recordings were done at EEG laboratory of the institute. EEG recording room was quite, comfortable, air conditioned and electrically shield. It was recorded on a standard protocol from both the groups in similar conditions using 32 channels Recorder Medicare System (RMS) and window XP based twin 3.5a EEG software. The sampling rate for

EEG was 256 Hz. First observation was conducted at beginning of the study and subsequently at two months and at four months of pre-test respectively. All participants were explained the procedure prior to recording. Recording was done during morning hours between 8 AM and 11 AM. Subjects were asked to shampoo the head and not to apply oil thereafter in the morning before coming to laboratory. They were instructed to have normal breakfast before coming for recording. Electrodes used were reusable silver disc shaped and they fixed on designated site over scalp.

Electrode placement and machine: Twenty one electrodes were positioned as per 10-20 system electrode placement system of IFSECN (International Federation of Societies for EEG and Clinical Neurophysiology).[24] These scalp locations were referenced to linked earlobes with the ground at the forehead. For analysis in this study, EEG data from following locations i.e. Fp1, Fp2, T3, T4, P3, P4, O1 and O2 were used.

Method of recording: Subjects were asked to be sitting on chair and relax completely. The electrode placement site was rubbed and conducting paste was applied to have good conductance of electric signals and to stabilizing the electrode on the scalp. They were secured at the site by a cotton plug over it. The impedance for each electrode was checked and kept below 10 ohms. The electrode leads were plugged into a head box which was connected to the EEG machine by a screened multiway input cable. EEG filters were used to exclude unwanted signals from the record. In present study, filter setting for low frequency was 1 Hz and that for high frequency was 70 Hz. In addition, a notch filter of 50 Hz was also used. The sampling rate of signals was 256 Hz. Subjects were then asked to close their eyes softly and recording was taken for ten minutes. After the completion of recording, electrodes were removed and head was cleaned by fresh running tap water.

Post-processing of EEG data: The EEG record was visually analyzed employing monopolar montage with a common average reference (CAR). The initial 30 second and last 30 second record was excluded from processing. An artifact free stable 10 second tracing was selected for analysis. Frequency analysis program software of EEG machine was used for data analysis. Percentage value for alpha band was obtained. Data collected were recorded in excel sheet and were analyzed further.

Statistical analysis: To find out difference between periods (pre and post period of 2 months and 4 months respectively) separately in both groups paired sample, t-test was applied and graded significance level was denoted as ($p<0.05$).

Results

The total subjects taken for the study were sixty two. Two subject from experimental group and 5 subjects in control group were excluded as they showed reluctance after few sittings to continue in the study. Thus at the close of study, 29 subjects in experimental group and 26 subjects in control group were available for the analysis. As defined above, all participants were female in the age range of 17 to 21 years with no prior exposure of meditation practice.

At the beginning of experiment (pre experimental stage), both experimental and control groups were almost identical with no significant difference regarding percentage of EEG alpha waves. Table 1 & Fig. 1 present mean values of alpha waves at pre-experimental stage (0 day) and post experimental stage at 2 months and 4 months of control and experimental groups. The mean value of alpha wave frequency (%) in control group at beginning was 49.65 ±21.598 which increased to 52.58±18.005 at 2 months. In experimental group, it was 49.52 ±18.169 which increased to 54.31±22.490 at 2 months. However, this increment at two months was not statistically significant in both groups.

At 4 months, mean value of alpha waves frequency (%) increased to 66.59±9.493 and the increment was significant at the level of $p<0.01$ compared to baseline values. Conversely the changes in control group at 4 months mean value of it insignificantly decreased from 49.65±21.598 to 48.88±17.653.

Discussion

Alpha waves are considered relaxed brain wave. These waves are usually generated either in right hemisphere of brain or in a synchronized pattern between both right and left hemispheres.[9] These waves kick in when our mind and body are completely relaxed and free of stress. It modulates many psychological, neurological, and physiological functions in human. Higher levels of creativity, super learning ability, emotional stability, peak performance, increased level of serotonin, lower level of stress and anxiety are benefits occurred with the generation of alpha waves.[20]

Many studies over the past five decades have scientifically examined effectiveness of meditation. They have demonstrated that long term as well as short term meditation training has demonstrable effects on brain and other bodily systems.[3,13,14,25] MRI studies have shown increased signal intensity in insula and cingulated cortices of brain.[18] Preksha Meditation is a powerful method for awakening and expanding consciousness as well as for strengthening the vital and psychic energy.[11] We, therefore, expected that the EEG measurements after practice of Preksha Meditation for 2 to 4 months would show significant changes on EEG in normal students.

Anand et al in 1960 studied four Yogis who practiced Samadhi.[21] They observed that their resting EEG records showed persistent alpha activity with increased amplitude modulation during samadhi. The alpha activity could not be blocked by various sensory stimuli during meditation. Two Yogis, who kept their

hand immersed in ice cold water for 45–55 min, also showed persistent alpha activity both before and during this practice. This suggested that expert meditators have high value of alpha activity which is not disturbed by external stimuli. Wallace (1970) observed that during meditation, oxygen consumption and heart rate decreases and skin resistance increases.[26] He further observed that EEG shows specific changes in certain frequencies particularly in alpha range. Percentage and voltage of alpha waves are usually higher in person performing meditation.[22] On EEG, changes in alpha waves were observed over posterior half of the head i.e. occipital region of the brain.[9] Many studies aimed to find out the source of alpha activity using magneto-encephalography (MEG) and EEG simultaneously. Yamamoto et al (2006) observed that medial prefrontal cortex (mPFC) and anterior cingulated cortex (ACC) play an important role in generation of alpha activity in practitioners of transcendental meditation.[23]

Impact of Preksha Meditation on alpha waves: In present study we observed a statistically significant ($p < 0.05$) increment in mean (%) of alpha waves frequency from 49.52 + 18.169 at baseline to 66.59 + 17.653 at four month (Table 1). However control group did not show any significant change between observations of baseline to four months (49.65 + 21.598 at beginning vs. 48.88 + 17653 at 4 month). The changes observed at 2 month of meditation were, however, insignificant. It shows that two months of meditation is not enough for beginners to demonstrate changes in EEG.

Our observations are consistent with many earlier studies which have shown positive effect of meditation on alpha brain waves.[26-29] Numerous studies have revealed that there is increase in alpha waves during meditation as compared to control who are not doing meditation. However, Kasamatsmu & Hiraim 1966, Tyson (1985), and Klimesch (1999), have noted either no change or a decrease in alpha band power following meditation.[15,19,20] There is no satisfactory explanation for this variance from present study. This could be attributed to different techniques of meditation and to different population group. Our study on a large number of subjects and under control conditions will give a better picture of changes in EEG.

Lee et al (1997) investigated the effects of Chun Do Sun Bup (CDSB) Qi-training on EEG pattern.[30] They observed that mean relative power and changes of mean absolute power of alpha wave increased significantly in the occipital regions. Their observations suggest that sound exercise and meditation reduce activation of the visual cortex and influence the thalamus and other functions of the brain. Khare and Nigam (2000) studied EEG patterns in 30 normal healthy individuals practicing meditation and compared it with 10 normal healthy controls not practicing meditation.[31] They observed predominant alpha wave activity with an increase in its voltage in meditator as compared to controls. In addition to increase in percentage of alpha waves in meditator, there was good coherence between two hemispheres suggesting good homogeneity, uniformity and increased orderliness of brain. Arambula et al (2001) observed that appearance of alpha waves coincided with shift in breathing.[32] They observed a significant decrease in respiration rate during the meditation with a predominance of diaphragmatic breathing. There was also more alpha EEG activity during the meditation compared to the pre-meditation level. Travis et al (2001) observed that during transcendental meditation there were significantly higher EEG alpha amplitude and higher alpha coherence.[33] Vijaya Lakshmi et al (2011) observed an increase alpha and theta waves following meditation in 13 of 15 subjects.[34]

Our study with large number of subjects and under strict control parameters have created strong evidences to set up beneficial effect of meditation practice on alpha waves in normal adults. However, there are many areas which need to be investigated such as changes in different lobes of brain and coherence, EEG changes while doing meditation, EEG changes with different types and individual components of meditation and changes in other EEG waves.

Table 1: Comparative values of alpha waves frequency (%) at different follow up periods between control and experimental groups

Group	Duration of PM	(%) mean	S.D.	SE	't'
Control	0 day	49.65	21.598	4.236	
Experimental	0 day	49.52	18.169	3.374	.025 ns
Control	60 days	52.58	18.005	3.531	
Experimental	60 days	54.31	22.490	4.176	.317 ns
Control	120 days	48.88	17.653	3.462	
Experimental	120 days	66.59	9.493	1.763	4.556**

******$p \leq .01$; ns–Not Significant

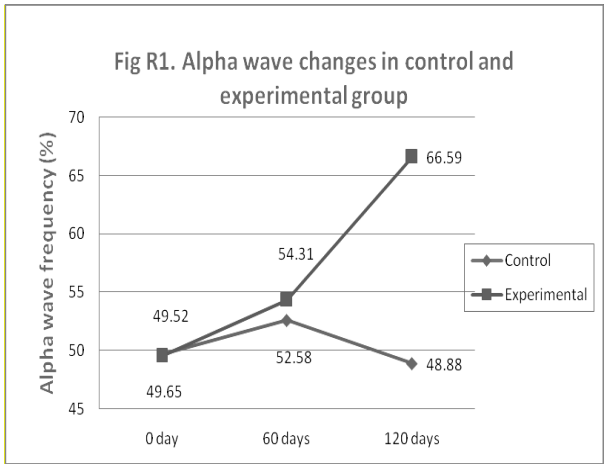

Fig. 1: Effect of Preksha Meditation on alpha waves in brain

Fig. 1 shows similar range of alpha waves in control and experimental groups at baseline which increased slightly but insignificantly after 2 months. At 4 months experimental group showed significant improvement whereas control group showed decrement.

Conclusions

EEG changes in alpha wave frequency were studied in 29 girls undergoing Preksha meditation training (experimental group) and 26 girls as control for 4 months. A significant increase in alpha waves was observed after 4 months of PM practice in young novice students. This increase was observed after 4 months and not at 2 month suggesting that longer practice of meditation is needed to bring out significant improvement. No such changes were observed in control group. It shows that Preksha meditation is conducive to calm the brain and to get control over normal wandering nature.

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