Impact of preksha meditation on alpha waves in EEG

Samani Shreyas Pragya[1], Pratap C Sanchetee[2,*]

[1]Associate Professor, [2]Professor, Dept. of Yoga and Science of Living, Jain Vishva Bharti Institute (Deemed University), Ladnun, Rajasthan, India

***Corresponding Author: Pratap C Sanchetee**
Email: pratap.sanchetee@gmail.com

Received: 19th December, 2017 **Accepted:** 7th September, 2018

Abstract

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

Materials 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 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 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, in beginning 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 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 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.

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 reverses the role of the autonomic 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, addiction, dementia, heart diseases, diabetes and sleep disorders etc.[1,3-7] Its use in promoting health as well as in prevention and treatment of various diseases is on increase throughout the globe.[8]

Meditation refers to a wide variety of practices and they can be grouped into two basic approaches i.e. concentrative meditations and open mindness meditations.[9] Most meditation techniques are varying combination of these two. In concentration meditation e.g. transcendental meditation (TM), person aims at single pointed focus on some sound, image or sensation to achieve greater awareness. On the other hand open mindness e.g. vipassana and zen meditation, involves opening up or becoming more alert to the continuous passing stream of thoughts, images, emotions and sensations without identifying oneself with them. Open mindness also known as nondirective meditation yields more marked changes in electrical brain wave activity than concentration meditation.[10]

Preksha meditation (PM) was developed by Acharya Mahaprajana in 1978 as a simple and comprehensive method for betterment of life.[11] Though primarily a mindfulness practice, it has element of concentration also. It has eight components which are used in different combinations i.e. *kayotsarg* (relaxation), *anteryatra* (internal trip), *swas preksha* (perception of breathing), *shareer preksha* (perception of body), *chaitanya kendra preksha* (perception of psychic centers), *lesya dhyana* (perception of psychic colors), *anupreksha* (contemplation), and *bhavana* (positive feelings). Several investigations have demonstrated that PM has optimistic impact on human body and mind.[12] PM have also shown to have therapeutic benefits on many diseases such as stress, diabetes, hypertension, coronary heart diseases, etc.[1,13,14]

Meditation is an internal subjective experience and demonstration of its effectiveness was left to the teaching of religious gurus. It is quite difficult to quantify it even with elaborate techniques.[15] Lack of physical evidences is responsible for its decreased acceptance and popularity amongst scientific community and general public.[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), electrophysiological studies (electroencephalography and galvanic skin resistance etc), autonomic function studies, and epigenetic studies.[6,15-18] All these techniques have their merits and limitations.

The human brain has more than 100 billion neurons. To pass the information throughout the body electrically, brain produce electrical impulses which can be described in spatial scales. Electroencephalography (EEG) records these electrical signals from the scalp.[19,20] It has the advantages of being relatively inexpensive, simple recording procedure, good sensitivity and wide availability. Thus it is most widely used investigation to study effects of meditation. Its major limitation is that spatial resolution is quite poor compared to advanced techniques like functional magnetic resonance imaging (fMRI). EEG waves are measured in cycles per second (Hertz or Hz) and are classified as alpha (8-12 Hz), beta (13-30 Hz), theta (4-8 Hz), delta (0.5-4 Hz) and gamma brain (>30 Hz) waves. Our overall brain activity is a mix of all the frequencies at the same time.[19] While alpha power increases and theta power decreases from early childhood to adulthood, opposite holds true for the late part of the lifespan.[21] While beta waves are generated when the brain is actively engaged in material activities, theta waves are associated with drowsiness and delta waves are primarily associated with deep sleep. Gamma activity, usually seen in expert meditators, is associated with processing of meaningful activity and integration of stimuli into a coherent whole.

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. Alpha waves are characteristic of wakeful rest, is often associated with what is known as "super learning".[9,22] Many studies reveal that during meditation, there is an increase in alpha waves with increase in its coherence.[23-24] However, most of these studies are either observation on small numbers of subjects or with poor scientific methodology. Abdullah and Omar (2011) observed that listening to Quran recitation can generate alpha wave and help a person to remain in relax condition.[29] However, Takahashi and Murata et al (2005) and Baijal and Srinivasan (2010) have observed that fast theta power and slow alpha power in frontal areas are there during meditation.[30,31] These variations are perhaps related to type and duration of meditative practices. 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 preksha meditation practice.

Materials and Methods

In present study, normal healthy female students were taken as subjects. They were all from Acharya Kalu Kanya Mahavidhyalaya, 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. 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. PM module as explained below was administered to them as a group meditation in 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: In this participants were instructed to inhale long and then exhale and while exhaling they had to produce a sound like buzzing bee. This sound was repeated for nine to eleven times in 5 minutes.

Relaxation (Kayotsarga): 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 for 5 minutes. The concentration was completely on breathing.

Leshya-Dhyan (Color Meditation): We have selected green color perception and meditation room was flooded with light green illumination. Subjects were suggested to visualize green color around them including in the environment.

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

EEG Recording: All the recordings were done at EEG laboratory of the institute in a quite, comfortable, air conditioned and electrically shield room. 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 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. 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 before coming to laboratory. They were instructed to have normal breakfast before 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).[19,20] These scalp locations were referenced to linked earlobes with the ground at the forehead.

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. 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 cable. Filter setting for low frequency was 1 Hz and that for high frequency was 70 Hz. 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 Data: EEG record was visually analyzed. 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.

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 to continue in the study. Thus we had 29 subjects in experimental group and 26 subjects in control group for the analysis. 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. 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 (Table 1 & Fig. 1). In experimental group, it was 49.52 ±18.169 which increased to 54.31±22.490 at 2 months. However, increment at two months was statistically not significant in both groups.

At 4 months, mean value of alpha waves frequency (%) increased to 66.59±9.493 and it was significant at the level of $p<0.01$ compared to baseline values (Fig. 2). 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 (Fig. 3).

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	.025^{ns}
Experimental	0 day	49.52	18.169	3.374	
Control	60 days	52.58	18.005	3.531	.317^{ns}
Experimental	60 days	54.31	22.490	4.176	
Control	120 days	48.88	17.653	3.462	4.556**
Experimental	120 days	66.59	9.493	1.763	

******p≤.01; ns–Not Significant

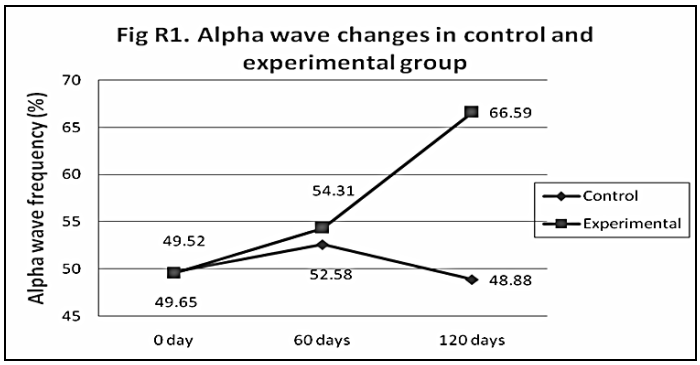

Fig. 1: Effect of preksha meditation on alpha waves in brain

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 slight decrement.

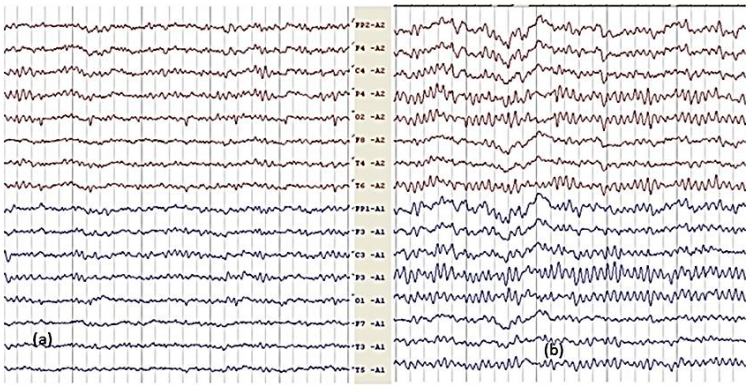

Fig. 2: EEG record at (a) baseline and at (b) 4 months in a subject from experimental group showing significant change in alpha waves from 8-9 Hz at beginning of study to 9-10 Hz after preksha meditation training for 4 months

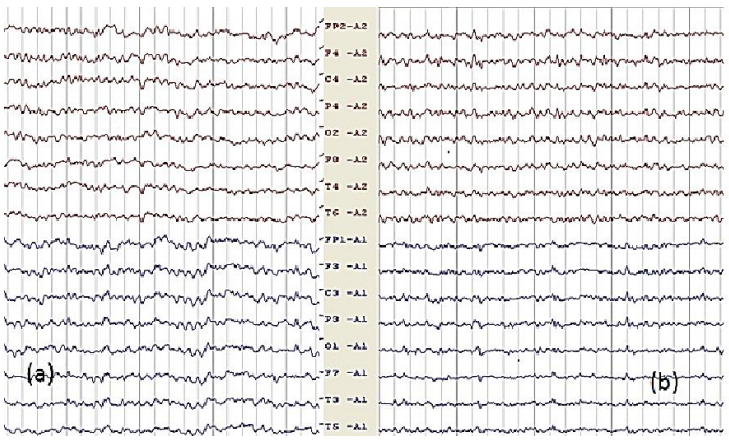

Fig. 3: EEG record at (a) baseline and at (b) 4 months in a subject from control group showing no significant change in alpha waves

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] 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.[22]

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] fMRI 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]

Anand et al in 1960 studied four Yogis who practiced *Samadhi*.[23] They observed that resting EEG showed persistent alpha activity with increased amplitude modulation during *Samadhi*. The alpha activity could not be blocked by various sensory stimuli during meditation. Many studies done earlier have confirmed that EEG shows specific changes in certain frequencies particularly in alpha range.[9] Percentage and voltage of alpha waves are usually higher in person performing meditation.[24] 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.[27]

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. 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.[23,24,32] 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.[15,21,22] 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 has given a better picture of changes in EEG.

Lee et al (1997) observed that mean absolute and relative power of alpha wave increased significantly in the occipital regions with ChunDoSunBup (CDSB) Qi-training.[33] 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.[34] They observed predominant alpha wave activity with an increase in its voltage in meditator as compared to controls. Arambula et al (2001) observed that appearance of alpha waves coincided with shift in breathing.[25] 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.[26] Vijaya Lakshmi et al (2011) observed an increase alpha and theta waves following meditation in 13 of 15 subjects.[28]

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.

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.

Acknowledgement

This paper forms the part of dissertation submitted by first author (SSP) for PhD (2014) to Jain Vishva Bharti Institute (JVBI), Ladnun, Rajasthan, India under the guidance of second author (PCS). We greatly acknowledge the constant guidance and support of Samani Riju Pragya and Samani Amal Pragya, from Department of Jainology, JVBI. We also acknowledge the contribution of Dr K.R. Haldiya, Scientist (Retd.) Jodhpur for guidance in statistical analysis.

References

1. Sengupta P. Health impacts of yoga and pranayama: A state-of-the-art review. *Int J Prev Med.* 2012;3:444-458.
2. Tang YY, Posner MI, Rothbart MK. Meditation improves self-regulation over the life span. *Ann NY Acad Sci.* 2014;1307:104-111.
3. Speca M, Carlson LE, Goody E, Angen M. A randomized, wait-list controlled clinical trial: The effect of mindfulness meditation-based stress reduction program on mood and symptoms of stress in cancer outpatients. *Psychosomatic Med.* 2000;62:613–622.

4. Teasdale JD, Segal ZV, Williams JM, Ridgeway VA, Soulsby JM, Lau MA. Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *J Consult Clin Psychol.* 2000;68:615-623.
5. Harrison LJ, Manocha R, Rubia K. Sahaja yoga meditation as a family treatment programme for children with attention deficit-hyperactivity disorder. *Clinical Child Psychol Psychiatry.* 2004;9:479-497.
6. Yang KP, Su WM, Huang CK. The effect of meditation on physical and mental health in junior college students: A quasi- experimental study. *J Nursing Res.* 2009;17:261-269.
7. Hofmann SG, Sawyer AT, Witt AA, Oh D. The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *J Consult Clin Psychol.* 2010;78:169-183.
8. 10 Barnes PM, Bloom B, Nahin RL. Complementary and alternative medicine use among adults and children: United States 2007. *Natl Health Stat.* 2008;12:1–23.
9. Woolfolk RL. Psychophysiological correlates of meditation. *Arch Gen Psychiat.* 1975;32:1326-1333.
10. Lagopoulos J, Xu J, Rasmussen I, et al. Increased theta and alpha EEG activity during nondirective meditation. *J Altern Complement Med.* 2009;15:1187-1192.
11. Acharya Mahaprajna. In: Muni Mahendra Kumar (ed.), Muni Mahendra Kumar, Jethalal S. Zaveri (trans.). Preksha Meditation: Theory and Practice. Jain Vishwa Bharati, Ladnun: 2004,
12. Shekhawat PS, Khangarot YS, Mishra JPN. Influence of Preksha meditation on blood profile of adults. *Int J Yoga Allied Sci.* 2012;1:93-104.
13. Zamarra JW, Schneider RH, Besseghini I, Robinson DK, Salerno JW. Usefulness of the transcendental meditation program in the treatment of patients with coronary artery disease. *Am J Cardiology.* 1996;77:867-870.
14. Kabat-Zinn J, Wheeler E, Light T. Influence of a mindfulness meditation- based stress reduction intervention on rates of skin clearing in patients with moderate to severe psoriasis undergoing phototherapy (UVB) and photo chemotherapy (PUVA). *Psychosom Med.* 1998;60:625-632.
15. Kasamatsu A, Hirai T. An Electroencephalographic study on the Zen meditation (Zazen). *Folia Psychiatr Neurol JPN.* 1966;20:315–36.
16. Boccia M, Piccardi L, Guariglia P. The meditative mind: A comprehensive meta-analysis of MRI studies. *Biomed Res Int* 2015; Article ID 419808, 11 pages: Retreived on 31 Oct 2016; http://dx.doi.org/10.1155/2015/419808.
17. Davis SF. Handbook of research methods in experimental psychology. Blackwell Publication, Oxford, UK, 2003.
18. Lutz A, Greischar LL, Perlman DM, Davidson RJ. Bold signal in insula is differentially related to cardiac function during compassion meditation in experts vs. novices. *NeuroImage.* 2009;47:1038–1046.
19. Mishra UK, Kalita J. Clinical Electroencephalography. Elsevier a division of Reed Elsevier India Private Limited, India, 2005.
20. Klem GH, Luders HO, Jasper HH, Elger C. The ten-twenty electrode system of the International Federation. The International Federation of Clinical Neurophysiology. *Electroencephalogr Clin Neurophysiol Suppl.* 1999;52:3-6.
21. Klimesch W. EEG alpha and theta oscillations reflect cognitive and memory performance: A review and analysis. *Brain Res Rev* 1999;29:169-95.
22. 20 Tyson PD. Task-related stress and EEG alpha biofeedback. *Biofeedback Self-regulation.* 1987;12:105-119.
23. Anand BK, Chhina GS, Singh B. Some aspects of electroencephalographic studies in yogis. *Clin Neurophysiol.* 1961;13:452-456.
24. Deepak KK, Manchanda SK, Maheshwari MC. Meditation improves clinico-electroencephalographic measures in drug-resistant epileptics. *Biofeedback Self-Regulation.* 1994;19:25-40.
25. Arambula P, Peper E, Kawakami M, Gibney KH. The physiological correlates of kundalini yoga meditation: A study of yoga master. *J* Applied *Psycho Biofeedback.* 2001;26:147-153.
26. Travis F. Autonomic and EEG patterns distinguish transcending from other experiences during transcendental meditation practice. *Int J Psychophysiol.* 2001;42:1-9.
27. Yamamoto S, Kitamur Y, Yamada N, Nakashima Y, Kuroda S. Medial prefrontal cortex and anterior cingulate cortex in the generation of alpha activity induced by transcendental meditation: A magnetoencephalographic study. *Acta Medica Okayama* 2006;60:51-58.
28. Vijayalakshmi K, Mamatha BV, Mathews TS, Kumaran K. Analysis of neuro cognitive effects on meditation. *Int J Computer Application.* 2011;36:6-9.
29. Abdullah AA, Omar Z. The effect of temporal EEG Signals While Listening to Quran Recitation. *Int J Advanced Sci. Engineering Information Technology*. 2011;1:978-983.
30. Takahashi T, Murata T, Hamada T, Omori M, Kosaka H, Kikuchi M, et al. Changes in EEG and autonomic nervous activity during meditation and their association with personality traits. *Int J Psychophysiol.* 2005;55:199-207.
31. Baijal S, Srinivasan N. Theta activity and meditative states: Spectral changes during concentrative meditation. *Cognitive Process* 2010;11:31-38.
32. Banquet JP. Spectral analysis of the EEG in meditation. *Electroencephalography Clin Neurophysiol*. 1973;35:143-151.
33. Lee MS, Bae BH, Ryu H, Sohn JH, Kim SY, Chung HT. Changes in alpha wave and state anxiety during Chun Do Sun Bup Qi-training in trainees with open eyes. *Am J Chin Med.* 1997;25:289-99.
34. Khare KC, Nigam SK. A study of electroencephalogram in meditators. *Indian J Physiol Pharmacol.* 2000;44:173-78.

How to cite this article: Pragya S. S, Sanchetee P. C. Impact of preksha meditation on alpha waves in EEG. Indian J Clin Anat Physiol. 2018;5(4):519-524.