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Effect of Concentrative Meditation on Brain Waves/Activity

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Abstract – The specific purpose of the study was to see the effect of concentrative meditation on human brain Activity/Wave with well planned, systematically developed program of meditation.

The statistical analysis of data collected on sixteen subjects of age group ranging between 20-25 years belonging to different groups. The subjects were divided randomly into two equal groups consisting of eight subjects each; belonging to group I (concentrative meditation) and group II (control group). The data for Neuro-Physiological variable were collected five times in the progressive manner that is before the start of the experiment as pre-test and after the 3rd, 6th, 9th and 12th week along with EEG as to record the progressive performance of the subjects. Finally at the end of 12 weeks the training programme was concluded. The treatment was given six days in a week.

To compare the results, analysis was done through frequency analysis and spectral analysis in numeric form with the help of FFT (Fast Fourier Transform) which converted brain Activity/Wave (Hertz) in to numbers by the electronic encephalogram (Sixteen channels) and EEG Analysis Software super Spec version 4.2.6 (RMS). Statistical analysis was done with the help of SPSS 2007 and the trend was used to see the effectiveness of meditation on different brain waves by comparing their magnitudes.

Alpha frequency is the prominent frequency of occipital area and the emphasis of the present study was on the alpha frequency band, the analysis was done for the readings from the occipital region (O1 and O2) with time bound of two minute to transform the wave frequency in the digital form. Digital filters were computer algorithm that took a digitized signal and transformed it by filtering some frequencies. The most common band-pass was from 1 Hz to 50 Hz. In the present study, it was sufficient to have frequency band in the range from 1 Hz to 25 Hz and the data were expressed in μV2/Hz.

Key words: EEG machine and its related equipment (RMS), super spec software version 4.2.6., Concentrative meditation, Alpha, Beta, Low Beta, Theta, and Delta Waves/Activity.

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INTRODUCTION

There are numerous experts and practitioners who define and explain the meaning and concept of yoga in their own way. Some explain it as a philosophy and others as a science but on the basis of literature available and with our own experience we accept it as a combination of both philosophy and science. We cannot accept it completely as a science because one cannot evaluate everything in the form of experiment related to human behavior and his environment. However it happens (e.g. Kundalini awakening) on the other hand that cannot be justified to accept it totally as a philosophy because there are number of studies have been found which involved science (e.g. physiology and biochemistry etc.).Meditation is the seventh limb of hatha yoga. Although Hatha Yoga is primarily concerned with the physical side, its main objective is to control the mind, which in turn opens the way to higher consciousness. There were many practitioners and experts who explain dhyana (meditation) in their own way, According to Hatha yoga pradeepika written by swami swatmarama meditation comes under antaharanga yoga. The medical benefits of meditation are scientifically proven. From a scientific perspective, we already know by reviewing the literature that meditation leads the brain to create specific brain wave/activity (for example alpha and theta wave/activity). From an emotional perspective, one of the goals of meditation is to cultivate detachment, develop a reduced intensity of emotions and to reduce our desire for novelty. If we meditate regularly for a period of time, we can cultivate a sense of detachment from our hectic life – and by extension our outlook toward work and life changes. By reducing the stimulus field, we reach a state of 'Flow' which involves the merging of action and awareness.When the cognition is entirely

concentrated in that field thus becoming its own field of observation – that is, when the observer is observed – it is meditation. Meditative styles can broadly be classified in to two type's mindfulness and concentrative depending on how the attentional processes are directed. The Most meditations lie somewhere on a continuum between the poles of these two general methods (Andresen, 2000; D. H. Shapiro & Walsh, 1984; B. A. Wallace, 1999). However, meditative traditions often do not characterize themselves according to this schema but rather place more emphasis on the benefits from the 7 practice. Mindfulness practices involve allowing thoughts, feelings or sensations, while maintaining a specific attentional stance: awareness of the phenomenal field as an attentive and non-attached observer without judgment or analysis. Examples include Zen, Vipassana, and the western adaptation to Mindfulness Meditation (Kabat- Zinn, 2003).Concentration is developed by single-mindedly focusing the attention on a selected object. There is a wide range of objects that can be used for meditation, and forty have been specifically recommended in Buddhist literature, although it is quite possible that other things may be included in the list as well. Classical examples are one's own breaths, a Buddha image, candlelight, a painted disc or dyed cloth stretched on a round frame (kasina), water, empty space, or any still object, etc. The reason why a rather large variety of objects is described is to provide a wide choice for practitioners with different preferences and temperaments. A suitable object of meditation facilitates the practice and ensures better progress. In this technique of concentration practice, inhalation and exhalation are employed as a tool to keep the mind still and focused. The mental recitation of bud-dho serves to fortify the practice. Some meditators may find this a more convenient concept on which to retain their attention.

DIFFERENT LEVELS OF CONCENTRATION

The Buddhist commentaries mention three levels of concentration. The first, momentary concentration (khanikasamadhi), is a quality of mind that is inherently common in all sentient beings. This is an essential faculty that we all need in our everyday activities, and we can experience it even when we are engaged in the most mundane chores like eating, drinking, reading, writing a letter, or driving. In fact, it seems impossible to perform any function effectively without a certain amount of concentration. In the same way, it may also be said that our capacity and efficiency to work depend largely on the amount of concentration we are able to mobilize in the fulfilment of our duties.

The second level, called access or approximate concentration (upacarasamadhi), is a more developed form of concentration attainable through the process of mental development mentioned above. At this stage, the mind of the meditator is elevated beyond the ordinary level of consciousness but is not as yet well established in deep concentration.

The third level is attainment concentration (appanasamadhi). This is a stage where the mediator's mind becomes well established in one-pointedness and is completely under control.

There are so many advantages to meditation. When the researcher first originally thought about this, the researcher indeed wanted to make it numerous. Meditation is as powerful as the researcher thought it would be. Here is the definitive list of benefits that meditation can provide to humans as the effect of its practice.

Studies have shown that meditation can bring about a healthy state of relaxation by causing a generalized reaction in multiple physiological and biochemical markers, such as increased EEG (electron encephalogram) alpha, a brain wave/activity associated with relaxation.

ELECTROENCEPHALOGRAM (EEG)

The recording of the electrical activity of the brain is known as electroencephalography and the electroencephalogram (EEG) is a graphic representation of the electrical activity of the cerebral cortex and influence the sub-cortical structures has upon the cerebral cortex. It is a record of more or less rhythmic fluctuations in the electrical potentials that occur in the brain. The EEG is a graph of voltage against time and is shown as series of biphasic wave/activity, possessing both positive and negative polarities.

Electroencephalograph (EEG) set-up

Fig. 1.

BRAIN WAVE/ACTIVITY

There are categories of these brain wave/activity; they ranged from the high amplitude, low frequency delta wave/activity to the low amplitude, high frequency beta

wave/activity. Men, women and children of all ages experience the same characteristic brain wave/activity. There are various types of brain waves namely:

Delta Activity/Wave

Theta Activity/Wave

Alpha Activity/Wave

Low Beta Activity/Wave

Beta Activity/Wave

Gamma Activity/Wave

ALPHA ACTIVITY

Alpha wave/activity are electromagnetic oscillations in the frequency range of 8–12 Hz arising from synchronous and coherent (in phase / constructive) electrical activity of thalamic pacemaker cells in humans. They are also called Berger's wave/activity in memory of the founder of EEGand are found in the EEGs of almost all normal adult people when they are awake in a quiet resting state of cerebration. These waves/activities occur most intensely in the occipital region but can also be recorded from the parietal and frontal regions of the scalp. Their voltage usually is about 50 microvolt. During deep sleep, the alpha wave/activity disappears. When the awaken person's attention is directed to some specific type of mental activity, the alpha wave/activity are replaced by asynchronous, higher-frequency but lower-voltage beta wave/activity. As soon as the eyes are opened these alpha wave/activity disappear and are replaced by faster activity of beta wave.

BETA ACTIVITY

Beta wave/activity or beta rhythm is the term used to designate the frequency range of human brain activity between 13 and 25Hz (13 to 25 transitions or cycles per second). Beta wave/activity is split into three sections: High Beta Wave/activity (19 Hz+); Beta Wave/activity (16–18 Hz); and Low Beta Wave/activity (13–15 Hz). Beta states are the states associated with normal waking consciousness. Beta wave/activity are always recorded from the parietal and frontal regions of the scalp during extra activation of the central nervous system or during tension.

DELTA ACTIVITY

A delta wave/activity is a high amplitude brain wave/activity with a frequency of oscillation between 0–3hertz. Delta wave/activity, like other brain wave/activity, are recorded with an electroencephalogram (EEG) and are usually associated with the deepest stages of sleep (2 and 3 NREM), also known as slow-wave/activity sleep (SWS) and aid in characterizing the depth of sleep.

THETA ACTIVITY

Cortical theta rhythms observed in human scalp EEG are a different phenomenon with no clear relationship to the hippocampus. In human, EEG studies, the term theta refers to frequency components in the 4–7 Hz range, regardless of their source. Cortical theta is observed frequently in young children. In older children and adults, it tends to appear during drowsy, meditative or sleeping states, but not during the deepest stages of sleep.

GAMMA ACTIVITY

A gamma wave/activity is a pattern of neural oscillation in humans with a frequency between 26 to 100 Hz, though 40 Hz is prototypical.

According to a popular theory, gamma wave/activity may be implicated in creating the unity of conscious perception (the binding problem). However, there is no agreement on the theory.

EEG AND MEDITATION

The brain operates to specific frequencies. Neural and electrical activity in the brain is reflected in wave/activity which can be measured. Depending on the state of the mind, the wave/activity has differing cycles. Beta wave/activity (13 to 30 cycles per second) is the fastest and we are most used to them in our waking state. Alpha wave/activity (eight to twelve cycles per second) is generated in detached awareness and day dreaming. Alpha wave/activity is the link between the conscious and subconscious mind. Theta wave/activity (three to seven cycles per second) appears in the dreaming state and in REM (Rapid Eye Movement) sleep and delta wave/activity (0.5 to 3 cycles per second) are associated with deep sleep. Most of us are used to the faster wave/activity in a waking state but we are not used to consciously entering the lower frequencies. Meditation enables us to access to lower frequencies (alpha and lower), which in itself has recuperative properties and is one of the benefits of meditation.

METHOD AND PROCEDURE

The specific purpose of the study was to see the effect of concentrative meditation on human brain Activity/Wave with well planned, systematically developed program of meditation. The statistical analysis of data collected on sixteen subjects of age group ranging between 20-25 years belonging to different groups. The subjects were divided randomly into two equal groups consisting of eight subjects each; belonging to group I (concentrative meditation)

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TABLE NO. 1

WEEKLY SCHEDULE FOR DIFFERENT EXPERIMENTAL GROUPS

Days/week	Experimental group-I (Concentrative Meditation) 6:00- 6.45 am
Monday to Saturday/ 1st to 3rd week	Prayer - 5 min., Suryanamaskara – 5 rounds. Savasana – 2 min., Trataka – 3 min., Treatment – 5 min.
Monday to Saturday/ 4th to 6th week	Prayer - 5 min., Suryanamaskara – 5 rounds., Savasana – 2 min., Trataka – 5 min.,Treatment – 10 min.
Monday to Saturday/ 7th to 9th week	Prayer - 5 min., Suryanamaskara – 5 rounds. Savasana – 2 min., Trataka – 5 min., Treatment – 15 min
Monday to Saturday/ 10th to 12th week	Prayer - 5 min., Suryanamaskara - 5 rounds. Savasana – 2 min., Trataka – 5 min.,Treatment – 20 min.
Sun.	Rest

Further the data was examined by applying trend analysis through graphical representation and repeated ANOVA with regard to experimental group and control group.

RESULTS AND DISCUSSION

To compare the effect of meditational technique (concentrative meditation) and control group the data was examined by applying trend analysis for graphical representation and repeated measures ANOVA. The pretest-posttest randomized group design was employed in this study. Where ever 'F' value was found significant with reference to adjusted post mean value. The level of significance was kept at .05

TABLE 1

DESCRIPTIVE STATISTICS OF ALPHA ACTIVITY

Duration	Training Groups	Mean	Std. Deviation
Pre Test	Control Group	44.4900	29.40918
	Concentrative Meditation	33.8731	21.45713
After 3 weeks	Control Group	50.1249	26.81004
	Concentrative Meditation	47.7111	24.95099
After 6 weeks	Control Group	49.5807	48.29774
	Concentrative Meditation	110.0956	39.03931
After 9 weeks	Control Group	51.9797	55.10264
	Concentrative Meditation	125.0684	35.48500
Post test	Control Group	26.1919	14.49830
	Concentrative Meditation	173.2072	43.72498

TABLE 2

DESCRIPTIVE STATISTICS OF BETA ACTIVITY

Duration	Training Groups	Mean	Std. Deviation
Pre Test	Control Group	173.6772	114.03395
	Concentrative Meditation	222.9877	78.95466
After 3 weeks	Control Group	97.6521	40.42667
	Concentrative Meditation	114.2042	92.33955
After 6 weeks	Control Group	97.6521	40.42667
	Concentrative Meditation	114.2042	92.33955
After 9 weeks	Control Group	92.6565	55.45167
	Concentrative Meditation	59.5783	45.50367
Post test	Control Group	80.2219	47.96946
	Concentrative Meditation	45.0727	41.37416

TABLE 3

DESCRIPTIVE STATISTICS OF LOW BETA ACTIVITY

Duration	Training Groups	Mean	Std. Deviation
Pre Test	Control Group	256.7614	487.06999
	Concentrative Meditation	13.1875	16.96514
After 3 weeks	Control Group	10.2647	3.92287
	Concentrative Meditation	38.4877	68.19233
After 6 weeks	Control Group	14.9441	23.70385
	Concentrative Meditation	21.6474	18.17289
After 9 weeks	Control Group	38.7698	37.36259
	Concentrative Meditation	35.5743	34.15209
Post test	Control Group	137.8589	176.44241
	Concentrative Meditation	26.0297	14.29724

TABLE 4

DESCRIPTIVE STATISTICS OF THETA ACTIVITY

Duration	Training Groups	Mean	Std. Deviation
Pre Test	Control Group	262.2710	155.71328
	Concentrative Meditation	198.7470	73.22231
After 3 weeks	Control Group	135.8194	90.89249
	Concentrative Meditation	104.7566	107.96312
After 6 weeks	Control Group	141.4859	132.77804
	Concentrative Meditation	58.3866	42.29594
After 9 weeks	Control Group	59.1221	40.45266
	Concentrative Meditation	45.3491	30.67229
Post test	Control Group	93.1815	71.17598
	Concentrative Meditation	33.9675	20.78582

TABLE 5

DESCRIPTIVE STATISTICS OF DELTA ACTIVITY

Duration	Training Groups	Mean	Std. Deviation
Pre Test	Control Group	243.7747	146.81941
	Concentrative Meditation	187.3735	87.32654
After 3 weeks	Control Group	360.6489	236.74209
	Concentrative Meditation	89.5190	66.38516
After 6 weeks	Control Group	150.5710	98.35899
	Concentrative Meditation	72.5709	46.72815
After 9 weeks	Control Group	80.0670	50.61319
	Concentrative Meditation	50.3369	32.49502
Post test	Control Group	65.0395	35.06036
	Concentrative Meditation	39.8359	34.06009

When the comparison was made about brain waves/activity of control and experimental groups it was observed that amplitudes of Delta, Theta, Beta and Low beta activities were found significant and haphazard deterioration whereas the amplitudes of alpha activity (F=2.66, p=.067) were more synchronized with the duration at .05 level of significance found insignificant difference.

In order to find the effectiveness of the meditation in producing high frequency alpha activity the researcher had to compare the mean values of treatment group and a control group. On the basis of the post mean comparison concentrative meditation group (173.20±43.72) was higher than the control group (26.19±14.49) during the treatment. Hence, it was inferred that the treatment group (Concentrative meditation) were effective in producing the alpha activity in comparison to that of the control group.

CONCLUSION

The performance of concentration meditation was associated with the changes the EEG that are capable of generalization across subjects i.e. spectral analysis showed highly individual responses to concentrative practices.

The result showed that practice of concentrative meditation has associated with a greater tendency to produce alpha in the meditative state.

On the basis of graphical representation of alpha activity (trend) it reported increased alpha EEG activity in practice meditational group as compared to control group.

The findings produced increased occipital alpha power in experimental group than the control group.

Again the study explored that as the daily practice of meditation and increased load intensity after particular duration, affected more significantly on brain activity (alpha activity).

When an EEG showed alpha spindles at regular intervals with high amplitude it could be presumed that these symbolized meditation and simultaneous rising of one-pointedness.

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