

**Original Article**

A Study on Effect of Indian Classical Music on Brain Activity Using EEG Signals

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Introduction

“Music’s the medicine of the mind” by John A Logan. One of the way the neuron and synapse will be active is by listening to music regularly and it depends on sound wave heard ¹. While listening to music there is a increased frontal midline theta power² and same effect can be seen during meditation³. Music is like an art which can be experience at anytime and anywhere ⁴. Music with a range of 60-80 beats/min has calming effect to brain and it mainly depends on pitch, harmony & melody. Linear sequence of tones is considered as melody, pitch affects our perception, harmony is created by combination of tones of different pitches. Indian classical music has two types of carnatic music containing south Indian ragas, tala & pallavi. Then Hindustani music contains elobaration of north & south Indian ragas⁵. We can see the babies falling asleep to melodies lullabies is a evidence that

music has definite effect on human brain. It has a special quality that left side hemisphere processes rhythm lyrics. Right side is for melodies, sound and harmonic relationship overtime⁶. Hence music is helpful in utilizing both the hemispheres. Sometimes memories of our past experience also recalled by listening to music and it is called flashbulb memory⁷.

Human Electroencephalography (EEG) was discovered by a German psychiatrist Hansberger in 1924. He revealed that a change can be seen in brain waves while performing mental task when eyes are closed⁸.

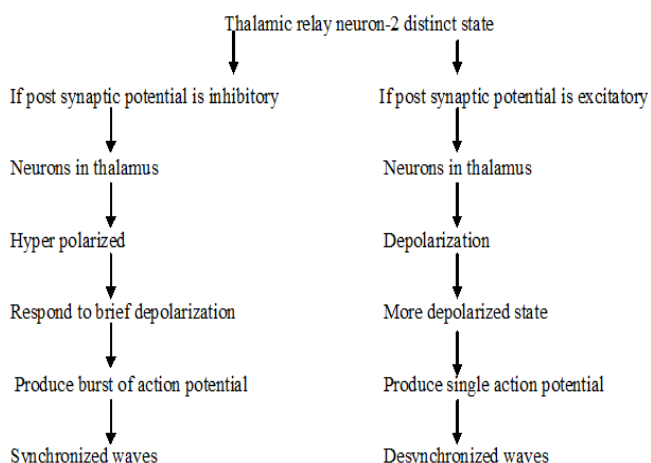
EEG is a graphical representation of difference in voltage between two different cerebral location are plotted over time⁹. During alert or wakeful state EEG shows a pattern of low voltage, fast electrical activity called desynchronized waves. While eyes closed or calming and deep sleep them shows high voltage slow waves called synchro-

nized waves. These are summated waves highly variable but it has a typical wave patterns at different condition. EEG waves are classified according to their frequency (Table.1)¹⁰.

Table 1 : classification of EEG waves.

Waves	Frequency	Condition
Alpha	8-13HZ	Person awake but relaxed ,eye closed
Beta	13-30HZ	Eye open, arousal
Theta	4-7HZ	Slowest wave, sleep
Delta	0.5-4HZ	Deepest sleep

The excitatory post synaptic potential (EPSP) and inhibitory post synaptic potential (IPSP) are summated to form EEG and this causes neurons to fire synchronously. This synchronization helps brain processes & conduct information more effectively. During arousal or open eye this synchronization is abolished because EPSP & IPSP are not summing this we refer as desynchronization. Normally the thalamic nuclei & cortical areas interact to produce post synaptic potentials⁹. As shown in flow chart.



EEG can be used in other medical conditions like monitoring alertness, coma and brain death, locate areas of damage following head injury, stroke, tumour monitor cognitive engagement (alpha rhythm) investigate epilepsy and locate origin of seizure, test drug effects in epilepsy, assist in experimental cortical excision of epileptic focus, monitor brain development in human and animal models, test drugs for convulsive effects, investigate sleep disorder and physiology¹¹.

Materials and Methods

The study was done in 30 healthy subjects aged between 19-40 years comprising of 15 males (24.8±7.4) and 15 females (27.6±6.4) Based on inclusion & exclusion criteria (Table 2) Ethical clearance was taken from the ethical committee. The experiment was performed at Srinivas Institute of Medical Sciences & Research Centre, Mangalore conducted in morning with overnight fasting condition in a sound proof room in sitting position. The subjects were instructed to remain still as far as possible when the instrument is recording EEG. Single recording were taken if there is a recording error, then the electrodes were reapplied & measurement was repeated.

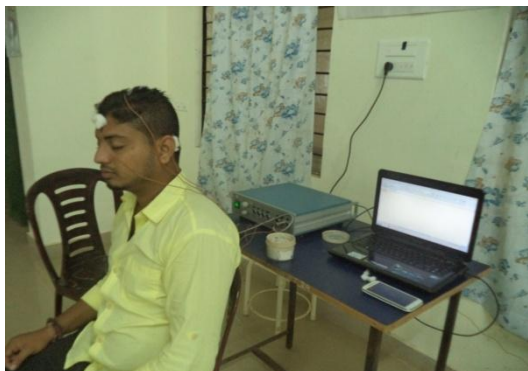
Table.2: selection of subjects based on inclusion & exclusion criteria

INCLUSION	EXCLUSION
Normal hearing perception	Deaf people
Song selection	Who hate music
Students & working people	Housewife
Habitual music listeners	Depressive (CNS Middle ear infection, epilepsy, people on anti depressants)

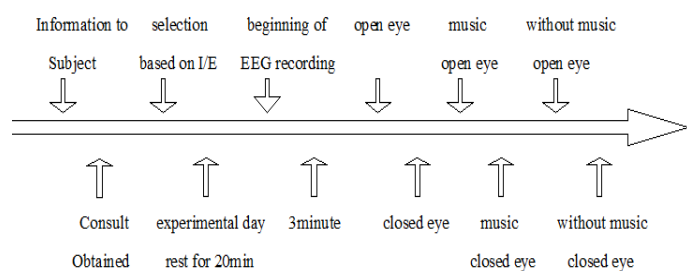
EEG Recording Protocol

EEG recording were taken by using digitized polygraph, polyrite-D. Scalp electrodes (1-3mm diameter) silver-silver chloride (Ag-AgCl) disk type was used. Recording electrodes are placed by using paste electrolyte on the left side at T3 position. Reference electrode is placed on CZ, FP2 ground. The electrodes are placed on 3 location 10-20 standard EEG surface electrode placement configuration are used (Fig. 1). EEG signals were recorded and raw data were filtered using low & high frequency filter with cut-off frequency of 3-50HZ and sensitivity adjusted to 20mv. The noise was eliminated through notch filter. The music was played from an external music player at comfortable listening level.

Fig.1: Placement and recording of EEG electrode.



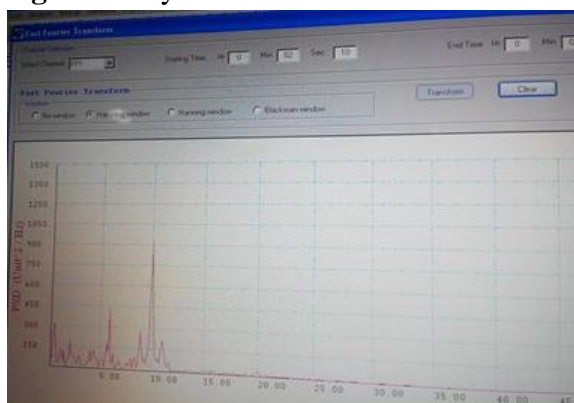
Study Design



Data Processing

The filtered data were analyzed by using fast Fourier transformation (FFT). As the EEG waves are more sensitive so we considered only best of 10sec duration. Time domain, frequency domain, time frequency domain are the different methods used to analyze the EEG. But we used PSD (power spectral analysis) for analyzing and feature extraction of EEG signal. This method determines power of the signal is distributed in different frequency ranges. It gives an idea at which frequency the variation of energy is strong & which frequency they are weak. Calculating power within specific frequency range is possible by using PSD (11). (Fig. 2)

Fig.2: Analysis of EEG Waves.



Statistical Analysis

Statistical software MS EXCEL 2010 was used for analysis. The data was analyzed for normal distribution and descriptive statistics were used. The α -wave power and α - β wave power between different groups were compared by Paired Student t-test. All were two-tailed and conducted at 0.05 significance level. The Student t-test was calculated by using graph pad software, quickcalcs.

Result

- 1) Mean \pm SD of age in study group of males is 24.8 ± 7.4 and females 27.6 ± 6.4 .
- 2) There is a significance difference ($p < 0.0043$) in α -wave recording before music and with music but it is not significant for β -wave. The effect with music and after music in α -activity is significantly high ($p = 0.001$) whereas in beta waves there is no significant result found.
- 3) There is significance difference in α - β recordings while listening to music but no such changes in other conditions (via before & after music)
- 4) The α -difference indicates the amount of change in EEG from open eye to closed eye. (Table.2)

Table 2: Shows the amount of changes during various stages of music therapy

Sl.no	Stages of music therapy	MEAN \pm SD (α - β)	P-VALUE
1.	Before music	91.6 \pm 27.2	<0.0001
	With music	270.5 \pm 21.3	
2.	With music	270.5 \pm 21.3	<0.0001
	After music	60.9 \pm 53	
3.	Before music	91.6 \pm 27.2	<0.0006
	After music	60.9 \pm 53	

Discussion

In this study we found that there is an effect of music on alpha waves. Other study suggested that alpha frequency increases in nasyid music and decreased in rock music indicating more brain

activity in rock music and calmer effect on nasyid music¹². Similarly other study suggested that when subject listened to their preferred song an increase in alpha wave amplitude¹³ and also this is associated with decreased cerebral activity indicating mind is concentrating more¹. Asian nursing research reported that music therapy may have experienced more joyful emotions and also improve cognitive function and positive behaviour in group music therapy¹⁴.

Other study suggested that triangular type wave of music made patients calm down in group music therapy¹⁵. Comparing with our study power of alpha wave from temporal lobe were significantly higher while listening to music indicating the person is comfortable and relaxed¹⁶. In self selected music shows an alpha desynchronization mainly in parietal and occipital areas¹⁷.

Other study shows that brain processes sound at many levels and music reduces dominant beta waves to alpha wave and this effect is of short duration¹⁸. Music has the capacity to change physiological and psychological level in osteopathic treatment¹⁹.

Music may have therapeutic use on human brain:

Benefits of music therapy:

- 1) Under physiological condition like improving reading and literacy skill, concentration^{20,21}, mathematical abilities²².
- 2) Under disease condition like treatment for schizophrenia, some researchers found that a patient listened to his favourite music the secretion of β -endorphins was increased and their pain was relieved²³. And also decreased Cortisol level so that stress will be reduced²⁴ thereby beneficial to lowering anxiety²⁵.

Conclusion

This study investigated the effect of classical music on brain function during three experimental conditions (before music, with music, without music) our study shows that while listening to carnatic music the alpha power is high compared

to other two conditions. So music produces calmer effect and synchronizes the sensory inputs.

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Conflict of Interest: “None to Declare”

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