Effect of Indian classical music microtones on sleep quality and memory in young adults

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ABSTRACT

Introduction and Aim: Music therapy '*Raag Chikitsa'* can be hailed as a safe adjunct in therapy for insomnia and memory disturbances. In the current study, effect of *'Raag Chikitsa'* on sleep and memory was explored.

Material and methods: Present study was conducted on 148 healthy volunteers between the age group 18-21. Subjects were asked to answer a validated Epworth Sleepiness scale and Pittsburgh sleep quality index simultaneously, following which memory tests were conducted. They were then directed to listen to *'Raag Darbari'* for 15 minutes for 30 days. Following this sleep and memory tests were repeated on them.

Results: The result was analysed using Wilcoxon signed rank test. p value<0.05 was regarded as significant. Mean Epworth total score and PSQI was reduced significantly after exposure to music. There was a significant improvement in memory after exposure to *'Raag Darbari'*. PSQI score decreased significantly in subjects who preferred classical music. There was a significant improvement of word recall after 15 minutes, paired associated word recall and story recall in them as well.

Conclusion: The results help to safely state that sleep quality and memory improves with music therapy.

Key words: Music therapy; memory tests; Pittsburgh sleep quality index; Epworth sleepiness scale; *Raag Darbari.*

INTRODUCTION

Music has been an integral part of our lives since ages. Music has physical, emotional social aesthetic and spiritual components. A systematic review of literature regarding therapeutic benefits of music extended to patients with established anxiety disorders revealed reduction in anxiety scores due to the relaxing and stress relieving effect of music (1). Regular listening to music has an ability to improve parent child interaction and help to boost their emotional connectivity (2). Music has reported to relieve labor pain and anxiety of mothers and reduces postpartum analgesic requirement (3). In a study done by Lin *et al.*, on cancer patients results reflected that chemotherapy induced anxiety is decreased effectively by thirty minutes of musical therapy intervention (4). Preliminary evidence from randomized control trials of musical therapy as an intervention have proved to be beneficial in conditions ranging from anxiety, cancer, chronic pain and also Alzheimer's disease (3). Music has myriad styles owing to various ethnicities and culture. Music over time has evolved into various forms. India, a land of various cultures and beliefs has its own inherent music styles. Indian classical (ancient) music has two components *Hindustani* and *carnatic.* The notes (*swara*) in this classical music are structured into different Ragas. One such Raag is Raag Darbari. Ancient Indian Vedic literature has mentioned "*Raag Chikitsa*" which is known as Music therapy. Evidence based medicine reveals listening to certain Ragas has therapeutic benefits (5).

In Sanskrit *'Raag'* literally means mood or color. Each Raag invokes certain emotions. A recent study from India has postulated that Indian classical music significantly reduces cortisol levels, a stress indicator during cardiopulmonary bypass thus reducing intraoperative stress. The same study points out the reduced requirement of propofol, fentanyl and vecuronium mixture during cardiopulmonary bypass surgery suggesting that Indian classical music has therapeutic benefits (3). Sleep is a normal physiological process and vital part of our daily routine. Insomnia is a sleep disorder, which is defined as subjective perception of difficulty in initiation of sleep combined with less duration, consolidation compromised quality that arises despite of sufficient opportunity to sleep (6). According to a study done in South India, prevalence of insomnia in healthy adults was 18.6% (7). Considering the detrimental effects of insomnia such as cognitive impairment can result in compromised quality of life and reduced global productivity (8). Patients with sleep disturbances exhibit reduced grey matter in sub regions of the prefrontal cortex (9) and decrease in hippocampal volume (10). Sleep dependent memory consolidation is decreased in primary insomniacs. This shows the link

between sleep, neuroplasticity, procedural and declarative learning (11).

As the prevalence of insomnia is increasing, the use of sleeping pills has also increased. Increased use of hypnotics is identified with elevated risk of morbidity and mortality (12). Hence, it would be wise to think of an alternative non pharmacological intervention which could avoid adverse effects of drugs in treatment of insomnia. This study would add to the evidence pool which claims the usefulness of Indian classical raga as a therapy and a safe alternative or adjunct to the mainstream drug therapy.

MATERIALS AND METHODS

The present questionnaire based interventional study was carried out following the ethical clearance obtained from the institutional review board. The students of either gender studying MBBS at our institution aged between 18 -21 years were recruited for the study. The criterion for exclusion was the students who were on medication or history of chronic illness or unwillingness of the student to participate in the study. The students who had signed the informed consent were divided into 6 batches of 25 each and were assigned to one of the trained interviewer. The trained interviewer would provide them with a written summary of the experimental protocol. The personal right to withdraw from the study was maintained.

Following this, the study was conducted in a 2-step manner:

Step1 – The participants were asked to answer a validated sleep questionnaire Epworth Sleepiness Scale and Pittsburgh Sleep Quality Index simultaneously. The participants were asked to write their choice of music. The memory tests were conducted on the participants. The participants were assigned code numbers to ensure confidentiality and anonymity. The participants were given CDs of a music piece containing Hindustani Classical musical *Raag Darbari* microtones comprising 15-minute time frame. They were instructed to listen it before going to sleep every day for duration of 30 days.

Step 2 – After 30 days the participants were asked to report back in batches and their sleep scores and memory tests were conducted again.

Epworth Sleepiness scale is a self-administered validated questionnaire with eight questions. It is a simple tool to measure daytime sleepiness in a person. The participant is given situations during which there are chances of dozing during routine hours. The participants are required to rate on a scale of (0-3) 4 point. Scores more than 10 are considered as excessive daytime sleepiness (13).

Pittsburgh Sleep Quality Index questionnaire is a self-reporting standardized effective instrument to evaluate the sleep quality in the past one month. It barely takes 15 minutes for completion and offers 19 questions (14). A global PSQI score was created for each participant after submission of 7 components. (0-3 scale), with final scores ranging between 0-21, where higher scores specified worse sleep quality. A global PSQI Score > 5 was considered poor sleep quality indicator. (PSQI new instrument for psychiatric practice and research). Memory tests like immediate word recall, word recall after 15 minutes, paired associative learning and story recall were conducted on the participant in presence of trained interviewers (15).

Statistical Analysis

The statistical data was studied using the SPSS 15.0 (SPSS South Asia, Bangalore). Data with normally distributed parameters was presented as means and standard deviations. Wilcoxon signed rank test (non-parametric test) was used to compare the sleep scores and memory test scores after Indian classical music intervention. A significance level for statistical test results was determined to be $p<0.05$.

RESULTS

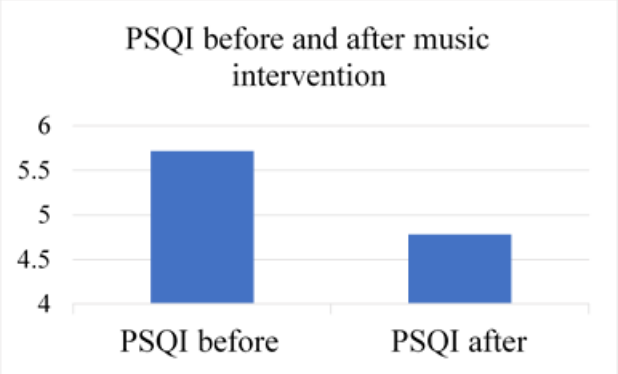

Fig. 1: Comparison of mean PSQI values before and after exposure to *Raag Darbari* (n=148)

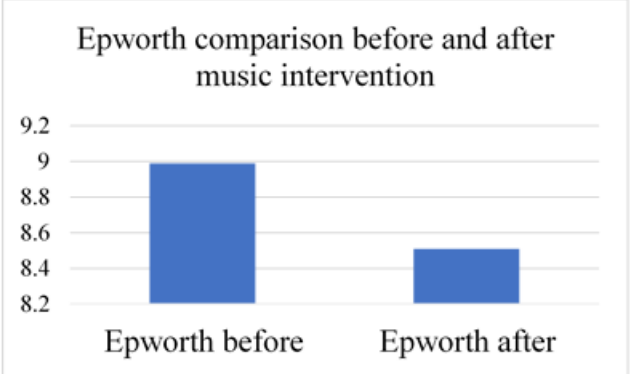

Fig. 2: Comparison of mean Epworth values before and after exposure to *Raag Darbari* (n=148)

Table 1: Z values and p values obtained after comparison of PSQI, Epworth total before and after exposure to Raag Darbari.

n=148	PSQI	Epworth total
Z value	4.83	2.25
p value	0.000*	0.025*

p value< 0.05 is considered significant.

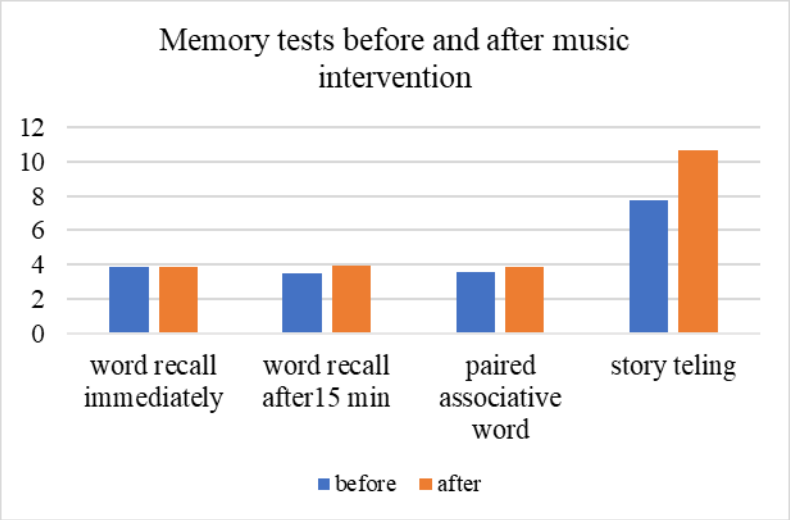

Fig. 3: Comparison of mean scores of memory tests comprising of immediate word recall, word recall after 15 minutes, paired associated word recall and story recall. (n=148)

Table 2: Z values and p values obtained after comparison of immediate word recall, word recall after 15 minutes, paired associated word recall and story recall before and after exposure to *Raag Darbari.*

n=148	Immediate word recall	Word recall after 15 min	Paired associated word recall	Story recall
Z value	0.21	5.96	4.76	8.74
p value	0.834	0.000*	0.000*	0.000*

p value< 0.05 is considered significant.

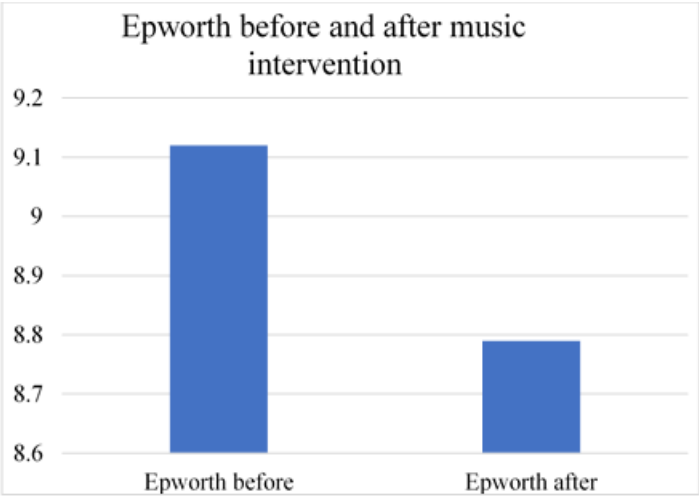

Fig. 4: Comparison of mean Epworth values before and after exposure to *Raag Darbari* in subjects with preference to classical music (n=81)

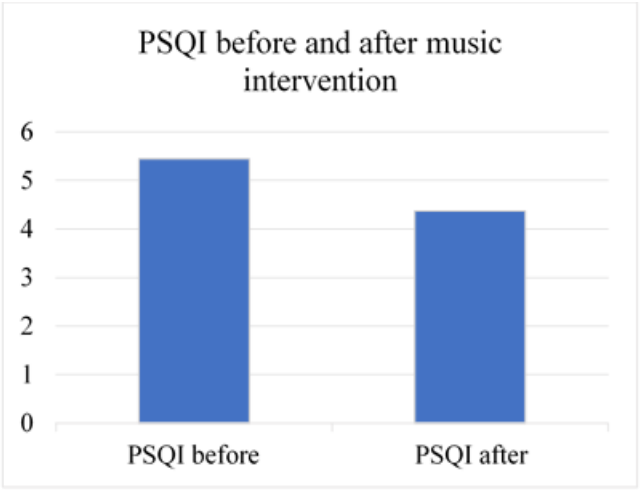

Fig. 5: Comparison of mean PSQI values before and after exposure to *Raag Darbari* in subjects with preference to classical music(n=81)

Table 3: Z values and p values obtained after comparison of PSQI and Epworth total before and after exposure to *Raag Darbari* in subjects with preference to classical music.

n=81	PSQI	Epworth total
Z value	4.18	1.23
p value	0.00*	0.22

p value< 0.05 is considered significant

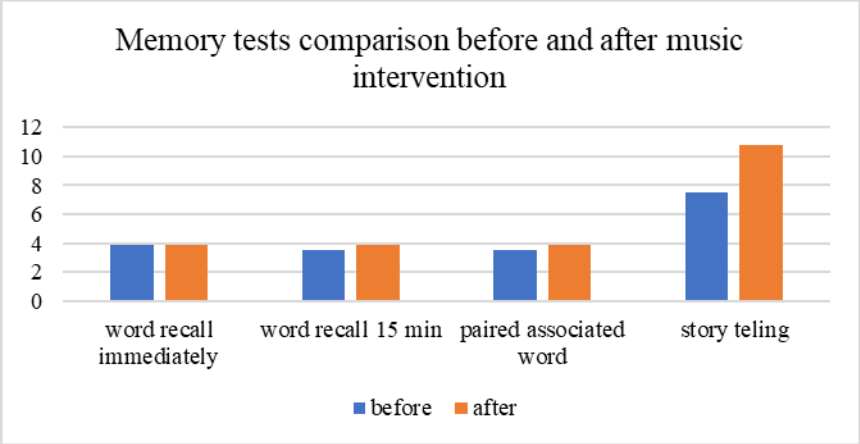

Fig.6: Comparison of mean scores of memory tests comprising of immediate word recall, word recall after 15 minutes, paired associated word recall and story recall in subjects with preference to classical music(n=81)

Table 4: Z values and p values obtained after comparison of immediate word recall, word recall after 15 minutes, paired associated word recall and story recall before and after exposure to *Raag Darbari* in subjects with preference to classical music.

n=81	Immediate word recall	Word recall after 15 min	Paired Associated word recall	Story recall
Z value	5.90	4.23	3.86	6.97
p value	0.56	0.00*	0.00*	0.00*

p value< 0.05 is considered significant

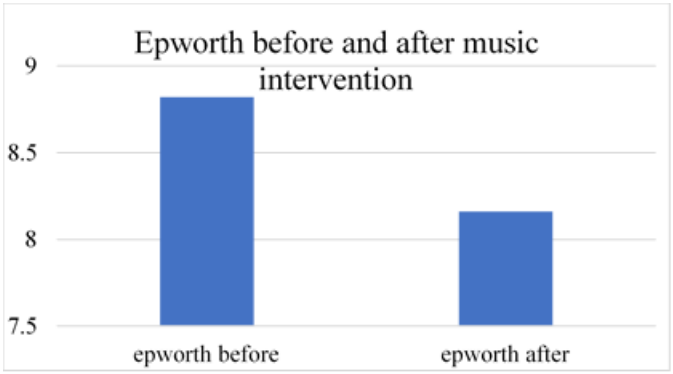

Fig. 7: Comparison of mean Epworth values before and after exposure to *Raag Darbari* in subjects with preference to heavy metal music (n=67)

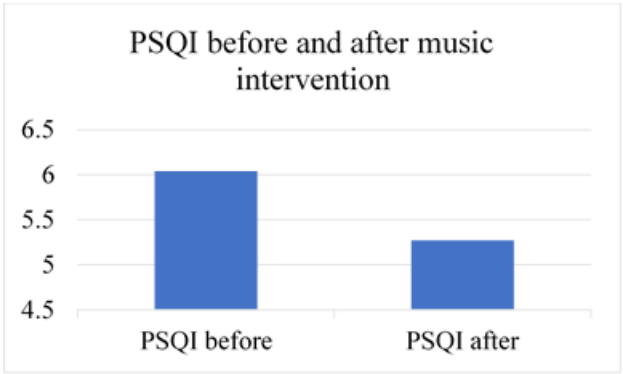

Fig. 8: Comparison of mean PSQI values before and after exposure to *Raag Darbari* in subjects with preference to heavy metal music (n=67)

Table 5: Z values and p values obtained after comparison of PSQI and Epworth total before and after exposure to *Raag Darbari* in subjects with preference to heavy metal music

n=67	PSQI	Epworth total
Z value	2.63	2.05
p value	0.01*	0.04*

p value< 0.05 is considered significant

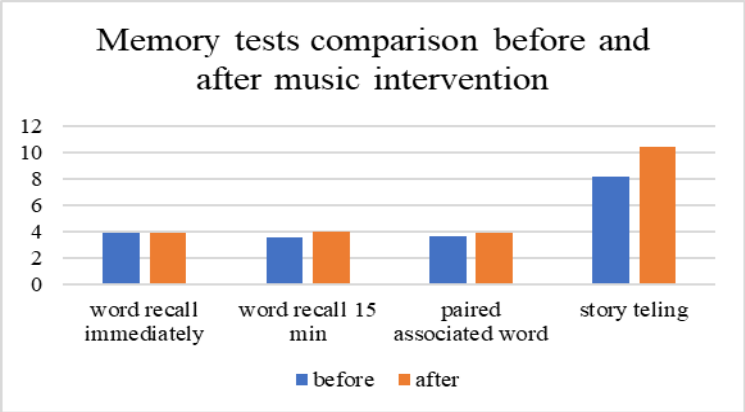

Fig. 9: Comparison of mean scores of memory tests comprising of immediate word recall, word recall after 15 minutes, paired associated word recall and story recall before and after exposure to *Raag Darbari* in subjects with preference to heavy metal music (n=67).

Table 6: Z values and p values obtained after comparison of immediate word recall, word recall after 15 minutes, paired associated word recall and story recall before and after exposure to *Raag Darbari* in subjects with preference to heavy metal music.

n=67	Immediate word recall	Word recall after 15 min	Paired Associated word recall	Story recall
Z value	0.47	4.21	2.86	5.26
p value	0.64	0.00*	0.01*	0.00*

p value < 0.05 is considered significant

DISCUSSION

In the present questionnaire based interventional study we evaluated 148 subjects to observe the effect of Indian classical music intervention on sleep and memory. Current study demonstrates new evidence about the beneficial effects of *Raag Darbari* on sleep quality and memory irrespective of choice of music. Listening to music for 15 minutes for a duration of 30 days significantly improved the quality of sleep as indicated by the reduced PSQI score with highly significant p value (Table 1). In our study we observed significant reduction in Epworth total score after the intervention which is indicative of reduced day time sleepiness. An Indian randomized control trial concluded the benefits of listening to *Raag Bahaar* microtones on sleep quality in patients with depression (16). Our study is in accordance with a study by Harmat *et al.*, who observed that sleep quality would be affected by many variables including musical tempo as well as personal preference (17). Chang *et al.*, confirmed that in patients with chronic insomnia, listening to music for 45 minutes before sleeping for four days significantly shortened stage 2 sleep duration, while widened REM sleep (18). Chen *et al.*, validated these findings in young individuals with longer sleep latency that sedative music intervention resulted in shorter stage 2 NREM sleep and a longer REM sleep (19). Several previous studies have concluded that music has profound effect on sleep in clinical settings attributable to muscle relaxation and distraction of thought (20, 21). The proposed reason for improvement in sleep quality has been reported earlier as reduction in the activity of neuroendocrine system and sympathetic system (22). Musical intervention has been hypothesized to reduce negative thoughts and anxiety in combination of self-regulation of mood to overcome stress linked poor sleep quality (23, 24).

The potential mechanism for inducing sleep via music could be reduction is the levels of stress hormones cortisol (23). A study done by Sandeep *et al.*, provides evidence of listening to *Raag Darbari* music resulted in reduced levels of cortisol in post-operative patients during cardiopulmonary bypass (3). This could be the possible explanation of our findings.

In the present study, there is significant improvement in word recall, paired words recall and storytelling by the subjects after listening to music. In a randomised interventional study researchers concluded that music therapy facilitated recovery of verbal memory in stroke patients (25). MRI studies concluded that cerebral areas directly associated with memory consolidation such amygdala, hippocampus, orbitofrontal cortex, parahippocampal gyrus, nucleus accumbens and temporal poles are active during music listening (25, 26). A study done by Fang *et al.*, demonstrated the benefits of music therapy on improving the memory in patients with mild to moderate Alzheimer's disease (27). Previous studies provides evidence that listening to music may contribute to neuromodulation involved in memory circuits (28). Previous studies also suggest

upregulation of neurotransmitters like Dopamine, glutamate and release of neurotrophins, which play a key role in neuromodulation (29, 30).

CONCLUSION

Our study is in accordance with previous studies stating that sleep quality and memory definitely show improvement with music therapy. It can prove as a safe, easy, cost effective, alternative method for pharmacological intervention in insomnia. Our study gives information on usefulness of *Raag Darbari* on memory enhancement. However further studies are required to validate the role of *Raag Darbari* on memory disorders.

Strengths and limitations

The study was carried out by trained interviewers. Standardised and validated questionnaires were used to assess sleep quality. The results of our study would yield potential benefits wherein non-pharmacological interventions plays a key role in treatment. In cases like insomnia in pregnancy, night shift workers, elderly morbid, paediatric sleep irregularities, altered circadian rhythm, Indian Classical music therapy could be beneficial. The new information offered by this study is that *Raag Darbari* enhances memory in young adults. Our study could establish a link between informational background of integration of Indian traditional medicine (*Raag Chikitsa)* and evidence based modern medicine for treatment of insomnia as a non-pharmacological intervention.

Limitations of our study being small sample size and self-reporting questionnaires for sleep quality were used for the study with lack of objective measurements.

CONFLICT OF INTEREST

The authors declare there is no conflict of interests regarding the publication of this paper.

SOURCES OF FUNDING

No external funding was utilised in the period of the study.

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