Role of *Gāyatrī Mantra* Recitation on Cognitive Function of University Students.

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ABSTRACT

Background:

Cognitive Function is considered to be one of the components to enhance the academic excellence. The traditional techniques in the Indian education system included numerous techniques to develop their mental faculty and *Mantra* recitation was one of it that can also add value to academic institutions in the current scenario too.

Aim: To improve cognitive function by reciting *Gāyatrī Mantra*.

Objective: To evaluate the effects of *Gāyatrī Mantra* recitation on Cognitive Function as measured by Digit Symbol Substitution Test (DSST).

Methods and Materials:

Subjects are 52 college going boys and girls with age range of 18-45 years old, were trained for reciting *Gāyatrī Mantra* with intonations (*Swara*) for 7 days (1 week). It is a simple pre - post design and assessment were done for DSST before and after 7 days of intervention at S-VYASA University (*Prashanti Kutiram*), Bangalore.

Results:

Result shown improvement in the pre – post mean values in total substitution score of males (19.17%), female (18.10%) and in combined subjects (18.55%). Net score of males (19.22%), female (18.44%) separately and in combination (18.77%) improved. P-value of total substitution in *Gāyatrī Mantra* recitation is significant (<0.001) and the p-value of net score is significant (<0.001).

Conclusion:

Gāyatrī Mantra is an effective means in improving Cognitive Function in healthy university students. Thereby incorporation of *Gāyatrī Mantra* may be helpful to improve the academic ability along with their all-round personality development.

Key words: Gāyatrī Mantra, Mantra, Mantra recitation, Cognitive Function, DSST.

1. INTRODUCTION

Mantra is a Sanskrit word that consists of two parts: the root word "man", which relates to thought and the suffix –"tra", which refers to tools or instruments. The word literally means "a tool of the mind" or "instrument of thought."

Mantra chanting is a meditative practice or repetition of any mantra from the rich tradition of Indian spiritual practices.

The Etymological meaning of mantra is:

मननात् त्रायते इति मन्त्रः ॥

Mananāt trāyate iti mantra ॥

The meaning is by chanting the mantra we can protect ourselves. In other words, we can get rid of all our hindrances either mental or emotional through chanting of mantra."

Mantra; is a spiritual word, or a phrase, or a brief prayer that we repeat loudly or mentally to ourselves to calm down both the body and mind. This can improve the concentration to help and restore the spirit (Bormann J., 2010).

1.1 *GĀYATRĪ MANTRA:*

The Etymological meaning of *Gāyatrī Mantra* is:

गायन्तं त्रायते इति गायत्री ।

One who sings (recites) this (*Gāyatrī Mantra*), he will be protected.

ॐ भूर्भुवः सुवः तत्सवितुर्वरेण्यं भर्गो देवस्य धीमहि धियो यो नः प्रचोदयात्॥ ऋग् वेद ३ ।६२ ।१६

om bhūrbhuvaḥ suvaḥ tatsaviturvareṇyaṁ bhargo devasya dhīmahi dhiyo yo naḥ pracodayāt॥

ṛg veda 3.62.16

Oh! God the giver of life, remover of pain and sorrow, cause of the happiness, oh! Creator of universe may we receive the supreme divine light, may you guide our intellect in the right direction. Let us meditate on that excellent glory of the divine Light (Vivifier, Sun). May he stimulate our understandings (knowledge, intellectual illumination).

Recitation of *Gāyatrī Mantra* removes all obstacles in our path to increase wisdom, spiritual growth and development. The mantra is simple prayer to the Lord to remove our ignorance and illuminate our mind with knowledge and intellect called *Jnāna* in *Sanskrit* language. We all want to increase the intelligence, concentration, memory and brain capacity for information. This is a key for strength and success in information age. Whatever we want to achieve in our life, the first and foremost requirement is that our intellect, our understanding must be an excellent form Repetition of *Gāyatrī Mantra* with faith and reverence will help not only in cleansing the mind but also in achieving greater concentration. *Gāyatrī Mantra* is a prayer to the god *Savitā* who is core and Centre for the whole universe to make our mind and intellect sharp and creative to live in the world peacefully and eco-friendly. This chant is as valuable and appreciable in modern world as it was in ancient times. We can use it whenever we wish to gain new insight and inspiration and to increase memory and concentration, even or mundane tasks (Monier-Williams, 1893).

1.2 WHAT IS COGNITIVE FUNCTION?

Cognitive functioning is the intellectual activity that includes mental processes such as, attention, processing speed, learning and memory, executive function, verbal fluency, and working memory. Cognitive function relates to the mental performance that enables information processing, applying knowledge, and changing preferences. It involves various cognitive domains such as memory, attention, executive functions, perception, language, and psychomotor functions (Preedy V.R., 2017).

Cognitive function declines with aging, but it is not uniform; some people experience very little cognitive decline whereas others suffer from mild to moderate to severe decline in some components of cognitive function. The causes or mechanisms of this decline are not clear, but there is evidence to indicate a role for inflammation in reducing cognitive ability. In aged rats that received a single injection of lip polysaccharide (LPS), there was an impaired reversal of learning and attention shifts but not effect on discrimination teaching (Panickar KS, Jewell DE, 2018). Loneliness is a significant concern among the elderly, particularly in societies with rapid growth in aging populations. Loneliness may influence cognitive function, but the exact nature of the association between loneliness and cognitive function is poorly understood. The purpose of this systematic review was to synthesize current findings on the association between loneliness and cognitive function in older adults (Lisa Boss et al., 2015).

Cognition is "the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses". It is related to processes such as attention, the formation of knowledge, memory and working memory, judgment and evaluation, reasoning and "computation", problem solving and decision making, comprehension and production of language. Cognitive processes use existing knowledge and generate new knowledge. Image-1 shows the basic cortical and sub-cortical connections of language speech and formation by Broca's and Wernick's areas (Reinhard Rohkamm, Ethan Taub, 2004).

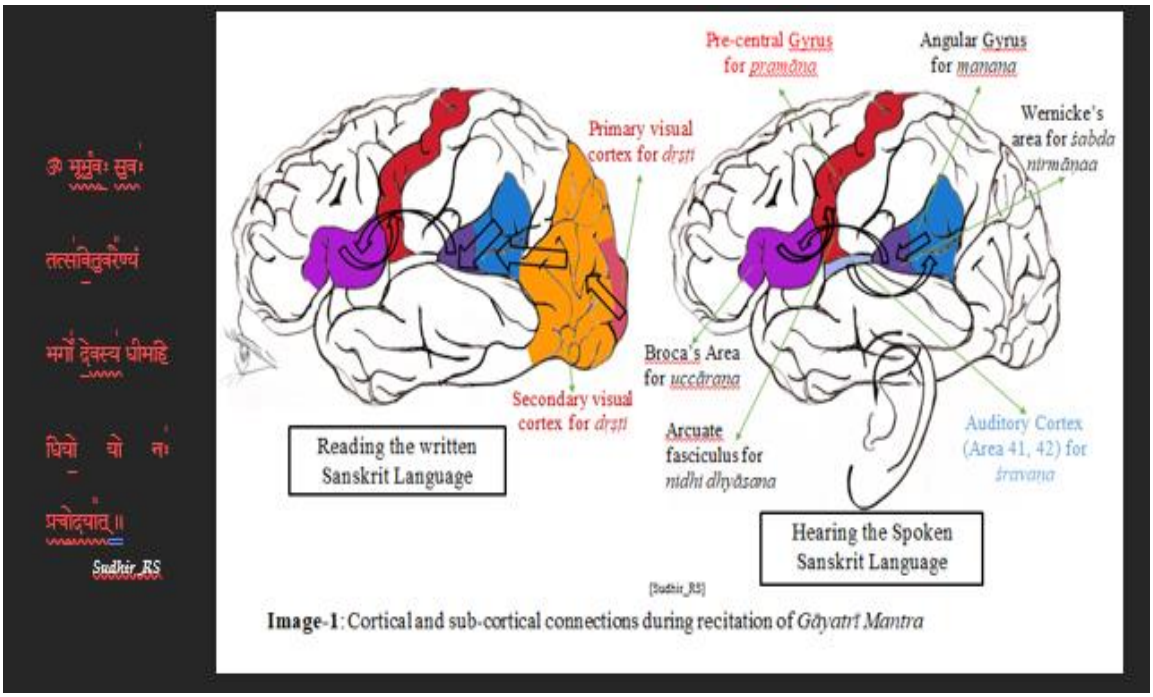


Image-1: Cortical and sub-cortical connections during recitation of *Gāyatrī Mantra*

Cognitive function encompasses the life-long process of learning, ranging from quantitative reasoning to memory formation—both long- and short-term processes. Cognition was originally thought to be exclusively regulated by the central nervous system (CNS), with long-term potentiating and neurogenesis contributing to the creation and storage of memories (M.G. Gareau, 2016).

Cognitive function plays an important role in our daily activities, including sports. Because many sports are performed in a dynamic and ever-changing environment, players have to make optimal decisions as quickly as possible under conditions of physiological stress. Hence, it is intriguing to examine how acute exercise alters cognitive function. These findings suggest that physiological changes induced by acute exercise have the potential to improve cognitive function. Hence, the effects of acute exercise on cognitive function seem to be determined by the balance between the metabolic demands and beneficial effects of exercise in the brain. According to this model, improvements in cognitive function during moderate exercise suggest

that the beneficial effects are predominant during moderate exercise. Therefore, it is highly likely that the effects of acute exercise on cognitive function are multifaceted and determined by the integration of many physiological, as well as psychological, factors induced by exercise. The findings provided in this chapter help to understand the exercise–cognition interaction under conditions of physiological stress (Soichi Ando, et al. 2013).

2. AIM AND OBJECTIVES OF THE STUDY

2.1 AIM: To improve cognitive function by reciting *Gāyatrī Mantra*.

2.2 OBJECTIVE: To evaluate the effects of *Gāyatrī Mantra* recitation on Cognitive Function as measured by Digit Symbol Substitution Test (DSST).

2.3 RESEARCH QUESTION: Does *Gāyatrī Mantra* recitation enhance the cognitive function of university students?

2.4 ALTERNATIVE HYPOTHESIS: The *Gāyatrī Mantra* recitation will enhance the cognitive function of university students.

2.5 NULL HYPOTHESIS: The *Gāyatrī Mantra* recitation may not enhance cognitive function of university students.

3. MATHODS AND MATERIALS

3.1 MATHODS:

3.1.1 ETHICAL CONSIDERATION:

Approval of the University ethical committee (IEC) was taken before conducting the study. The students have given their consent for the study.

3.1.2 DESIGN OF THE STUDY:

This is a simple pre-post design. The pre data was taken prior to the intervention. After 7 days of intervention, the post data was taken.

3.1.3 ASSESSMENT TOOL: DIGIT SYMBOL SUBSTITUTION TEST (DSST)

This test consists of array of nine numbers, each paired with a symbol. Beneath the array is a set of numbers alone, and the subject's task is to write the correct symbol under each of these numbers as rapidly as possible. The raw score is computed by counting the number of correct

responses made in 120 seconds. This is a powerful test of cognitive function, because it places a demand on speed, attention, visual scanning, and memory (Hinton-Bayre A, 2012).

In the previous study, University professors (N = 56) were assisted, divided into two age groups (<50 years and >50 years) and two physical activity level groups (high and low), were tested on three tasks requiring increasingly complex cognitive processing—simple reaction time (SRT), choice reaction time (CRT), and on a digit symbol substitution test (DSST). A significant main effect for exercise, with high active subjects performing better than low active subjects, was found for SRT ($p < .001$) and CRT ($p < .01$) but not for DSST ($p < .09$). Significant main effects for age, with younger subjects performing better than older subjects, were found on DSST ($p < .01$) and CRT ($p < .05$) but not for SRT ($p < .09$). However, compared to normative scores of the population at large, there was a slight increase in DSST percentile ranks with age for the older aerobically active professors, whereas a decrease occurred for the inactive subjects (Lupinacci NS, *et al.*, 1963).

3.1.4 INTERVENTION:

The subjects were asked to recite *Gāyatrī Mantra* with its intonations, for 10 minutes. During *Gāyatrī Mantra* recitation participants were asked to close the eyes & repeat the mantra continuous for 10 minutes, subjects followed the traditional procedure of reciting it loudly for its best effect to invoke the innate power of effulgence and intellect.

ॐ भूर्भुवः सुवः तत्सवितुर्वरेण्यं भर्गो देवस्य धीमहि धियो यो नः प्रचोदयात्॥ ऋग् वेद ३।६२।१६

om bhūrbhuvaḥ suvaḥ tatsaviturvareṇyaṁ bhargo devasya dhīmahi dhiyo yo naḥ pracodayāt||

ṛg veda 3.62.16

Oh! God the giver of life, remover of pain and sorrow, cause of the happiness, oh! Creator of universe may we receive the supreme divine light, may you guide our intellect in the right direction.

3.1.5 EXPERIMENTAL PROCEDURE:

The students were trained in *Gāyatrī Mantra* recitation over a period of 07 days. All the college students were assessed on Digit symbol substitution test (DSST) before and after a period of *Gāyatrī Mantra* recitation. They were asked to sit comfortably on the floor in cross leg with eyes closed. The students were asked to recite *Gāyatrī Mantra* loudly with its intonations for

10 minutes continuous. As shown in image-1, the cortex and sub-cortical connections of reading, hearing happens with *Sanskrit* language. The ability of student with or without a thought or emotion can progress the recitation and with less or no mistakes in DSST.

3.1.6 DATA EXTRACTION:

The total substitutions and wrong substitutions were scored and the net scores were calculated by deducting wrong substitutions from the total substitutions attempted (Agarwal et al., 2002).

The students were asked to be seated comfortably and given the DSST (Digit symbol substitution test) sheets. He/she was then instructed showing sheet with symbols & numbers. After the instruction to "start", students started substituting symbols according to their numbers. The numbers proceeding horizontally and worked as fast and operate as they could. The given period to complete the task was of 120 Seconds and at the end of which the experimenter said "stop". The sheets were collected to score at office by the researcher. Each symbol that was substituted is given a score of 01, each error was scored 01 and each omission was also given a score of 01. Finally, the total scores were tabulated for correct calculation, errors and omissions separately. For the present study only, the scoring was taken into consideration.

3.2 MATERIALS

3.2.1 SUBJECTS & SOURCE:

The study involves both male and female in the age group of 18-45 years old and total number of participants/students, n=52. Sample size was calculated by using G*power having fixed α - 0.05, Power - 0.80, Effect size - 0.05, mean of group I - 54.83, mean of group II - 49.43, standard deviation of group I - 12.39 and standard deviation of group II - 12.73. At S-VYASA University (*Prashanti Kutiram*), Bangalore; A well-known world class Yoga University affiliated by UGC.

3.2.3 INCLUSION & EXCLUSION CRITERIA:

- Healthy college students who were ready to volunteer for recitation and research.
- Age range is between 18 to 45 years.
- Students with some disabilities related to vocal cord.
- Those who are under medication or suffering from any type of problem.

4. DATA ANALYSIS

The data was entered in the Microsoft excel. Then the data was analysed using R studio for normality using Shapiro-Wilk Normality test. Thereafter hypothesis tests were conducted. After completion of Normality test, we have seen that in the Male subject's data, Total Substitution and Net Score values were normally distributed and thus we have conducted Parametric test (T-test) for Male subjects to assess the mean values of pre – post data. And again, after the completion of Normality test, we have seen that, in the Female and combined subject's data were not normally distributed, and thus we conducted non-parametric test (Wilcoxon test).

5. RESULTS

5.1 TABLES FOR MALE DATA:

Table 1: Normality tests, Central Values and pre – post mean scores analysis for the Male Subject's data

Particulars	**Total Substitution**		**Net Score**		**Wrong Substitution**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**
Mean	67.57	80.52	66.74	79.57	0.83	0.96
SD	15.37	12.05	15.35	12.11	1.90	2.33
Median	69	79	69	77	0	0
Shapiro wilk Test (*p)*	0.4819	0.2535	0.5302	0.2811	<0.0001	<0.0001
T.test (*t)*	<0.001		<0.001		NA	
Wilcoxon-test (*z)*	NA		NA		0.8947	

Legends:

- Mean values for Total substitution, Net score, and Wrong substitution increased by 12.95, 12.83 and 0.13 respectively.
- Median values for Total substitution, Net score and increased by 10 and 8, but for Wrong substitution the pre and post median was 0 respectively.
- The pre and post values of Total substitution and Net score were normally distributed, but the pre and post values of Wrong substitution were not normally distributed.
- The increase in post values of Total substitution and Net score for male subjects were exponentially significant (t<0.001) against their pre values as per T-test.

5.2 TABLES FOR FEMALE DATA:

Table 2: Normality tests, Central Values and pre – post mean scores analysis for Female Subject's data

Particulars	Total Substitution		Net Score		Wrong Substitution	
	Pre	Post	Pre	Post	Pre	Post
Mean	73.93	87.31	72.41	85.76	1.52	1.55
SD	12.56	10.64	13.04	11.52	3.18	3.12
Median	72	88	71	85	0	0
Shapiro wilk Test (*p)*	0.6499	0.0288	0.3876	0.0302	<0.0001	<0.0001
Wilcoxon-test (*z)*	<0.001		<0.001		0.5879	

Legends:

- Mean values for Total substitution, Net score and Wrong substitution increased by 13.38, 13.35, and 0.03 respectively.
- Median values for Total substitution, Net score and increased by 16 and 14, but for Wrong substitution the pre and post median was 0.
- The pre and post values of Total substitution and Net score and Wrong substitution were not normally distributed.
- The increase in post values of Total substitution and Net score for male subjects were exponentially significant ($z<0.001$ and $z<0.001$) against their pre values as per Wilcoxon-test.

5.3 TABLES FOR COMBINED DATA:

Table 3: Normality tests, Central Values and pre – post mean scores analysis for the combined subject's data

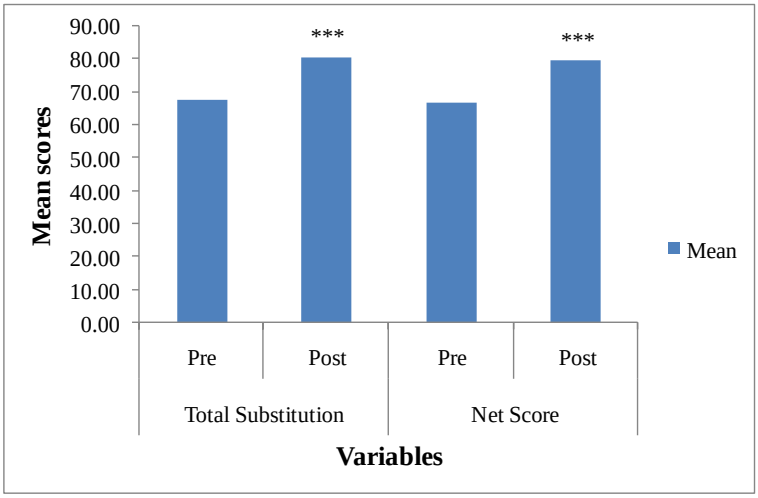
Particulars	Total Substitution		Net Score		Wrong Substitution	
	Pre	Post	Pre	Post	Pre	Post
Mean	71.12	84.31	69.9	83.02	1.21	1.29
SD	14.23	11.78	14.39	12.18	2.71	2.82
Median	70.5	83	69	82.5	0	0
Shapiro wilk Test (*p)*	0.6426	0.008	0.640	0.02	<0.001	<0.001
Wilcoxon-test (*z)*	<0.001		<0.001		0.7333	

Legends:

- Mean values for Total substitution, Net score and Wrong substitution increased by 13.19, 13.12, and 0.08 respectively.
- Median values for Total substitution, Net score and increased by 12.5 and 13.5, but for Wrong substitution the pre and post median was 0.
- The pre and post values of Total substitution, Net score and Wrong substitution were not normally distributed.
- The increase in post values of Total substitution and Net score for male subjects were exponentially significant ($z<0.001$) against their pre values as per Wilcoxon-test.

5.4 GRAPHS FOR MALE DATA:

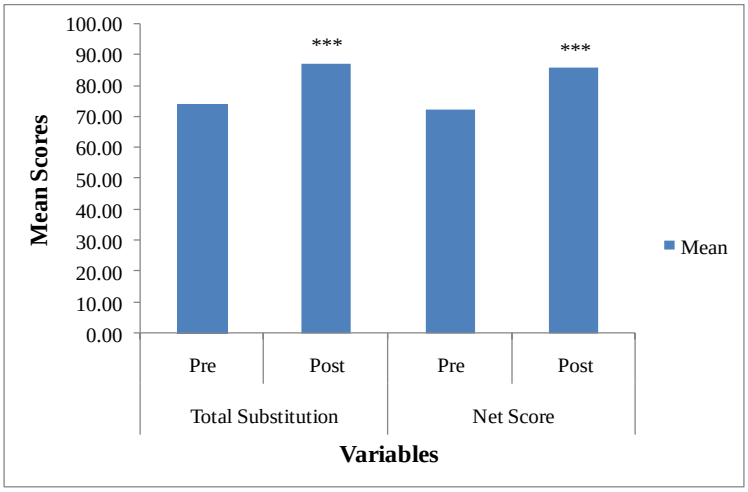
Figure 1: Comparison of pre vs post mean values of Total substitution and Net score for male subject's



Legend: Above figure 1 clearly shows increases in mean scores of post values for Total Substitution and Net Score by 12.95 and 12.83 respectively in comparison to their respective pre values.

5.5 GRAPHS FOR FEMALE DATA:

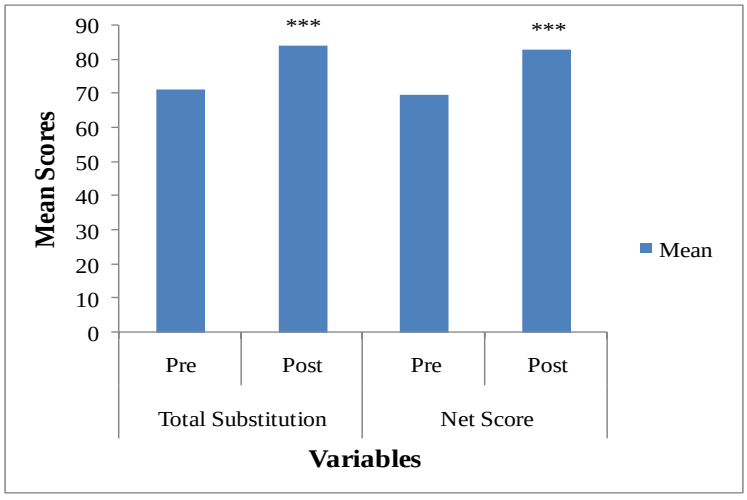
Figure 2: Comparison of pre vs post mean values of Total substitution, Net score, and Wrong substitution for female subject's



Legend: Above figure 2 clearly shows increases in mean scores of post values for Total Substitution and Net Score by 13.38 and 13.35 respectively in comparison to their respective pre values.

5.6 GRAPHS FOR COMBINED DATA:

Figure 3: Comparison of pre vs post mean values of Total substitution, Net score, and Wrong substitution for combined subject's



Legend: Above figure 3 clearly shows increases in mean scores of post values for Total Substitution and Net Score by 13.19 and 13.12 respectively in comparison to their pre values.

6. DISCCUSION

6.1 PRESENT STUDY REPORT:

Previous studies had shown the effect of *Mantra* recitation on Psychological and Spiritual Benefits (Pradhan & Derle, 2012), and improvements in attention (Sushrutha S, Manjunath NK, 2009).

The present study showed was also in line with the previous studies that 10-minutes of *Gāyatrī Mantra* recitation facilitated university student's cognitive performance. This study, attempted to measure the total substitution, wrong substitution and net score of university students. Results are showing improvement in total substitution in male subjects (19.17%), in female subjects (18.10%) and in combined subjects (18.55%) and net score in male subjects (19.22%), in female subjects (18.44%) and in combined subjects (18.77%). p-value of total substitution in *Gāyatrī Mantra* recitation is significant (<0.001), whereas p-value of wrong substitution in male subjects (0.895), in female subjects (0.588) and in combined subjects (0.733) is not significant (>0.05) and the p-value of net score is significant (<0.001).

6.2 COMPARISION WITH PREVIOUS STUDY:

Gāyatrī Mantra recitation results in significant improvement in performance or attention in school children. The subject consisted of school students included boys 30 and girls 30, where they were trained for *Gāyatrī Mantra* recitation for five days. They were assessed on DLST immediately before and after two sessions of GM recitation (10min) and poem line recitation (10 min) with equal duration. 50% of participant's performed *Gāyatrī Mantra* recitation and remaining of the fifty percent, Poem Line recitation on day 06. They found that the *Gāyatrī Mantra* recitation invoked the thinking capacity of the experimental group compared to control group who were stressed with random thinking (Pradhan & Derle, 2012).

Another study was done on the Effect of *Hare-Krishna Maha Mantra* on some mental health indicators of participants. Five subjects were assessed during one week baseline and four-week intervention chanting phase. The result showed that there is significant reduction in stress, depression and verbal aggressiveness (Wolf, 1999).

Previous studies reported that practice of *Om* recitation is effective in improving pulmonary function and vital capacity in healthy individual; 82 subjects were participated in this study divided into two study group (SG) consisting 41 participants and control group (CG) consisting 41 participants; SG practiced Om recitation per day for the period of 6 days for two weeks and

CG did not ask to practice. The result showed there is significant improvement in peak expiratory flow, forced expiratory flow, significant improvement in slow vital capacity (Pradhan & Derle, 2012).

Another, study conducted on '*Om*' recitation, where experienced mediators (experience of 5-25 yrs.) were investigated for autonomic and respiratory variable changes. Each subject was assessed in two types of meditation session's; i.e., mental chanting of '*Om*' experimental and non-targeted thinking as control. Significant reduction in heart rate during meditation was reported among meditators (Telles, Nagarathna, & Nagendra, 1998).

Studies have shown that the attention process involves the prefrontal and temporal (including the Para hippocampal gyros) cortices of brain network of brain regions, additionally it also involves anterior cingulated gyros (Filbey, Russell, Morris, Murray, & McDonald, 2008). The vibrations of mantra chanting have been reported to bring a positive influence on the energy levels to individuals. Further sympathetic and parasympathetic nervous system is reported to be harmonized by Meditation (Predrag. K.Nikic, 2010).

The particular subtle sound vibration is called *Mantra* and traditionally spiritual practice begins with it by teaching from a guru to his students. Spiritually *Mantra* is a tool for awakening the inner great power, namely *Mantra Sakti* and *Mantra Caitanya.* (S. Saraswati, 1986)

6.3 POSSIBLE MECHANISMS:

Sound creates vibrations as it is a wave form travels in air or gaps of skull and brain. If the recitation from self happens with emotion about meaning of mantra, it releases suitable hormones. (K. Maria, et al., 2018) At-least of hormonal balance happens called as homeostasis (R. Ghosh, 2016). Hence recitation is an effective tool to maintain physical brain or neurons function with force behind called as "*udāna*". (Ashish, 2021)

Special senses to perceive the script or hearing the recitation as shown in the image-1, might helped the fewer mistakes in female than male on DSST. According to Ben J Harrison, Carles Soriano-Mas, 2009, there was abnormal and heightened functional connectivity of limbic and cortico-striatal regions found on MRI of obsessive- compulsive disorder (OCD). According to Jan C Beucke, 2013, Anti-depressant medication may reduce this connectivity through orbito-frontal cortex and sub-thalamic nucleus and basal ganglia. The improvement in cognition with recitation of *Gāyatrī Mantra* may help the OCD patients as non-pharmacological therapeutic technique.

According to Jai Paul Dudeja, 2017, Dr. Howard Steingull, an American Scientist established that the recitation of Gayatri Mantra produces a frequency of 110,000 Hz. The cosmic energy associated with the Gayatri Mantra is the Sun. reciting this mantra increases the blood supply to the areas of the brain and can significantly impact spatial and verbal memory. Moreover, reciting it the right way, with the right diction emanates a sound vibration that is great for the heart. It helps lowering heart rate and maintain a balance in breathing. Ideal is to chant it early morning.

7. CONCLUSION

Previous studies on Yoga programs reported enhanced general health as a result of the practice of Yoga way of life. Our study is consistent with this finding, indicating that mantra recitation can improve the cognitive function of university students.

Significance of *Gāyatrī Mantra* recitation on improving the cognitive function of university students have been understood by marking done on the subjects. The study concludes that the mantra chanting should be included in the curriculum of university students for an improvement in their Cognitive function. Although this preliminary research is promising, well-designed studies are needed before a strong recommendation is made. In conclusion, data indicates that *Gāyatrī Mantra* is an effective means for improving cognitive function task in DSST performance on healthy students.

Incorporation of *Gāyatrī Mantra* within a university setting may be helpful to raise the academic ability of the university students along with their all-round personality development.

8. APPRAISAL

8.1 STRENGTH OF THE STUDY:

Present Study is the attempt found the effect of ancient tool called *Gāyatrī Mantra* recitation on physical brain function that is “cognition” among university students. Digit Symbol Substitution Test is a simple paper pencil task to evaluate the traditional recitation. All the students were felt comfortable in taking this test. They were quite co-operative and excited to know their pre and post cognitive function status as shown by DSST. This study has shown encouraging results.

8.2 LIMITATIONS OF THE STUDY:

- Small sample size without control group.

- The intervention was only for 10-minutes *Gāyatrī Mantra* recitation and simple group pre – post design.
- No neuro-imagery measurements used for this study.

8.3 SUGGESTIONS FOR THE FURTHUR STUDY:

- Future studies should be done in other student groups from different parts of India and other countries to establish the generalizability.
- Long-term studies to assess long term impact of *Gāyatrī Mantra* recitation.
- The sample size could be increased for significant result and randomization can be used for sampling.

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