

Effect of OM chanting on working memory among school-going children

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Adolescents today face increasing cognitive challenges due to over exposure to digital media and reduced engagement in activities that help improve their cognitive functions such as working memory. Working memory plays a vital role in learning, attention and academic performance, yet interventions targeting its improvement in healthy children are limited. This study aimed at observing the effect of OM chanting on working memory amongst school children. 67 students of eighth-grade, aged between 13-15, who were willing to participate were recruited for the study and separated into two groups *i.e.*, experimental (n=34) and control group (n=33). The intervention group was asked to chant 21 rounds of OM chanting during the morning assembly and before going home *i.e.*, twice a day. Working memory was measured using the digit span test, data was collected before and after the 4-weeks intervention period. Digit span test comprises two subtests. Digit span forward (DS-F) examines short-term memory, while digit span backward (DS-B) measures working memory. In the intervention group, a significant improvement was seen in both the tests, while there was no significant change in the control group. Paired sample t-test was applied to measure the changes between pre and post data of both the test. p-value for DS-F in experimental group was 0.001 and for DS-B is 0.003. From these results we can infer that OM chanting has a positive and calming effect on our brain with increase in working memory capacity of students, which helps in retention and concentration, and thus can improve their academic performance.

Keywords: Adolescence, OM chanting, Working memory, Yoga

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Corona virus disease 2019 (COVID-19) has affected us in many ways. Whether directly or indirectly it has made a significant impact on everyone's lives. Due to COVID restrictions, online mode of teaching was adapted, students showed lack of interest and deviated their mind towards games, videos and social media¹. Because of the limited access for the activities outside, they were bound to stay indoors hence, without any choice they preferred to spend time on social media as a recreation. After the pandemic most of the adolescents have become addicted to mobile phones and social media. A study shows that around 33% of adolescents in India are addicted to mobile phones². Children are not going outdoors instead overusing their brain in the wrong direction by wasting their time on social media and mobile games. This lack of outdoor activities can also lead to adverse effect on their overall well-being and cause various diseases such as obesity, anxiety, depression, bipolar and other psychological and neurological disorders^{3,4}. This

addiction may also alter their cognitive processes including their memory⁵.

There are several types of memory such as short-term memory, long-term memory, semantic memory, episodic memory and *working memory*. Short-term memory functions similarly to a mental post-it note, retaining information for a brief period⁶. Long-term memory, on the other hand, serves as a huge mental library of the human brain, storing events and knowledge throughout time⁷. Whereas, working memory (WM) is one of the executive functions which includes a number of higher-level cognitive control abilities. It is our ability to store the information and manipulate it to perform complex cognitive tasks such as language comprehension, learning and listening⁸. Working memory can be mistaken for short-term memory, however, short-term memory is used merely to store the information for brief period of time⁹, for example: remembering someone's mobile number for short time, but WM stores the data and manipulates it, for example: solving short mathematical problems in our mind. WM is also different from long term memory despite

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their close relationship. Information goes into long-term memory through WM¹⁰. Long-term memory refers to the information that we have gathered through time. One of the goals of working memory is to transfer new information to your long-term memory. Earlier models emphasized the role of the prefrontal cortex in WM, highlighting its function in maintaining active representations through persistent neural firing¹¹. However, Christophel *et al.*¹² demonstrated that WM is a distributed and flexible process involving not only the prefrontal cortex but also the sensory, parietal and temporal cortices, each contributing to synthesize the information. A recent study proved that WM involves multiple mechanisms, including activity-silent periods, where neurons stop firing but still retain the memory information through short-term synaptic changes. The study also shows that WM is not static, but dynamic, meaning that memory representations change over time depending on the task demands and goals¹³.

Adolescence is a transitory stage that involves considerable physical and psychological growth. All the cognitive functions including working memory improve significantly during adolescence, it is also the time period during which the brain typically handles a large volume of incoming information from the outside environment¹⁴.

Working memory capacity of children increases in a linear pattern across the childhood and adolescent years¹⁵. Although WM capacity was understood as a constant trait, some researchers proved that it can be improved using adaptive training¹⁶ and its plasticity can be found in older adults as well¹⁷.

Increased working memory capacity can help a child to understand the concepts clearly and perform well in the academics and it can bring behavioural and neurophysiological changes in children^{18,19}. Also, WM deficit can lead to various developmental and learning disorders such as ADHD, dyslexia, and dyscalculia²⁰. While numerous studies have focused on clinical populations, research assessing the impact of WM training in healthy children and adolescents remains surprisingly limited²⁰. In this study, OM chanting is presented as a simple and accessible school-based approach for enhancing working memory in healthy school children.

Different kinds of meditation practices are investigated to understand the well-being of individuals. These practices include, yoga²¹, yoganidra²², pranayama²³, etc. Researchers are now showing

interest in yoga since it has become more and more popular in the last few years across the globe. Yoga is an ancient practice which was developed in India as a tool for self-realization. But now it has been proven by many researchers that along with its spiritual benefits, yoga has so many therapeutic benefits, it is a system of mind-body medicine which has gained popularity as a treatment for a variety of illnesses and health issues, with a goal of promoting wellness²⁴. AYUSH as a whole comes under one umbrella of traditional medicines focusing on improving the overall well-being of a person²⁵. A recent study also says that Integrative therapy combining Ayurveda and Yoga may offer an economical and scalable treatment option for COVID-19, reducing healthcare burden and risk exposure for high-risk COVID patients²⁶. Yoga as a holistic science helps in enhancing overall cognitive abilities, which includes visuospatial working memory and attention, it also alleviates stress among students²⁷.

Chanting “OM” sound is an essential part of the yogic practice. According to Maharishi Patanjali, *it is the representation of universal spirit in the form of a sound*. It consists of 3 syllables *i.e.*, A, U and M. A-kara is the first sound, U-kara is the transition between other two syllable *i.e.*, A and M and M-kara is the last sound. In Patanjali Yoga sutra, it is mentioned that by chanting OM regularly and contemplating its meaning again and again, one can move ahead towards samadhi and overcome all the nine obstacles (Laziness, Doubt, Dullness, Cravings, Wrong perception, Disease, Procrastination, Inability to achieve the refinement, Instability) which are the distractions of the mind. If we look into modern research, we find evidence that it enhances the activity of *parasympathetic nervous system* and promotes relaxation²⁸. In addition to this, it increases the electrodermal resistance, which leads to decrease in stress²⁹. A fMRI study on 12 healthy adults within the age group of 22-39 shows several changes in neuronal activity of brain while listening or chanting of the sound “OM”. While chanting OM, there is activation as well as de-activation in some areas of the brain. A study observes a significant bilateral de-activation in some areas such as orbitofrontal gyri, para hippocampal gyri, thalami, hippocampi and right amygdala. There is also a de-activation of limbic system which may lead to balanced state of emotions and calming down of the brain³⁰. A recent study on 20 adult males illustrates activation of various resting-state networks of our brain such as frontoparietal

control network (FPCN), which is the hub that rapidly and flexibly switches with any of the networks; Dorsal attentional network (DAN), which is involved in sustained attention; ventral attentional network (VAN), which is used for re-location of attention; and default mode network (DMN), which is responsible for mind wandering. In regular meditators it has been observed that there is more de-activation of DMN³¹. This activation may lead to proper functioning of these networks that can improve the cognitive functions, including working memory.

A previous study on adults within the age group 25-55 years³² demonstrated that OM chanting has a positive effect on verbal and spatial memory following a three-month intervention. However, the specific relationship between OM and working memory remains unexplored. Therefore, the present study aims to investigate the impact of OM chanting on working memory when administered over shorter period of four weeks.

Materials and Methods

Research design

The study followed a pre-post design and participants were selected using convenience sampling from two sections of 8th grade-Section A and Section B. Section A was assigned as the experimental group and Section B as the control group, thereby forming two distinct groups for comparison.

Procedures

The procedure began with the pre-assessment of both groups using the Digit Span Forward (DS-F) and Digit Span Backward (DS-B) tests. The experimental group received an intervention of 21 rounds of OM chanting, conducted twice daily as part of their school schedule for a duration of four weeks. The control group continued with their regular academic routine without any intervention. After the four-week period, post-assessment was conducted using the same tests (DS-F and DS-B). The collected data were then statistically analysed to evaluate the effect of the intervention on working memory (Fig. 1).

Study participants

A screening of 78 participants was done, who were all 8th grade students with girls (N = 37) and boys (N = 30) at Merit Higher Secondary School, Indore, Madhya Pradesh. The mean age of the participants was 13.4±0.658. The demographic data of all the participants are shown in Table 1. All the measures were taken care for inclusion and exclusion criteria,

and total 71 students were selected for the study, in which 4 opted out due to health issues. Therefore, 67 students participated till the end of the study, of which 34 students were in experimental group and 33 students were in control group (Fig. 2).

Inclusion and exclusion criteria

Both male and female students aged between 13 to 15, who were healthy and without any history of health issue were included in the study.

Students with mental disabilities like ADHD, obesity, psychosis and other psychological and neurological disorders were excluded from the study.

Assessments

Wechsler Intelligence Scale for Children (WISC) is an instrument to measure overall intelligence of children aged between 06-16 years, it measures the 05 sub-domains viz., *Verbal Comprehension Index, Visual Spatial Index, Fluid Reasoning Index, Working Memory Index and Processing Speed Index*. The test selected for this study is *digit span test* which is one of the sub-tests to measure the working memory index in WISC-5, It Includes 2 subsections: *Digit Span Forward (DS-F)* and *Digit Span Backward (DS-B)*³³.

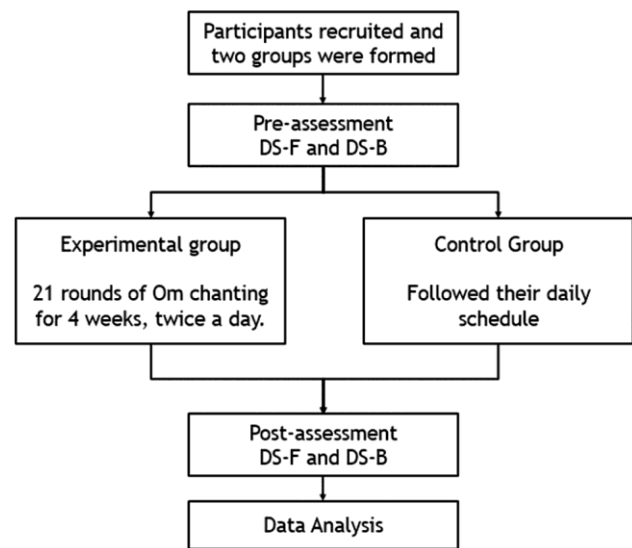


Fig. 1 — Flow chart showing the study procedure in brief

Table 1 — Demographic data of the participants

	Age	Total	Boys	Girls
Experimental group	13	21	9	12
	14	7	8	1
	15	4	2	2
Control group	13	22	5	17
	14	9	6	3
	15	2	1	1

In DS-F, a series of numbers are shown to the participant, who is then asked to recall them in exact same order, it is a measure of short-term memory as it requires participant to simply remember the sequence.

In DS-B, participants are required to recall the digits in the reverse order, it evaluates the working memory as it is required to memorize the numbers and immediately recall the same in reverse order, *i.e.*, to manipulate the numbers.

Both the tests start with three digits; these digits gradually increase after each correct response. The test stops when the participant fails in two attempts of the same duration. The highest number of digits that the participants can properly memorize and repeat determines their test score. If the students can memorize a set of numbers, then they will move to next level which contains one extra digit and if they fail to memorize the particular number sequence, the next best (previous) score was considered as their final score. This test tells us about the working memory capacity in students while sharpening their attention at the same time.

Intervention

The intervention started with 21 rounds of Omkara chanting to the experimental group before their first lecture in school during assembly time and the second chanting was done in the afternoon before heading back home. The control group was following their

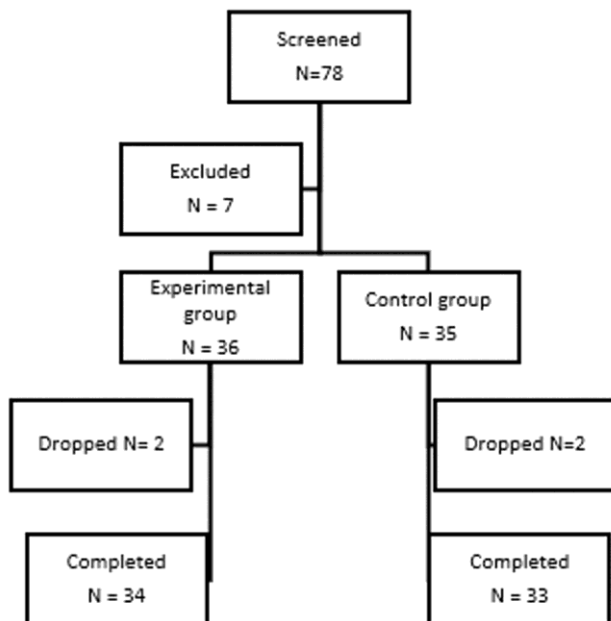


Fig. 2 — Flow chart showing the number of excluded and dropout participants

daily school schedule only. The entire intervention was given five days-a-week for a period of four weeks. The pre and post data was taken on first and the last day of the intervention using digit span test which is the subtest for working memory in Wechsler Intelligence Scale for Children (WISC).

Ethical approval

This study is approved by the Institutional Ethical Committee (IEC) of SVYASA Yoga University. IEC no. is: RES/IEC-SVYASA/ERC-313/2023. The consent form was given to all the student’s parents for allowing their children to participate in the study. A prior approval from the management of Merit Higher Secondary School, Indore was also taken.

Results

Between-group comparisons using the Mann–Whitney U test indicated that the experimental and control groups were comparable at baseline, with no significant differences observed in DS-F (U = 462, p = .243) or DS-B (U = 427, p = .080) scores. Following the four-week intervention, there were still no significant differences between the groups in either DS-F (U = 521, p = .597) or DS-B (U = 524, p = .631), suggesting that the groups remained statistically similar even after the intervention. However, within-group analysis revealed significant improvement in the experimental group following the OM chanting intervention. The Wilcoxon signed-rank test indicated a significant increase in both DS-F (W = 13.0, p = .003) and DS-B scores (W = 23.5, p = .005) from pre to post-intervention. In contrast, the control group showed no significant changes in either DS-F (W = 15.0, p = .351) or DS-B (W = 30.0, p = .464) scores over time. The mean scores of both the groups are shown in Table 2 & Table 3, and the comparison

Table 2 — Scores of DS-F and DS-B of experimental group

Variables	Base-line (Mean± SD)	After chanting (Mean± SD)	p-value
Digit-Span Forward	5.53±0.71	6±1.15	0.003**
Digit-Span Backward	4.44±1.04	4.94±1.15	0.005**

p-value is calculated for the change between pre and post data. **p<0.01

Table 3 — Scores of DS-F and DS-B of control group

Variables	Base-line (Mean± SD)	After chanting (Mean± SD)	p-value
Digit-Span Forward	5.72±0.71	5.82±0.81	0.351
Digit-Span Backward	4.91±0.87	5±0.79	0.464

p-value is calculated for the change between pre and post data.

of means is also presented in (Fig. 3). These results suggest that OM chanting may lead to improvements in working memory within the experimental group, while no such change was observed in the control group.

Discussion

The current study aims to evaluate the effect of daily OM chanting on working memory among adolescents, for whom working memory training is particularly critical as this is the time period where it matures. If more attention is paid to WM at this age, they would excel in their academics, thereupon helps in sustenance of information. The present study is an attempt to provide a technique which is easy and effective to increase the working memory capacity in school children. The intervention was of 04 weeks, and a significant improvement was observed in the student's working memory and in their performance. Some researchers have already observed the effect of OM chanting on spatial and verbal memory of children as well as in adults³². They have observed that OM chanting has very significant effect on our physical as well as mental health, and it is a very simple and practical method for systematic training towards the awareness of resuming the dormant capabilities of the brain³⁴. So, this present study supports the existing evidence presented by above mentioned studies.

We have already understood that the activities related to human brain rapidly change according to the need of that particular task, during working memory delay or retention, sometimes neurons do not even fire signals¹³. So, for improving the complex brain functions like this, we need an intervention that affects all the areas of the brain simultaneously.

To observe the change in the neuronal activity fMRI is used, it is an advanced neuroimaging technique that allows researchers to observe brain

activity, it reveals which part of the brain are active during specific functions or tasks. When we dwell deeper into the fMRI studies related to OM chanting, we found that it activates as well as de-activates many areas of the brain which may lead to improved functioning of the brain³⁰. It stimulates the vagus nerve, which regulates our parasympathetic nervous system, resulting in deep relaxation and stress reduction²⁸. It also activates the resting-state networks of human brain, which may help in improving the working memory capacity along with other cognitive functions³¹.

Strength of this study is that the integration of OM chanting into the daily school schedule adds practical relevance and day-to-day applicability. If OM chanting is done every day, it helps in reducing cortisol level and improves the cognitive processes and enhances the learning abilities and concentration levels³⁵. So, it works on overall physical and mental wellbeing. According to Yogic lore, OM chanting not only helps in attention and learning abilities grossly, rather it helps in reducing the speed of the mind by bringing stability to parasympathetic nervous system²⁸. Thus, enabling the immune system which aids in overall physiological as well as cognitive functions. OM chanting also helps in reducing impulsions and hyperactivity which is a great hindrance in learning amongst children. It also brings sustenance in maintaining emotional quotient while responding to day-to-day challenges. Thus, we see an overall personality change in responding to the needs of others.

Limitations and future directions

The limitation of this study was that it did not employ randomization hence, there is a risk of selection bias which may affect the validity of the study findings. Secondly, the sample size is relatively small therefore, the result limits the applicability on the larger population leading to reduction in statistical power. Also, a shorter intervention period may not allow for a comprehensive assessment of the chanting effect.

We aspire and recommend that the future studies should focus on larger sample size with randomization so that normal distribution of the data can be seen. We also suggest that observing the changes on more variables with a longer duration of intervention also with different age groups can be thought of, to observe the cognitive changes. Since it's proven that chanting of OM-kara has soothing and

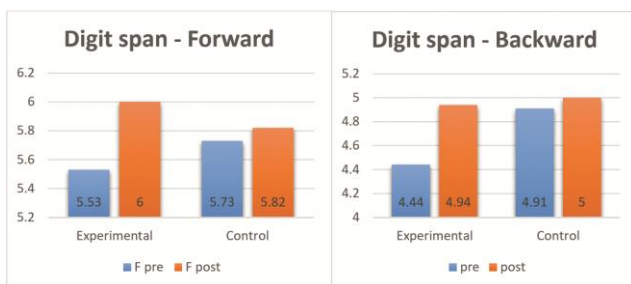


Fig. 3 — Comparison of means of pre and post scores in both the test for experimental and control group

calming effect on the brain, and more studies can be done on children with various behavioural and mental health conditions.

Conclusion

Our findings suggest that there is significant improvement in the working memory of school going children. So, it is advisable to incorporate OM chanting in school going children as an everyday practice since the benefits are appreciable and long-standing. Also, this practice is simple, inexpensive, and easy to do, when this becomes a habit of practice, children may see a remarkable change in their personality.

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Conflict of Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Author Contributions

First author, D.K. contributed to the conceptualization of the study, data collection, and preparation of the manuscript. Second author, D.K. contributed to the conceptualization, data interpretation, and critical review of the manuscript. Both authors have read and approved the final version of the manuscript.

Ethics Approval

Participants' safety was maintained during the intervention and ethical approval of was also taken from the Institutional Ethical Committee. With IEC number: RES/IEC-SVYASA/ERC-313/2023.

Informed Consent

All the participants parents were asked to fill the consent form that explains the detailed procedure

prior the data collection. The confidentiality of the details of participants was strictly maintained.

Data Availability

The data supporting the findings of this study are not publicly available in order to protect the privacy and confidentiality of the participants, in accordance with ethical guidelines and institutional policies. However, the data may be made available to editors or peer reviewers upon reasonable request and subject to approval by the corresponding author and the Institutional Ethics Committee.

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