

## Research article

# Enhancement of the Cognitive Abilities in Visually Impaired Children Following a Yoga Based Intervention

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## Introduction

Vision is the one of most vital components of human existence. According to World Health Organization (WHO), 1.4 million children with Visual Impairment (VI) are irreversibly blind [1]. Children who suffer loss of vision due to eye injury, disease or genetic disorder rely on other senses to experience the world. Blindness or visual impairment also impedes the quality of their education. Although facilities like Braille and other assistance is provided to them, often there are limitations both in their understanding of academic concepts and in their performance [2]. A number of studies have examined the connection between sensory function and cognition in different age groups, establishing a correlation between perception and cognition in an individual [3,4]. Research indicate connection between beliefs, emotions, linguistic representation, higher cognitive function and our perception of what we see [5].

Research findings indicate an improvement in primary cognitive processes such as attention, memory, perception and observation among students who practice yoga, and are especially are influenced by long term yoga practice [6]. A study by Naveen et al. affirmed an 84% increase in spatial memory and verbal cognitive skills among school children who practiced unilateral breathing [7]. Yoga and meditation increase neurogenesis and neuroplasticity, thus they can be used as an essential tool to increase cognition and improve behavior without causing any side effects, unlike medication [8].

Some studies in the past have correlated the loss of vision with

reduction in cognition [9]. Although yoga-based interventions have been shown to improve cognition in individuals, there is no study that interlinks the two, and the impact of yoga on the cognition and academic performance of children with visual impairment has not been explored. To fill this gap in the literature, the present pilot feasibility study explores the role of a novel yoga and pranayama-based workshop, the Art of Living Prajna Yoga, on improvement in recall memory and cognition among blind children. Kanchibhotla et al. have earlier studied the effect of this workshop on normal children, ascertaining that there was improvement in cognition as well as awakening of intuition through such a yoga and meditation practice, which could potentially lead to better decision-making ability among children [10].

## Methods

An open trial single arm, pre-post study design was adopted. The participants underwent a seven- hour yoga workshop spread over two days at their schools. Rey's Auditory Verbal Learning Test (RAVLT) was used to assess the recall memory of the participants. The sample was collected on Day 0 (pre) and Day 2 (post) to observe the difference in memory retention post intervention.

The study population consisted of 113 blind children in the age group 7-18 years studying at Andha Jana Sansthan, Surat, and Gujarat. Explaining the study to the head of the institution, informed consent was sought from them. The study was conducted from January, 2019 to April, 2019. Ethics approval was obtained from the Institutional

ethics committee bearing registration number SSIAR/IEC/06.

The children underwent the Art of Living Prajna Yoga, which is composed of three ancient techniques of pranayama (breathing techniques), super brain yoga and yoga nidra (supine relaxation). Pranayama is a technique that involves control of the breathing pattern, which is traditionally believed to extend the life force or 'prana'.

Super Brain Yoga is an ancient technique that combines acupressure (light tugging of the ear lobes with crossed arms) and squats to improve brainpower. Yoga Nidra or yogic sleep is an effortless meditation technique through which a deep state of relaxation can be achieved. It is done lying down supine, and uses systematic muscle relaxation targeting various parts of the body.

The sequence was taught to students and they were encouraged to practice it daily for 20 minutes. Teachers at school were requested to supervise the daily practice of the yogic module.

Assessment of recall memory was done by Rey auditory Verbal Learning Test (RAVLT). The test was performed according to standard instructions presenting five learning trials and recall for 15 noun word list (list A). The first five recalls trials were summed up and scored as trial A1-A5 and represented as immediate recall or short term memory. This was followed by presentation of distractor list (list B) recall after showing distractor list. Following this the subject was asked to repeat as many words from list A without hearing it again and was defined as delayed recall or long term memory. The sum of all trials was represented as recognition [11].

Analysis of the scores obtained before and after intervention was conducted using paired-sample *t* test to obtain *p* values. Difference between the scores was considered significant if the *p* value was less than 0.05. Apart from the descriptive statistical tools, a repeated measure ANOVA was used to determine the effect of gender and age on the pre-post scores.

## Results

Table 1 depicts the demographic details of the participants.

Table 2 depicts the overall RAVLT mean scores of the participants before and after the intervention. The mean recall scores for the first five trials, representing short term memory and recognition improved significantly after the two-day intervention (*p* value <0.001).

Table 3 depicts the RAVLT mean scores of the males and females separately. As observed in the table, all the recall trials show significant improvement post intervention except distractor recall. Both genders show significant improvement in performance post-intervention.

## Discussion

Very few studies have investigated the benefits of yoga practice for blind individuals. It is considered difficult for blind children to practice yoga. Ghosh (2017) made it evident that there was an enhancement in sensory perception and self-esteem among visually impaired students with the practice of yoga [12]. Mohanty et al. developed an inclusive yoga module for children with visual impairment, and indicated that 80% of the subjects who used the module reported satisfaction and practiced the sequence daily. Their performance in throwing tennis balls also improved significantly post their yoga intervention [13].

**Table 1:** Demographic details (n=113) n (%).

Characteristics	Type	All Participants
Gender n (%)	M	79 (69.9)
	F	34 (30.08)
Age (years)	Mean (SD)	15 (4.23)
	Min	7
	Max	18

**Table 2:** Overall RAVLT Scores – mean (SD) and *p* value.

	Day 0	Day 2	<i>p</i> value
Trial 1-5 Recall	8.33 (4.26)	11.75 (3.67)	<0.001**
Distractor list Recall	6.18 (3.54)	6.97 (3.51)	0.028'
Immediate Recall	9.78 (4.07)	12.52 (3.00)	<0.001**
Recognition	51.73 (18.51)	70.62 (18.61)	<0.001**

\**p* value <0.05 - significant

\*\**p* value <0.001 - significant

**Table 3:** RAVLT Scores - mean and *p* value of Males and Females.

Males			
	Day 0	Day 2	<i>P</i> value
Trial 1-5 Recall	8.22 (4.29)	11.84 (3.59)	<0.001**
Distractor list Recall	6.05 (3.39)	6.95 (3.59)	0.062
Immediate Recall	9.73 (4.03)	12.62 (2.65)	<0.001**
Recognition	51.27 (18.03)	70.91 (18.04)	<0.001**
Females			
	Day 0	Day 2	<i>P</i> value
Trial 1-5 Recall	8.59 (4.17)	11.53 (3.90)	<0.001**
Distractor list Recall	6.48 (3.93)	7.03 (3.34)	0.345
Immediate Recall	9.91 (4.23)	12.27 (3.74)	<0.001**
Recognition	52.85 (19.86)	69.91 (20.21)	<0.001**

This pilot study explored the role of a different yoga-based intervention in improving cognition for children with visual impairment. Our results show an overall improvement in recall memory of the subjects after the intervention. Kanchibhotla et al.'s research findings on the same yoga and pranayama based workshop had pointed that students' could perform computer based cognitive tests with their eyes closed with up to 80% accuracy [10]. This and several other research studies highlight the positive role of yoga and pranayama in developing the human mind and cognition [6,14]. Our senses and cognitive functioning help us to orient ourselves and navigate the world. However, loss of even one of the senses can impact one's balance, thus effecting perception [15]. The benefits of such holistic practices have been extensively studied and practiced. This study highlights the importance of the practice of yoga and pranayama by the visually impaired community.

The study assessed verbal memory and hence the cognition of children with visual impairment before and after the practice of yoga. Significant improvement in the performance was observed across the group post-intervention. This could indicate that the cognitive ability of the participants became stronger after the intervention, as shown by the high accuracy in the performance on memory tasks. Improved cognition could be inferred from the increased mental processes and

faster information processing in children post-intervention. A similar trend was observed when the data was analyzed by dividing the study population by gender. Both male and female children benefited equally from the intervention.

There were, however, some limitations to the study, such as the lack of control group, lack of randomization, bias due to self-selection and lack of a long-term follow up. The data from the pilot study only lays the foundation for larger, long-term studies that assess the role of yoga-based interventions on cognition in children with visual impairment.

Further studies with a larger sample and including a control group should be conducted in order to measure a wider range of cognitive abilities like attention, intelligence, and more.

## Conclusion

This pilot study assessed verbal memory enhancement among blind children through a yoga and pranayama based module. Verbal memory is an important aspect in improving cognitive qualities in children with visual impairment. Our study demonstrated a significant improvement in cognitive abilities of blind children after yoga practice. Yoga and pranayama can be utilized as safe and effective interventions to help develop cognitive ability in such children as well as improve their physical and mental health. This study can further be used to explore and develop a set of holistic practices in the curriculum for differently-abled children and help enhance their academic performances.

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## Author Contributions

All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

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