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RESEARCH ARTICLE

EVALUATION OF EFFECT OF YOGA TRAINING ON SHORT TERM MEMORY IN ADOLESCENT AGE GROUP

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ABSTRACT

Objectives: Memory is major tool for an individual to achieve successful career in this competitive world. The present era created lot of stress, anxiety and disturbance in sleep, which adversely affect individual performance. Hence, we evaluated the effect of six months yoga training on short term memory in school going boys.
Materials and Methods: This was a cross sectional study involving 40 yoga trained and 40 yoga untrained school going boys aged 11 - 15 yrs. Short term memory evaluation was done using various memory tests.
Results: We observed that there was a statistically significant increase in short term memory quotient in yoga trained when compared to yoga untrained group.
Conclusion: The present study showed that thesix months of yoga training showed significant improvement in short term memory

INTRODUCTION

Yoga is a mental, spiritual and physical discipline for achieving union and harmony between our mind and body (**Rocha *et al*., 2012**). Yoga is the oldest system of personal development. It consists of a series of postures called asana and various breathing exercises called pranayama which encourage balance between the physical, mental, emotional and spiritual aspects of the body (**Ross *et al*., 2010; Gaurav, 2011**). In this competitive era, Children's suffering from high level of stress, anxiety, depression and frustration affect their memory adversely. Memory is the process whereby newly acquired information is stored and preserved for later recall. Memory is necessary for learning. Knowledge about the world is acquired by the process of learning. The nature of learning associated with memory mainly in children has given much importance in the formal education. Yogic lifestyle, yogic diet, yogic attitudes and other yogic practices helps to strengthen one's body and mind and develop positive health. This enables one to withstand stress by normalizing the perception of stress and optimizing the reaction to it (**James *et al*., 2004**). Yoga has claimed to improve concentration, attention and memory (**Subramanya *et al*., 2009**).

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Despite a growing clinical studies and systematic reviews on the therapeutic effects of yoga (**Ross *et al*., 2010; Subramanya *et al*., 2009; Smith *et al*., 2007; Elsenbruch *et al*., 2005; grossman *et al*., 2007**) there is still a lack of solid evidence regarding its clinical relevance. Some studies reported positive effects of the yoga interventions, but other studies are less conclusive. Hence, present study was conducted to evaluate the effect of yoga training on short term memory in adolescent age group.

MATERIALS AND METHODS

Study Population

Eighty school going boys between the age group of 11 to 15 years were recruited for the study. 40 boys undergoing regular yoga training 5 days a week were randomly selected from Sri Amrutha Vidyalaya, Davangere. 40 boys of same age who have never undergone yoga training are selected from other schools of Davangere.

Inclusion criteria

- Children of age group 11-15 yrs.
- Children of above average IQ were selected for the study based on Raven`s standard progressive matrices and performance in school.

- Study group which consists of students who underwent yoga training regularly for a minimum period of 6 months were selected.
- Control group consists of student who never underwent yoga training.

Exclusion criteria

- History of extensive sports training.
- History of systemic diseases and conditions such as bronchial asthma, epilepsy and other neuropsychological disorders, visual and hearing impairment, neuromotor dysfunctions, cardiovascular ailments, tuberculosis, hypertension and diabetes mellitus.
- History of major surgery related to brain, cardiovascular and respiratory system in the recent past.
- Children with average or below average IQ

Study Design

This was a cross sectional study involving school going children. Based on yoga training, they were divided into two groups - Yoga trained and Yoga untrained. The study was conducted between period of Feb 2013 to May 2014. Prior to enrolment, an explanation of the protocol was given to the students and parents and a written consent was taken from the parents/Guardians, School Authority and from the students too. Study group consisting of 40 boys underwent yoga training under a qualified instructor for a period of more than 6 months from 8 am to 9am for 5 days a week.

The schedule consisted of:

1. Warm-up exercises,
2. Prayer
3. Asanas
4. Pranayama,
5. Meditation 6.Shavasana

The Asana practiced were

I. In standing posture;II. In sitting posture;

1. Vrikshasana 1. Padmasana
2. Trikonasana 2. Vajrasana
3. Hasthapadasana3. Shashankasana

III. In prone posture IV. In supine position

1. Dhanurasana 1. Halasana
2. Makarasana 2. Shavasana

The different type of Pranayama performed were;-

- Surya anulomaviloma Pranayama
- Chandra anulomaviloma Pranayama
- Nadisuddhi Pranayama

The session was concluded by meditation and finally shavasana.

Methods of collection of data

Every student was explained individually about the procedure before undergoing the test. Instruction to the student was given in their local languages and consent was taken before doing the test. Following parameters were recorded in each subject. All the data of individual subject were entered in proforma for each subject.

Recording of Anthropometrical Parameters

- Height (Ht in cms) measured with subject, standing without shoes, nearest to 0.1 cm error by using a Standard Height measuring Scale.
- Weight (Wt in kg) measured with subject, wearing minimum clothing, nearest to 0.1 kg error by using a standard weighing machine.
- Body Mass Index (BMI) in kg/m2: It is calculated using a Quetelet's index.

Body mass index = Weight in kilograms / Height in meters square

Short term memory evaluation

Various memory tests were used to assess short term memory in both study group and controlled group. The study involved non-invasive procedure with no financial burden on subjects parents. The following battery of memory tests were administered to the subjects (**Hirisaye *et al*., 2006**)

1. Personal Information

Table 1. Personal Information

Sl.No	Items	Response	Score
1	How many people are there in your family		1
2	What day is it today		1
3	When did you first join school		1
4	What is the name of this month		1
5	In which state are you living		1
Total Score			

2. Mental control- Table 2

3. Sentence repetition

Each of the sentences was presented one by one to the subjects for immediate reproduction. Each sentence was read slowly, distinctly and at a uniform rate during presentation. The subjects recall was either noted verbatim or each of the correctly recalled clauses was ticked. One mark for each clause correctly reproduced

4. Logical memory

Immediate - number of ideas recalled immediately after the first trial. Rani was a little girl / who lived in a village / one day / she took / her dog / with her / to a forest / there they played / and enjoyed nature / very much / there suddenly / a strong windstorm arouse / and carried them away / to an unknown land /both Rani and her dog were happy / and thrilled / to see the wonders / of the new land.

Table 2. Mental control

Sl. No	Items	Time	Error	Score			
				3	2	1	0
1	Repeating days of the week forward			All Correct within 15 sec	All Correct beyond 15 sec	With 1 mistake	>than one mistake
2	Repeating days of the week backward			All Correct within 20 sec	All Correct beyond 20 sec	With 1 mistake	>than one mistake
3	Repeating months of the year forward			All Correct within 25 sec	All Correct beyond 25 sec	With 1 mistake	>than one mistake
4	Repeating months of the year backward			All Correct within 45 sec	All Correct beyond 45 sec	With 1 mistake	>than one mistake
5	Deduct 5's from 60			All Correct within 60 sec	All Correct beyond 60 sec	With 1 mistake	> than one mistake
Total Score							

Table 3. Sentence repetition

Sl. No	Sentence	Score
1	He hoped to win the prize	0
2	The ink had dried up and I could not write	0
3	Be good and you will be happy	0
4	He has gone down to the river to bathe	0
5	The city that is set on a hill cannot be hid	0
Total score		

5. Word recall meaningful

A card was shown on which some meaningful words were written. After seeing them carefully (for 30 seconds) after sometime (2 min), second card shown. In this you have to identify the meaningful words already seen.

Score: Each meaningful word correctly identified and named was given a score of one.

MEANINGFUL WORDS
CARD – I

Money Shoe Bird Book Gun
Hat Nail Moon Fish Key
Hook Nail Money Key
Honey Book JamCurd.

CARD – II

Dish Fish Sail Spoon
Mat Moon Hat Shoe
Bird Pail GunSun

Score: Each nonmeaningful word correctly identified and named was given a score of one.

NON MEANINGFUL WORDS
CARD - I

Dag RofMunCvcPel
Lon MezPaeLifSeg

CARD - II

Dag NidRofTib
MunWulCvcXum
PelKas Lon Fol
MezVeePaeTul
LifRet SegHar

8. Delayed response learning

A small arithmetic problem was given and the subject was asked to keep the result of it in his mind and use it to solve another problem 10 seconds later.

Table 4. Digit span

Digit forward (4a)		Digit backward (4b)	
4 – 2	6 – 4	5 – 8	8 – 2
5 – 7 – 3	4 – 1 – 7	7 – 5 – 4	1 – 5 – 8
5 – 3 – 8 – 7	6 – 1 – 5 – 8	3 – 6 – 5 – 8	9 – 5 – 7 – 3
1 – 6 – 4 – 9 – 5	2 – 9 – 7 – 3 – 4	1 – 9 – 2 – 7 – 4	4 – 8 – 5 – 2 – 9
3 – 4 – 1 – 7 – 9 – 6	6 – 1 – 5 – 8 – 3 – 9	3 – 8 – 4 – 9 – 5 – 2	6 – 9 – 3 – 5 – 1 – 7
7 – 2 – 5 – 9 – 6 – 8 – 5	4 – 7 – 1 – 5 – 3 – 8 – 6	2 – 9 – 1 – 6 – 8 – 5 – 3	5 – 8 – 4 – 1 – 7 – 3 – 6
4 – 7 – 2 – 9 – 1 – 6 – 8 – 5	9 – 2 – 5 – 8 – 3 – 1 – 7 – 4		
Number of digits correctly reproduced =		Number of digits correctly reproduced =	

6. Digit span- Table 4

7. Word recall non meaningful

A card was shown on which some nonsense syllables were written. After seeing them carefully (for 30 seconds) after

- 6+4= …….. interval add x to 5+2=
- 3+9 =…….. look at the picture add x to 5+5 =
- 7 – 3 = …….. interval add x to 11 - 4 =
- 4 – 4 =…….. look at the picture add x to 12 – 7 =

Score: Correct answer for each problem score one.

9. Picture recall

The exposure time for each row is as follows;

1.Row 1 : 2 seconds 1. 2 seconds 1) 2)
2.Row 2 : 3 seconds 2. 3 seconds 1) 2) 3)
3.Row 3 : 4 seconds 3. 4 seconds 1) 2) 3) 4)
4.Row 4 : 5 seconds4. 5 seconds 1) 2) 3) 4) 5)

Score: Recalling the picture in the same order within a row Figure 1a, 1b, 1c and 1d.

10. BVRT

One by one some cards were shown and the subject was asked to look at them carefully. After some time (10 seconds) cards are taken back and subject is asked to draw the same figures which he has seen before (provide the subject with paper and pencil with an eraser).
Score: No of correct reproductions
Figure1e.

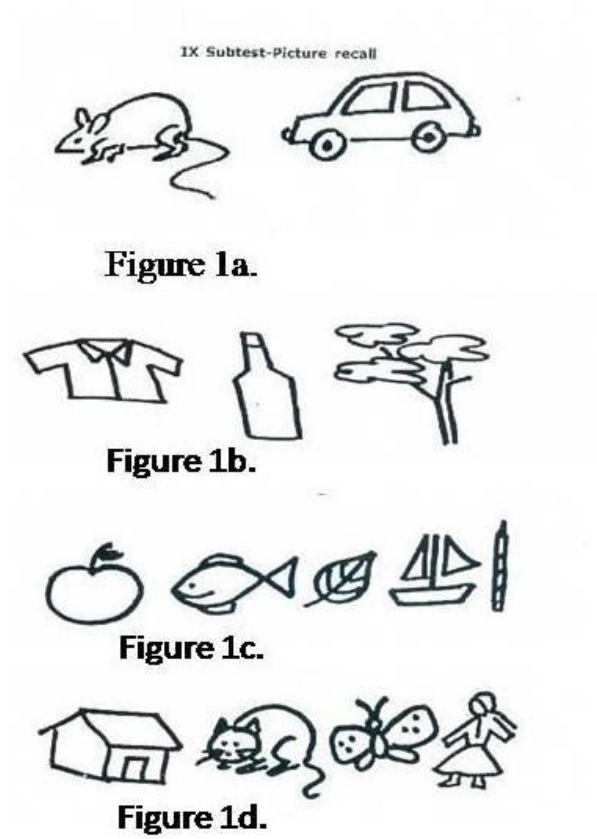
After the subjects understand the intention, the administrator read the first presentation at the rate of one pair every two seconds. After reading the first presentation, test for recall is done by presenting the first recall test. After telling first word of a pair and allow five seconds for a response.

If the subject gives a correct response, it is said it is right and proceeded to the next pair. If the subject gives an incorrect response say 'No' association is corrected and proceeded to the next pair; after the first recall is completed, a 10 second interval is allowed and second pair is presented, proceeding as before.

Score: One credit for each correct response, if given within 5 seconds.

Table 5.

First recall		Second recall		Third recall	
Needle	Thread	Diary	Pen	Matchbox	Fire
Matchbox	Fire	Coin	Purse	Needle	Thread
Pen-knife	Eraser	Pen knife	Eraser	Diary	Pen
Cloth	Flower	Needle	Thread	Pen-knife	Eraser
Diary	Pen	Postcard	Stamp	Ribbon	Comb
Pencil	Spoon	Pencil	Spoon	Coin	Purse
Post card	Stamp	Ribbon	Comb	Blade	Scissors
Ribbon	Comb	Cloth	Flower	Pencil	Spoon
Blade	Scissors	Matchbox	Fire	Cloth	Flower
Coin	Purse	Blade	Scissors	Postcard	Stamp



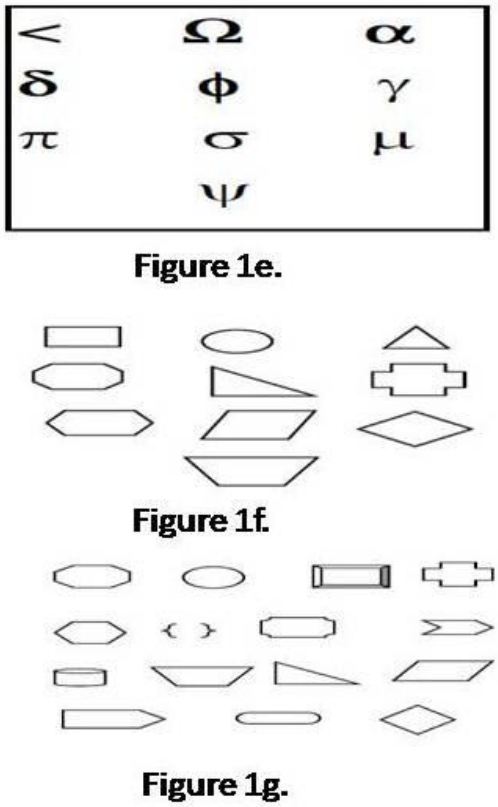


Figure 1.

11. Paired Associate learning

Administrator tells the subject, that he is going to read a list of words two at a time and to listen carefully, because he would expect subjects to remember the words that go together.

Final score: Add all credits on easy items and divide the score by 2=A.
Add all credits on hard items = B

Score on entire tests = A+B =

12. Cattell's Retentivity Test

A card on which some geometrical figures have been drawn was shown to the subject was asked to look at them carefully (for 30 seconds) after some time (2 min) a second card is shown from which they have to show the geometrical figures they have already seen in the first card.

Score: Each geometrical figure correctly identified given as score of **ONE**.
Total score=
Figure 1f and 1g.

Final Scoring inmemory tests for children

Table 6.

Sl. No	Sub Tests	Max score	Score
1	Personal Information	5	
2	Mental Control	15	
3	Sentence Repetition	9	
4	Logical memory	18	
5	Word recall meaningful	10	
6	Digit span	15	
7	Word recall non-meaningful	10	
8	Picture recall	4	
9	Delayed response learning	4	
10	BVRT	10	
11	Paired associate Learning	21	
12	Cattle's retentivity test	10	
Total Score		131	

Reliability of the test: Depends upon how strictly the test conducted and subject's level of motivation to perform the test.

STATISTICAL ANALYSIS

All Statistical analysis was done by using the SPSS package 16th version. The unpaired' test was used to compare differences between the Means of the yoga trained and yoga untrained school children. The results are expressed as Mean and Standard Deviation (SD) for all the quantitative data.

- p Value > 0.05 is taken as ' not Significant' .
- p Value < 0.05 is taken as 'Significant
- p Value < 0.001 is taken as 'Highly Significant'

RESULTS

In the present study 40 yoga trained boys from Sri Amrutha Vidyala and 40yoga untrained boys from other schools of davangere were studied and compared. The data was collected and statistically analysed and studied. The age, height, weight, IQ of all the boys of both the group were well matched. The present study observed that memory quotient was significantly higher in yoga trained group compared to yoga untrained group. Group (104.95 ± 6.7 vs. 81.93± 6.95,p=0.000).
Table 7. Figure 2

DISCUSSION

The present study showed that yoga practice improves short term memory in school going children. Results of this study corroborate well with previous investigations that showed yoga improves short term memory.

Table 7.

Variable	Yoga trained N=40		Yoga untrained N=40		Statistical Analysis unpaired t test df=78
	Mean	Std Deviation	Mean	Std Deviation	
Memory Quotient	104.95	6.7	81.93	6.95	15.08, P<0.000

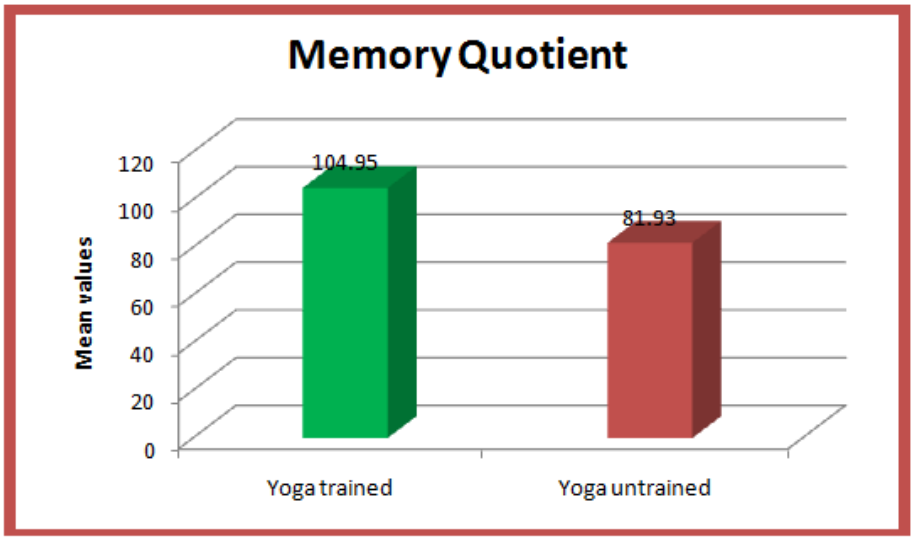


Figure 2.

(**Kauts *et al*., 2012; Rangan *et al*., 2009; Manjunath *et al*., 2004; Kochar, 1974**). Memory mainly in school going children has given much importance in the education system. Growing competitions and expectations created lot of depression, stress and anxiety, which adversely affect memory in turn, increases stress and anxiety. It has become vicious cycle. Yoga practice breaks this cycle by improving memory. Some of the studies revealed that yoga is an effective tool in improving quality of life by reducing depression, stress and anxiety (**Smith *et al*., 2007**). Yoga helps in gaining control over the mind andthus improves concentration and attention-span and hence both IQ and memory power can be enhanced (**Uma *et al*., 1989**).The strength of present study is that, it depends on robust study design with the capability to evaluate variation in memory scores.

Future Directions

From the finding of the present study, we can conclude that yoga training improved short term memory in school going children. Therefore, it is recommended that yoga training should be included in the school curriculum.

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