

# Effect of Left, Right and Alternate Nostril Breathing on Verbal and Spatial Memory

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## ABSTRACT

**Introduction:** Yoga has beneficial effects on memory. In females, left hemisphere of the brain is responsible for verbal memory and right hemisphere is responsible for the spatial memory, while the opposite is true for males.

**Aim:** Aim of the present was to study the effect of unilateral right nostril breathing, left nostril breathing and alternate nostril breathing on verbal and spatial memory scores.

**Materials and Methods:** A total of 51 female subjects (age 18-25 years, mean±SD =21.71±3.11) were taken and divided into three groups (n=17). Each group was imparted one of the three different types of nostril breathing practices such as Right Nostril Breathing (RNB), Left Nostril Breathing (LNB) and

Alternate Nostril Breathing (ANB) for 1 week for 45 minutes daily. Subjects were given the memory test, before and after 45 minutes of intervention for three consecutive days. Memory tests were performed by using Wechsler Adult Intelligent Scale.

**Statistical Analysis:** Results were analysed by ANOVA with SPSS version 17.0.

**Results:** Results showed that there was increase in recall of digit span-forward, digit-span backward, associate learning and spatial memory scores with RNB, LNB and ANB, which were statistically highly significant ( $p < 0.005$ ).

**Conclusion:** Inclusion of nostril breathing in exercise regimen may be helpful in improving recall of memory.

**Keywords:** Nostril breathing exercise, Spatial memory scores, Verbal memory scores, Wechsler memory scale

## INTRODUCTION

Yoga includes practices such as physical postures (asanas), voluntary regulation of breathing (pranayama) and meditation, among other techniques [1]. The nasal cycle is phenomenon of alternate periodic breath functions and its variations are characterized by the alternating patency of the nostrils for every two to eight hours [2], with a rhythmic and alternating shift of activity in the autonomic nervous system and cerebral activity [3]. Practice of asanas, pranayama and meditation improves autonomic cardio respiratory variables [4]. Joshi M has shown that immediate effect of right and left nostril breathing increases verbal and spatial scores corresponding to the cerebral hemispheres contra lateral to the patent nostril [5].

The memory is one of the ability of the brain to store and retrieve information of both verbal and non verbal nature. The Patanjali yoga sutras describe memory as 'an experienced object not being lost from the mind'. Explicit or declarative memory is that memory that can be brought to conscious awareness. Visual and spatial memory is an important part of explicit memory [6]. Anterior areas of the temporal cortex are involved in representation of verbal conceptual knowledge organized categorically [7]. Various studies have shown that lesions in the left temporal lobe disrupt verbal memory to a greater extent and the lesions in the right temporal lobe disrupt visual-spatial memory [8]. Many studies have shown that there is improvement in academic performance in subjects performing transcendental meditation [9-16].

## AIM

The present study was designed to study the effect of unilateral right nostril breathing, left nostril breathing and alternate nostril breathing on verbal and spatial memory scores in female subjects because at present there are no such studies in the female subjects alone.

## MATERIALS AND METHODS

This study was conducted by the Physiology department of Santosh Medical College Ghaziabad after taking the proper ethical

clearance. For the study 51 healthy female students of Santosh medical college Ghaziabad with age group ranging from 18-25 years, were chosen in the post menstrual phase. Sample size was calculated on the basis of an effect size of (0.69) which was obtained from the previous study on verbal and spatial memory on yoga breathing of Naveen, Nagarathana, Nagendra & Telles, 1997 [17]. It was calculated using G-power software, where the level was 0.05 and power was 0.95. Health status of the subjects was ensured on the basis of general physical examination and personal history. Those with any medical complications were excluded from the study. Informed consent was taken from them. Subjects were randomly divided into three groups of 17 subjects each. (n=17) Each group was imparted one of the three different types of nostril breathing practices such as right Nostril Breathing (RNB), Left Nostril Breathing (LNB) and Alternate Nostril Breathing (ANB) for 1 week for 45 minutes daily. Subjects were given the memory test before and after 45 minutes of intervention for three consecutive days [18].

The right nostril breathing (RNB) involves alternate cycle of inhalation and exhalation through the right nostril while the left nostril is occluded and left nostril breathing (LNB) involves alternate cycle of inhalation and exhalation through the left nostril while the right nostril is occluded. Alternate nostril breathing (ANB) involves inhalation through one nostril while the other nostril is occluded and vice versa.

Memory tests that were performed by using Wechsler Adult Intelligent Scale (WAIS) [19] scale included: a) Digit span forward; b) digit span backward; c) paired associative learning (easy and hard) with 10 items each.

Digit span forward includes six pairs for the numerical items of easy task and four pairs for the numerical items of hard task. The test material was projected on a screen, allowing 10 sec for each slide. After the 10 slides were shown, an arithmetic problem (e.g. + 5-4+9-6-8-3) was projected on the screen. Immediately after this, subjects were asked to recall and write down (or in case of spatial memory, to draw) within 60 sec the 10 test items which were shown to them.

Digit span backward is a test in which the subject recalls digits sequence in a reverse order. This is opposite to digit span forward, in which the numbers have to be recalled in the same sequence order as they have been given.

Paired associate learning is a text in which the subject is presented with ten pairs of unrelated words. The first word provided by the investigator has to be associated appropriately by the subjects for example paper-pen. Spatial memory test consist of simple line diagrams. The drawing was easier to produce. Drawings that could be reproduced verbally example square and circle were not used. For both the verbal and for the spatial memory test a correct response was scored as 1 and incorrect as '0'. This was based on the conventional scoring for Wechsler memory scale [20,21].

## STATISTICAL ANALYSIS

Paired t-test was used for intra group comparison (i.e. before and after the yoga training). Inter group comparison between all the three groups LNB, RNB and ANB was done with ANOVA. Results were analysed by using SPSS version 17.0.

## RESULTS

[Table/Fig-1] shows that the mean age of the subjects was 21.71±3.11 years, mean height was 155.4±4.13 cm and mean weight was 47.3±4.17 kg.

As shown in the [Table/Fig-2] with (LNB) there is increase of digit span forward, digit span backward and associate learning scores. Spatial memory scores are also increased. With (RNB) there is an increase of digit span forward, digit span backward, associate learning and spatial memory scores. With (ANB) also there is increase of digit span forward, digit span backward, associate learning scores and spatial memory scores.

	Mean ± SD
Age (y)	21.71± 3.11
Height (cm)	155.4± 4.13
Weight (kg)	47.3±4.17

[Table/Fig-1]: Demographic data of the subjects (51 females).

Parameters	Verbal Memory Test						Spatial Memory Test (SMT)	
	Digit Span Forward(DSF)		Digit Span Backward(DSB)		Associate Learning(AL)		Before	After
	Before	After	Before	After	Before	After		
Left nostril Breathing(LNB)	6.11±0.6	8.06±1.0*	5.18±1.1	7.12±0.4*	11.68±0.9	13.53±1.9*	5.43±0.8	7.33±0.7*
Right nostril Breathing(RNB)	5.68±0.9	6.70±0.6*	5.04±0.8	6.05±0.7*	11.43±0.7	12.40±1.0*	5.38±1.0	6.39±0.7*
Alternate nostril breathing (ANB)	6.13±1.0	7.16±1.0*	5.11±0.8	6.15±0.74*	11.68±1.0	12.71±0.7*	5.53±0.7	6.60±0.6*

[Table/Fig-2]: Effect of three yogic breathing practices on immediate verbal and spatial memory scores (Mean ± SD).

\*p<0.005

Group	Comparisons	Difference	p-value
LNB	DSF after Vs before	1.93	<0.005
	DSB after Vs before	1.92	<0.005
	AL after Vs before	1.83	<0.005
	SMT after Vs before	1.87	<0.005
RNB	DSF after Vs before	1.01	<0.005
	DSB after Vs before	1.00	<0.005
	AL after Vs before	0.98	<0.005
	SMT after Vs before	0.99	<0.005
ANB	DSF after Vs before	1.01	<0.005
	DSB after Vs before	1.03	<0.005
	AL after Vs before	1.02	<0.005
	SMT after Vs before	1.04	<0.005

[Table/Fig-3]: Intra group comparison of all the three groups LNB,RNB and ANB, for before and after DSF, before and after DSB, before and after AL and before and after SMT using paired t-test.

As shown in the [Table/Fig-3], for LNB, results are significant for DSF, DSB, AL and SMT (p<0.005). For RNB results are significant for DSF, DSB, AL and SMT (p<0.005). For ANB also results are significant for DSF, DSB, AL and SMT (p<0.005).

As shown in the [Table/Fig-4] when all the three groups LNB, RNB and ANB were compared for After DSF, After DSB, After AL and After SMT. It was found that the left nostril breathing(LNB) has better memory scores as compared to right nostril breathing(RNB) and alternate nostril breathing (ANB), for all after DSF, after DSB, after AL and after SMT (p<0.005).

## DISCUSSION

Memory is the latent capacity to retain and recall information about past and present incidents. This recall process involves generation of a sequence of entities in the response set which corresponds to the entities of stimulus set that decides the nature of recall function [18]. In order to perform important duties, recall valuable experiences for guidance in daily living, or to write, think and feel, one must utilize the material recalled to conscious mind by the power of memory.

Our study assessed the effect of three different types of yogic breathing practices, right nostril breathing (RNB), left nostril breathing(LNB) and alternate nostril breathing (ANB) on verbal (digit span forward DSF, digit span backward DSB, associate learning AL) and spatial memory scores SMT. Results had shown that there was increase in recall of all digit span-forward, digit-span backward, associate learning and spatial memory scores, with all the three types of yoga breathing practices (p<0.005). Further it was found that LNB has better memory scores as compared to RNB and ANB (p < 0.005). Our study results are comparable to Meesha et al., [5]. They showed that LNB causes increase in memory scores, while in our study not only LNB but RNB and ANB also increased the verbal and spatial scores. Our study results are also comparable to Naveen et al., [17]. They showed that with nostril breathing there is increase in only spatial scores, while in our study there is increase of both verbal and spatial scores.

The possible mechanism of how unilateral nostril breathing affects central nervous system is not clearly understood. Keuning and

Tests	Parameters	Mean ± S.D	p value
After DSF	LNB	8.06±1.0	p<0.005
	RNB	6.70±0.6	
	ANB	7.16±1.0	
After DSB	LNB	7.12±0.4	p<0.005
	RNB	6.05±0.7	
	ANB	6.15±.74	
After AL	LNB	13.53±1.9	p<0.005
	RNB	12.40±1.0	
	ANB	12.71±0.7	
After SMT	LNB	7.33±0.7	p<0.005
	RNB	6.39±0.7	
	ANB	6.60±0.6	

[Table/Fig-4]: Inter group comparison between all the three groups LNB, RNB and ANB, for After DSF, After DSB, After AL and After SMT by using ANOVA.

Eccles and Lee showed that with the airflow into the nostril, mechanical receptors in the nasal mucosa are activated and this signal is unilaterally transmitted to the hypothalamus, which is considered the highest centre for autonomic regulation [2,22]. Stimulating the hypothalamus or mesencephalon causes nasal vasoconstriction, hence more free airflow, which is greater on the ipsilateral side than on the contra lateral side, which differentially affect the ipsilateral and contralateral cerebral hemispheres, thereby changing the relative EEG activity and hence influencing relative spatial and verbal performance.

Our results are contradictory to the results of Thakur et al., [18]. They showed that RNB and ANB causes more increase in memory scores as compared to LNB. While in our study LNB causes more increase of memory scores as compared to RNB and ANB. Our study results are also similar to Manjunath et al., [23]. They showed that that yoga practices including physical postures, pranayamas and meditation improves delayed recall of spatial information.

Some of the studies gave explanation that nostril breathing reduces the anxiety which thereby improves the performance for tasks requiring memory. Attention is the needle that cuts the grooves in record of memory cells thereby improving the attention span and memory as assessed in a study by decrease in reaction times [24]. Further studies are warranted to know the exact mechanism.

## CONCLUSION

Memory is required for performing day to day activities and recall of happy events. Inclusion of right, left and alternate nostril breathing in daily exercise regimen will be helpful in improving recall of memory.

**Lacunae and further study:** Further studies are needed on amnesic patients to extend the application of the pranayamas for their help.

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