Original Research Article

Immediate effect of nostril breathing on memory performance in adolescent population by using visual digit span test

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Abstract

Background: The nasal cycle is a physiological phenomenon, in which alternating congestion and decongestion of nasal pathway which affects the central nervous system. This alternate cycle lead to several physiological and cognitive changes such as lateralization of cerebral hemispheres. Practicing yogic breathing exercises such as right nostril breathing (RNB), left nostril breathing (LNB) and alternate nostril breathing (ANB) increases the memory performance. **Aim:** To study the immediate effect of right nostril breathing (RNB), alternate nostril breathing (ANB) and left nostril breathing (LNB) on the memory performance by using digit span test. **Materials and Methods:** Study Group: 30 clinically healthy individuals of age 18 to 25 years of both the sexes. Initially the memory performance was assessed by using digit span test. Different types of nostril breathing techniques were demonstrated to the participants, it was then practiced for 2 week. Then the tests were repeated to check for the improvement in memory performance. The scores of digit span test for each nostril breathing were tabulated and they are statistically analyzed by repeated measure ANOVA. **Results:** In the present study, the analysis of data shows that the memory performance was increased after right nostril breathing, with the mean and standard for easy task, difficult task and total score was 6.00±0.00, 3.63±0.49 and 9.63±0.49 with the statistically significant t value of 0.000. **Conclusion:** The present study shows that among the three different types of nostril breathing, right nostril breathing increases the activation of left cerebral hemisphere and thereby increases the spatial memory performance.

Keywords: alternate nostril breathing, left nostril breathing, memory performance, right nostril breathing

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Introduction

The nasal cycle is a physiological phenomenon, in which alternating congestion and decongestion of nasal pathway which affects the central nervous system. It is an ultradian rhythm regulated by hypothalamus that alters the patency of nostril for 2 – 8 hours.[1] These alternate cycles lead to several physiological and cognitive changes such as lateralization of cerebral hemispheres.[1] During spontaneous left nostril breathing spatial tasks (right hemispheric) are better performed and during right nostril breathing verbal tasks(left hemispheric) are

better performed.[2] In yoga there are several breathing exercises which regulates the rate and depth of breathing, including nostril manipulation.[3] Practicing yogic breathing exercises such as right nostril breathing(RNB), left nostril breathing(LNB) and alternate nostril breathing(ANB) increases the memory performance was reported in various studies done by Thakur *et al.*[4] Similarly another study done by Garg *et al.* indicates that the RNB, LNB and ANB influences the verbal and spatial memory.[5] Hence we were interested in studying its effect on memory. The aim of this study was to assess the effect of uni-nostril (RNB and LNB) and alternate nostril breathing on memory performance by using digit span test.

Materials and Methods

After obtaining institutional ethics clearance and written informed consent, this study was a conducted at the Department of Physiology, Coimbatore medical college and hospital. By random sampling, thirty clinically healthy individuals of age 18 to 25 years, both males and females were recruited for this study.

Exclusion Criteria: The individuals who were diagnosed of having learning problems, any metabolic and neurological disorders were excluded from the study.

Procedure: Clear instructions were given to all subjects and adequate time was ensured. After demonstration, the subjects were asked to practice it for 2 weeks. All subjects were assessed for working memory by using digit span test, where a series of easy tasks and difficult tasks were given repeatedly. The influence of nostril breathing was checked with yogic breathing exercises like (1) Right nostril breathing (RNB) , that involves cycle of inhalation and exhalation through right nostril in which the left nostril is closed, (2) left nostril breathing (LNB), that involves cycle of inhalation and exhalation through left nostril in which the right nostril is closed,(3)alternate nostril breathing (ANB)involves inhalation through one nostril while other nostril is occluded and vice versa for the next breathing cycle.

Assessment of spatial memory: The memory performance was assessed by using digit span test using digit span tester software. In this software, a sequence of numerical in 10 sets (6 items for easy task and 4 items for difficult task) from 2 digit number to 9 digit number was visualised in computer screen. The subject was asked to recollect the number and enter the number in the computer before and after 30 minutes of each type of nostril breathing. The scores of the digit span test of each type of nostril breathing were recorded . The data were evaluated and analysed using SPSS .

Statistical analysis: The data was tabulated in Microsoft excel sheet and it was analysed by repeated measure ANOVA since the memory performance was test in the same subject repeatedly after doing RNB, LNB and ANB. Within subject factors and between subject factors which influences the sphericity of the study was evaluated by Mauchly's test of sphericity which shows that p value is less than the α value, hence the null hypothesis is rejected.

Results

This study was conducted to study the immediate effect of right nostril breathing (RNB), alternate nostril breathing (ANB) and left nostril breathing (LNB) on the memory performance of thirty clinically healthy individuals of age 18 to 25 years by using the digit span test. The mean age of the study group of thirty clinically healthy volunteers was 22.5 ± 2.8 years.

Digit span forward test: The data of digit span forward test before and after doing RNB, LNB and ANB was tabulated (Table 1) It was found that mean and standard deviation of easy task, difficult task and total score of memory performance assessed by digit span forward test is 4.30±0.83, 1.40±0.62 and 5.76±0.86. The mean and standard deviation of easy task, difficult task and total score of memory performance assessed by digit span forward test after doing RNB is 6.00±0.00, 3.63±0.49 and 9.63±0.49 respectively. When they were analysed by Repeated measure ANOVA the F value was 0.000 (statistically significant).

The mean and standard deviation of easy task, difficult task and total score of memory performance assessed by digit span forward test after doing ANB is 4.67±0.92, 1.30±0.59 and 6.03±0.89 respectively. When they were analysed with DSF measure while normal breathing by Repeated measure ANOVA, the F value was 0.000 (statistically significant). The mean and standard deviation of easy task, difficult task and total score of memory performance assessed by digit span forward test after doing LNB is 4.43±0.93, 1.37±0.71 and 5.80±0.84 respectively. When they were analysed with DSF measure while normal

breathing by Repeated measure ANOVA, the F value was 0.000 (statistically significant).
From the above mean and standard deviation data of RNB, ANB and LNB, it was found that right nostril breathing has more significant effect on the digit span forward test than that of left nostril breathing and alternate nostril breathing.

Digit span backward test: The data of digit span backward test results before and after doing RNB, LNB and ANB was tabulated (Table 2). It was found that mean and standard deviation of easy task, difficult task and total score of memory performance assessed by digit span backward test is 4.10±0.66, 1.70±0.87 and 5.80±0.66. The mean and standard deviation of easy task, difficult task and total score of memory performance assessed by digit span backward test after doing RNB is 6.00±0.00, 3.63±0.49 and 9.63±0.49 respectively. When they were analysed by Repeated measure ANOVA the F value was 0.000 (statistically significant).

The mean and standard deviation of easy task, difficult task and total score of memory performance assessed by digit span forward test after doing ANB is 4.77±0.97, 1.47±0.68 and 6.20±1.03 respectively. When they were analysed with DSF measure while normal breathing by Repeated measure ANOVA, the F value was 0.000 (statistically significant). The mean and standard deviation of easy task, difficult task and total score of memory performance assessed by digit span forward test after doing LNB is 4.23±0.8, 1.57±0.97 and 5.80±0.66 respectively. When they were analysed with DSF measure while normal breathing by Repeated measure ANOVA, the F value was 0.000 (statistically significant).
From the above mean and standard deviation data of RNB, ANB and LNB, it was found that right nostril breathing has more significant effect on the digit span backward test.

Discussion

In this study, thirty clinically healthy volunteers were tested for digit span test after doing three different yogic breathing exercises such as right nostril breathing (RNB), left nostril breathing (LNB) and alternate nostril breathing (ANB). Memory is one of the ability of brain to store and retrieve information in the form of both verbal and spatial aspects. The retrieval of information process involves generation of sequence of entities in response set which are related to stimulus given, that decides the nature of recall. In order to perform day to day activities in life, working memory plays an important role. A common example of working memory is keeping in mind a newly read phone number until it is dialed and then immediately forgotten. The prime functional response for working memory is localized mainly in the temporal lobe and parietal lobe. This also depends on the regional cerebral blood flow.[6]

The digit span test is the most common used test in clinical neurophysiology to assess the working memory capacity.[7] However, the neuropsychological processes involved in DF and DB are different and they have also been found to be predictors of attention problems and executive functioning in children too.[8] The effect of unilateral forced nostril breathing on the cognitive function was proved by Shannahoff-Khalsa *et al.* who states that unilateral forced nostril breathing selectively stimulates the contralateral hemisphere produced an increase in EEG power.[8] In 1986, a study by Klein *et al.* showed that under resting conditions, right nasal dominance was coupled to relatively greater verbal performance, or left brain activity, and left nasal dominance was related to spatial or right hemispheric skills. It appears that nasal airflow may stimulate sympathetic dominance on the ipsilateral cerebral hemisphere. Therefore, it is possible that direct stimulation of one half of the cortex may occur by sympathetic stimulation and thus result in vasoconstriction. It is also likely that increased parasympathetic activation may occur simultaneously in the contralateral hemisphere to compensate for the contralateral sympathetic activation, thus helping to maintain adequate but altered cerebral perfusion.[9] But on contrary to this study, the present study showed that, the right nostril breathing increases the spatial working memory more effectively than the left nostril breathing. In a 1997 cognitive study by Naveen *et al.,* an attempt was made to detect the hemisphere specific effects of unilateral forced nostril breathing (UFNB) on memory skills.[10] They compared right UFNB, left UFNB, alternate nostril breathing, breath awareness after 10 days of practice. [10] Also it was proved in that study that all four breathing groups showed an increased response for spatial skills compared to that of verbal skills.[10] Yogic breathing exercises such as RNB, LNB and ANB has effect on the memory performance was studied by Thakur *et al*. and they state that right nostril breathing facilitates better inherent digit backward and digit forward span memory performance of left hemisphere.[4]

However, alternate nostril breathing may have an impact on the left hemispheric activity during recall function. [4]

Researchers have concluded that breathing through the left nostril increased performance in a spatial cognitive task, and was corresponding to the cerebral hemisphere contralateral to the patent nostril.[11] Another study proved that yoga improves performance on task requiring attention and reduces distraction under academic exam stress by using letter-cancellation task.[12] The effect of Yoga breathing through a particular nostril on contralateral event-related potential changes was assessed by Telles *et al.* states that right nostril yoga breathing facilitates the activity of contralateral (left) hemisphere, in the performance of the P300 task.[13] Yoga breathing through a particular nostril increases spatial memory scores without lateralized effects. [10] Average increase in spatial memory scores for the trained groups was 84%. It appears yoga breathing increases spatial rather than verbal scores, without a lateralized effect.[10] In comparison to all these studies, the results of our study revealed that the right nostril breathing increases the digit span forward and digit span backward test more effectively.

Conclusion

This study concluded that right nostril breathing facilitates better performance in spatial working memory task through digit span forward and digit span backward test by facilitating the cerebral blood flow to the left hemisphere by increasing the parasympathetic activity causing cerebral vasodilation. However, alternate nostril breathing and left nostril breathing only refresh the cerebral hemispheres helps in recalling process.

Acknowledgment: Nil

Conflicts of interests: Nil

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Table 1: Digit Span Forward Test Results of the participants

				Std. Error	t	Sig.	95% Confidence Interval	
	Variables	Mean	SD				Lower Bound	Upper Bound
DSF Normal	easy task	4.30	0.837	0.153	28.150	0.000	3.988	4.612
	difficult task	1.40	0.621	0.113	12.339	0.000	1.168	1.632
	total score	5.73	0.868	0.159	36.164	0.000	5.409	6.058
DSF RNB	easy task	6.00	0.000	0.000			6.000	6.000
	difficult task	3.63	0.490	0.089	40.602	0.000	3.450	3.816
	total score	9.63	0.490	0.089	107.652	0.000	9.450	9.816
DSF ANB	easy task	4.67	0.922	0.168	27.715	0.000	4.322	5.011
	difficult task	1.30	0.596	0.109	11.948	0.000	1.077	1.523
	total score	6.03	0.890	0.162	37.134	0.000	5.701	6.366
DSF LNB	easy task	4.43	0.935	0.171	25.963	0.000	4.084	4.783
	difficult task	1.37	0.718	0.131	10.420	0.000	1.098	1.635
	total score	5.80	0.847	0.155	37.511	0.000	5.484	6.116

RNB = right nostril breathing, ANB = alternate nostril breathing, LNB = left nostril breathing; DSF = Digit Span Forward

Table 2: Digit Span Backward Test Results of the participants

	Variables	Mean	SD	Std. Error	t	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
DSB Normal	easy task	4.10	0.662	0.121	33.935	0.000	3.853	4.347
	difficult task	1.70	0.877	0.160	10.618	0.000	1.373	2.027
	total score	5.80	0.664	0.121	47.817	0.000	5.552	6.048
DSB RNB	easy task	6.00	0.000	0.000			6.000	6.000
	difficult task	3.63	0.490	0.089	40.602	0.000	3.450	3.816
	total score	9.63	0.490	0.089	107.652	0.000	9.450	9.816
DSB ANB	easy task	4.77	0.971	0.177	26.876	0.000	4.404	5.129
	difficult task	1.47	0.681	0.124	11.789	0.000	1.212	1.721
	total score	6.20	1.031	0.188	32.952	0.000	5.815	6.585
DSB LNB	easy task	4.23	0.817	0.149	28.374	0.000	3.928	4.538
	difficult task	1.57	0.971	0.177	8.833	0.000	1.204	1.929
	total score	5.80	0.664	0.121	47.817	0.000	5.552	6.048

RNB = right nostril breathing, ANB = alternate nostril breathing, LNB = left nostril breathing; DSB = Digit Span Backward