International Journal of Healthcare Sciences ISSN 2348-5728 (Online)
Vol. 3, Issue 2, pp: (6-9), Month: October 2015 - March 2016, Available at: www.researchpublish.com

A Study on Effect of Nadi-Shodhana Pranayama on Verbal and Spatial Memory Scores

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Abstract: **Nadi shodhana pranayama "purification of subtle energy paths" where inhalation and exhalation are done through alternative nostrils for successive respiratory cycles. These relations of nasal cycle performance with hemispheric activity on few mental functions (Spatial/Verbal) are studied in the present study. Study included 100 subjects (first year medical and dental) aged between 17-21 years. Subjects were assigned into two groups: A. study group (n=50) and B. control group (n=50). Subjects from Group A were subjected to a twelve week of Nadi shodhana pranayama twenty minutes daily. Verbal and Spatial memory scores were measured on day 1 and after 12 weeks in both the groups. The results suggested a significant improvement in spatial and verbal memory score ($p<0.001$) in study group compared to control group. Nadi Shodhana pranayama increases both spatial and verbal memory scores.**

Keywords: **Memory scores, Nadi-shodhana pranayama.**

I. INTRODUCTION

Yoga is an ancient science which has been practised in India from over thousands of years (1). The systematic practice of Yoga as codified by Maharishi Patanjali defines Pranayama as 'The regulation of the movements of inhalation and exhalation'. Pranayama is an art of controlling the life force of breath, a spiritual and physical practice which integrates the mind, body and soul (2, 3).Nadi shodhana Pranayama also known as Alternate nostril breathing (ANB) is well known among pranayamas (5).Prana, the vital energy pervades the whole body, following flow pattern called Nadis, which are responsible for maintaining all individual cellular activity. The word Nadi means 'channel' and refers to the energy pathways through which prana flows and shodhana means purification. So Nadi Shodhana means channel cleaning. Nadi Shodhana, or the sweet breath, is simple form of breathing by alternate nostrils (4).

Nadi shodhana pranayama "purification of subtle energy paths" where inhalation and exhalation are done through alternative nostrils for successive respiratory cycles. Right nostril breathing (Surya Anuloma Viloma Pranayama) corresponds to activation of 'Pingala' subtle energy channel of yoga; related to sympathetic arousal and left nostril breathing (Chandra Anuloma Viloma Pranayam) to 'Ida' svara with parasympathetic activation. Nadi shodhana pranayama combines both of these into one cycle(6,7). The ultimate goal of this pranayama is to have a slow and rhythmical breath, alternating inhalation (puraka) and exhalation (rechaka) between the left and right nostrils. Humans naturally breathe preferentially through one nostril at a time. The preferred nostril alternates in a simultaneous congestion-decongestion cycle (8). Unilateral forced nostril breathing may differentially affect the ipsilateral and contra lateral cerebral hemispheres, thereby changing relative EEG activity and influencing relative spatial and verbal performance. "Right nostril dominance is associated with better verbal performance and left nostril dominance is associated with better spatial performance" (9) . Further, few studies reveal that there is a relationship between the breathing techniques such as uni-nostril (right and left nostril) and alternate nostril breathing on enhanced spatial memory performance (10).

Today's ever-changing, technologically advanced & highly competitive environment causes persistent stress to students. Pranayama is known since ancient times to relieve stress and to stabilize autonomic function of the body and to increase the concentration power which in turn increase the retaining and recalling capacity in students. With this background, the present study was undertaken to study the effect of nadi-shodhana pranayama on verbal and spatial memory scores.

II. METHODS

The present cross sectional study was done on 100 healthy first year medical and dental students of age group between 17 and 21years of A J Institute of Medical Science, Mangalore. After obtaining written informed consent and clearance from Institutional Ethics Committee subjects with history of Respiratory disorders, history of Congenital heart diseases, history of Epilepsy, history of Recent trauma, history of Spinal deformities, history of Exposure to yoga training and those who are not interested in pranayama were excluded from the study.The nature of the study was explained to all the subjects and a self structured questionnaire was given to all subjects, which included age, occupation and previous exposure to yoga training. Subjects were explained that parameters will be measured on day 1 and after 12 weeks of practicing Nadi Shodhana Pranayama. Then subjects were divided by randomised sampling into study group (n=50), who will practice Nadi Shodhana Pranayama for about twelve weeks and control group (n=50), who will not practice any kind yoga or meditation during study period.

'Nadishodhana Pranayama' training (2, 4, 7, 11):Nadi-shodhana pranayama. Practice sessions were held between 5.30pm and 6pm twenty cycles daily for twenty minutes, in a well lighted and properly aerated, calm and quiet room for the subjects included in the study group. They were asked to assume 'Sukhasana' (the comfortable posture) and regulate the alteration of breathing as follows:

1. Open the right hand and bend index and middle fingers against the palm. The thumb will be used for closing the right nostril while the fourth and fifth fingers will be used for the left nostril.

2. Start the exercise with relaxed attitude and concentration as explained below.

a) Exhale slowly and deeply without closing the nostrils but being ready to do so. Inhale slowly and quietly through the left nostril while closing the right. At the end of the inhalation, close both nostrils and hold the breath for a while (not more than 1-2 seconds).

b) Keep the left nostril closed and exhale through the right as quietly as possible. After exhaling completely, inhale slowly and quietly through the right nostril. At the end of the inhalation, close both nostrils and hold the breath for a while (not more than 1-2 seconds) and continue.

Then subjects of both the groups were administered verbal and spatial memory scores on day 1 and after twelve weeks. The subjects were told that the memory tests were for their self assessment to understand the benefit they derived from the course. They were subsequently given a report, so they were enthusiastic and interested. Subjects were seated approximately a meter apart to avoid distraction. The test material was projected on a screen, allowing 10 sec. for each slide. After the 10 slides, a mathematical problem (e.g., 7 minus 4 plus 9 minus 3 plus 6 minus 5 minus 8 plus 2) was projected on the screen, and was told to solve the problem. Immediately after this, the subjects were asked to recall and write down (or in the case of spatial memory, to draw) within 60 sec, the 10 test items which had been shown to them.

a) To test verbal memory standard nonsense syllables of three letters, e.g., xol, was selected from a prepared list.

b) To test for spatial memory geometrical and other shapes which could be described verbally, e.g., a square or a circle was not used. The drawings were very simple and easy to reproduce.

c) For both verbal and spatial memory tests a correct answer was scored as one, whereas a wrong answer was scored as zero. Maximum score was ten for each test.

Statistical analysis: All data thus obtained were expressed in mean ± SD.The data was analyzed using Student's paired't' test to compare the pre and post training values in study group. The data was analyzed using Student's unpaired't' test to compare study group with control group.

III. RESULTS

Nadi shodhana pranayama training of twelve weeks produced a highly significant (P<0.001) improvement in verbal and spatial memory scores in study group (Table III). It also showed a highly significant (P<0.001) increase in both verbal and spatial memory scores in study group compared to the control group (Table IV).

Table I: Age (in years) comparison between study group and control group

Group	N	Mean	S D	
Study group	50	18.16	0.618	t = 0.9299
Control group	50	18.26	0.443	P = 0.3547

Unpaired t test, p > 0.05, SD-Standard deviation.

The above table shows age of the studied subjects. Mean age observed in study group was 18.16 (±0.618) years and in controls was 18.26 (±0.443) years. No significant difference is seen in age between the two groups (p > 0.05).

Table II: Gender Distribution

	Males	Females	Total
1. Study Group	23	27	50
2. Control Group	9	41	50
			100

Table III: Comparison of verbal and spatial memory scores before (day 1) and after doing pranayama (after 12 weeks) in study group

Variables	Pre		Post		95% confidence interval	P value
	Mean	SD	Mean	SD		
VMS	5.34	1.96	7.06	2.23	(-2.32, -1.12)	<0.001**
SMS	4.58	1.75	8.32	2.02	(-4.32, -3.16)	<0.001**

Paired t test ***** Highly Significant,*** **VMS: verbal memory scores, SMS: spatial memory scores.**

Table IV: Comparison of verbal and spatial memory scores in study group with control group.

Variables	Control group		Study group		95% CI		P value
	Mean difference	SD	Mean	SD			
VMS	0.34	1.80	-1.72	2.12	1.28	2.84	<0.001**
SMS	0.76	2.05	-3.74	2.04	3.69	5.31	<0.001**

Unpaired t test **** Highly Significant**

IV. DISCUSSION

The present cross sectional study aimed to evaluate the effect of nadi shodhana pranayama on verbal and spatial memory scores in undergraduate students of age 18.21 years.In the present study, the group trained in Nadi shodhana pranayama showed a significant increase in spatial and verbal memory test scores(P<0.001). Khalsa et al found an increase in spatial performance on a cognitive task in 30 minutes of unilateral forced nostril breathing in 51 right-handed undergraduate students whose average age group was 20.7 year (15). In a study on 108 school children aged between 10–17 years observed a highly significant increase in spatial memory scores in all four trained groups but not on the verbal memory scores after ten days of specific yoga breathing techniques: (i) right nostril breathing, (ii) left nostril breathing, (iii) alternate nostril breathing, (iv) breath awareness without manipulation of nostrils (12).

Improvement in spatial and verbal memory scores following Nadi shodhana pranayama could be because of following reasons:

To the fact that reduced anxiety can improve performance on tasks requiring learning and memory (13).Ultradian rhythms of alternating cerebral dominance have been demonstrated in humans and other mammals during waking and sleep. This

cerebral rhythm is tightly coupled to another ultradian rhythm known as the nasal cycle, which is regulated by the autonomic nervous system, and is exhibited by greater airflow in one nostril, later switching to the other side (14). In this account, increased parasympathetic activation of a nostril causes the mucous membranes of that nostril to become engorged with blood. As a result, airflow decreases in it and the other nostril becomes more open. Unilateral forced nostril breathing may differentially affect the ipsilateral and contralateral cerebral hemispheres, thereby changing relative EEG activity and influencing relative spatial and verbal performance."The direction of this significant relationship is consistent with the claim that right nostril dominance is associated with better verbal performance and left nostril dominance is associated with better spatial performance"(9) . A more detailed analysis of their findings reveals that Spatial performance was slightly better when the left nostril was dominant than when the right nostril was dominant.

The question of how unilateral breathing improves sustained attention remains a question for future research, whether it is simply due to increased mental energy, or if there are other significant factors.

V. CONCLUSION

It is evident from the present study that Nadi Shodhana Pranayama produces an improvement in spatial and verbal memory scores. The positive results found in the present study might be applied to all schools and colleges to improve memory functions in students. A few minutes of practice daily may help in setting the mind better on works and studies. The daily practice could also be parts of physical fitness and life style modification programs in maintaining better physical and mental health to have a better future

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