

## Research Article

# Effect of Anulom Vilom Pranayam on auditory reaction time in Indian population aged 18-22 years

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### ABSTRACT

**Background:** Reaction time is one of the important methods to study a person's central information processing speed and is an index of sensory, motor and cognitive processes. Auditory reaction time, an important psychophysical method useful for relating mental events to physical measures is significantly correlated to changes in breathing period. Objective of the study was to evaluate effect of Anulom Vilom pranayam on auditory reaction time.

**Methods:** 60 volunteers from a tertiary care hospital of Mumbai were divided into two groups (study group and control group) of 30 each. Study group practised Anulom Vilom pranayam for 8 weeks. Control group were busy in their routine activities during that period. Pre-study and post-study measurements of auditory reaction times for high tone and low tone were done in both groups.

**Results:** Statistical analysis was carried out and paired t-test was applied. Post-study auditory reaction time of study group for high tone and low tone showed significant decline than control group.

**Conclusions:** Anulom Vilom pranayam which observed to reduce auditory reaction time have health promoting, boosting, toning effects on central neural structures; quantity, pattern of release of neurotransmitters and mental interaction involved in information processing. In light of the influence of psychosocial stressors, inappropriate nutrition and lack of physical activity in modern life on the development of stress related disorders, Anulom Vilom pranayam may have considerable potential in its prevention and is complementary to overall stress management.

**Keywords:** Anulom Vilom pranayam, Auditory reaction time, Stress management

### INTRODUCTION

Human body responses to a number of external environmental stimuli of different modalities and gives a desired, purposeful voluntary response to different types of stimuli.

Human reaction time (RT) is the time interval between the application of a stimulus and the appearance of appropriate voluntary response by a subject.<sup>1</sup> It reflects the speed of the flow of neurophysiological, cognitive and information processes which are created by the action of stimulus on the person's sensory system. The receipt of information, its processing, decision making and giving the response or execution of the motor act are the

processes which follow one another and make what we call the reaction time. It provides indirect but a simple mean of determining sensory-motor association and performance.<sup>2</sup> Measurement of reaction time is a sensitive, reproducible and non-invasive test and can be done with simple apparatus and set up. It is useful in the study of peripheral as well as central neural structures. Its measurement helps in determining sensory motor association and performance of an individual. It determines the alertness of a person because how quickly a person responds to a stimulus depends on his reaction time. It acts as a reliable indicator of rate of processing of sensory stimuli by central nervous system and its execution in the form of motor response.<sup>3</sup> It is an index of cortical arousal<sup>4</sup> and decrease in it indicates an improved

sensory-motor performance and an enhanced processing ability of the central nervous system.

It has been found that changes in breathing period produced by voluntary control of breathing are significantly correlated to changes in reaction time.<sup>5</sup> Physical conditioning exercises have been shown to shorten auditory reaction time (ART).<sup>6</sup> Various methods of pranayam are mostly characterized by breath holding at the end of maximum inspiration or maximum expiration and slowing of the respiratory rate. They also bring equipoise between psychic and somatic aspects of bodily functions.<sup>7</sup> Pranayam which is a yogic breathing technique produces consistent physiological changes and have sound scientific basis.<sup>8</sup> Pranayam are claimed to have beneficial effects on the body such as improving the functions of different systems of the body including performance of the CNS and the physiological and psychological benefits of pranayam have been demonstrated in several studies.<sup>9</sup> Benefits have been reported in peripheral nerve function<sup>10</sup> as well as central neuronal processing.<sup>11</sup> Studies have demonstrated that subjects trained in yoga and pranayam can achieve a state of deep psychosomatic relaxation (undisturbability).<sup>12</sup>

Having a short reaction time is vital in our day to day lives and also it has important implication in sports physiology. From biological point of view, an animal's ability to cope with the environmental changes for the maintenance of homeostasis depends on the integrity of cell communication and responses given by the various systems in terms of sensory perception and motor response.

Many factors have been shown to affect reaction time including, age, gender, physical fitness, fatigue, fasting, distraction, alcohol, breathing cycle, personality type, exercise, intelligence of the subject and whether the stimulus is auditory or visual. Out of these various factors, in this study we had studied the effect of practicing Anulom Vilom pranayam on auditory reaction time since it is a means of relating physical measure of mental events and also it can provide a quantitative measurement of the beneficial effect of Anulom Vilom pranayama.

## METHODS

The study was conducted in a well-known tertiary hospital in Mumbai after the institutional ethical clearance. The study included apparently healthy medical students of aged 18 to 22 years of both the sexes who were non-athletes, non-smokers, non-obese, non-alcoholics. Informed and written consent was taken from all the participants. The duration of the study was eight weeks.<sup>13</sup> Students who don't have any neurological illness, any acute illness, having normal hearing ability were included in this study after detailed history and clinical examination to detect systemic involvement of any disease. Those participants who have hearing

impairment, any organic disease of ear and nose, chronically ill or under any drug treatment and those who are undergoing any physical activity such as sports, athletic training or any other type of physical exercise were excluded from this study.

The apparatus used for measuring reaction time in this study was "Research Reaction Time apparatus" manufactured by Anand agencies, Pune-2. The operating panel on the Experimenters side consists of digital time display, power on-off press button and reset to zero press button. The bottom row has press buttons for auditory stimuli (high tone and low tone). The operating panel on the subject's side consists of press buttons for responding to auditory stimuli. Auditory reaction time was measured where subject has to respond to high tone and low tone sound stimuli by pressing the response button and the readings were recorded in milliseconds on the digital display screen of the apparatus for high tone and low tone sound stimuli respectively. All the subjects were thoroughly acquainted with the operation of the apparatus. Subjects were given practice session before recording actual readings. Before presenting the stimulus a "Ready signal or Warning signal" in the form of a verbal instruction "Ready" was given. They were also asked to refrain from tea, coffee, chocolates and caffeinated soft-drinks on the day of recording reaction time.

Before the start of study, auditory reaction time (ART) for high tone and low tone were measured in all 60 voluntary participants. After taking the pre-study readings, the 60 individuals were divided into study group and control group, each group containing 30 subjects of both sexes. Each individual from the study group was explained about the procedure of Anulom Vilom pranayam and sufficient trials were given for proper understanding. Anulom Vilom pranayam was practiced by the subjects of study group daily once in the morning for a period of 8 weeks on regular basis under our direct supervision without any holiday during the study period and the subjects from the control group were busy in their routine activities during that period. No subject in either group has been performing any pranayam before. At the end of 8 weeks parameters of the study were reassessed in both the study and control groups under similar environmental conditions.

### *Procedure of Anulom Vilom pranayam<sup>14</sup>*

The subject was seated in a comfortable sitting posture with back straight. Inhalation is through one nostril, and then breath is retained followed by exhalation through the other nostril in a ratio of 2:8:4, with eyes closed and concentrating on breathing.

One round of Anulom Vilom pranayam consists of six steps:

- i. Inhale through the left nostril, closing the right with the thumb, to the count of four.

- ii. Hold the breath, closing both nostrils, to the count of sixteen.
- iii. Exhale through the right nostril, closing the left with the ring and little fingers, to the count of eight.
- iv. Inhale through the right nostril, keeping the left nostril closed with the ring and little fingers, to the count of four.
- v. Hold the breath, closing both nostrils, to the count of sixteen.
- vi. Exhale through the left nostril, keeping the right closed with the thumb, to the count of eight.

This is one complete round of Anulom Vilom pranayam. After every 10 minutes one takes rest pause for 20-30 seconds. This procedure was practiced for 20 minutes daily. Data was collected and the level of significance was tested by paired t-test by SPSS software version 16.0 for windows. The p-value less than 0.05 indicate that the results are significant statistically and the p-value less than 0.01 indicate that the results are highly significant statistically.

## RESULTS

Table 1 shows that auditory reaction time for high tone in the subjects from study group was found to be significantly decreased (p value <0.01) when compared before and after Anulom Vilom pranayam whereas, the corresponding change in control group was not significant (p value >0.05).

**Table 1: Pre-study and post-study auditory reaction time (ART) for high tone in study group and control group.**

Auditory reaction time (ART) for high tone				
	Control group		Study group	
	Pre-study	Post-study	Pre-study	Post-study
ART for high tone	215.4 ± 13.2	215.2 ± 12.8	215.2 ± 12.5	211.7 ± 12.4
t-value	0.665		15.50	
99% CI	-0.839 to 1.372		2.851 to 4.083	
p-value	0.511 (NS)		0.01 (S)	

Values are expressed as Mean ± Standard Deviation. N=30 in each group  
 Note: CI= Confidence interval, S= Significant, NS= Non Significant

Table 2 shows that auditory reaction time for low tone in the subjects from study group was found to be significantly decreased (p value <0.01) when compared before and after Anulom Vilom pranayam whereas, the corresponding change in control group was not significant (p value >0.05).

**Table 2: Pre-study and post-study Auditory reaction time (ART) for low tone in study group and control group.**

Auditory reaction time (ART) for low tone				
	Control group		Study group	
	Pre-study	Post-study	Pre-study	Post-study
ART for low tone	214.1 ± 11.8	213.8 ± 12.5	214.0 ± 11.9	210.4 ± 11.6
t-value	0.665		10.06	
99% CI	-0.839 to 1.372		2.589 to 4.544	
p-value	0.511 (NS)		0.01 (S)	

Values are expressed as Mean ± Standard Deviation. N=30 in each group  
 Note: CI= Confidence interval, S= Significant, NS= Non Significant

## DISCUSSION

The morbidity, mortality as well as the loss of quality of life associated with stress related disorders underlines the need of effective preventive strategies. These strategies must have clinical as well as economic significance. Mind-body therapies may have considerable potential in the prevention and treatment of these disorders. Considering the increased psychological stress, inappropriate nutrition and lack of physical activity in modern life, routine pranayam practice can prove useful in order to modify various stressors. In the present study it was observed that auditory reaction time decreases after practicing Anulom Vilom pranayam in study group which was statistically significant. This observation indicates and can be explained on the basis of improved sensorimotor performance due to an enhanced processing ability of the central nervous system. These effects could be due to greater improved concentration power, ability to ignore and/or inhibit extraneous stimuli and also due to its beneficial effect on the autonomic nervous system. Reaction time gives us insight about the efficiency of information processing which involves the nature, intensity, frequency, pattern of stimuli, structural and functional characteristics of neuronal receptors, afferents, centers (i.e. central neurons), efferents and neurotransmitters. It is also influenced by several host factors like gender, age, level of consciousness, personality types, exercise, training, practice and errors etc.; several physiological factors like breathing cycles, fasting; environmental factors like types of stimuli; disease factors like lesions of central nervous system, musculo-skeletal system, physical illness (hypothyroidism), mental illness; abnormal conditions like brain injury, finger tremors; drugs factors like use of sedatives and toxicological factors like consumption of alcohol. In chronological studies like ours, it is influenced by the interaction of the individual and the environment which constitutes the degree of stress. Hence it is logical that if specific training in stress management is given then the information processing would improve and the reaction time would reduce.<sup>15</sup>

In human beings information processing is affected by the instinctual status, mental status, instinctual and intellectual development. Thus, a person with emotional disturbance or a confused or baffled individual would take more time to respond as compare to other individual with greater intellectual and emotional composure and conceptual clarity. Being pranayam an art of control of breathing, a practitioner of Anulom Vilom pranayam not only tries to breathe, but at the same time, tries to keep his/her attention on the act of breathing, leading to concentration. In the present study, while performing Anulom Vilom pranayam, subjects were also emphasized to concentrate on the act of breathing. This act of breathing removes his attention from worldly worries and de-stress. This stress free individual adapts better to the daily emotional, physical, and mental stresses. This stress free state of mind evokes relaxed responses.<sup>16</sup> In this relaxed states, parasympathetic nerve activity overrides sympathetic nerve activity.<sup>17</sup> Therefore, the significantly decrease in auditory reaction time could be due to better adaptability for mental stress induced by breathing act during Anulom vilom pranayam.

Pranayam shows a reduction in sympathetic activity which is the basis of its use in stress management.<sup>18</sup> In Anulom Vilom pranayama, the idea is to maintain a slow rhythmic pattern of breathing using both nostrils alternately which also produces a beneficial effect on the autonomic nervous system as reported in a study as decrease in sympathetic tone and the associated increase in parasympathetic tone following pranayam.<sup>19</sup> The increase in parasympathetic activity following practice of Anulom vilom pranayam in our study may possibly be due to increased oxygenation of tissues. Another study reported that pranayam rapidly alters cardiopulmonary responses and improves simple problem solving.<sup>20</sup> Other studies reported the effect of short term training in slow breathing pranayam on reaction time and found that there was appreciable but statistically insignificant shortening of reaction time.<sup>21</sup> Another study reported that nostril rhythm in pranayama increases the theta rhythm, the mean alpha (a) and beta (b) power followed by reduction in the asymmetry in b band in the EEG<sup>22</sup> indicating facilitation of processes of sensory signal transmission. As stated above, previous training is an important factor affecting reaction time and pranayama is also found to reduce reaction time by influencing higher functions of the central nervous system like perception, planning, execution of task, learning and memory. It improves coherence between the two cerebral hemisphere signifying synchronization of logical and intuitive function. It increases alertness along with relaxation. Alertness decreases reaction time of brain. Thus pranayam in general and Anulom Vilom pranayam in particular which are observed to reduce auditory reaction time have health promoting, boosting, toning effects on central neural structures; quantity, pattern of release of neurotransmitters and mental interaction involved in information processing. This is how, Anulom Vilom pranayam makes the mind steady and hence less

distractible, more acute, pointed, precise, and quick in responding to any stimuli.

### **Limitations of the study**

The intricacies of central and autonomic nervous mechanisms involved in the effects of Anulom Vilom pranayam on auditory reaction time needs further more psychophysiological, electrophysiological and neuro-biochemical studies on larger populations.

### **CONCLUSION**

This study suggests that regular practice of Anulom Vilom pranayam improves reaction time and higher brain functions. It is complementary to overall stress management (physical, instinctual, emotional, intellectual and spiritual). Hence the best effects of these techniques would be evident if coupled as alternative therapy or as adjunct to conventional therapy in stress related disorders. Inculcating the habit of regular pranayam early in life will definitely have favourable effect in measures involved in Total Stress Management.

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