

Effect of Mukh Bhastrika (A Type of Pranayama) on the Sensory-Motor Performance

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ABSTRACT

Background: Pranayama has a very important role in the yogic system of exercises and it has been said to be much more important than yogasanas for keeping sound health. The practice of Mukh Bhastrika, a type of pranayama, is known to improve human performance. The studies which have been conducted till date were on the effect of the short term practice of Mukh Bhastrika, other types of pranayamas and yoga in general. The Reaction Time (RT) is a means of determining the sensory motor association and the performance.

Aim: The aim of the present study was to know whether practising Mukh Bhastrika alone had any beneficial effect on the CNS arousal, the sensory-motor association and its performance.

Materials and Methods: This interventional study was done in 50 young, male volunteers in whom the auditory and the visual reaction times were recorded before and after 12 weeks of Mukh Bhastrika training.

Results: There was a decrease in both the auditory and the visual reaction times. This indicated an improvement in the sensory-motor performance and the enhanced processing ability of the central nervous system.

Conclusion: Hence, the regular practice of Mukh Bhastrika should be encouraged for better performance in situations which require faster reactivity such as sports, race driving, specialized surgery, machine operation, trainable mentally retarded children, etc.

Key Words: Mukh Bhastrika; reaction time; sensory motor performance

INTRODUCTION

Yoga is the most ancient system or education, which is based on a higher philosophical knowledge and a spiritual concept of man, for the harmonious development of the body and mind [1]. Yoga includes diverse practices such as physical postures (asanas), regulated breathing (Pranayama), meditation and lectures on the philosophical aspects of yoga [2]. Pranayama has been assigned a very important role in the yogic system of exercises and it has been said to be much more important than yogasanas for keeping sound health [3].

Bhastrika, a type of pranayama breathing [3], is a term which has been derived from the "bellow" which is used by the blacksmith to keep his coal furnace alive [4], in which the breath is actively blasted in and out in multiple 'whooshes' with forced abdominal contractions [5]. Bhastrika has been shown to produce central neuronal activation [6], to improve the speed of reaction and to produce a balance between the sympathetic and the parasympathetic aspects of the autonomic nervous system [7]. Mukh Bhastrika's central activating role and its effects on the sensory-motor association can be assessed by using sensitive and reproducible tests, one such test being the Reaction Time (RT).

The Reaction Time (RT) is defined as the time interval between the application of a stimulus and the response by the subject [8] or the time which is taken by an individual to respond to an external stimulus [9]. It is an indirect index of the processing ability of the Central Nervous System (CNS) and a simple means of determining the sensory – motor association and its performance [10]. It is an index of the cortical arousal in short [11]. A decrease in the reaction time indicates an improved sensory motor performance and an enhanced processing ability of the CNS [3]. It has been found

that changes in the breathing period which are produced by the voluntary control of respiration (like in various types of pranayama) are significantly correlated to the changes in the RT [12]. Thus, RT can be used as a simple and objective method to determine the beneficial effects of any kind of yoga training that enhances the performance/central neuronal activation [13], and thus can be planned to be used in a study on yoga.

Previous studies on yoga, [11], [13] and on the acute effect of Mukh Bhastrika [4] in yoga –trained subjects, on their visual and auditory reaction times, have shown an improved CNS processing ability. But until date, there are no references which are available on the long term practice of Mukh Bhastrika alone, in normal subjects, with no experience of performing or practising any form of yoga, including pranayama, so that the results obtained can be applicable in a regularly encountered scenario e.g. mentally retarded children, older sportsmen, surgeons, drivers and in all those whose occupation requires a better sensory-motor coordination. The shortening of the RT is of value in all such situations which require a faster reactivity, it will be of immense help in altering the lifestyle of trainable, mentally retarded children [14] and it is also an effective means of training players who perform poorly, on the measures of conceptual thinking, reaction time and concentration [3], [4].

Hence, this study was designed to know the effect of practising Mukh Bhastrika alone, for a longer duration, by normal young volunteers, by using RT as an index, on the sensory-motor performance.

MATERIALS AND METHODS

This study was conducted on fifty, apparently healthy, male individuals of the age group of 18-25 years. Ethical clearance was



[Table/Fig-1]: Subjects performing Mukh Bhastrika

obtained from the institution. Subjects with a uniform pattern of diet and activity were included and subjects who were trained athletes/yoga performers, smokers and alcoholics, those who were taking drugs or other forms of tobacco, those having any kind of cardiovascular disorders, colour vision defects or those having a visual acuity of less than 6/6, those who were using hearing aids and those with auditory defects were excluded. Informed consent was obtained from each participant. A detailed history was taken and a thorough physical and clinical examination of each participant was carried out. Before training them for Mukh Bhastrika, the simple visual reaction time and the simple auditory reaction time were recorded for each participant.

Mukh Bhastrika Training: The procedure of Mukh Bhastrika is as follows:

1. Sit on padmasana.
2. Keep the body, neck and head erect.
3. Close the mouth.
4. Inhale and exhale quickly ten times like the bellows of the blacksmith i.e., hissing sound, starting with a rapid expulsion of the breath, following one another in rapid succession.
5. After ten expulsions, the final expulsion is followed by the deepest possible inhalation.
6. The breath has to be suspended as long as it can be done, with comfort.
7. The deepest possible exhalation has to be done very slowly.
8. This completes one round of Bhastrika.
9. After one round is over, rest a while by taking a few normal breaths, and then start with the next round.
10. Practise up to three rounds.

This was carried out in at the Dhanvantri Yoga Centre, Hubli, Karnataka, India, everyday in the morning from 7 to 7.30 a.m., 5 days a week, for 12 weeks, on an empty stomach [Table/Fig-1]. The subjects were asked not to practise any other type of yoga, pranayama or exercise, and to have food only from the college mess during this period.

After the completion of the Bhastrika training for 12 weeks, there were no dropouts from the training session. The subjects were again subjected to the tests which have been described above, individually.

Reaction Time measurements

The simple auditory and visual reaction times were measured by using a "Response Analyser" [Table/Fig-2] which was manufactured



[Table/Fig-2]: Response Analyser

by "Yantrashilpa" Electronics-0101/Pune (YSRT-010-1). It is a microprocessor based system that is programmed to measure the reaction time of the subject to various sensory stimuli, namely sound, vision, touch and an electrical stimulus.

Before measuring the reaction time, each subject was made familiar with the "Response Analyser". Detailed instructions regarding the experimental procedures which were employed for each test were given to the subjects.

The subject was asked to sit comfortably on a chair and was allowed to take 15 to 20 minutes of rest before beginning the actual procedure. The subjects were kept mentally alert by asking them, "Are you ready?", to avoid any possible distractibility in the subjects. After some seconds, a stimulus was made to arrive, by pressing the start switch, by the examiner. The subject was instructed to press the thumb switch as soon as he was aware of the stimulus, but not prematurely.

The time of occurrence of the stimuli was changed as and when, during the performance of all the tests, with the help of a time setting, so that the subjects did not get clues as to when the stimuli would be presented to them. This was done to keep the subjects more attentive and to get more reliable reaction time readings. The subjects were also instructed to use the thumbs of the right and left hands alternatively, to press the thumb switch. This was to get the readings for that particular hand, and for that particular test.

1. **The Auditory Reaction Time Test:** This test measures the reaction to a sound (auditory) stimulus. The "audio" mode was selected and the mode indicator was switched on. A sound signal was given from in front of the subject. The "start" switch was pressed by the examiner and the subject reacted promptly to the auditory signal by pressing the thumb switch, as soon as the sound was audible to him. The reading on the display indicated the "Auditory Reaction Time" (ART) in milliseconds.
2. **The Visual Reaction Time Test:** This test measures the reaction to a visual (light) stimulus. The "visual" mode was selected and the mode indicator was switched on. A visual stimulus was given from in front of the subject. When the start switch was pressed by the examiner, a red light glowed in the bulb and the subject reacted by pressing the thumb switch, as soon as he saw the red light. The reading on the display indicated the "Visual Reaction Time" (VRT) in milliseconds.

Simple reaction times for the auditory and visual stimuli were measured in the fifty male subjects. Ten readings were taken for

each one of the stimuli (auditory and visual), by each hand (the right and left hands being used alternatively). An average of ten readings was taken as an individual value for that particular stimulus and for that particular hand. The readings were obtained (the ART for the right and the left hands, the VRT for the right and the left hands), before the Mukh Bhastrika training and also after 12 weeks of training. The results were analyzed statistically by applying the paired 't' test [15] and p values which were less than 0.05 were considered as indicating a significant difference between the compared values.

RESULTS

The mean age of the fifty male subjects was 19.48 ± 1.21 years, their mean height was 168.50 ± 9.57 cms and their mean weight was 56.88 ± 6.10 kgs. The parameters for the simple reaction time were as follows:

1. Auditory reaction time (ART) for both the right and the left hands: [Table/Fig-3].
2. Visual reaction time (VRT) for both the right and the left hands: [Table/Fig-4].

DISCUSSION

In the present study, we chose only male subjects to avoid any possible effect of the menstrual phase on the RT [10].

In our study, the ART and the VRT for both the right and left hands, had significantly reduced due to the Mukh Bhastrika training for 12 weeks. There is a lack of similar studies which were performed recently, after this study [6] wherein, before Mukh Bhastrika, the VRT and the ART were 244.57 ± 5.86 ms and 198.82 ± 5.86 ms respectively. Immediately after performing nine rounds of Mukh Bhastrika, the VRT and the ART decreased to 228.15 ± 5.84 ms and 172.58 ± 6.35 ms respectively. This decrease was statistically significant ($p < 0.01$), thus indicating that the performance of Mukh Bhastrika acutely enhanced the sensory information processing ability, hence resulting in a better motor performance.

A study on Kapalbhathi, a yogic breathing practice by utilizing abdominal maneuvers and the bellows type breathing that was similar to Mukh Bhastrika, has shown that the practice of Kapalbhathi for ten minutes increases the mental activity [16] and induces a calm alert state [17], due to which the reaction time may decrease, like the way it was shown to occur by the practice of Mukh Bhastrika in our study.

Other studies which have been done on yoga in general (which included pranayama with asanas) have been reported to produce a significant reduction in both the VRT and the ART [11], [14] and an improved sensory-motor performance.

Studies have reported that Hatha yogic practices like agnisar, nauli and bhastrika utilize forceful abdominal contractions, bringing about the stimulation of somatic and splanchnic receptors, thus inducing EEG changes around the somatosensory and the parietal areas of the cerebral cortex, thus suggesting an effective arousal [6],[18]. The reason for the shortening of the RT in our study also may be because of similar mechanisms.

Another study reported that during the concentrated mental exercise of pranayama breathing, there was a generalized alteration in the information processing at the primary thalamo-cortical levels [19], thus faster reactivity, like the one which was seen in the subjects

		n	Mean	SD	t	p
ART of right hand (milliseconds)	Before Mukh Bhastrika	50	202.44	19.39	8.727	0.0001 (HS)
	After Mukh Bhastrika	50	187.88	21.4		
ART of left hand (milliseconds)	Before Mukh Bhastrika	50	210.56	24.9	6.182	0.001 (HS)
	After Mukh Bhastrika	50	194.5	22.25		

[Table/Fig-3]: Auditory reaction time (ART)

n=Number of subjects.
SD=Standard Deviation.
HS=Highly Significant.

		n	Mean	SD	t	p
VRT of right hand (milliseconds)	Before Mukh Bhastrika	50	219.44	25.99	10.922	0.0001 (HS)
	After Mukh Bhastrika	50	201.38	25.44		
VRT of left hand (milliseconds)	Before Mukh Bhastrika	50	227.42	31.47	8.258	0.0001 (HS)
	After Mukh Bhastrika	50	209.44	27.59		

[Table/Fig-4]: Visual reaction time (VRT)

n=Number of subjects.
SD=Standard Deviation.
HS=Highly Significant.

of our study. Yet another study reported that hyperventilation selectively depressed the motor cortical inhibition in humans [20], and that Mukh Bhastrika involved active and rapid expiratory efforts which were similar to that which was seen in hyperventilation. But an important difference between the yogic bellows-type breathing like Mukh Bhastrika or Kapalbhathi and hyperventilation was that there were no abnormal EEG changes even after 10 minutes of Kapalbhathi, whereas prolonged hyperventilation produced abnormal EEG [16].

Hence, in brief, a decrease in the RT indicated an improved sensory-motor performance, which could be explained on the basis of the enhanced processing ability of central nervous system. Mukh Bhastrika can improve this processing ability by -

- A greater arousal and a faster rate of information processing.
- Improved concentration power and/or
- An ability to ignore or inhibit extraneous stimuli.

A greater arousal and faster information processing can be explained on the basis of Mukh Bhastrika-induced alterations in the afferent inputs from the abdominal and the thoracic regions, which in turn can modulate the activity at ascending reticular activating system and thalamocortical levels [4].

Thus, it can be concluded that the regular practice of just Mukh Bhastrika shortens the RT, which is of value in situations which require a faster reactivity such as sports, machine operation, race driving, specialized surgery, etc. It will be of immense help in altering the lifestyle of trainable, mentally retarded children and also it is an effective means for training players who perform poorly, on the measures of conceptual thinking, reaction time and concentration.

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