

# Conditioning Effects of 8 Weeks Training in Yogic Breathing Maneuvers on Abdominal Muscles Thickness

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## ABSTRACT

**Background:** Yogic Breathing Maneuvers (YBM) such as various forms of Pranayama and KapalabhatiKriya are known widely for its positive effects on the cardio- pulmonary and mental health. However, its role in improving abdominal muscle strength is yet unexplored. Abdominal muscles are known for its prime role in maintaining spinal stability, and prevention of mechanical low back pain. Abdominal muscles also have an important role in maintaining bronchial hygiene through forced expiratory mechanisms which may be affected due to muscles weakness observed following abdominal surgeries, spinal cord injuries, post pregnancy etc.

The reliability of Real Time Ultrasound in M mode is a proven tool for assessing the kinetic function of abdominal muscles and its thickness before and after rehabilitative intervention.

**Objective:** To study the effects of eight weeks of yogic breathing practices on thickness of Rectus Abdominis (RA), Transversus Abdominis (TrA), internal oblique (IO) and external oblique (EO) as assessed on Real Time Ultrasound in healthy young adults.

**Methodology:** The Abdominal muscle thickness of all the subjects were assessed using M mode of Ultrasound, before and after 8 weeks of training in various YBM.

**Results:** The thickness of RA, EO, IO, TrA, showed significant improvement after training in YBM, however, all muscles showed uniform changes.

**Conclusion:** The conditioning effect of YBM showed significant improvement and uniform changes in all 4 abdominal muscle thicknesses after eight weeks training in the healthy sedentary young subjects.

**KEY WORDS:** Yogic breathing maneuvers, Real time Ultrasound, Abdominal muscles

## INTRODUCTION

Pranayama is a package of various types of breathing maneuvers described in the 4<sup>th</sup> limb of Patanjali's Ashtanga yoga. [1] It forms the major part of Yogic Breathing Maneuvers (YBM). It involves controlling mind by controlling the *Vayu* (air) in Poorak (inspiration) and Rechak (expiration) [2] It is known for its physical as well as psychological benefits. [3] The effects of Pranayama have been studied on asthma [4,5] pulmonary function [3,4,5,6,7] autonomic

function, [8,9] cognitive performance [10,11] among other things. Shatkriyas find a special place in Hathayogic Texts. [12] They prepare a person for the practice of Pranayama following which all the benefits of Pranayama are enhanced. They can be described as internal cleansing practices with the help of air, water, friction etc as a medium. Kapalabhati is a commonly practiced, Kriya meant to clean the upper respiratory tract and sinuses, which is performed by fast abdominal contraction

synchronized with bouts of forced expiration and abdominal contraction.

Abdominal muscles are skeletal muscles, involved in spinal biomechanics. They help to maintain spinal stability. Strengthening of the core Abdominal muscles, especially the External Obliques (EO), Internal Obliques (IO) and Transversus Abdominus (TrA), play an important part in improving spinal stability and reducing mechanical low back pain. The abdominal core plays an integral role in multiplanar movement and postural control. Core muscles, are activated prior to the gross body movements.<sup>[13,14]</sup> Postural muscles, including transversus abdominis, internal and external oblique muscles, provide trunk stability, which is crucial to balance. They also have a very specific role to play in pulmonary function. Expiration during tidal breathing is claimed to be passive but, the EMG activity of abdominal muscles gives evidence that they are active even during quiet breathing.<sup>[15]</sup> The gentle contractions of Rectus Abdominus (RA), TrA and intercostal muscles during exhalation rhythmically connect the conscious and subconscious mind during movement.<sup>[16]</sup> Abdominal muscles have an important role in maintaining bronchial hygiene with the help of coughing, huffing and sneezing mechanisms. These functions of the abdominal muscles, may be compromised in conditions weakening the abdominal wall such as Post Abdominal surgeries, Spinal Cord Injuries, Post Pregnancy etc.<sup>[17,18]</sup>

Yogic Breathing maneuvers involve conscious voluntary and controlled Inspiration as well as expiration, which evoke a thought of abdominal muscles being actively involved during controlled Breathing. Certain practices like Kapalabhati and Bhastrika involve strong and rapid, isometric contractions of the abdominal muscles Yogic Breathing is known for its effects on the pulmonary system as well as in promoting mental well being. However, the kinetic analysis of YBM on abdominal muscles is yet to be

explored. Thus the conditioning effect of YBM such as Anulom- Vilom, Sheetal, Seetkari, Ujjayi, Bhramari, Bhastrika and Kapalabhati was observed on the thickness of RA, EO, IO, and TrA using Real time Ultrasound in M mode

There is a volume of literature evidence on use of ultrasound on the assessment of abdominal muscle kinetics especially in sports related research. Reliability to such studies is offered in all the steady postures such as supine, sitting & standing.<sup>[22]</sup> Thickness of abdominal muscles is used as a tool for *kinetic assessment* since they function isometrically during quiet breathing mechanism. Reliability of M mode for the assessment of abdominal muscles is already established.<sup>[19-23]</sup>

In Physiotherapy, objective assessment of individual muscle strength plays important role for evidence based training. Whereas, though there is lot of documentation on objective abdominal muscle strength in health and disease, no such documentation is found on effect of YBM on the same.

Thus, this study was carried out to assess the conditioning effect of YBM on all the 4 abdominal muscles, so that the outcome, if positive, may be used as an adjunct to various abdominal muscles strengthening protocols.

## MATERIALS & METHODS

An experimental study was carried out on 43 healthy female Physiotherapy students, in the age group of 18-25 years ( $22.37 \pm 1.09$  years). The thickness of RA, EO, IO, and TrA was assessed on a Real time Ultrasound in M mode by an experienced radiologist. The study was approved by the Ethics Committee at D. Y. Patil University and written consent was taken from all the participants

**Inclusion Criteria:** Subjects who were not engaged in any form of fitness regimes.

**Exclusion Criteria:** Subjects with known Cardio- Respiratory Problems such as Bronchial Asthma, recent episode of Pulmonary Tuberculosis etc, history of major abdominal surgery in last 6 months.

**Assessment of Abdominal Muscle thickness:** [19-22] the subject was asked to assume supine position on a plinth & abdominal area was exposed. A Siemens Acuson X300 Real time ultrasound machine in M mode with 10 MHz Transducer was used. First the RA was traced to get maximum clear picture where the transducer was fixed and resting thickness of muscle was noted in centimetres. The subject was instructed to do deep inspiration followed by complete exhalation along with abdominal hollowing & the thickness was measured by subtracting the resting thickness value from maximum thickness value obtained during complete exhalation. The same sequence was repeated for EO, IO & TrA respectively by re fixing the center of the transducer by placing it in a transverse plane just superior to the iliac crest, in line with the mid-axillary line, where clear image of all the three was available. [19] The same procedure was repeated by the same radiologist at the same time after the 8 weeks intervention of YBM.

**Intervention of YBM:** The Yogic Breathing Maneuvers which were included in this study were based on the Concepts preached by Shri Sadashiv Nimbalkar, founder president of Yoga Vidya Niketan School of Diploma in Yogic Education. The concepts and basic principles of practice, described by Shri Nimbalkar, in his text, [1] follows the principles of Hatha Yoga.

The sessions were conducted for 60 minute each, for 8 weeks. The yogic practices were taught in a progressive manner for 40 sessions spread over a period of 8 weeks (5 days a week). Each session was conducted in the morning as a curriculum class on yoga, on a relatively empty stomach. Sessions consisted of Prayer, followed by YBM for 30 mins, Omkar chanting for 10 mins & ended with

shavasana for 10 mins. Subjects were instructed to perform the practices within their capacities, in as smooth, coordinated, rhythmic and controlled manner, being fully conscious of the physical movements with well- coordinated breathing pattern.

Special emphasis was given to Pranadharana (fixation of mind on breath/breath awareness) and Prayatnashaitilya (Conscious Differential Relaxation of the body) throughout the practice.

In the initial 2 weeks Pranayama were performed without applying Tribandha (Moolabandha, Jalandhar Bandha, and Uddyan Bandha) and Kumbhaka phase. After 2 weeks Pranayama were carried out with Kumbhaka and tribandhas which were practiced in the ratio of 4:16: 8 (poorak: kumbhak: rechak). Every week, 5 rounds of each practice were increased.

Bhastrika Pranayama was introduced in the 4<sup>th</sup> week when the subjects had mastered kapalabhati and other pranayama, initially with sahaja (easy) Kumbhaka eventually progressing with the above mentioned units of time.

**Description of individual YBM:** The subjects were advised to sit on the floor in Padmasana or Ardhapadmasana or Sukasana (whichever was most comfortable) and maintaining an erect spine though out the session. The hands were placed gently on the knees.

- ❖ **Anulom-Vilom:** The subject was asked to assume Then the subject was asked to closes right nostril with left ring and little finger and inhale slowly & deeply through left nostril, & at end inhalation she was asked close the left nostril with thumb & simultaneously open the right nostril by releasing ring & little finger and exhale through right nostril. This marked 1 cycle of Anulom- Vilom.
- ❖ **Sheetali Pranayama-** Subject was asked to slightly protrude the tongue outside the lips after rolling it on either sides into a narrow tube and to inhale slowly through the mouth by sucking the air through the narrow tube of tongue. This

was followed by quiet expiration through the nose. (Fig. E)

- ❖ Sheetkari-This mode was similar to Sheetali pranayama but here the tongue was sustained inside the mouth, lips were spread laterally & with teeth clenched and the subject was asked to inhale by sucking the air through the clenched teeth.
- ❖ Bhramari-The subject was asked to close the ears by pressing the thumb and after slow & deep inspiration, the subject was asked to exhale via nose while offering minimal resistance by the soft palate in a slow and controlled manner so that a sound like humming of the bee was produced.
- ❖ Ujjayi- the subjects were instructed to constrict the opening of the throat gently by contracting the pharyngeal and intrinsic laryngeal muscles. This created some resistance to the passage of air during inhalation as well as exhalation. They were then asked to inhale and exhale through the partially closed glottis of the throat. Gently pulling the breath in, on inhalation and gently pushing the breath out on exhalation against this resistance, creating a well-modulated and soothing sound.
- ❖ Kapalabhati: At the end of initial deep inspiration, the subject was asked to retract her both shoulders to fix the chest in a fully expanded position, & sustain this position though out the breath cycle. In the fixed position of the thorax the subject was asked to relax the diaphragm & then start applying rhythmic subtle upward strokes by quick abdominal contraction followed by slow relaxation resulting into a sub-phase of active exhalation, followed by passive inspiration. The subject was asked to extend this phase till her own capacity & then release the breath slowly & fully which formed one breath cycle. . She was asked to take a break of 10 seconds in between the cycles& breathe deeply during the rest period. The subject was asked to sustain subtle strokes & avoid

violent bellowing movement of the thorax. The speed of rhythmic strokes was commenced with only 20 contractions per cycle & was gradually increased by 10 contractions each week till the subjects own capacity.

- ❖ Bhastrika: this maneuver was very similar to Kapalabhati. The only exception was that that both inspiration as well as expiration was actively performed. During inspiration abdominals protruded gently & during expiration they contracted gently resulting into bellowing movement of the abdominal wall

### STATISTICAL ANALYSIS

The pretest and post test data obtained was analysed on SPSS software version 16.Paired t-test was used to analyze the values of all the 4 abdominal muscles at 95% Confidence Interval

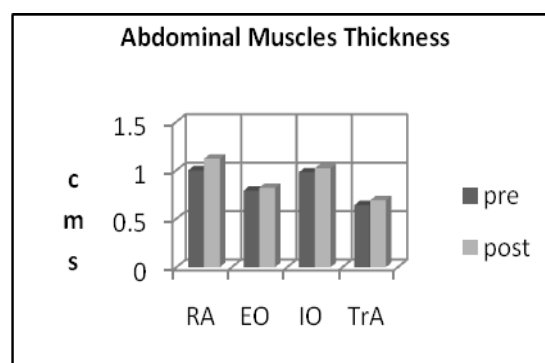
ANNOVA was used for intergroup comparison of rise in the thickness among four abdominal muscles

### RESULTS

All the 4 abdominal muscles showed a statistically significant rise in the thickness following 8 weeks of training in YBM. The statistical paired t test for RA was found as p value 0.000; EO 0.002; 0.005, TrA 0.000

**Table 1:** Comparison of Pretest & Post-test values of Abdominal Muscles Thickness

	RA	EO	IO	TrA
Diff. of means	0.12116	0.3116	0.03442	0.05000
Std Dev	0.1215	0.6314	0.0770	0.06824
Tvalue	6.538	3.236	2.930	4.804
Df	42	42	42	42
P value	0.000	0.002	0.005	0.000



**Fig. 1**

ANNOVA test for Inter group comparison of rise in the thickness among four abdominal muscles showed F value to be 0.001 indicating non-significant difference in performance among four abdominal muscles which means all the muscles showed uniform conditioning effects

## DISCUSSION

YBM is a component of Hathayoga which is primarily used for inducing relaxation & calmness of mind. Hence as per the yogic concept; *unlike spontaneous breathing*, YBM emphasizes on *conscious inspiration and expiration*, that brings about voluntary contractions of the Diaphragm, Abdominal muscles and Intercostals, which connects the conscious and subconscious mind. [24] Scientific literature evidence show that YBM mainly focus on improving various pulmonary parameters of volumes, chest expansion, breath holding time etc and mental well being. However, no study has been found on muscle kinetics to show positive effect of YBM. However, our study found statistically significant improvement in the abdominal muscle kinetics after 8 weeks training in 7 types of YBM. Though inspiration is considered to be active followed by passive expiration during quiet /spontaneous breathing, Izuka (2011) [25] reported abdominal activity during the same, attributing it to neuromotor automatic activity. Irrespective of the type of breathing pattern of YBM, each breath cycle was emphasized on performing slow, controlled and full exhalation, sustaining Inspiratory to expiratory ratio to 1: 2. Moreover, the slow YBM such as Anulom- Vilom, Ujjayi, Bhramari, Sheetal, Seetkari and fast YBM such as Bhastrika & Kapalabhati are associated with active and controlled expiration.

Kapalabhati and Bhastrika are maneuvers which involve strong forceful isometric contractions of the abdominal muscles which may be sustained upto 100 contractions in 1 cycle. This can be correlated to an improved recruitment of

motor units of the abdominal muscles during the fast isometric contractions in Kapalabhati and Bhastrika. This is supported by the findings of DeydreS et al, who studied and found enhanced effects of Deep Abdominal Muscle Thickness During Common Trunk-Strengthening Exercises Using Ultrasound Imaging. [23] Similarly, in a study by Hiroshi Ishida the author found correlation between EO and Peak Expiratory Flow (PEF) when all four abdominal muscle thicknesses was assessed in 23 healthy male volunteers at the end of a relaxed expiration & forced expiration in the supine position. [26] The author in other similar studies also found high correlation between Rectus abdominis muscle thickness and expiratory pressure production than the EO, IO, and TrA muscle thickness. [27] It has also been proven that Fast expiration exercise might be beneficial for increasing expiratory speed and neuromuscular activation of the internal oblique/transversus abdominis muscles compared to forced vital capacity [28] which complements the positive effects of fast YBM, Kapalabhati and Bhastrika on Abdominal muscle thickness

## CONCLUSION

Thus we can conclude that eight weeks training with YBM bring about significant improvement in abdominal muscle thickness correlating to improved strength in the healthy sedentary young subjects. YBM can be used as an adjunct to various abdominal muscles strengthening protocol for promoting health and in disease.

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