

## PHYSIOLOGICAL PURVIEW OF PRANAYAMA IN RESPIRATORY FUNCTIONS OF OVERWEIGHT INDIVIDUALS

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Published online: March, 2019

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### ABSTRACT

*Yoga* is an ancient Indian way of life, which includes techniques such as *yogasana*, *pranayama* and meditation to attain the highest level of consciousness. The science of *yoga* and its techniques have now been reoriented to suit modern sociological needs and lifestyles. Experts of various branches of medicine including modern medical sciences are realizing the role of these techniques in the prevention and mitigation of diseases and promotion of health. *Patanjali* advocated the eight fold path of *yoga*, popularly known as *ashtanga yoga* for all-round development of human beings through which one can attain mental purity and harmony. *Yama*, *Niyama*, *Asana*, *Pranayama*, *Prathyahara*, *Dharana*, *Dhyana*, *Samadhi* are the 8 steps of *Ashtanga yoga*. These steps are supposed to be practiced in a sequential manner. Among that *Pranayama* is a significant part of *yoga* and involves specific breathing techniques. In last decade, *yoga* and meditation became popular all over the world because science was able to demonstrate how they work on body, emotions and thoughts and help in restoring health. *Pranayama* is producing positive results in different systems of our body especially respiratory system by modulating in physiological level. It has three components to it namely controlled inhalation (*puraka*), controlled exhalation (*rechaka*) and holding of the breath (*kumbhaka*). Deep breath during *Pranayama*, tidal volume increases and lungs get more oxygen. The partial pressure of oxygen in lungs increases when inhale deeply after exhaling. When the partial pressure increases, the cells take in more oxygen. Practicing *pranayama* thus has positive effect on respiratory system at physiological level.

**Keywords:** *Pranayama*, Respiratory system, *Puraka*, *Rechaka*, *Kumbhaka*

### INTRODUCTION

*Yogabhyasa*, the study of *Yoga*-Philosophy and practice – has been popular in India since very ancient time. The science of *Yoga* was propounded by sages

thousands of years ago for the welfare of the people. *Maharshi Patanjali*, “The Father of *Yoga*” compiled and refined various aspects of *yoga* systematically in

his “*Yoga Sutras*”. He advocated the eight folds path of *Yoga*, popularly known as “*Ashtanga yoga*” for all round development of human beings through which one can achieve mental purities and harmony. Among those *Pranayama* has significant role in the hierarchy of *yogic* exercise. *Pranayama* is a significant part of *ashtangayoga*. It is performed after the successful practice of *Yama*, *Niyama* and *Asana*. The word *Pranayama* is derived from two words, *prana* and *ayama*. The term ‘*Prana*’ is further derived from the Sanskrit root ‘*Ana*’ with the prefix of ‘*Pra*’ and suffix of ‘*Acha*’ (*shabdakalpadruma* 3<sup>rd</sup> volume). ‘*Prana*’ means breath and ‘*ayama*’ means extension of breath. The word *prana* also indicates the vital energy, which governs the entire function of the body and mind. As long as *prana* flows in an appropriate measurement, life exists. As the flow ceases, life also ends. *Pranayama* is the scientific way of regulating this energy. There is no purificatory action greater than *pranayama*. Referring to *Pranayama*, Patanjali’s *Yoga Sutra* (2:52) state: *Tatah kshiyathe prakasavaranam – ‘Thence the covering of the light is destroyed’*. Here the covering refers to that which obscures the *chitta*, consciousness of the individual. *Chitta* is pure by itself being made of *satwa*, but is obscured by *rajas* and *thamas*, just as fire is enveloped by smoke. This covering is removed by the regular practice of *pranayama*. Thus it is said that *pranayama* purifies the consciousness, and once revealed, the light of knowledge shines.

*Maharshi Patanjali’s Yoga Sutra states* (2:49)

“*Tasmin Sati Swasa praswasayor gativicchedah pranayama*”

*Pranayama* is the pause in the movement of inhalation and exhalation when that is secured. *Patanjali* has defined *pranayama* as regulation of breath or the control of *prana*, which follows after securing that steadiness of posture or seat, *asana*<sup>5</sup>.

- नाभिस्थः प्राणपवनः स्पृष्ट्वा हृदकमलान्तरम् ।  
कण्ठाद् बहिर्विनिर्याति पातुं विष्णुपदामृतम्॥  
पीत्वा चांबरपीयूषं पुनरायाति वेगतः।  
प्रीणयन्देहमखिलं जीवयन्जठरानलम्॥

(शा.पू.५/४४-४५)

*Pranavayu* located at umbilicus, touches inside of heart. From neck, it passes outside and gets back in a very short time, through same route after assimilating *Vishnu padamrutha* or *ambarapiyusha* in itself. This *pranavayu* maintains entire body & it nourishes *jadaragni*

### Classification of *pranayama*

The various *pranayama* are obtained by modulating the process of *Puraka*, *Rechaka* and *Kumbhaka*. Based on these three components *pranayama* are nine:

- *Nadi shodhana*
- *Bhastrika*
- *Kapalabhati*
- *Sheetali / Sheetkari*
- *Bhramari*
- *Ujjayi*
- *Moorcha*
- *Surya bheda*
- *Chandra bheda*

### PHYSIOLOGY OF NADISHUDHI PRANAYAMA

*Nadishudhi pranayama* is a balancing *pranayama* which removes impurities of *nadi*. When the balance between the flow of the right and the left nostril is upset, the *prana* is affected by it, and it results in some sort of ailments. If one wants to restore the balance he should restore the balance between the flows of breath.

### The effect of *Nadishodhana pranayama* on respiratory system:

*Nadishodhana pranayama* does the *shodhana* of *nadis* through which the *pranic* energy flows. By this the *Pranamaya Kosa* also gets cleansed, and components of *Pranamaya Kosa* like *Pancha prana* and *Upapranas* functions properly. *Nadis* are also representatives of *Pranamaya Kosa*, *pranavayu* moves through purified *nadis* and performs the *swasana prakriya* properly. *Nadishodhana pranayama* decrease the work of breathing, strengthens and trains the diaphragm and other respiratory and abdominal muscles, improves gas exchange and oxygenation. Other effects are reduced stress, give more relaxation, give energy

and vitality and improve overall health and well-being.

In the *swasa samprapthi* the flow of *prana vata* gets obstructed by vitiated *kapha*, and it spreads in all direction and vitiates the *pranavaha srotas* also. *Pranayama* destroys the impurities of *nadis* and helps in the proper movement of *prana vata* without any obstruction. When the *prana vata* movement is in proper channel it helps in the proper functioning of digestive fire also. Thus it burns the body fat and by that the *Medovridhi*.

*Nadishodhana* maintains the homeostasis of the body. Hypothalamus is the homeostasis center of our body. Nucleus of the hypothalamus can be divided into *ushna* center and *seetha* center. *Ushna* center includes sympathetic activating center, heart rate and BP accelerator center, heat gain center, punishment center, feeding center, thirst center etc. *Seetha* center includes parasympathetic activating center, heat loss center, satiety center, heart rate and BP inhibiting center etc. *Ushna* center is similar to *vata pitta* in function and *seetha* center to *kapha*. Even though *Ushna guna* decreases *vata*, all other functions of *ushna* center are related to *vata*. Balancing these two centers regulates the function of *Nadi* and by that it corrects *pancha vata*, *pitta* and *kapha*.

Practice of *Nadishodhana* enhances voluntary regulation of the breathing to make respiration rhythmic and it also make the mind calm. During the practice the subject tries to keep his or her attention on the act of breathing leading to concentration which in turn de-stress the subject and improves the pulmonary functions. *Nadishudhi pranayama* is normally done in a relaxed condition in which the demand for oxygen from the body is minimal. It has three components to it namely controlled inhalation (*Puraka*), controlled exhalation (*Rechaka*) and holding of the breath (*Kumbhaka*).

**Various physiological changes occurring during different phases of pranayama are:**

#### **PURAKA PHASE**

During the *Puraka* phase the lungs are expanded considerably and the walls of alveoli are stretched maximum. After a particular degree of stretching, the

stretch receptors situated in the alveolar walls are stimulated. In normal breathing, at the stage or even before this, the inhibitory impulses would have been sent to the inspiratory center and the phase of expiration starts. But as the phase of inhalation is continued by our strong voluntary control, the normal stretch reflex is inhibited and therefore no exhalation is possible. The chest continues to get expanded under cortical control. The stretch receptors are thus trained to withstand more and more stretching. During this phase the intra-pulmonary pressure is raised. The diaphragm does not move freely as the abdomen is kept slightly inward and controlled. Therefore the alveoli in the upper pulmonary part are filled with air. As the venous return increases due to prolonged inspiration, cardiac output increases thereby increasing pulmonary circulation, better ventilation perfusion ratio and better gas exchange. *Puraka* is not merely a mechanical prolongation of inspiration but it is done with full concentration of mind.

#### **KUMBHAKA PHASE**

Retention of air is done under voluntary control of cerebral cortex by inhibiting stretch reflex mechanism. The duration of *Kumbhaka* is gradually increased over a long practice of *pranayama* due to adaptation of respiratory center to higher concentration of CO<sub>2</sub> in blood. During the practice of *Kumbhaka* the oxygen level in the body fall and the carbon dioxide levels increases, depending upon the speed of metabolism. Increased carbon dioxide levels stimulate the brain's capillaries to dilate, and improve cerebral circulation. The brain also stores a certain amount of carbon dioxide, which allows an efficient oxygen exchange and carrying capacity of the lungs. *Kumbhaka* restores the levels of carbon dioxide in the brain tissues, allowing the system to fully extract oxygen (Kandel E.R., 2000). Actually *pranayama* is a practice to increase the duration of *Kumbhaka*, and by this the functional capacity of the lungs is improved and body is adapted to less quantity of oxygen. As the blood circulating in the lungs is more, the opening of the collateral channels during the breath hold, leads to efficient exchange of gases (Dr. Pradnya D. Dandekar)

## RECHAKA PHASE

*Rechaka* is a voluntarily controlled exhalation as compared to normal exhalation. The time, force, ventilation and the flow of air are controlled in order to increase the duration of *Rechaka* as per the time ratio. The exhalatory force is reduced and the air is allowed to escape slowly. For this purpose, exhalation is carried out through one nostril only by creating a slight airway restriction, and one can regulate volume of air to be expelled out per unit of time. This helps in prolongation of exhalation and to reduce the force of outgoing air. In *Rechaka*, one uses expiratory reserve volume for exhaling completely before starting the next *Puraka* phase. In this phase the intra-pulmonary pressure slowly reduces and the alveoli are gradually deflated. By this time when one is exhaling slowly the percentage of carbon dioxide is still increasing in the blood and the chemoreceptors in the medulla are trying to inhibit exhalation and to start inhalation by stimulating the inspiratory center. Similarly the peripheral chemoreceptors are also trying to bring about inspiration in a reflex as they are sensitive to the lower oxygen concentration in the blood. In *Rechaka* the duration of exhalation is prolonged to inhale maximum quantity of fresh air during next inhalation, which offers better gaseous exchange<sup>7</sup>.

## EFFECT OF NADISHUDHI PRANAYAMA ON PULMONARY FUNCTION

In all *Pranayama* procedures the only respiratory parameter that reduces is the rate of respiration and all the other parameters including volumes and capacities increase depending on the regularity of practice.

### Increased strength of respiratory musculature

Regular efficient usage of muscles of respiration causes their bulk to increase and Elastic and Collagen fibers get strengthened and extensibility will increase thereby will allow efficient contractions, improving the inspiratory and expiratory power, cleansing of airway secretions thereby decreasing the resistance to the air flow which will aid in the full and free utility of alveoli<sup>11</sup>.

### Release of lung surfactant and prostaglandins

Lung inflation near to total lung capacity in *pranayama* acts as a major physiological stimulus for the secretion of pulmonary surfactant and prostaglandins.

Pulmonary surfactant increases the lung compliance and prostaglandin reduces the bronchiolar smooth muscle tonicity thereby allowing more and more air to enter into lungs which leads to increase of lung volumes and capacities<sup>8</sup>.

### Stimulation of stretch receptors

Inflation of the lungs nearly to total lung capacity in *pranayama* stimulates the stretch receptors, which reflexively relaxes smooth muscles of larynx and trachea-bronchial tree, thereby improving the lung volumes and capacities<sup>11</sup>.

### Removal of undue tension

Practice of *pranayama* in relaxed state of body and mind, relaxes the skeletal muscles which help the thoracic cage to relax better than before and it will also cause withdrawal of the broncho-constrictor effect by relaxing smooth muscles of bronchi, thereby one can appreciate hike in the values of pulmonary function parameters<sup>8</sup>.

### Decreased rate of respiration

Respiration during *pranayama* practice is under the control of Pneumotaxic respiratory center. Pneumotaxic center will control the Apneustic center which has its role in normal quiet breathing. So this regulated pattern of breathing during *pranayama* may be adopted by Apneustic center in normal quiet breathing leading to decreased rate of respiration<sup>9</sup>

### Extended expiratory period

With a regular practice of *pranayama* dorsal group of neurons responsible for inspiration in normal quiet breathing may be inhibited by Apneustic and Pneumotaxic centers leading to extended expiratory period<sup>10</sup>.

### Increase in the voluntary breath holding time

This may be due to acclimatization of the chemoreceptors of lungs to hypercapnea and hypoxia or decreased responsiveness of respiratory center or increased development of respiratory musculature leading to increased muscle endurance and delayed fatigue<sup>11</sup>.

## CONCLUSION

*Pranayama* is the science of proper breathing. Breath is the main source of nourishment for all the cells of the body and we can't live without oxygen for more than a few minutes. By learning how to increase total lung capacity plus specific *pranayama* practices, we can increase the flow of vital energy to various organs in our bodies, build our immunity to disease, and overcome many physical ailments. By regulating the breath and increasing oxygenation to brain cell, we help to strengthen and revitalize both the voluntary and autonomic nervous system. When practiced consistently, *pranayama* also has a powerful stabilizing effect on the mind and emotions thus promoting calm and relaxation.

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**Source of Support: Nil**

**Conflict Of Interest: None Declared**

How to cite this URL: Pretty P: Physiological Purview Of Pranayama In Respiratory Functions Of Overweight Individuals. International Ayurvedic Medical Journal {online} 2019 {cited March, 2019} Available from: [http://www.iamj.in/posts/images/upload/1639\\_1643.pdf](http://www.iamj.in/posts/images/upload/1639_1643.pdf)