Chapter I

INTRODUCTION

“As long as there is breath in the body, there is life.

When breath departs, so too does life.

Therefore, regulate the breath.”

-Hatha Yoga Pradipika

Yogic techniques are known to improve one’s overall performance and work capacity (Bhattacharya and Krishna, 1960). Yoga appears to provide a comparable improvement in health status (Caroline et al., 2007). Training to yoga respiration selectively increases the respiratory sensation, perhaps through its persistent conditioning of the breathing pattern (Florence et al., 2005). Perhaps one of the most powerful tools in yogic practices is the use of the breath to bring our consciousness back in tune with the Divine Cosmic Breath. Yoga breathing, or Pranayama, is the science of breath control. Pranayama can produce different physiological responses in healthy individuals (Upadhyay et al., 2008). The science of Pranayama is based on the retention of prana called 'Kumbhaka'. Among the many kinds of Pranayama, Suryabhedana, Anulom Vilom and Bhasrika are considered as the significant types of the core structuration of Pranayama.

There are a number of old texts on Yoga such as Patanjali's Yoga Sutra and Yogdarshan, Hatha Pradeepika, Gherandasamhita, Shivasamhita, Gorakashamhita etc. Patanjali follows Yoga of eight limbs whereas the others follow six limbs for Yoga (Shadana Yoga). Basically all follow the same basic principles, the various limbs are described in the scriptures for understanding Yoga in the ultimate analysis.

According to Panini, the Grammarian, the word Yoga is derived from two roots viz. Yujir and Yuja. Yujir referring to yoking (yujir yoga), and Yuja referring to mental concentration (yuj Samadhan) and to sense control (Astdhyayi).\(^4\)

Yoga standing for mental concentration is the theme of the entire Indian system dealing with yoga. Therefore, the second deviation of the word Yoga consists in the stopping or blocking the activities of the mind (PYS)\(^5\). According to Bhagvat Gita, perfection in action is known as Yoga.

Modern is indebted to ancient India for its precious gift of ideology and technology of yoga. The seeds of yoga system may be discovered in the Vedic Samhitas because Vedas are the foundation of Indian culture, philosophy and religion. The Vedas have been generally interpreted as the basis of ritualistic traditions of India, but the spiritual elements are also profusely available in the Vedic hymns. Hiranyagarbha of the earliest Vedic and Upanishads lore is spoken of as the first being to reveal yoga (Mahabharata)\(^6\).

Next to Vedas, the Upanishads are the most important repositories of vedic thought. They have inspired the people to gain spiritual knowledge. The Upanishads represent the body of the spiritual realizations based upon individual experiences. The quest of Upanishads is truth and this quest is more through realization than through intellect. The Prasna Upanishad describes the superiority of the prana to all other senses including the manas. It is said that the whole universe remains under the control of prana (Prasnopanisad)\(^7\). In the Mundoka Upanishad, it is also advised that one should meditate on the self in the form of Om (Mundokapanisad)\(^8\). In the Chandogya Upanishad, there is a detailed discussion regarding the spiritual elements within our organism and in the whole universe. The dialogue takes place between Narad and Sanat Kurma who explains the significance of Chitta to Narad. Since Chitta is the abode of all types of thinking and control over the Chitta is essential for the flower of the path of yoga (Chandogya Upanishad)\(^9\).

\(^4\) Astdhyayi, 3.3.121
\(^5\) Patanjaliyogasutra, 1/2
\(^6\) Mahabharata, 12.35.69
\(^7\) Prasnopanisad, 2-13
\(^8\) Mundokapanisad, 2.2.6
\(^9\) Chandogya Upanishad, 7.5.1
The Puranas form a vast literature of Hinduism. Among the available puranas eighteen are important. Out of these, few puranas give details about yoga. The puranas are many but the one that is most important as a background of a definite spirituality and constructive philosophy is Bhagavata Purana. The Bhagavata Purana explains Bhakti yoga. Linga Purana gives the details about Yama, Niyama and Pranayama. Vayu purana gives details about Pratyahara, Dharana and Dhyana. The Bhagavata indeed opens with the fine emphasis upon transcendent truth from which emerges the life of shadows. Devotion to lord is also a form of yoga because the recitation of the divine name also helps to concentrate the mind. The bhakti yoga and the other forms of yoga are also described in details in all the Purans in general and in the Bhagavat Purana in particular. Through the Bhakti Yoga one can attain the Grace of God (Bhagavata Purana).

The Ramayana consists of 24,000 slokas distributed among seven chapters. The great book of yoga known as Yoga Vasistha, was written in this time in Ramayana. Valmiki wrote his magnum opus in the ideal ornate giving a silent touch of transformation to the feelings. The Ramayana, more than any other scriptures, has been able to maintain freshness of appeal for Dharma. It has done the noble task of raising the nation – wide spiritual tone of society. It is rich in Vedic values. Valmiki’s theme in the Ramayana remains human with a concept of character in which virtues of truth, honour, duty and self-restraint illumine every trying moment and impending doom in the minds of people. In the great system of yoga Tulsi Das’s Bhakti Yoga the same three means (devotion, love and surrender) or self-guidance are employed in different order aiming at maturity of mind and self realization. Consistency of effort is essential in Yoga-Sadhana. Continuous toil with strong interest is considered to be very important and helpful for an early success in attainment of the Chief Goal, Patanjali, the great sage has said (PYS).

The Mahabharata has been declared as the treasure of knowledge. Its author himself says that whatever is not here is nowhere. According to the Mahabharata, it is assumed that the system of Yoga started from Brahma himself. His son Vasistha was called so because he had controlled his mind and mastered his senses, without sense -

10 Bhagavata Purana, 1.1.1
11 ibid, 1.9.23
12 ibid, 3.28.9
13 Patanjaliyogasutra, 1/21
control, no yoga was possible. Self-control has been described in the Mahabharata as the highest duty for the wise and the man of tapas (Mahabharata)\textsuperscript{14}.

The book, which has been and is still the main spring in Hindu life, is the Bhagwat Gita. As the part of the Mahabharata, it has been treated as a separate book of Indian spirituality. It is generally said that the Upanishads are the Cows, the milkman is Krishna and milk is the Gita. The Bhagawat Gita is known as jewels of the Mahabharata which give the definition of Yoga. All the 18 chapters in the Gita are designated as the types of yoga to train the body and mind. The 18 chapters are reduced into 4 chapters—the Karma Yoga, the Raja Yoga, the Bhakti Yoga and the Jnana Yoga. Traditions lay down that the spiritual life begins with karma yoga, perfection in action. But the action is the duty of man (BG)\textsuperscript{15}. The karma yoga of the Gita is a unique philosophy of action and it declares that the nature has given the right of action to man only and the right of the result of action is under the authority of nature (BG)\textsuperscript{16}.

The Prana word is found in Vedic dictionary. It has been used in the same meaning in Indian literature. Usually Prana has been translated as breath in English. Breath means to inhale while Prana is different from breath. Swami Vivekanand has translated the word Prana as psychic force which is not correct but is nearer to the exact meaning of the Prana.

Etymologically the word Prana is combination of two words, pra and ana. According to Sanskrit grammar the word Prana has been derived from the root Anprane. Prana is that which is brought forcefully or in a special manner. Thus Prana is the vital energy of Universe which pervades in the whole body. All created forms are dependent on Prana whether they may be human, animal, plant or mineral.

Bodily Prana first evolves as mind in the brain, \textit{Akasa} in the region of throat, \textit{Vayu} in the region of heart, \textit{Agni} in the region of naval, \textit{Jala} in the region of testies and \textit{Prithvi} in the region of perineum. According to Hathapradipika, \textit{Prana} and \textit{Chitta} are intricately related to each other. Here \textit{vayu} is synonyms with Prana and is used for

\begin{itemize}
\item \textsuperscript{14} Mahabharata, 1.181.13
\item \textsuperscript{15} Bhagwat Gita, 2/50
\item \textsuperscript{16} \textit{ibid}, 2/47
\end{itemize}
air. If the Prana ceases to work means death (HP II/3)\(^\text{17}\). According to Hathapradipika if the prana is controlled, the Chitta will also be controlled and if the Chitta is controlled the Prana will be automatically controlled. All types of vibrations and fluctuations come to a standstill when Prana and Chitta are steady and silent. Wise yogis studied this connection between breath and consciousness and advocated the practice of Pranayama to stabilize energy and consciousness (HP II/4)\(^\text{18}\).

Pranayama is an important and integral part of Yoga sadhana. Etymologically the word Pranayama has been derived from the combination of two Sanskrit words Prana and Ayama. Prana means subtle life force which provides energy to different organs, mind also controls many vital life processes. Ayama means expansion, control and extension. The practice of Pranayama is emphasized in almost all the traditional scriptures. According to Yogic terminology a systematic process by which one gains control over Prana is referred to as Pranayama. Pranayama constitutes fourth step of eightfold of Yoga described in the Patanjaliyogasutra\(^\text{19}\) and occupies second place in Hathapradipika\(^\text{20}\) and fifth place in Gherandasamhita\(^\text{21}\). According to Patanjaliyogasutra, Pranayama is a cessation of the movement of inhalation and exhalation (PYS)\(^\text{22}\).

The relation of the three components of Pranayama i.e. Puraka, Kumbhaka and Rechaka is described by many of the traditions. So in this connection the most favoured view is to have the duration of Puraka, Kumbhaka and Rechaka in the proportion of 1:4:2. According to another tradition, this proportion should be 1:2:2. There is a third tradition which lays down the same measure (1:1:1) for all the three parts of Pranayama.\(^\text{23}\)


\(^{19}\) Patanjaliyogasutra (PYS)


\(^{22}\) Patanjaliyogasutra, PYS II/49

Different phases of Pranayama

Pranayama consists of three processes - Puraka, Kumbhaka and Rechaka. Kumbhaka is further classified into Sahita and Kevala. Sahita is to be practiced until one attains Kevala Kumbhaka (HP II/71). 24

Puraka (Complete inhale) is just as a man sucks in water through the stem of a lotus so should breath be drawn in. Rechaka (Complete exhale) consists in giving out, through the nostrils, the impure air from the lungs. Kumbhaka (Complete hold of breath) is to keep still without breathing in or breaking out, nor move any limb. When Pranayama is done with Puraka and Rechaka, it is called Sahitakumbhaka. Sahita kumbhaka is classified into two categories - Sagarbha and Nigarbha. Kumbhaka while repeating a Bja Mantra is Sagarbha and that without such repetition is Nigarbha (GS V/47). 25 Pranayama, without any Puraka and Rechaka in which the breath is retained without making any effort, is known as KevalaKumbhaka (HP II/72). 26

Puraka Phase or inspiration phase

During the phase of Puraka the lungs are expanded considerably and the walls of alveoli are stretched to the 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 inspiration center and the phase of exhalation would have been started in a reflex. But as we continue the phase of inhalation 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 also raised. The diaphragm does not move freely as the abdomen is kept slightly inward and controlled. Therefore, the alveoli in the upper pulmonary part is filled with air. One uses the inspiratory capacity for prolonged phase of puraka. This has a beneficial effect on the gaseous exchange, which then works efficiently throughout

the day. Puraka is not merely a mechanical prolongation of inspiration but is done with full concentration of mind (Gore, 2008).

**Kumbhaka Phase**

Kumbhaka is a voluntary suspension of breath. After a particular stage in Puraka, as per the time series observation, one stops inhalation and retains the inhaled air in the lungs for proportionate time. The intra-pulmonic pressure (in alveoli), which is raised to one's optimum capacity, is maintained during Kumbhaka phase. The alveoli and the bronchioles are stretched to their optimum level. The stretch receptors, however, cannot bring about the reflex contraction of the lungs, and the respiratory muscles cannot relax as they do normally, due to strong motor control (Gore, 2008).

**Rechaka Phase or expiration phase**

Rechaka is a voluntarily controlled exhalation as compared to normal exhalation. The time (duration), 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, thus by creating a slight airway restriction, 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 chemo receptors in the medulla are trying to inhibit exhalation and to start inhalation by stimulating the inspiratory center. Similarly, the peripheral chemo-receptors are also trying to bring about inspiration in a reflex as they are sensitive to the lower oxygen concentration in the blood (Gore, 2008).

Nadi literally means 'flow or current'. In the ancient texts it is mentioned that there are seventy two thousand nadis in the psychic body of man. These are visible

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28 *ibid*, p 174
29 *ibid*, pp 177-178
like currents of light to a person who has developed psychic vision. In recent times the word *nadi* has been translated as nerve, but actually nadis are not nerves as we know them, for they are composed of astral matter. Like the chakras they are not located in the physical body, though nerves of the physical body can be considered as their corresponding physical manifestations. Nadis are the subtle channels along which the vital forces of prana flow. Out of the large number of nadis in the psychic body, fourteen are more important, and of these three are the most important namely Ida, Pingala and Sushumna. All the nadis are subordinate to sushumna including the three mentioned above. Sushumna nadi runs within the spinal cord, from mooladhara chakra at the bottom to ajna chakra at the top. It is silvery in colour. Emanating from the left side of mooladhara and passing through each chakra in turn in a curving path, finally ending on the left side of ajna chakra, is ida nadi, blue in color. Emanating from the right side of mooladhara and passing in an opposite manner to that of ida, up to the right of ajna, is pingala nadi which is fiery red in colour. Ida and pingala are the pathways of the two polar opposites of life force flowing within us (Kuvalyananda, 2010).³⁰

Ida is negative, and is also called the moon (chandra) nadi, while pingala is positive and is called the sun (surya) nadi. These force currents in ida, pingala and sushumna operate alternately and the current that is flowing at any particular time can be determined by noting the flow of breath in the nostrils. If the left nostril has a greater flow of air, then ida nadi is predominant. When the flow is greater in the right nostril, pingala is predominant. If the flow is equal, then sushumna is ruling (Kuvalyananda, 2010).³¹

Suryabhedana comes from the two roots. Surya is the ‘sun’ and Bhedana comes from the root ‘bhid’, which means to crush, break, or transmitted through. In Surya Bhedana Pranayama, breath is inhaled through the right nostril. In other words, Prana passes Surya or Pingala Nadi. Kumbhaka be out of breath and then exhaled through the left nostril which is the way to Ida Nadi (Joshi, 1983).³²

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³⁰ Kuvalyananda (2010). *op. cit.*, p 59
³¹ *ibid.*, pp 58-64
Technique of Suryabhedana Pranayama

Sitting in any comfortable position as Padmasana or Siddhasana, keep your back erect and rigid. Rest your chin groove between the collar bones. Stretch the life of grace. Rest in the back left wrist with his left knee. Jnana Mudra is made with the left hand. Bend your right arm at the elbow. Bend the forefinger and middle finger on the palm side, keeping them inactive. Bring the ring and little finger towards the thumb. Place the right thumb on the right side of the nose just below the nasal bone, the ring and little fingers on the left side of the nose just below the nasal bone, just above the curve of the fat in the nostrils. Press the ring and little finger of the left to block the nose completely. With right thumb, press the right side of the body fat. Now inhale slowly and deeply controlled by the aperture closer to the right nostril, tip your thumb nail. Lungs filled to the brim (whoppers), block the right nostril so that both are now blocked. Hold your breath for seconds (Antara Kumbhaka). Keeping your right nostril completely blocked, open the left nostril and exhale through the partly slowly and deeply. This completes the one cycle of Suryabhedana Pranayama. Continue straight over the cycle for 5-10 minutes, depending on the capacity. The whole process of the movement of air is felt in the fingertips and thumbs and nose membranes, where the pressure is applied. Air movement makes a sound similar to air escaping from the cycle of the pipe. This sound pressure must be kept constant throughout the different nostrils. Eyes, temples, eyebrows and forehead skin should be completely passive and should not seem to strain. The mind must be completely absorbed in listening to the sound of air movement and the right to maintain a proper rhythm of breathing. Each inhalation and exhalation should last just as long. Inhalation and exhalation should not be forced. Even with a slow rhythm they should be maintained throughout. Savasana is lying down after graduation draws Pranayama. Focus sure and be aware that you are actively breathing right nostril (Joshi, 1983).33

The first two fingers of the right hand are to be curved and last two fingers are to be kept straight and to be held together. Now straighten the thumb and bend the right hand in the elbow, place the curved fingers in such a way that they come near the lips. Keep the hand from shoulder to elbow glued to the chest and right hand thumb on the right side of the nose and last two fingers on the left side of the nose.

Now by pressing the thumb, the nasal cavity on the right side can be closed and by pressing the last two fingers left side cavity can be closed. The pressure should be light on just below the nasal bone, where the fleshy part begins. With this arrangement of the fingers, one can close any of the two nasal cavities. Here only the movement of thumb and the last two fingers is expected. It is called Prana Mudra.

Movement of other parts should be avoided. The face should be kept quite gay and relaxed in order to practice breathing more effectively. The left hand should be kept in Dhyana Mudra and the right hand in Pranava Mudra. The eyes should be closed and the whole attention should be concentrated on breathing.

During practice suryabhedana pranayama we use Jalandhar Bandh. However, one may guess that Rishi Jalandhar might have defined the act of this bandh for the first time, and the same was named after him. If we try to trace the meaning of the word Jalandhar, "Jal" means "Net", in this case, net of Nadis (energy channels) and the word "Dhar" means to stop or to hold the flow of the fluid (Amrut), flowing through the nadis. This bandh can be achieved without getting into any asana pose. But generally, it is studied in Padmasan or any other asana specified for Dhyana process. Padmasana or Siddhasana are considered as the best positions to practice this bandh. To practice this bandh, neck is to be bent a little. It is to be pressed onto the depression just as a spring is pressed with a little force. The release of the force brings the spring back into normal position. The same principle is to be applied in this bandh. Since all the muscles of the neck and the throat are contracted totally, a force is exerted onto the seven paths in the throat. The presence of the force interferes with the breathing process. Hence, this bandh is to be attained after Puraka and is to be released before Rechaka. The bandh is necessary in Kumbhaka (Gore, 2008).

There are numbers of Pranayama in yoga sadhana according to various yogic scriptures. Hathapradipika suggests eight pranayama i.e. Suryabhedana, Ujjayi, Sitali, shitkari, Bhastrika, Bhramari, Mureccha and Plavani.

In Suryabhedan, all the inhalations are done through the right nostrils and all the exhalations are done through the left nostrils. Kumbhaka is to be practiced until one feels the retention up to the hair and tips of the nails (HP II/48-49). Take in

through the right nostrils the external air according to capacity and great effort retain it by means of Jalandharbandha, continue the kumbhaka till heat is felt right up to the tips of nails and roots of hair (GS V/58-59).

In Ujjaiyi, it is referred that closing the mouth, one should slowly draw in air through both the nostrils, producing a sound in such a way that its touch is felt from the throat to the chest (HP II/51). Draw in air by both the nostrils, hold it inside contracting the chest and throat and then moving the air in the mouth and bending the neck perform jalandharbandha and retain the breath as long as one can do it with ease (GS V/64-65).

In Ujjaiyi through the mouth the sound sit should be produced (while inhaling), and exhalation should be done only through the nose. By practicing assiduously in this manner one (the Yogi) becomes a second cupid (HP II/54).

In Sitali, inhaling by (manipulating) the tongue Kumbhaka (retention of breath) should be performed, as before, and then the wise (Yogi) should exhale through both the nostrils (HP II/57). Draw in air by the tongue and fill the chest slowly, and performing Kumbhaka for a short time, exhale through both the nostrils (GS V/68).

Bhastrika means ‘bellows’ in Sanskrit. Rapid succession of forcible expulsion is a characteristic of Bhastrika. In Bhastrika, Getting settled in Padmasana, the wise should, with the neck and body held erect, close the mouth and effort fully exhale through the nostrils, making a sound, so that exhalation is felt in the chest, throat and (upper part of the) skull; then he should breathe quickly till the (inhaled) air reaches the cardiac region i.e. the lungs (HP II/60-61). As the bellows of the blacksmith is inflated again and again, similarly steadily move the air in and out using both the nostrils. Doing so twenty times, perform kumbhaka and then exhale in the manner laid down (GS V/70-71).

The word Bhramari is derived from ‘Bhramara’ which means a black bee. While practicing this kumbhaka, a humming sound is produced through the nostrils which resembles the buzzing of black bee so it is called Bhramari. In Bhramari, a sound resembling the hum of a male bee (and after performing Kumbhaka) slow exhalation, producing the very low hum of a female bee, an indescribable blissful experience fills the mind of eminent Yogis (HP II/68). When it is mid-night, in a place where there are no sounds of any living creatures etc., let the Yogi practice Puraka and kumbhaka, closing the ears by the hands, then he should listen by the right ear to welcome internally aroused sounds of cricket, flute, thunder, cymbals, bigbee, bell, gong, trumpet, one sided drum, double sided drum in the order (GS V/73-75).

In Murccha, at the end of Puraka (inhalation) one (the aspirant) should adopt a very firm Jalandhara (Bandha) and exhale slowly. This is known as Murccha (Kumbhaka). It leads to loss of (all) awareness and gives pleasure. By performing kumbhaka comfortably, fixing the mind between the eye-brows inside and detaching oneself from all objects there arises enjoyable tranquility of the mind. When the mind joins with Atman, verily it results in bliss (GS V/78).

In Sanskrit Murccha means a suspension stage of all mental activities.

In Plavani, with the stomach completely filled with a liberal quantity of air introduced (through the mouth and the oesophagus), a Yogi easily floats like a lotus leaf even on the deepest water (HP II/70). In Sanskrit, Plavani means to float.

By proper practice of Pranayama all diseases are annihilated. Several diseases like hiccup, asthma, cough and pain in the head, ear and the eyes, develop from a disorder of Pavana. One should exhale, retain and inhale in a regulated manner and should in this way attain success (in Pranayama). When the Nadis get purified, appearance of external signs like slimness of the body and luster, are certain. By purifying the Nadis one is able to retain breath with ease; the (gastric) heat is increased; and experience of (internally aroused)
sound and good health are secured (HP II/16-20).

By (practicing) Kumbhakas Kundalini is aroused; and the passage of Sushumna is cleared from all obstacles and success in Hatha Yoga is achieved (HP II/75).

Slimness of body, luster on the face, clarity of voice, brightness of eyes, freedom from disease, stimulation of gastric heat and purification of the Nadis are the marks of success in Hatha Yoga (HP II/78).

Pranayama is a systematic practice of respiration which makes the lungs stronger, improves blood circulation, and makes the individual healthier. If this exercise of respiratory system is done regularly and efficiently, it leads to increase in respiratory stamina, relax the chest muscles, expand the lungs, raise energy levels, calm the body and also cause marked improvement in lungs functions.

As a technique, pranayama can assume rather complex forms of breathing, but the essence of the practice is slow and deep breathing. Such breathing is economical because it reduces dead space ventilation. It also refreshes air throughout the lungs, in contrast with shallow breathing that refreshes air only at the base of the lungs (Bijlani, 2004).

Pranayama breathing has been shown to alter autonomic activity. A study by Udupa et al. (1975) indicate that pranayama training produces a decrease in basal sympathetic tone. Raghuraj et al. (1998) have reported that Nadi-shodhana pranayama increases parasympathetic activity. Slow and deep breathing itself has a calming effect on the mind and helps an individual to de-stress (Sandeep et al., 2002).

Pranayama is an important part of yoga sadhana. Its technique has been practiced for centuries by ardent students of yoga in remote ashrams, and has been preserved for us through many generations both in practice and in hand written books. During the last three decades the subjects such as yoga, pranayama, meditation and even kundalini are being discussed all over the world not only by the yoga teachers.
but also by the general public and scientists. It has been proved beyond doubt that pranayama is a very important means of preventing and curing many ailments\textsuperscript{56}.

Normal quite breathing is very shallow as compared to pranayamic breathing. In successive deep breathings one can inhale and exhale more than four litres of air each time. But in normal breathing only one eighth of this capacity is used. In pranayama one breathes to one’s full capacity every time, filling and emptying the lungs to the maximum possible extent. All the alveoli are stretched fully in puraka and shrink fully in rechaka. This promotes blood circulation in all the parts of the lungs and helps diffusion of gases on a larger scale. Normally the upper portion of the lungs near the apex does not expand and contract appreciably in shallow breathings. In pranayama they are also filled and emptied. It is observed that any part of our body which remains inactive for a long time loses its tone and efficiency, its blood circulation becomes sluggish. There may be congestion of blood and accumulation of waste materials which makes the concerning organ more prone to infection and decay. Lung-affections like tuberculosis is, thus, more commonly observed in the upper parts which are comparatively inactive. Pranayama can surely be said to remove this possibility; of course, it is neither necessary nor desirable to fill the lungs completely in each breath all the twenty four hours of the day. That would certainly be very hazardous. But a few rounds of pranayama each day are certainly very useful for maintaining the respiratory system in a healthy condition (Joshi, 1986)\textsuperscript{57}.

The respiratory system is directly influenced by pranayama due to every part of the lungs being filled completely, the walls of the alveoli being stretched and relaxed alternately, due to changes in the ventilator rate and pressure in the two cavities, and the training of the respiratory centre. Pranayama helps to increase the vital capacity and strength of the respiratory muscles. An obvious result of this is more efficient breathing. Cleaning of the respiratory passage is one of the important benefits of pranayama. Owing to all these effects, pranayama has a great therapeutical value for the treatment of disorders of the respiratory tract. It is also one of the best preventive measures in case of these and other disorders (Joshi, 1986)\textsuperscript{58}.

\textsuperscript{56} K. S. Joshi (1983), op. cit, p 9
\textsuperscript{57} K. S. Joshi (1983), op. cit, p 111
\textsuperscript{58} K. S. Joshi (1983), op. cit, p 119
There have been many studies on yoga and its effects on physical and physiological function (Hadi, 2007) but with the phenomenal and ever increasing popularity of Pranayama in the past few years, there is a lack of studies on this particular discipline and as a result the present study has been undertaken to examine the effects of Suryabhedana Pranayama with different ratio of Puaraka, Kumbhaka and Rechaka on the respiratory and circulatory functions. In Suryabhedana Pranayama, all the inhalations are done through the right nostrils and all the exhalations are done through the left nostrils (Hathapradipika\textsuperscript{59}).

\textsuperscript{59} Digambarji & R. N. Shastri (1998). \textit{op. cit.}
OBJECTIVES OF THE STUDY

- To compare the effect of different ratios of Puraka, Kumbhaka and Rechaka in Suryabhedana Pranayama on selected circulatory and respiratory function.
- To compare the effect of different time durations of Suryabhedana Pranayama with different ratios of Puraka, Kumbhaka and Rechaka on selected circulatory and respiratory function.
- To identify and compare the pattern of improvement in different ratios of Puraka, Kumbhaka and Rechaka in Suryabhedana Pranayama in different time durations on selected circulatory and respiratory function.

RESEARCH QUESTIONS

In respect to the purpose of the study the following research questions were formed:

- Whether there is an effect of different ratios of Puraka, Kumbhak and Rechaka in Suryabhedana Pranayama on selected circulatory and respiratory function, irrespective of different time durations?
- Whether there is an effect of different time durations of Puraka, Kumbhak and Rechaka in Suryabhedana Pranayama on selected circulatory and respiratory function, irrespective of different ratios?
- Whether, there is an interaction effect between different time durations and different ratios of Puraka, Kumbhak and Rechaka in Suryabhedana Pranayama on selected circulatory and respiratory function?

DELIMITATIONS

- The study was delimited to eighty male school students, age ranging between 11-15 years.
- The training period was delimited to 8 weeks.
- The study was delimited to three different ratios of Puraka, Kumbhaka and Rechaka in Suryabhedana Pranayama i.e. 1:1:1, 1:2:2 and 1:4:2.
- The study was also delimited to following variables of respiratory and circulatory function:
Respiratory variables
1. Positive Breath Holding Time (PBHT)
2. Respiratory Rate (RR)
3. Peak Expiratory Flow Rate (PEFR)
4. Vital Capacity (VC)
5. Forced Vital Capacity (FVC)
6. Maximum Voluntary Ventilation (MVV)
7. Forced Expiratory Volume in First Second (FEV-1)

Circulatory variables
1. Systolic Blood Pressure (SBP)
2. Diastolic Blood Pressure (DBP)
3. Resting Heart Rate (RHR)

LIMITATIONS
- Extra practice, if any, of the subjects in case of highly motivated individuals, with the desire to perform better than others, could not be controlled and considered as one of the limitation for the study.
- Effect of social and psychological stress on the subjects during tests could have also altered the results to some extent.

HYPOTHESES

On the basis of literature reviewed, experts' opinion, objectives, observation and scholars own understanding, the following hypotheses were formulated:

1. In each of the selected circulatory and respiratory function, there will be a significant difference among the different ratios of Puraka, Kumbhaka and Rechaka in Suryabhedana Pranayama, irrespective of different time durations.
2. In each of the selected circulatory and respiratory function, there will be a significant difference among the different time durations of Puraka, Kumbhaka and Rechaka in Suryabhedana Pranayama, irrespective of different ratios.
3. There will be a significant interaction effect between time durations and different ratios of Puraka, Kumbhaka and Rechaka in Suryabhedana Pranayama on selected circulatory and respiratory function.

DEFINITION AND EXPLANATION OF TERMS

Pranayama

Pranayama consists of modifications of the breathing process which we bring about deliberately and consciously in a sitting posture which is steady and comfortable.\(^6^0\). Pranayama is a conscious prolongation of inhalation, retention and exhalation\(^6^1\).

Suryabhedana Pranayama

In Suryabhedana, all the inhalations are done through the right nostrils and all the exhalation are done through the left nostrils\(^6^2\).

Puraka

A Puraka in Pranayama is the act of controlled inhalation which should be deep, complete and a slow act, there being no extra force applied for sucking the air in\(^6^3\).

Kumbhaka

A Kumbhaka in Pranayama is involved in stopping all movements of breath by holding all the respiratory apparatus tight and still\(^6^4\).

\(^6^0\) K. S. Joshi (1983). *op. cit.* , p 11
\(^6^3\) K. S. Joshi (1983). *op. cit.*, p 52
\(^6^4\) *ibid.*, p 54
Rechaka

A Rechaka in Pranayama is the act of controlled exhalation which is slow, deep, uniform and complete in equal time in each round. At the end of a rechaka, the lungs should be emptied to the maximum, their tissues contracting as much as possible\(^{65}\).

Jalandhara Bandha

Jalandhar Bandha means chin lock. In this, the head is bent and the chin is pressed firmly on the jugular notch. Owing to this sharp bend of neck, the internal and external carotid arteries, carotid sinuses and sinus nerves are pressed. This specific neuromuscular action around the front side of the neck influences the circulation, nervous function and the glandular secretion\(^{66}\).

Positive Breath Holding Time

Positive breath holding time has been defined as an individual’s ability to hold breath after a voluntary forced maximal inhalation.

Respiratory Rate

Respiratory Rate is the number of beats taken in a minute or number of inspiration / expiration in a minute\(^{67}\). The Average respiratory rate reported in a healthy adult at rest is usually given as 12–18 breaths per minute\(^{68}\).

Peak Expiratory Flow Rate

It is the maximal flow (or speed) achieved during the maximally forced expiration initiated at full inspiration, measured in liters per minute with a peak flow meter\(^{69}\).

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\(^{65}\) K. S. Joshi (1983). *op. cit.*, pp 52-54

\(^{66}\) ibid., p 176


Vital Capacity

It is the maximum amount of air one can expel from the lungs after a maximum inhalation. A normal adult has a vital capacity between 3 and 5 litres.\(^{70}\)

Forced Vital Capacity

The determination of the vital capacity from a maximally forced expiratory effort.\(^{71}\) It is the volume of air that can forcibly be blown out after full inspiration, measured in liters. FVC is the most basic maneuver in spirometry tests.\(^{72}\)

Maximum Voluntary Ventilation

The volume of air expired in a specified period during repetitive maximal effort.\(^{73}\) It is a measure of the maximum amount of air that can be inhaled and exhaled within one minute. For the comfort of the patient this is done over a 15 second time period before being extrapolated to a value for one minute expressed as liters/minute. Average values for males and females are 14–18 and 8–12 liters per minute respectively.

Forced Expiratory Volume in First Second

FEV\(_1\) is the volume of air that can forcibly be blown out in one second, after full inspiration. Average values for FEV\(_1\) in healthy people depend mainly on sex and age.\(^{74}\)

Blood Pressure

The blood pressure is the pressure on the walls of the arteries when the blood moves in them. It is different during the contraction known as systolic blood pressure and relaxation of heart is known as the diastolic blood pressure.\(^{75}\)


\(^{71}\) I. Beardsell et. al. (2009). *MCQs. Royal Society of Medicine Press.*


\(^{73}\) I. Beardsell et. al. (2009). *op. cit.*

\(^{74}\) L. L. Perez (2013). *op. cit.*

Resting Heart Rate

Resting heart rate is the number of times the heart beats per minute in resting condition. The typical resting heart rate in adults is 60–80 beats per minute.\(^7^6\)

SIGNIFICANCE OF THE STUDY

- The result of the study may highlight the efficacy of different variations or ratios of Puraka, Kumbhaka and Rechaka in Suryabhedana Pranayama in relation to time duration for the selected circulatory and respiratory function.
- This study may help the Yoga Instructors and physical education teacher to develop training schedule based on the difficulties of different variation of Suryabhedana Pranayama to achieve excellence.
- The findings of this study may give certain guidelines based on different ratios or variations in Suryabhedana Pranayama.
- Suryabhedana Pranayama with specific ratio of puraka, kumbhaka and rechaka may be a part of an effective fitness program for the society.
- The findings of the study may add new knowledge in the field of Yoga and Physical Education.
- The result of the study may give us scientific reasons to analyze the improvement in circulatory and respiratory function.