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Yoga and Pranayama to Improve Respiratory Pressure, Pulmonary Function and Boost Immune Responses to Combat the Present COVID-19 Pandemic

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Abstract

Corona virus disease 2019, a novel pneumonia is shaking the entire world. This pandemic is caused by a novel corona virus, SARS-CoV-2, a dreadful virus thought to be spread from bats to humans via pangolins. First reported in Wuhan, Hubei province of China, the virus has spread to around 213 countries across the globe infecting lakhs and lakhs of people. The virus mainly spreads by droplets coming from the coughing, sneezing activities, by touching the infected surfaces, person to person contact etc., causing severe respiratory problems. Scientists across the globe are working hard to prepare potential drug candidates and vaccines to target this novel virus. As the virus mainly infects lungs and causes severe respiratory illness, increasing the lung capacity by improving respiratory pressure and pulmonary function will help protect and save the lives of the people from severe ill effects of the SARS-CoV-2 infection. In addition, the people with compromised immune system are mainly prone to severe infection. Yoga and Pranayama are the best solutions to improve pulmonary function and to boost the immune system. The main purpose of the present article is to raise awareness amongst the public regarding the importance of Yoga and Pranayama in improving the respiratory function and as well in boosting the immune system to fight against this novel corona virus.

Keywords: Corona Virus Disease 2019; SARS-CoV-2; Respiratory Pressure; Pulmonary Function; Immune System; Yoga; Pranayama.

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Introduction

Now the entire world is fighting against a dreadful virus, SARS-CoV-2, which is infecting lakhs and lakhs of people across the globe. The first report on infection by this virus was on 30th December 2019 in Wuhan city, Hubei province of China.[1] Rapid spreads of this virus thereafter to various countries make the WHO (World Health Organization) to declare the outbreak as Public Health Emergency of International Concern on 30th Jan 2020. WHO named this virus temporarily as 2019-nCoV (2019 novel corona virus)[2] and the disease caused by this virus as COVID-19 (Corona virus disease 2019). The virus belongs to the beta-corona virus group of family coronaviridae, showing similarities with SARS-corona virus that caused a SARS pandemic in 2002 and is therefore permanently named as SARS-CoV-2 by WHO. Both SARS-CoV that caused 2002 pandemic and SARS-CoV-2, responsible for 2019 pandemic were recognized from the same country i.e. China. Between November 2002 and August 2003 SARS-CoV infected 8422 cases resulting in 919 deaths with a case-fatality rate of 11% and the virus spread to 32 different countries.[3] From the first infection that was reported in December 2019, the SARS-CoV-2 has infected 2,510,177 people with 172, 241 confirmed deaths and has spread to 213 countries, areas or territories (report by WHO as on 23rd April 2020; https://www.who.int/

emergencies/diseases/novel-coronavirus-2019). The virus has a broad range and infects humans, bats, birds, mice, snakes and other animals.[4,5] Bat species are reported as reservoirs of this dreadful virus and transmits the virus to humans through intermediate hosts.[6,7] Pangolins were thought to be the intermediate hosts in the spread of SARS-CoV-2 from bats to humans.[8] Fig. 1 shows the mode of transmission of SARS-CoV-2.

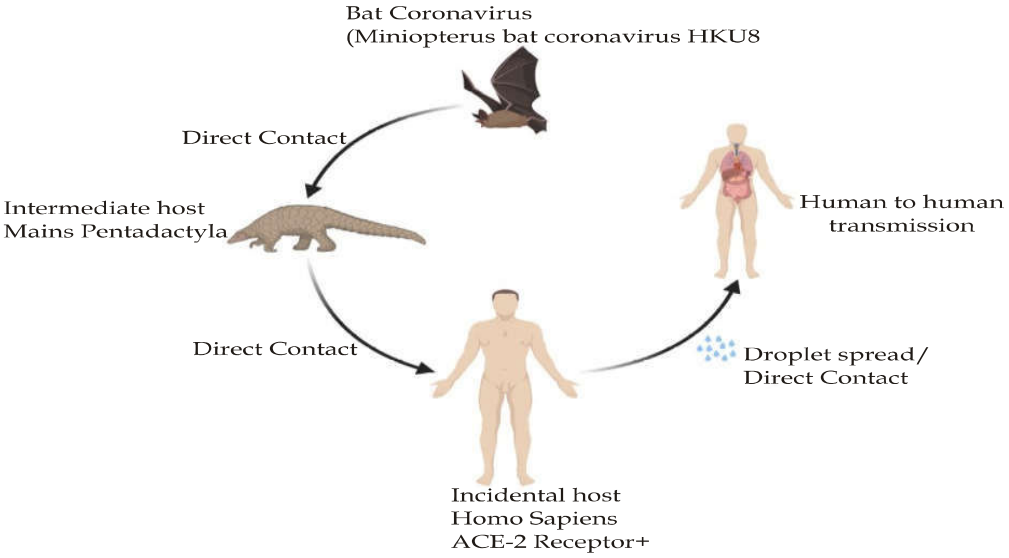
The virus mainly spread by the droplets coming from the coughing, sneezing activities, by touching the infected surfaces, person to person contact (shaking hands, hugging), hidden transmission (Infected asymptomatic persons known as carriers unknowingly involve in transmission of virus to unsuspecting individuals).[9,10,11,12] To date, we know that 80% of infected person's exhibit mild to moderate symptoms like cough, high fever and only around 20% of the infected patients develop severe symptoms such as pneumonia and acute respiratory distress syndrome (ARDS).[13, 14, 15]

Genome sequencing studies of SARS-CoV-2 revealed 88% sequence similarity with two bat-derived SARS-like CoV, suggesting its origin from bats and SARS-CoV-2 also shared 79.5% sequence identity with SARS-CoV.[7,16] SARS-CoV-2 is a positive-strand RNA virus and the genome codes for four main structural proteins viz., the spike protein (S), nucleocapsid protein (N), membrane protein (M), and the envelope protein (E).[15] The structure of SARS-CoV-2 is shown in Fig. 2.

The key protein that facilitates entry of virus into the target cell is 'S' protein and it is a transmembrane protein with a short intracellular tail, a transmembrane anchor, and a large ecto domain. The ecto domain consists of 2 sub units, S1 subunit, meant for receptor binding and a S2 subunit meant for membrane-fusing.[17] The two CoV strains (SARS-CoV and SARS-CoV-2) use the same host receptor to gain entry into the target cell, as is evident from the amino acid sequence analysis of 'S' protein.[18] ACE-2 (Angiotensin-Converting Enzyme 2) is the receptor used by SARS-CoV[19] and also by the SARS-CoV-2. Fig. 3 shows the interaction between SARS-CoV-2 and ACE-2 receptor on the target cell.

The key cells involved in ACE-2 expression are the renal tubular epithelium, vascular endothelial cells, and in Leydig cells (testes)[20,21] and also expressed in the lung, kidney, and gastrointestinal tract.[22, 23, 24]

If we look at the action of virus, the virus mainly infects respiratory system either by droplets, respiratory secretions or via direct contact and causes serious respiratory illness.[25] The virus was also isolated from faecal swabs and as well from blood indicating multiple routes of transmission.[26] ACE-2 receptors are abundant on lung alveolar epithelial cells and enterocytes of small intestine[27] indicating these are the prime sites of infection. The incubation period of the virus is 1–14 days, mostly 3–7 days and during the latency period the virus is contagious.[28]



Source: Contributed by Rohan Bir Singh, MD; made with Biorender.com

Fig.1: Depicts the transmission cycle of SARS-CoV-2 from bats to humans via Pangolins. The person to person transmission occurs through droplets coming from the coughing and sneezing activities and person to person contact.

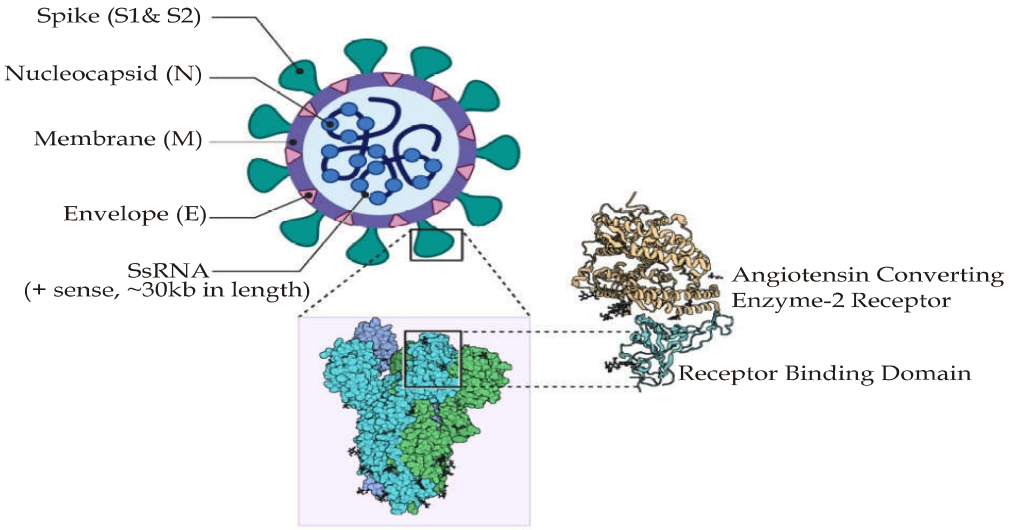


Fig.2: Depicts the structure of SARS-CoV-2 virus, a positive-strand RNA virus and the genome codes for four main structural proteins viz., the spike protein (S), nucleocapsid protein (N), membrane protein (M), and the envelope protein (E). The figure also shows the structure of the spike protein of virus which mainly binds to the Angiotensin Converting Enzyme 2 receptor (also shown in the figure), a host receptor to gain entry into the host cells.

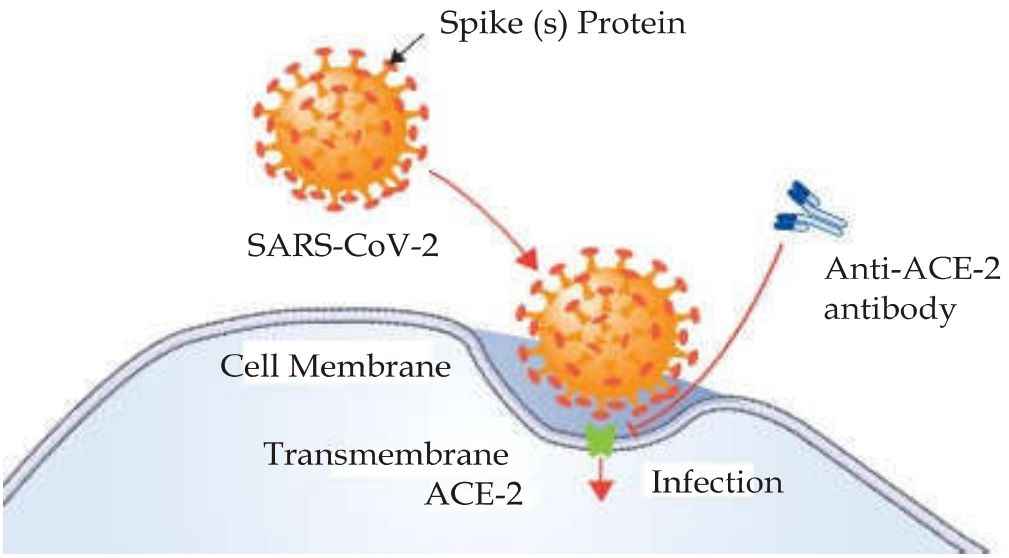


Fig.3: Depicts the entry of SARS-CoV-2 virus into the target cell by binding to the transmembrane ACE-2 (Angiotensin Converting Enzyme 2) receptor present on the host cells with the help of its spike (S) protein.

The virus affects both upper (nose, sinuses and throat) and lower respiratory tracts (air ways and lungs). The symptoms of upper respiratory tract infection include runny nose, sneezing, nasal congestion, sore throat, headache and achy muscles. Besides these common symptoms COVID-19 upper respiratory tract infection include cough, shortness of breath, fever, diarrhoea, and tiredness.[29] The symptoms of lower respiratory tract include severe cough with mucous production, shortness of breath, chest tightness and wheezing. If the virus infection spread deep in to the lungs, results in pneumonia. In case of normal healthy individuals, when they inhale, the lungs and their alveoli (tiny air sacs) fill with oxygen and these alveoli get rid of carbon dioxide when exhale and pass oxygen into the blood vessels. The alveoli become infected and inflamed in pneumonia and it results in the accumulation of fluid and inflammatory cells in the lungs preventing oxygen from getting through,

resulting in breathing difficulties and lack of oxygen in the blood.

The people with chronic lung disease, diabetes, chronic heart disease, Immune suppressed conditions, aging, and alcoholism are more prone to develop pneumonia with COVID-19 infection. The symptoms of severe pneumonia caused by COVID-19 include cough (with and without mucous), shortness of breath, fever, loss of appetite, fatigue, headache, muscle aches, chest pain under the breast bone, rapid breathing, weakness, sweats etc. Another serious infection caused includes ARDS, which is a life threatening complication. It is mainly caused by injury to the lungs due to infection or trauma. The injury results in the leakage of fluid into the lungs. This causes extreme difficulty in breathing and results in significant reduction in oxygen in the blood stream which ultimately results in damage of brain, other organs and body tissues. In most of the cases, people who are infected with SARS-CoV-2 suffer from mild flu-like symptoms and only a few people experience severe symptoms and develop ARDS, sometimes leading to respiratory failure coupled with multiple organ failure and even deaths.[30]

The old people and the individuals with certain disorders such as diabetes, chronic obstructive pulmonary disease, hypertension, cardiovascular disease develop ARDS, septic shock, metabolic acidosis, coagulation dysfunction, finally leading to the death[30]. As of now there is no specific recommended treatment to treat SARS-CoV-2 infection. The current treatment strategy includes symptomatic treatment along with oxygen therapy. Patients with respiratory failure are treated with mechanical ventilation. Patients with septic shock need hemodynamic support. The immune system plays a vital role in the control and resolution of SARS-CoV-2 infections.[31] Besides strengthening immune function, improving lung capacity by increasing respiratory pressure provides significant protection. The main purpose of this article is to educate the public regarding the importance of Yoga and Pranayama in improving the respiratory strength i.e. lung capacity as well boosting the immune system to fight against this novel corona virus.

Yoga and Respiratory system

The health and fitness fields are paying much attention towards yoga, an ancient Indian exercise. It is believed that both yoga and pranayama exhibits a profound and powerful effect on the respiratory system than on any other organ in the body. Many of the studies clearly showed the positive impact of yoga in improving the pulmonary function.[32,33,34,35,36] Several studies reported the improvement in vital capacity and PEFR (Peak Expiratory Flow Rate) with yoga training.[35, 37, 38] Of the several exercise regimens, yoga is found to be superior and effective.[39]

Remarkable change in lung functions can be achieved by practising yoga even for short duration.[40,41,42,43] The effect of slow and fast pranayama in strengthening the respiratory muscles was studied by Madanmohan et al.[44] Several factors such as chest expansion, respiratory muscle strength, lung dimensions, alveolar surface area and air way resistance effect respiratory function. In the Asthanga yoga, pranayama is one of the limb which includes various kinds of breathing patterns that have profound effects on the pulmonary function than any other part of the human system. These breathing patterns include alternate nostril breathing, Kapalabhati, Mukha bhasthrika pranayama, Bhrahmari pranayama etc. The positive effects of pranayama on lung function have been well documented.[32,34,45] Significant improvement in the pulmonary parameters was observed in hypothyroid patients after yoga and pranayama training.[46]

Yoga enhances physical strength, respiratory pressure and overall health in all age groups. Reddy et al.[47] also reported effect of yoga training in improving handgrip, respiratory pressures and pulmonary function in school children and suggested that yoga has to be introduced in all schools to improve overall health and performance of students. Bezerra et al.[48] reported that a 12-Week Yoga Program improves respiratory function in aged women.

Yoga asanas for improving respiratory pressure and pulmonary function

The yoga poses that improves respiratory pressure and pulmonary function include [49]: (i) Vrikshasana, the tree pose; (ii) Padahastasana, hand to feet pose; (iii) Trikonasana, the triangle pose; (iv) Chakrasana, the wheel pose; (v) Natarajasana, Lord of the dance pose; (vi) Vakrasana, the spine twist pose; (vii) Bhujangasana, the cobra pose; (viii) Paschimottasana, seated forward bend; (ix) Katuspadasana, the cat pose; (x) Kurmasana, the turtle pose, (xi) Salabhasana, the locust pose; (xii) Dhanurasana, the bow pose; (xiii) Janusirshasana, head to knee forward bend; (xiv) Viparitakarani, Legs-Up-The-Wall pose; (xv) Sarvangasana, shoulder stand pose.

Pranayama for improving respiratory pressure and pulmonary function

The various pranayama techniques[49] like (i) Adhama Pranayama, a deep breathing technique with or without air retention; (ii) Kapalabhati, also known as the forehead shining breathing technique, a breathing technique in which air is exhaled with vigour through the nostrils; (iii) Nadi Sodhana, also known as Anuloma Viloma Pranayama or the alternate nostril breathing technique; (iv) Bhastrika, a breathing technique that produces a loud noise as loud as the sound from a sickle due to fast and strong inhalation and exhalations. These respiratory exercises are coupled with exercises that strengthen abdominal muscles like Uddiyana Bandha (Uddiyana means upward, Bandha means to lock) also known as upward abdominal lock involves contraction of the abdominal region while breathing normally or after a forced exhalation and Jalandhara Bandha also known as throat lock involves contraction of larynx muscles after an inhalation.

Yoga and Pranayama in Immune functioning

Like soldiers, who restlessly safe guard our country from intrusion of enemies at borders, our immune cells fight against various invading microbes to keep us safe but without receiving any credit for their untiring effort. Now the entire world is restlessly fighting against an unseen enemy in the form of SARS-CoV-2. This dreadful virus is spreading and infecting people of all age groups across the globe mostly effecting small children and aged people. Small children have under developed immune system and aged people have compromised or weakened immune system. As of now there is no proper and suitable drug candidate identified that correctly targets this virus. Both drug and vaccine trials are under the way.

Some people who are infected with this virus are recovering quickly and others are not. Effective immune functioning is the main reason for early recovery of some infected people while the people with immune dysfunction are subjected to death. So it's the responsibility of every individual to support and strengthen this precious gift in the form of immune system given to all of us by the God. Yoga and Pranayama are the best options among various ways (Nutritious food, exercises etc.) that help to boost immune system and immune functioning. Practising yoga and pranayama on daily basis not only increases respiratory pressure and pulmonary functioning but also balances nervous system, lowers blood pressure, gives relaxation from stressful events, activates lymphatic system (the system that plays immense role in producing immunological responses). The importance of pranayama in immune boosting is reported by Vinod et al.[50] Twal et al.[51] reported the importance of yogic breathing in reducing pro-inflammatory biomarker levels. They reported that practising pranayama increases NK cells (Natural Killer cells involved in innate immune mechanisms). Falkenberg et al.[52] reported that regular practice of yoga improves cell mediated and mucosal immunity. Zhu, 2020 [53] stated that regular exercise has an anti inflammatory effect and improve immune responses. Bayley-Veloso and Salmon[54] reviewed importance of yoga in clinical practice.

Yoga asanas for immune boosting

Some of the immune boosting yoga poses[55,56] include- (i) Bhujangasana, the cobra pose; (ii) Matsyasana, the fish pose; (iii) Adho mukha svanasana, the downward dog pose; (iv) Uttanasana, the forward bend (The forward bends mainly enhances blood flow to the sinuses, ease congestion and by draining the lungs prevent complications from secondary infections); (v) Dhanurasana, the bow pose; (vi) Kurmasana, the tortoise pose, supports the thymus, the primary lymphoid organ involved in development and maturation of T-lymphocytes (cells involved in cell mediated immune responses). The yoga poses with forward bends or inverted postures like Adho mukha svanasana improves blood flow to the sinuses and as well prevent the complications of secondary infections by draining the lungs.

Pranayama in Immune boosting

The pranayama techniques [57,58] that boost immune functioning include (i) Bhramari Pranayama, the Humming Bee Breathing technique; (ii) Kapalbhati Pranayama, the forehead/skull shining breathing technique; (iii) Anuloma Viloma Pranayama, the alternate nostril breathing technique; (iv) Bhastrika Pranayama, the Bellow Breathing Technique –Breath of Fire; (v) Udgeeth Pranayama, the Chanting Breathing Technique; (vi) Cat and Cow breathing exercise; (v) Dog breathing Exercise.

Importance of pranayama in Immune boosting

Swami Satchidananda[59], in his book, The Breath of Life clearly explained how pranayam improves lives of individuals. According to swami ji, practicing pranayama loads the blood with extra

more oxygen than normal breathing. We all know that oxygen is life i.e., our body requires oxygen to sustain life. Oxygen plays central role in enhancing the body's ability in the absorption of both micro and macro nutrients both of which are required to build healthy immune system. Besides this, oxygen aid in blood detoxification, neutralises toxins, plays role in free radical displacement, relieves from anxiety and stress, strengthens cardiac muscle contraction, aids in the destruction of anaerobic microbes, viruses and parasites etc. So proper levels of oxygen in the body are vital and improve health, physical stamina, and endurance.

Pranayama includes belly breathing exercises also known as diaphragmatic breathing which helps in strengthening digestive system and it's a fact that major part of our immune system is localized in digestive tract folds (in the form of Mucus Associated Lymphoid Tissues (MALT). Diaphragmatic breathing also massages various glands and internal organs thereby enhance the flow of lymph to the targeted regions.[60] A study reported that deep belly breathing also strengthens our body defences by changing certain immune cells gene expression.[61] In another study by the Norwegian University of Science and Technology (NTNU) holding the breath not only change the immune cells (white blood cells) genetic activity, but it also results in significant increase of activity of these cells to fight against various infections.[62] Pranayama also enhance immune functioning by dealing with the stress-response.[63]

Conclusion

The COVID-19 has spread worldwide to around 213 countries or areas or territories as on 21st April 2020. Viral infections are very tough to deal with, as antibiotics are also ineffective against viruses. Till to date there is no specific treatment to treat the infection caused by this novel SARS-CoV-2 virus. Scientists across the globe are working hard to find out specific therapies and vaccines to target this virus. Our immune system plays a pivotal role in the control and resolution of various microbial born infections. Many of our life style factors including stress weaken the immune system and there by diminish our body's ability to defend against bacteria and viruses. Coupled to compromised immune system, poor pulmonary function further aggravates the symptoms of COVID-19. In the face of current situation, we all should improve our respiratory strength and boost our immune system to fight against this novel virus. Yoga and Pranayama are the only alternatives to boost our immune system and to improve respiratory function. So, come let us practice our ancient techniques of yoga and pranayama to face the challenge posed by this unseen virus.

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