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Review Article

# Integrating Yogic Practices to Conventional Medicine in Preventing and Treating Medical Disorders

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Abstract :

Yoga is increasingly recognized as a mind-body therapy for the prevention and treatment of several medical disorders. Yoga is an umbrella term that incorporates physical postures, breath-regulating exercises (pranayama), and meditation, and is known to maintain physical, mental, and emotional well-being. This review summarizes the scientific evidence of the existing literature demonstrating the effects of yoga on various parameters and body systems and its role in strengthening the immune system and combat medical problems, particularly cardiorespiratory disorders, COVID-19, stress, anxiety, and depression. A growing body of evidence indicated that yoga can downregulate pro-inflammatory markers, boosts immunity, and have favorable modulating effects on the immune and genetic level. Such positive impacts of yoga have made it to be an excellent add-on therapy for a number of acute and chronic medical conditions. However, more studies are required to explain the mechanisms and beneficial effects of yoga on the cellular and molecular level.

Keywords : yoga; pranayama; meditation; immunity; cardio-respiratory disorders; alternative and complementary therapy

## Introduction

Yoga is a science that brings perfect balance and union of the mind, body, and spirit so that one can attain optimum capacity [1,2]. Yoga fosters physical, mental, spiritual, social, and environmental harmony [3]. National Center for Complementary and Alternative Medicine (NCCAM) has classified yoga as a mind-body therapy that combines physical postures, meditations, and breathing techniques called Pranayama ("Prana" means vital force or life energy, and "ayama" means to prolong) [1,4,5]. Studies show that yogic practices induce improved cardiorespiratory performance [6], improves exercise tolerance in patients with COPD [7], reduces stress [8], decreases blood pressure in hypertensive patients [9], produces improvement in blood glucose in diabetics [10], controls symptoms in asthma patients [11], has positive effects on anxiety and depression [12], and reduces pro-inflammatory cytokines secretion [2]. Besides, yoga is effective for cancer-related conditions [13,14], chronic low back pain [15], and chronic neck pain [16]. The yogic practice also significantly increases immune-related cytokines, such as interleukin-12, and interferon-c in serum, reduces the plasma levels of adrenalin, increases plasma levels of serotonin, attenuates oxidative stress, and improves the antioxidant levels, thereby improving immune function [17].The reduction in oxidative stress and

improvement in endothelial functions are also the beneficial effect of long-term meditation [18]. Singh et al. reported that the yoga association in changing hormonal levels, inflammatory outcomes, and anti-viral outcomes inside the human body could be of enormous advantage in treating infectious conditions [18]. We were motivated to write this review hypothesizing that the holistic approach of yoga could be used as an adjunct to mainstream medicine to prevent and treat various medical disorders, including the ongoing Coronavirus Disease (COVID-19).

## Methodology

To conduct this literature review, we conducted an advanced search on the National Library of Medicine electronic database, PubMed using the boolean operators (i.e., "AND," "OR,") to connect the relevant terms like "yoga", "yogasana", "pranayama", "breathing exercises", "meditation", "respiratory disorders", "cardiovascular disorders", "immunity" and "COVID-19", "stress", "anxiety", and "depression" to retrieve the related articles. We used boolean operator, "NOT" to exclude such other non-conventional interventions like Qigong, Tai qi quan, etc. In this review, we have incorporated randomized controlled trials, observational studies, meta-analysis, and reviews and cross-examined them for relevant citations. The time period of articles was not specified, and only English literature was included. Subsequently, we compiled a list of studies that could provide facts and evidence to reveal the association between yoga and COVID-19.

## Yoga and immunity

Yoga postures that twist and compress organs help massage and rejuvenate immune organs. For instance, Kurmasana (tortoise pose), which exercises the thymus gland, could create specific benefits to improve immune function(19). Yoga has been shown to improve the markers of immunity of the patients [20]. It has been observed that yoga is directly related to increasing levels of superoxide dismutase and lymphocytes, however, decreasing the number of eosinophils and monocytes [21]. A pilot RCT study suggests that a month of yoga intervention could increase CD4 cell counts and mean CD4/CD8 ratio as well [22]. A popularly known meditation called transcendental meditation has a direct impact on the psycho neuroendocrine axis [23]. This axis is related to the interaction between psychological factors, the central nervous system, and immune function. The practice of transcendental meditation modifies hypothalamic and hypophyseal activity and leads to the daily lowered secretion of catecholamine, β-endorphins, and adrenocorticotropic hormones. In addition, it is found to be causing a decreased percentage of functional lymphocyte beta-adrenergic receptors in practitioners and a positive effect on leukocyte deoxyribonucleic acid by modulating its repair [23]. Studies also show that yoga could influence the immune system increasing the natural killer cells [24] and cellular ATP [25]. ATP facilitates IFN production and IFN signaling, which drives the immune cells to transform them into the so-called "anti-viral state"[26].

Yoga maintains telomerase length and increases telomerase activity as well. Immune cell telomeres are the protein complexes that protect and stabilize the ends of eukaryotic chromosomes, which truncate during cell division [27]. Shortened telomeres are markers of immune cell aging, vulnerability to apoptosis, and related with adverse clinical outcomes and premature death in many age-related diseases [28]. Likewise, psychological stress is linked with reduced telomerase activity, short telomeres, and increased cell aging [25]. However, telomere length is protected partly by the naturally occurring enzyme telomerase, which helps slow or reverses cell aging [27]. Longer telomeres and higher telomerase activity are therefore considered to be salutogenic immune system profiles. In a study by Bhasin et al., long-term relaxation therapies like yoga are related to telomere packing, telomere maintenance, and tight junction interaction [25]. Furthermore, regular meditation tends towards an increase in Aβ40 levels, tumor necrosis factor alpha, IgG, and IgA levels while it is associated with a reduction in the activity of the cellular transcription factor NF-kB, inflammatory cytokines, and circulating levels of CRP [18, 29-31].

## Sympathetic and parasympathetic modulating effect of yoga

Yoga down-regulates the hypothalamic-pituitary-adrenal axis, which in turn decreases the release of cortisol and catecholamine [29]. It has been found that the sympathetic nervous system inhibits anti-viral genes and activates pro-inflammatory genes [18], while meditation relieves psychological stress by decreasing sympathetic nervous system activity and up-regulating parasympathetic function [32]. Meditation such as Omkar meditation, characterized physiologically as a wakeful hypometabolic state of parasympathetic dominance, causes an increase in cerebral perfusion besides decreasing vascular resistance, blood levels of catecholamines, cortisol, and lactate, leading to a decline in O2 consumption and CO2 elimination with a decrease in respiratory rate and minute ventilation with no change in respiratory quotient [6].

Breath-regulation exercise (Pranayama), an integral part of yoga, is a gradual unforced cessation of breathing that uses voluntary regulation of breathing to make respiration rhythmic and calm our mind [33,34]. Among different types of pranayama, alternate nostril breathing involves voluntary regulation of breathing with attention and concentration where one nostril predominates the other and follows the definite cycle [34]. The right nostril dominance corresponds to activation of the sympathetic system, and left nostril dominance corresponds to the parasympathetic system leading to a proper balance of sympathetic and parasympathetic systems [35]. This modulation of the autonomic nervous system is due to the conditioning effects of yoga on autonomic function, mediated through the limbic system and higher areas of the central nervous system [6].The voluntary slow deep breathing during yoga sessions functionally influences the ANS through stretch-induced inhibitory signals, and hyperpolarization currents propagate through both neural and non-neural tissue, which synchronizes neural elements in the heart, lungs, limbic system, and cortex. During deep inspiration, stretching of lung tissue produces inhibitory signals by the action of slowly adapting stretch receptors and hyperpolarization current by the action of fibroblasts. Both inhibitory impulses and hyperpolarization current synchronize neural elements and modulate the nervous system and decrease metabolic activity indicative of the parasympathetic state [33]. Additionally, a significant reduction in systolic, diastolic, and mean arterial pressure after regular practice of Hatha yoga indicates a gradual shift of autonomic equilibrium toward relative parasympatho-dominance because of the reduction of sympathetic activity [6].

## Yoga modulates gene expression inducing beneficial health effects

Yoga and meditation is involved in enhanced gene expression that are related with energy metabolism, mitochondrial function, telomere maintenance, and insulin secretions, and decreased gene expression associated with inflammatory response and stress-related pathways [25]. One significant among such genes is mitochondrial ATP synthase that plays an essential role in the production of adenosine triphosphate (ATP). Yoga upregulates ATP synthase and enhances mitochondrial reserve capacity resulting in decreased production of reactive oxygen species, which in turn reduces the oxidative stress of cells [25]. This is very beneficial during infection. Meditation has also been associated with the reduced expression of pro-inflammatory genes in blood cells [32] and improved cellular health with the ability to lower regulation of protein synthesis and viral genome activity [30]

## Effect of yoga in respiratory disorders

Stretching yoga exercises for 90 min has been found to be increasing salivary human beta-defensins-2, an antimicrobial peptide that destroys the hydrophobic core of lipid bilayer of micro-organism which is usually found in epithelial cells of the oral cavity and respiratory tract [36]. Yogic exercises such as inversions, prone poses, and back-bends, along with

strong breathing exercises strengthen the torso and initiate diaphragmatic breathing that improves respiratory performance and increases chest expansion [37]. There is some evidence that yoga may improve quality of life, symptoms, forced vital capacity, peak expiratory flow rate, and reduce medication usage in people with asthma [38]. A study by Lorenc et al. states that yoga, when performed as a moderate-intensity exercise, may stabilize the sympathetic nervous system and condition autonomic function, decrease airway resistance, and improve respiratory muscle strength, but limited data are available [39]. An RCT that enrolled asthma patients showed a considerable increase in histamine dose required to provoke 20% decline in FEV1 during yoga breath, but not with the control [40]. In another study involving twenty-two COPD patients who were subjected to selective yoga exercises showed improvements in vital capacity, maximal inspiratory pressure, maximal expiratory pressure, and consequently improved lung function [41]. Studies have shown that yogic breathing (pranayama) and postures can increase aerobic capacity and improve lung function [6, 42]. The effects of increasing the aerobic capacity in preventing lung damage can be explained by various mechanisms-

1. Increasing the aerobic capacity modulates the inflammatory process and lung remodeling, thus restoring normal lung tissue elasticity, increasing ventilation, and improving pulmonary flow and function [43]
2. Increasing the aerobic capacity induces decreased pulmonary lipid peroxidation and increased glutathione peroxidase, hence working as an antioxidant to limit free radicals production and preventing lungs from oxidative damage [44].

Additionally, yogic breathing (pranayama) stretches the lung tissue, producing inhibitory signals from the action of slowly adapting receptors and hyperpolarizing currents. These inhibitory signals coming from the cardiorespiratory region involving vagi are thought to synchronize neural components in the brain, inducing changes in the autonomic nervous system and a resultant condition characterized by reduced metabolism and parasympathetic dominance [45]. Thus, pranayama modifies various inflammatory lung reflexes and interact with the central neural element to bring new homeostasis in the body.

Diaphragmatic breathing that uses the diaphragm as a major respiratory muscle creates a deeper breathing pattern, improves the breathing technique, and prevents partial contraction of the diaphragm, which normally occurs in regular breathing [37]. Diaphragmatic breathing also encourages the use of the abdominal wall, and greater mobility of the diaphragm increases functional capacity and inspiratory capacity [37]. Similarly, skull shining breath (Kapalabhati pranayama )helps in removing secretions from the bronchial tree, cleansing up the respiratory tract and the alveoli [42]. In the study by Visweswaraiah et al., integrated yoga that included various postures, relaxation techniques, breathing practices, and meditation helped in achieving earlier sputum negativity, improved radiographic picture, FVC, weight gain, and reduced symptoms in the yoga group as compared to control group as an add-on to anti-tuberculosis treatment in sputum-positive cases of pulmonary tuberculosis [46]. Likewise, a yoga system called Hath yoga which is most commonly practiced globally, promotes physical and emotional well-being [47]. A study demonstrated that after regular Hath yoga practice for 3 months, significant improvement in forced expiratory volume in one second (FEV1), forced vital capacity (FVC), peak expiratory flow rate (PEFR), forced expiratory volume percentage (FEV%), were seen, which indicated the strengthening of respiratory musculature [6].

## Effect of yoga on Cardiovascular System

It was demonstrated that the 12-week Hatha yoga (one of the most widely practiced forms of yoga, consisting of elements of physical postures, conscious breathing, and meditation) program produced beneficial changes in cardiovascular endurance and muscular strength [48]. A prospective cohort study involving thirty-three subjects (30% with and 70% without established coronary artery disease) who were provided yoga and meditation course of 90 minutes 3 times weekly for 6 weeks showed significant drop in blood pressure, heart rate, and BMI [49]. In another study in which thirty-six healthy nonsmokers volunteers in Nepal were subjected to a survey were asked to perform alternate nostril breathing (Nadisuddhi pranayama) in sessions for four weeks, which suggested fall in pulse rate, respiratory rate, systolic blood pressure, diastolic blood pressure and rise in pulse pressure and peak expiratory flow rate [34]. The potential mechanism may be that the yogic breath, through activation of stretch receptors in lungs during high tidal volume inhalation as in Hering Bruer reflex, increases the frequency and duration of inhibitory neural impulses, which bring about the withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing a decrease in peripheral resistance and thus decreasing the BP [50]. Similarly, breathing at high frequency in Skull-shining breath (Kapalbhati) caused sympathetic stimulation, and alternate nostril breathing (Nadisuddhi pranayama) reduced sympathetic activity [33, 51]. In this way, various cardiac and hemodynamic adjustments are triggered in response to variation of breathing patterns causing both tonic and phasic changes in cardiovascular functioning [51]. In addition, yoga was also associated with reduced BMI as well as waist and hip circumference, decreased total cholesterol [52], and attenuated weight gain, more prominently among individuals who were overweight. [53]. The study by Hartley et al. found that yoga induces favorable effects on HDL cholesterol and triglycerides and uncertain effects on LDL cholesterol; however, evidence were limited [54].

## Yoga and COVID-19

Inflammation in COVID-19 is associated with the action of inflammatory cytokines like interleukin-6 (IL-6), tumor necrosis factor (TNF6–9), and acute-phase protein C-reactive protein (CRP10–12). However, yoga stimulates inflammatory reflex (cholinergic anti-inflammatory pathway) and decreases the production of TNF, which is an early mediator of inflammation [55]. In the study by Chen et al. [2], reduced secretion of cytokines including IL-6, TNF-$\alpha$, and IL-1$\beta$ levels were observed after yoga training as compared to pre-yoga condition and control group. Additionally, yoga has been found to increase immune-related cytokines, such as interleukin-12 and interferon-c in serum [17]. Yoga induces beneficial effects in patients with comorbidities like hypertension, diabetes, COPD, and stress [7-10], which are the risk factors associated with COVID-19. Likewise, smoking is associated with disease progression and severity of COVID-19 [56]. In contrast, yoga has been shown to promote the desire to stop smoke [57]. ACE-2 receptor has been known as a co-receptor for 2019-nCoVentry [58], and a recent study revealed the increased expression of ACE-2 receptor inadipose tissue [59]. Thus, obese people having more adipose tissue are more likely to catch 2019-nCoV than non-obese people. However, yoga causes a decrease in serum leptin levels, body mass index, waist-hip circumference and total cholesterol [60]. Also, a meta-analysis reported that meditation increase immune responses to vaccination [31], and it does not only help during the preventive and treatment phase but also in post-recovery management [61].

## Effect of yoga on stress, anxiety, and depression

Stress, anxiety, and depression are negative emotional states which engender adverse effects on the autonomic, cardiovascular and immune system. Stress can result in increased latent viral reactivation and susceptibility to upper respiratory infection [62-64]. It exerts negative influences on immune response and decreases the functional immune measures (proliferative response to mitogens and natural killer cell activity) [65,66]. However, studies have shown that yoga is helpful in

managing stress, anxiety, and depression through the use of postures, breathing exercises, and meditation [8,12,67]. Riley and Park have summarized the potential biological mechanisms including autonomic nervous system and vagal nerve activity, nitric oxide and endothelial function, endogenous endocannabinoids and opiates, cytokine levels, and limbic system activity, as well as psychological mechanisms like positive affect, mindfulness, and self-compassion that could have mediated yoga-induced stress reduction [68].

## Adverse effects associated with yoga

The reported incidence of yoga-related adverse effects is noteworthy, although they are relatively low. According to the study by Cramer et al. [69], 98.2% of acute and 90.5% of chronic adverse effects were associated with a musculoskeletal system like back, neck, and shoulder pain, sciatica, and osteoarthritis. Central retinal vein occlusion [70] and progressive optic neuropathy in glaucoma patients [71] have been found to be caused by Sirasana (head-stand posture). Similarly, spontaneous pneumothorax [72] and pneumomediastinum [73] have been reported to occur after vigorous yoga breathing techniques like Kapalbhati pranayama. Nevertheless, most of the serious adverse events were mentioned in the case reports and were found to be caused by particular risky yoga breathing-techniques and postures. Hence, high-intensity yoga and breathing techniques can be dangerous and should only be practiced with caution under the supervision of yoga experts and therapists.

## Conclusion

The preventive and therapeutic role of yogic practices can be applied as an adjuvant to conventional medicine in the management of a wide variety of medical conditions. The existing research evidence advocates the medical community to go beyond the ego and boundaries of various therapies or interventions and integrate yogic practices in modern medicine to restore health and maintain physical and psychological well-being. Despite the multi health benefits of yoga, large-scale controlled clinical trials are scarce and necessitate exploration through further studies.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Authors' Contributions

Amrish Thapa contributed to the conception and design of the research and coordinated the entire team in accomplishing this work. All authors participated in online discussion, searched and collected relevant articles, and played an important role in drafting specific sections of the manuscript. Amrish Thapa, Rajan Oliya, and Rakesh Kumar Das worked together to compile all the points and drafted the first manuscript. Amrish Thapa and Ayush Chandra edited and revised the manuscript. All authors agree to be fully accountable for ensuring the integrity and accuracy of the work and read and approved the final manuscript. Amrish Thapa and Rajan Oliya contributed to the work equally and should be regarded as co-first authors.

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