

Therapeutic efficacy of yoga in context of pulmonary function and co-morbidities in COVID-19: Evidence from Clinical Trials

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Abstract

Background: Various forms of yoga practices have been implicated in the betterment of respiratory health. Recently, the benefits of practicing Yoga have been investigated in many clinical trials and studies using different Yoga protocols in COVID-19 patients. We explore the evidence for effects of yoga and pranayama on improving pulmonary function and general immunity, particularly in the milieu of respiratory health during the COVID-19 pandemic.

Methods: We searched for clinical trials on PubMed regarding yoga interventions helpful in improving pulmonary function and comorbidities such as immune dysfunction and mental stress in COVID-19. We included 15 clinical trials and 3 meta-analyses from the years 1990 to 2025 in this review that used some kind of yoga intervention to assess the effects of Yoga on pulmonary function and the trials on yoga interventions for COVID-19 management.

Results: The research suggests that structured yoga interventions can help improve pulmonary function, enhance immune markers, and be effective in stress management in populations with comorbidities in COVID. Evidence from various studies suggests that pranayama and breathing exercises enhance respiratory capabilities, reduce perceived exertion, and improve cardiovascular functions. Specific pranayama techniques, such as Bhramari and Sheetal, have demonstrated notable improvements in respiratory function and heart rate variability (HRV) in post-COVID patients. Yoga can modulate immune responses, potentially aiding in the development of resistance against viral infections, including COVID-19, particularly in individuals with comorbidities like hypertension and diabetes. Additionally, yoga practices are highlighted as effective interventions for stress relief and mental health support during the pandemic.

Conclusion: Considering evidence from clinical studies, Yoga is a potential complementary therapeutic approach to improve lung function, respiratory immunity, and immunological status and eventually be effective for the management of COVID-19, highlighting its role in integration into public health strategies to enhance overall well-being.

Keywords: Yoga, Pulmonary function, Lung function, COVID-19

Introduction

Yoga is one of the ancient Indian techniques for physical, mental, and spiritual well-being. The word 'Yoga' is derived from the Sanskrit root word 'Yuj', meaning 'join or

connect,' that represents the union of body, mind, and spirit (Arora and Bhattacharjee, 2008). This collective emphasis on mind, body, and spirit makes Yoga different and

special from other exercise programs. Hatha Yoga is the most practised form of yoga that combines various forms of physical postures, breathing exercises and meditation techniques and has become increasingly popular across the Western world. The close interconnection between the mind and body, and the therapeutic potential of restoring their equilibrium, has been extensively explored in both scientific research and philosophical discourse over recent decades (Streeter et al., 2012; Morgan et al., 2014; Nagendra, 2020; Wang and Szabo, 2020). The goal of yoga is to cultivate a tranquil mind through the disciplined preparation of the body. Research has shown that regular yoga practice fosters a profound sense of well-being, enhances relaxation, sharpens concentration, boosts self-confidence and efficiency, improves interpersonal relationships, increases attentiveness, reduces irritability, and promotes a more optimistic outlook on life (Malathi and Damodaran, 1999; Kraemer and Marquez, 2009; Tulloch et al., 2018).

Although few scientifically designed and replicable clinical trials have evaluated the effects of yoga on functioning of the immune system, many studies on yoga have highlighted favourable results in immune function related disorders. Yoga is beneficial in developing immunity in several non-communicable chronic diseases such as asthma, hypertension, heart disease, metabolic and psychiatric disorders (Chu et al., 2016; Nagarathna et al., 2019; Wang and Szabo, 2020). Yoga is also beneficial for communicable or infectious diseases. In the pathophysiology of infectious diseases, both innate immunity and adaptive immunity play a vital role. Recent evidence suggests the efficacy of Yoga for improving respiratory immunity and the role of pranayama and breathing exercises in the treatment or prevention of diseases involving the respiratory system, such as acute respiratory infections, influenza, and Tuberculosis (Visweswaraiah and Telles, 2004; Rohini et al., 2025). Despite multiple

reviews on yoga and respiratory health, few have critically evaluated clinical trials specific to COVID-19-related pulmonary dysfunction and systemic comorbidities. This review uniquely consolidates trial-based evidence to highlight yoga's multidimensional therapeutic role in addressing both respiratory impairment and immune vulnerability during the pandemic.

Material and methods

We searched clinical trials (randomized or non-randomized) on PubMed from 1990 to 2025, using keywords: 'Yoga', 'Pranayama', 'Breathing exercises', 'COVID-19', 'Pulmonary function', 'Lung function', 'Respiratory function' and 'Chronic Obstructive Pulmonary Disease'. The inclusion criteria were to screen for the trials that used some kind of yoga intervention to analyse the effects of yoga on pulmonary function and COVID-19-related comorbidities, such as immunity and stress. We excluded the basic biomedical research papers and the yoga trials not relevant to COVID-19.

Results and Discussion

Yoga and Pranayama for respiratory function and general immunity

An add-on yoga program to the Tuberculosis treatment in a sanatorium in Bangalore showed a reduction in symptom score and improvement in lung function and weight at the end of 2 months. There is evidence that Pranayama and breathing exercises show favourable effects on the respiratory system. Yoga training has been found to strengthen expiratory muscles, and pranayama improves ventilatory lung functions (Madanmohan et al., 2012). The summary of the clinical trials and their statistics is reported in Table 1. Joshi et al. (1992) reported improvement in ventilatory functions, with reduction in respiratory rate (RR) and increased forced vital capacity (FVC) along with better forced expiratory volume (FEV1%), peak expiratory flow rate (PEFR), and increased breath-holding capacity after 6 weeks of pranayama (Joshi et al., 1992). Kapalbhathi, a type of breathing exercise found to be beneficial for toning

abdominal and diaphragm muscles, is shown to help with the removal of bronchial secretions and the cleansing of respiratory passages and alveoli (Chandrasekhar et al., 2014). A yoga regimen of 3 months, including Pranayama and breathing exercises, was found to improve lung capacity and cardiovascular function in 80 patients with CAD (Yadav et al., 2015). A study done in patients with COPD found that twice-weekly yoga for 12

weeks can be helpful for improving lung capacity and reducing shortness of breath and inflammation. They emphasised that it's a simple and cost-effective way of treatment. Another study conducted on 50 medical students found improvement of pulmonary functions such as tidal volume, vital capacity, and breath-holding time after 30 minutes of yoga sessions for 2 months (Chandrasekhar et al., 2014).

Table 1: Summary of clinical studies included in the review:

Sr. No.	Type of Yoga studied	Statistical evidence	Conclusion	Author & Year
1.	Pranayama	n=75 (33 males, 42 females); Practiced twice daily for 20 minutes over 6 weeks; Respiratory rate decreased (males: 18.2 to 17.5 breaths/min, $p<0.001$; females: 19.2 to 19.1 breaths/min, $p<0.001$); Forced vital capacity (FVC) increased (males: 3.169 to 3.20 L, $p<0.001$; females: 2.31 to 2.37 L, $p<0.001$); Maximum voluntary ventilation (MVV) improved (males: 124.9 to 137.2 L/min, $p<0.001$; females: 85 to 94 L/min, $p<0.001$); Peak expiratory flow rate (PEFR) rose (males: 6.9 to 7.3 L/sec, $p<0.001$; females: 3.5 to 5.1 L/sec, $p<0.001$); Breath-holding time (BHT) increased (males: 53.4 to 73.5 sec, $p<0.001$; females: 41.9 to 54.9 sec, $p<0.001$)	6 weeks of pranayama practice improved lung capacity, breath control, and respiratory efficiency, indicating enhanced endurance and pulmonary function	Joshi et al, 1992
2.	Sudarshan Kriya and Pranayama	n=27 (cancer patients in remission), NK cell counts significantly increased at week 12 ($p = 0.001$) and week 24 ($p = 0.0001$) compared to baseline; At week 24, NK cells were significantly higher in the intervention group compared to controls ($p < 0.05$); Tobacco addiction reduced in 21% of 82 participants at 6 months	Boosted immune function through increased NK cells; No effect on T-cell subsets; Helped in reducing tobacco addiction in a subset of users	Kochupilla i et al, 2005
3.	Pranayama (Nadisuddi, Kapalbhati, Bhastrika, Brahmari, Pranava Pranayama)	n=50 (medical students); Practiced 30 minutes daily for 2 months; Vital capacity (VC) increased from 2972 ± 213.15 ml to 3372 ± 528.77 ml ($p<0.005$); Tidal volume (TV) improved from 496 ± 84.06 ml to 588 ± 150.88 ml ($p<0.005$); Expiratory	Two months of pranayama and Surya namaskar significantly enhanced pulmonary function,	Chandrasekhar et al, 2014

	and Surya namaskar	reserve volume (ERV) increased from 888 ± 183.30 ml to 1096 ± 386.73 ml ($p < 0.005$); Breath-holding time (BHT) improved from 33 ± 5.77 sec to 58.6 ± 12.78 sec ($p < 0.005$); 40 mm endurance increased from 30.8 ± 5.13 sec to 53.52 ± 15.68 sec ($p < 0.005$); Peak expiratory flow rate (PEFR) improved from 388.8 ± 15.36 L/min to 425.2 ± 38.74 L/min ($p < 0.005$).	endurance, and breath control. Pranayama toned the abdominal and diaphragmatic muscles and helped clear respiratory passages and bronchi.	
4.	Yoga training (Meta-analysis)	n=233 (5 randomized controlled trials); Significant improvement in forced expiratory volume in one second (FEV1): weighted mean difference (WMD) 123.57 mL, 95% CI: 4.12-243, $p=0.04$; FEV1% predicted (WMD: 3.90%, 95% CI: 2.27-5.54, $p < 0.00001$); 6-minute walking distance (6MWD) improved by 38.84 m (95% CI: 15.52-62.16, $p=0.001$);	Yoga training improved lung function and exercise capacity in COPD patients, supporting its role as an adjunct to pulmonary rehabilitation.	Liu et al, 2014
5.	Pranayama	n=50 (25 intervention, 25 control); Practiced 30 minutes twice daily for 3 months; COPD Assessment Test (CAT) score significantly improved from 21.2 ± 2.6 to 17.4 ± 2.5 ($p < 0.001$) in the intervention group, while the control group showed no change (21.6 ± 2.7 to 21.4 ± 2.7 , $p > 0.05$); 6-minute walk test (6MWT) showed significant improvement in the intervention group compared to controls ($p < 0.05$);	Three months of pranayama significantly improved COPD symptom scores and exercise tolerance. The findings suggest pranayama as an effective adjunct rehabilitation strategy for COPD.	Gupta et al, 2014
6.	Yoga practice	n=80 (40 yoga + conventional medicine, 40 conventional medicine only); Practiced daily for 3 months; Significant improvements in slow vital capacity (SVC) from 1.8703 ± 0.09 L to 2.185 ± 0.10 L ($p=0.002$), forced vital capacity (FVC) from 1.589 ± 0.08 L to 2.122 ± 0.11 L ($p=0.002$), forced expiratory volume in 1 second (FEV1) from 1.441 ± 0.09 L to 1.737 ± 0.09 L ($p=0.045$), peak expiratory flow rate (PEFR) from 3.316 ± 0.27 L/s to 4.077 ± 0.25 L/s ($p=0.05$), maximum voluntary ventilation (MVV) from 46.709 ± 2.83 L/min to 59.667 ± 3.29 L/min ($p=0.014$), and diffusion capacity for carbon	Three months of yoga regimen significantly improved lung function, diffusion capacity, and cardiovascular parameters in CAD patients, supporting its role as a complementary therapy alongside conventional medicine.	Yadav et al, 2015

		monoxide (DLCO) from 13.802 ± 0.66 to 17.504 ± 0.88 ($p=0.034$).		
7.	Yoga interventions (Meta-analysis)	n=752 in 12 trials; Yoga showed a moderate effect on health-related quality of life (HRQOL) (Hedges' $g = 0.51$, 95% CI: 0.25–0.76, $p<0.001$) and a small effect on mental well-being (Hedges' $g = 0.38$, 95% CI: 0.15–0.62, $p=0.001$); Studies had a mean Physiotherapy Evidence Database (PEDro) score of 6.1, indicating high methodological quality	Moderate improvement in HRQOL and mental well-being in older adults, though further research is needed to determine the optimal duration and frequency for maximum benefit	Tulloch et al, 2018
8.	Anulom Vilom Pranayama, Diaphragmatic Breathing	n=60 (4 groups, 15 each); Breath-holding time (BHT) increased most in diaphragmatic breathing (DBE) group (51.53 ± 16.61 sec to 65.6 ± 15.81 sec, $p<10^{-5}$), followed by Anulom Vilom Pranayama (AVP) (43.00 ± 20.33 sec to 51.47 ± 22.32 sec, $p<10^{-5}$). Rating of perceived exertion (RPE) decreased significantly in AVP (4.60 ± 0.83 to 3.20 ± 0.86 , $p<10^{-5}$) and DBE (4.13 ± 0.64 to 3.06 ± 0.53 , $p<10^{-5}$). One-way ANOVA showed significant variation for RPE change ($p<0.05$) with maximum reduction in AVP	AVP was most effective in reducing perceived exertion during breath-holding, while DBE maximized BHT. A combination of AVP and DBE may be useful for pulmonary health, especially during lockdown periods	Shukla et al, 2020
9.	Various Yoga Styles (Hatha, Bikram, Kundalini, Sudarshan Kriya, Kripalu, Yin) (Meta-analysis)	n=672 in 12 studies, 4-28 weeks; Hatha yoga significantly reduced perceived stress scale (PSS) scores from 13.6 ± 1.2 to 8.9 ± 1.2 (effect size = 1.38); Bikram yoga decreased PSS by 4.7 points ($p=0.001$, $\eta^2_p = 0.173$); Kundalini yoga led to significant improvements in stress scores compared to the control group after 3 months ($p<0.05$); Studies varied in intervention duration, with longer durations showing more consistent stress reduction	Yoga interventions effectively reduced stress across different styles and durations, with longer interventions showing stronger effects. Further studies are needed to explore long-term psychological mechanisms	Wang F et al, 2020
10.	Tele-yoga for stress management	n=95; Practiced twice a day, 5 days a week for 4 weeks; Perceived Stress Scale (PSS) scores significantly reduced from 17.46 ± 6.97 to 12.15 ± 4.59 ($p<0.01$, effect size = 0.43); Yoga Performance Assessment (YPA) scores improved from 17.61 ± 2.71 to 26.31 ± 2.91 ($p<0.01$); Positive correlation	Tele-yoga significantly reduced stress and improved well-being, with higher session attendance leading to greater	Jasti et al, 2020

		between age and yoga adherence ($r = 0.37$, $p < 0.01$); Strong correlation between session attendance and stress reduction in the top 25% responders ($r = 0.93$, $p < 0.01$)	benefits. Feasible and effective for psychological resilience, especially during COVID-19	
11	Mindfulness and Yoga	$n=93$ (40 intervention, 53 control); 92% of CRAFT participants vs. 58% of controls ($p < 0.001$) implemented self-care practices during lockdown; CRAFT group showed 78% perceived benefits vs. 52% in control ($p = 0.020$); Yoga/meditation was the most adopted practice in CRAFT (51% reported benefits) vs. 3% in control; Significant reduction in anxiety and stress compared to controls	Yoga and mindfulness-based CRAFT program improved resilience, stress management, and emotional well-being in student musicians, making it a valuable intervention during crises	Bartos et al., 2021
12	Video conferenced Yoga program	$n=7$ patient-caregiver dyads (advanced cancer, stage III/IV); 6 of 7 dyads (85%) continued sessions via videoconferencing; Dyads completed an average of 8.2 sessions (range: 1–10)	Video conferenced yoga was well-accepted among advanced cancer patients and caregivers, beneficial during COVID-19	Snyder et al., 2021
13	EIT-guided yoga breathing training	$n=61$, significant reduction in postoperative pulmonary complications (36.7% vs. 87.1%, RR 0.42, 95% CI 0.26–0.69); pleural effusion incidence (30% vs. 74.2%, RR 0.40, 95% CI 0.23–0.73); delayed onset of complications (HR 0.43, 95% CI 0.21–0.87, $p = 0.019$)	Enhanced pulmonary function, reduced postoperative pulmonary complications	Chen H et al., 2024
14	Yoga practising	$n=110$, intervention included Ayurveda medicine and Yoga (30 minutes morning, 15 minutes evening) for 90 days reported improved 6-minute walk test (40m vs. 10m), SD=50 meters, 95% CI($\alpha=0.05$)	Improved lung function and reduced fatigue	Yadav B et al., 2021
15	Bhramari and Sheetal Pranayama	$n=90$, FVC increased from 3.2 ± 0.5 L to 3.7 ± 0.4 L ($p < 0.001$) in Bhramari group; from 3.3 ± 0.4 L to 3.7 ± 0.3 L ($p < 0.001$) in Sheetal group; RMSSD increased by 5.5 ms ($p < 0.01$) in Bhramari and 4.8 ms ($p < 0.02$) in Sheetal Pranayama group	Enhanced respiratory function and autonomic stability	Rohini P et al., 2025
16	Short and Long duration	$n=$ variable (~12 per group, number of groups=3), D-dimer levels decreased	Better immune response, reduced	Rain M et al., 2022

	breathing techniques	in recovered individuals ($p = 0.002$) and healthcare workers ($p = 0.01$); 6-minute walk test improved in COVID-positive ($p = 0.01$) and healthcare workers ($p = 0.002$); better immune response	risk of thrombosis, improved endurance	
17	Sudarshan Kriya Yoga	$n=69$; Hamilton's Anxiety scores significantly reduced from 17.3 to 11.0 ($p<0.001$); Depression scores dropped from 11.1 to 7.7 ($p<0.001$); Zung's Anxiety (44.2 to 36.5 ($p<0.001$)) and Depression (46.3 to 38.2 ($p<0.001$)) scales also showed significant improvements; Effect size moderate (Cohen's $d = 0.66$ for anxiety, 0.61 for depression)	Significant reduction in anxiety and depression levels observed after ten days of intensive SKY therapy, followed by a plateau phase; effective as an adjunct therapy	Doria et al., 2015
18	Yoga and Naturopathy	$n=130$ (85 males, 45 females); Practiced 60 minutes daily for 2 weeks; Hospital Anxiety and Depression Scale (HADS) scores significantly reduced for anxiety ($p<0.01$) and depression ($p<0.01$); Corona Anxiety Scale (CAS) scores also showed a significant decrease ($p<0.01$) post-intervention; 33% had borderline depression, 9.2% had severe depression, 40% had borderline anxiety, and 12.3% had severe anxiety before intervention; 45.38% reported COVID-related dysfunctional anxiety on CAS.	Yoga and naturopathy interventions significantly reduced anxiety and depression among COVID-19 patients, suggesting their role as complementary therapy alongside conventional care.	Jerrin et al., 2021

A study conducted in HIV patients evaluating the effects of a group-based cognitive behavioral stress management program of 10 weeks demonstrated positive effects on mood, adrenal hormone regulation, and probable immune system reconstitution (Antoni et al., 2005). Meditation practices have resulted in decrease serotonin levels with an increase in melatonin levels (Tooley et al., 2000). Sudarshan kriya and pranayama are renowned techniques that help in stress reduction and improvement of immune functions. A study among cancer patients those on completion of their standard therapy showed that Sudarshan kriya and pranayama increased NK cells significantly, which is a predictor of longer

disease-free survival among breast cancer patients (Kochupillai et al., n.d.).

Yoga for respiratory function in COVID-19

As the upper respiratory tract facilitates the entry for SARS-COV-2 virus, the healthy respiratory function is very important to fight the virus and prevent progression and fatalities. There are several clinical trials that highlight the overall effects of yoga towards improvement in pulmonary function in patients with COPD (Tillu et al., 2020). Moreover, Anuloma-villoma pranayama reduced perceived exertion during breath-holding, and diaphragmatic breathing exercises increased breath-holding time (Ransing et al., 2020). A randomized controlled trial (Yadav et al.,

2021) with 110 participants assessed the impact of Ayurveda and yoga on long-term COVID-19 recovery compared to the WHO's rehabilitation protocol. This intervention included Agastya Haritaki (6g), Ashwagandha (500mg twice daily), and yoga (30 minutes morning, 15 minutes evening) for 90 days. Results reported the improvements in respiratory function (6-minute walk test: 40 meters vs. 10 meters in controls) and fatigue (Yadav et al., 2021).

A randomized controlled study on post-COVID patients (n=90, aged 19-40) evaluated the efficacy of Bhramari and Sheetal Pranayama on enhancing lung function and HRV. Participants were grouped as follows: control, Bhramari, and Sheetal (30 each), with the intervention groups practicing for 15 minutes twice daily over six months. Results reported noticeable improvements in pulmonary function, with FVC increasing from 3.2 ± 0.5 L to 3.7 ± 0.4 L in the Bhramari group ($p < 0.001$) and from 3.3 ± 0.4 L to 3.7 ± 0.3 L in the Sheetal group ($p < 0.001$). HRV, assessed through the root mean square of successive differences (RMSSD), also improved, increasing by 5.5 ms in the Bhramari group ($p < 0.01$) and 4.8 ms in the Sheetal group ($p < 0.02$), indicating better autonomic regulation (Rohini et al., 2025). These findings suggest that regular practice of Bhramari and Sheetal Pranayama may support post-COVID recovery by enhancing respiratory function and balance in the autonomous nervous system.

A review study highlighted Bhramari Pranayama as an effective lifestyle intervention for improving lung function, HRV, and immunity. Regular practice for 10–20 minutes daily over 4–6 weeks was shown to reduce resting heart rate, increase HRV, and enhance lung function. It also supports autonomic balance, better sleep, and higher nitric oxide production, which aids respiratory health and immune defense against infections like COVID-19 (Trivedi and Saboo, 2021). Considering its ease of practice and multiple health benefits, Bhramari Pranayama could be a valuable

addition to daily routines for overall well-being and disease prevention.

Yoga and immunity specific to COVID-19

Better host immunity is a vital requisite for the prevention of any infection. A disturbed immune system, evidenced by lymphopenia and increased C-reactive protein (CRP) levels, is the characteristic feature in severe COVID-19 infection. Considering the natural phenomenon of the body to fight an infection with the help of a large number of WBCs and other defence mechanisms, there is a better chance of winning over a virus attack for a strong and efficient immune system. It has been shown that systematic, especially personalised asanas, specific pranayama, meditation along with mantras can improve immune strength in the body to fight against viral infections.

Yoga has the potential to fight viral infections. Immunity is the most important factor in easing the eradication of the virus from the body. Yoga could help by modulating the HPA axis, which is involved in psychological stress related to the COVID-19 pandemic (Morgan et al., 2014; Basu-Ray et al., 2022). Yoga can act by restoring the imbalance caused by impaired and suboptimal immune responses (Shi et al., 2020). Yoga can regulate IFN- γ levels and boost innate immune responses, which are responsible for eliminating the virus (Pedersen and Ho, 2020). This ability of Yoga can be beneficial to fight the coronavirus and has the potential to slow down the pandemic. Yoga can be used as a complementary intervention for the population suffering from diseases with inflammatory components. A meta-analysis of 15 trials with 1053 participants reported that yogasanas reduced IL-1 β and showed indications of lowering IL-6 and TNF- α , suggesting its role in regulating inflammation (Falkenberg et al., 2018). Cytokine storm is present in COVID-19 infection, represented by increased cytokine levels, lymphopenia, and decreased IFN- γ expression, and Yoga's

ability to reduce these pro-inflammatory markers suggests its potential in the prevention of COVID-19 (Fu et al., 2020; Basu-Ray et al., 2022).

Yoga including meditation can be effective complementary and adjunctive interventions against severe infectious diseases such as malaria, HIV/AIDS, and SARS. A study reported that six weeks of twenty minutes of consistent mindfulness meditation daily significantly downregulated a 19-transcript composite of pro-inflammatory transcription factor NF- κ B with an increase in anti-inflammatory activity by glucocorticoid receptor and elevated type-1 interferon signalling linked to COVID-19 treatment (Bower et al., 2015). This was also supported by a study showing that 90 minutes of stretching by yogic asana could enhance expression of antibacterial peptides, β -defensin and HBD-2, which help in enhancing innate immunity (Eda et al., 2013) in the case of COVID-19 (Kim et al., 2018).

Yoga for COVID-19 with comorbidities
COVID-19 patients were reported to have a high prevalence of comorbidities such as hypertension and diabetes (Nagarathna et al., 2019). In diabetics infected with SARS-COV-2, yoga can be beneficial by acting on the HPA axis, which significantly contributes to poor glycaemic control, which could help to facilitate the elimination of the virus and early recovery from the illness (Nivethitha et al., 2016). In the case of hypertensive patients with COVID, Yoga could help to control BP by decreasing sympathetic nervous system activity and increasing baroreflex sensitivity (Liu et al., 2014). There were many clinical trials that reported the efficacy of yoga training to improve pulmonary function (Gupta et al., 2014). Recently, the AYUSH ministry has identified the potential of Yoga to improve respiratory immunity and prevent infection in the COVID-19 pandemic and published guidelines for yoga practitioners. It includes different yoga protocols of various durations and for different age groups. They

also recommended Jalneti, Sutraneti, and Bhasrika kriya once or twice a week. They have a set of recommendations of yog kriyas for hospitalized COVID patients as well. There is strong evidence of Yoga, especially Pranayama, improving pulmonary function in patients with COPD (Shukla et al., 2020). Also, the studies on yoga have shown enhanced exercise capacity, improved lung function, and reduced dyspnoea in patients with COPD (Maxwell et al., 2015). Considering evidence from clinical studies, Yoga has the potential to improve pulmonary function, respiratory immunity, and immunological status and eventually help to fight COVID-19 (Basu-Ray et al., 2022; Chandra et al., 2024).

Yoga for mental health and stress induced by COVID-19

The adverse mental health issues, such as stress and depression increase the risk of occurrence of acute respiratory infections (Li and Goldsmith, 2012). Stress raised by the pandemic, loneliness and depressive feelings from social distancing measures may be tackled by practising simple yoga exercises, such as pranayama and meditation. These simple and feasible measures can be easily advertised using electronic or print media displays at public gatherings (Kraemer and Marquez, 2009) as a part of public health campaigns. Yoga may evidently be an effective therapeutic adjuvant for COVID-19 associated mental health problems (Tulloch et al., 2018).

A study (Jerrin et al., 2021) on yoga and naturopathy in 130 COVID-19 patients (85 males, 45 females) found a marked reductions in anxiety and depression after 60-minute daily sessions for 2 weeks. Hospital Anxiety and Depression Scale (HADS) scores dropped significantly ($p < 0.01$ for both anxiety and depression), while the Corona Anxiety Scale (CAS) scores also showed a marked decrease ($p < 0.01$). Before the yogic intervention, 33% and 9.2% had borderline depression and severe depression, 40% and 12.3% showed borderline and severe anxiety, with

45.38% reporting COVID-19-related dysfunctional anxiety (Jerrin et al., 2021). These findings suggest yoga and naturopathy as effective complementary therapies for mental health support in COVID-19 recovery.

The anxiety due to the recent COVID pandemic was a universal. Lockdown and social distancing added further to this stress and loneliness. Also, lockdown adversely affected daily schedules and sleep cycles, further disturbing circadian rhythm and biological clocks, which also acts as an important factor for compromised immune function. This highlights the need for mind-body interventions like structured daily schedules, sleep-wake cycles and yoga practice. Yoga has the potential to address physical, mental, and emotional attributes. The practice of yoga is reported to enhance GABA, the inhibitory neurotransmitter, by the stimulation of the vagus nerve (Wang and Szabo, 2020). The stress hormones, such as cortisol, can be balanced through yoga practice through slow breathing exercises, which improve respiratory health and thereby physical wellness (Harinath et al., 2004).

Workplaces and hospitals were known to be places of consistent anxiety/stress, source of infections, and places with no access to walking tracks, gyms, or swimming pools. Workplace in-house yoga practice can be an alternative to an inactive lifestyle while during the COVID-19 pandemic. A recent systematic review provided evidence of positive psychophysiological effects of yoga by affecting anxiety, depression, and self-efficacy positively. Yoga practice improved both mental and physical well-being by improving endogenous melatonin secretion (Paudyal et al., 2018).

Yoga for pregnancy-related complications during the COVID-19

A systematic review evaluating the effects of yoga interventions on pregnancy related health among working and non-working women has demonstrated alleviation of anxiety and stress, besides boosting

immunity. Researchers report that prenatal yoga is an easily accessible tool for pregnant women having anxiety and depression, which can also be practised even at the workplace. Besides dhyana, prenatal yoga includes aspects of yoga including breathing exercises and postures that can be practised by pregnant women (Venugopal et al., 2020). Yoga can be an effective and feasible self-care intervention to practice during pregnancy and can help pregnant women for increasing quality of life by addressing mental health issues during COVID-19 pandemic.

Yoga for the elderly in the context of COVID-19

Yoga can be a useful tool for elderly care that can impart physical wellbeing by increasing muscle strength and endurance, improving postural stability and balance, reducing fatigue and risks of falls (Chu et al., 2016). Besides that, yoga may enhance positive mood states and reduce anxiety and depression, which can cause immunomodulation and reduce the occurrence rate of respiratory tract infections. This potential of yoga can be beneficial as a preventive measure for elderly people who are vulnerable to COVID-19 infection. A recent systematic review of RCTs reported that yoga interventions can enhance both mental health and quality of life in ageing people over 60 plus years of age (Wu et al., 2018). Simple yoga postures such as *tadasana*, *ardha chakrasana*, *katichakrasana*, *bujangasana*, etc, could be disseminated through digital media and could be practiced easily by the elderly as well (Streeter et al., 2012). There is also abundant literature on the positive effects of yogic interventions on elderly people with comorbidities such as cardiovascular diseases, diabetes, COPD, etc. (Bernardi et al., 1998).

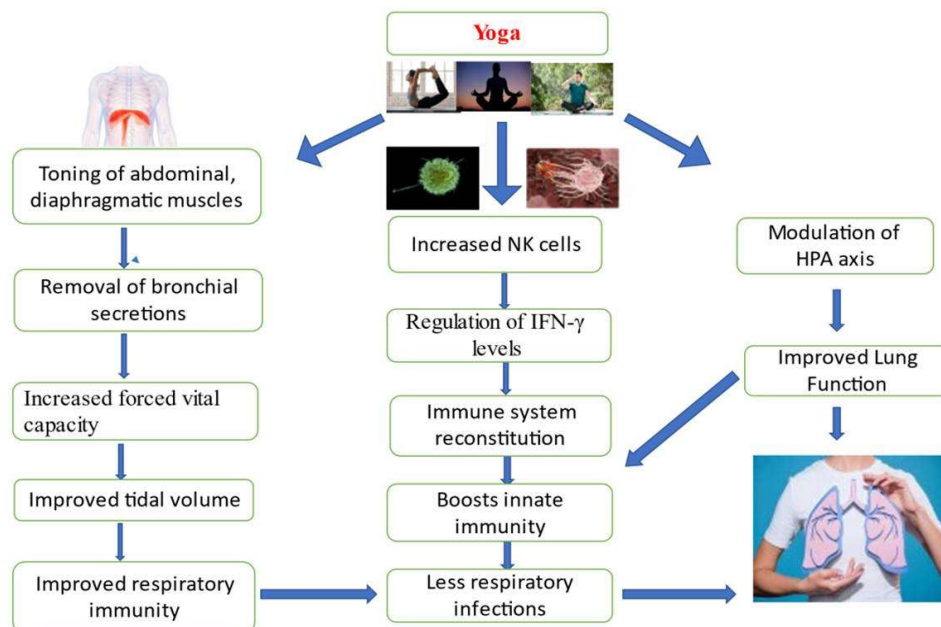
Integrative studies on yoga and pranayama for COVID-19

Researchers from the Massachusetts Institute of Technology have stated that “certain meditation, yoga asana (postures),

and pranayama (breathing) practices may possibly be effective adjunctive means of treating and/or preventing SARS-CoV-2 infection”. There is literature evidence relevant to the anti-stress and anti-

inflammatory effects of yoga asanas, seated meditation postures, and pranayama practices (Mehta et al., 2020). Different pathways of how yoga contributes to respiratory health are shown in Figure 1.

Figure 1: Effects of Yoga on Lung Function:



The figure shows the multiple mechanistic pathways by which yoga and pranayama contribute to improvement in lung function and immunity.

Yoga-Based Interventions for COVID-19 Survivors

Potential after-effects of the pandemic have to be considered from both the individual and societal point of view, in addition to the burden of acute infection. The inflammatory burden in individuals represents chronically increased inflammatory components in circulation and tissues due to inherent subclinical infection, even in the post-pandemic era. This would contribute to chronic comorbidities in the survivors. In this scenario, the adoption of yoga, pranayama, and other healthy lifestyle practices in daily routine would be definitely helpful (Bushell et al., 2020).

Tele-Yoga for stress management during the COVID-19

In a recent study by Jasti et al. (2021), 4 weeks of tele-yoga sessions were shown to be easy to learn, safe, and feasible and also showed positive effects on stress by

inducing mental relaxation, feeling refreshed, less tired and energetic, and enhancing the concentration ability. Especially during the challenging times of the pandemic, tele-yoga can prove a beneficial tool to maintain physical and mental health, avoiding any exposure and social contact (Jasti et al., 2020).

Effects of the yoga program on students during the pandemic

Along with the vulnerable elderly group, young adults taking tertiary education worldwide were also bearing great concern, as this population already had psychological distress and physical problems, such as reduced physical activity and increased sedentary behaviour before the onset of the pandemic, (Bayram and Bilgel, 2008). Moreover, various adverse conditions such as psychological distress, sedentarism, isolation or loneliness, poor sleep quality, and financial burden have been reported among students from Greek,

American, Chinese, and Swiss universities during pandemic (Kaparounaki et al., 2020).

The quasi-experimental study among musician students in Spain evaluating evident benefits perceived through CRAFT program that includes mindfulness, yoga, positive-mind and emotional intelligence, has shown that the skills learned in the program could be used independently in response to the unprecedented natural life events, reinstating that previous exposure to such techniques is likely to be beneficial for young adults to overcome stressful situations (Cao et al., 2020).

Yoga for cancer patients during the COVID-19 pandemic

The COVID-19 pandemic further exacerbated the stress of cancer patients in terms of disease fear, accessibility of health care, and safety concerns. A study evaluating a yoga program delivered via video conferencing found it acceptable, feasible, and beneficial for stage 3 and 4 cancer patients. Yoga programs may have the potential to help the cancer patients to keep calm and relaxed and help reduce stress (Bartos et al., 2021).

A recent research study (Chen et al., 2024) reported the benefits of electrical impedance tomography (EIT)-guided yoga breathing exercises in improving pulmonary function and reducing complications after esophagectomy. Among 61 older esophageal cancer patients, those who practiced yoga breathing had fewer pulmonary complications (36.7% vs. 87.1%, RR 0.42, 95% CI 0.26–0.69) and a lower incidence of pleural effusion (30% vs. 74.2%, RR 0.40, 95% CI 0.23–0.73), as well as a delayed onset of complications (hazard ratio (HR) 0.43, 95% CI 0.21–0.87, $p=0.019$) when compared to the control group (Chen et al., 2024). These findings indicate that EIT-guided yoga breathing may support postoperative recovery by reducing pulmonary risks and improving respiratory outcomes.

Yoga for healthcare workers during the COVID-19 pandemic

Health care workers are one of the most vulnerable groups and are likely to face the highest amount of stress and workload during pandemic situations. Maintaining their physical and mental health is very important. Virtual yoga-based breathing exercises and meditation in healthcare workers working at a large cancer centre were found to be useful, feasible, and acceptable (Snyder et al., 2021).

A study (Rain et al., 2022) analyzed the impact of short and long duration breathing techniques on health of COVID-19 patients, COVID recovered individuals, and healthcare workers for a period of 15 days. The study contained two groups, one with intervention and other without intervention as control groups. The outcomes were assessed through biochemical markers, exercise capacity, and heart rate variability (HRV). Results showed a significant drop in D-dimer levels in recovered individuals ($p = 0.002$) and healthcare workers ($p = 0.01$), suggesting a lower risk of thrombosis. The 6-minute walk test distance improved in COVID-positive patients ($p = 0.01$) and healthcare workers ($p = 0.002$), indicating enhanced endurance (Rain et al., 2022). These findings indicate that yogic breathing may aid recovery and immune regulation in mild to moderate COVID-19 cases.

Sudarshan Kriya Yoga (SKY) - Hope during the COVID-19 pandemic

SKY is a unique yogic practice that consists of specific, controlled, cyclic, rhythmic, sequential breathing techniques. SKY balances and helps in regulation of autonomic nervous system thereby helping in reduction of anxiety, stress, depression, and PTSD. It boosts natural host immune defences essential for fighting microbial infection. SKY helps in mood relaxation and lead to elevated total T cells, T helper cells, NK cells, and antioxidant defence. These observations they suggest the potential of SKY for improving immunity

against viral infection and individuals' mind-body connections in COVID-19 patients and recovered individuals (Narayanan et al., 2021; Zope et al., 2021).

A study (Doria et al., 2015) reported that SKY showed a marked reduction in stress scores for anxiety and depression in 69 participants. Hamilton Rating Scale for Anxiety scores decreased from 17.3 to 11.0 ($p < 0.001$), while Hamilton Rating Scale for Depression scores dropped from 11.1 to 7.7 ($p < 0.001$), with notable improvements also observed on the Zung Self-rating Anxiety Scale (44.2 to 36.5 ($p < 0.001$)) and Zung Self-rating Depression Scales (46.3 to 38.2 ($p < 0.001$)). With a moderate effect size (Cohen's $d = 0.66$ for anxiety, 0.61 for depression), the most significant changes occurred within the first 10 days before stabilizing (Doria et al., 2015). These findings indicate that SKY may serve as an effective adjunct therapy for managing anxiety and depression.

Conclusion

Potential of yogic interventions, including pranayama, asanas and meditation, to improve pulmonary function, respiratory and general immunity can be instrumental in the management of COVID-19 severity. A series of reviews during the pandemic highlights the promising effects of yoga exercises and meditation practices in alleviating depression, anxiety and improving quality of life. Clinical evidence indicates that it can also prove as potential tool for tackling long-term physical and mental health issues related to the pandemic. Yoga practices are cost-effective and potentially complementary therapies that can be prescribed as adjuvant treatments for prevention, non-pharmacological management and COVID-19-related tailored treatments. It can be easily adapted as a part of daily lifestyle to improve overall immunity at the individual and public health level.

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