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## Original Research Article

## Efficacy of pranayama in preventing COVID-19 in exposed healthcare professionals: A quasi-randomized clinical trial

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## ABSTRACT

**Background:** The global outbreak of COVID-19 has created a challenging situation, especially for the frontline Health Care Professionals (HCPs), who are routinely exposed and thus are at a higher risk of infection. Pranayama, a component of Yoga, is known to improve immune function and reduce infection. However, no clinical trial on the efficacy of Pranayama in preventing COVID-19 has yet been conducted. **Aim and objective:** This quasi-randomized clinical trial assessed the efficacy of Pranayama in preventing COVID-19 infection in HCPs routinely exposed to COVID-19.

**Methodology:** The study was conducted at 5 different COVID-19 hospitals, India in year 2020. The inclusion criteria were being an HCP exposed to COVID-19 patients and being negative on antibody tests. 280 HCPs were recruited sequential and assigned to intervention and control groups. Of these, 250 HCPs completed the study. The intervention was twice daily practice, for 28 days, of specially designed Pranayama modules under the online supervision of Yoga instructors. The HCPs in the control group were advised to continue their normal daily routine, but no pranayama sessions. Participants who developed symptoms suggestive of COVID-19 were subjected to Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) or Point of Care Rapid Antigen Test (RAT) for confirmation of the diagnosis. All the participants were tested for antibodies to COVID-19 on 28th day of the intervention to detect any asymptomatic infection.

**Results:** The intervention (123) and control (127) groups had comparable demographics and baseline characteristics. At end of 28 days of intervention, nine participants in the control group and one in the intervention group developed COVID-19 (P-value: 0.01, Odds Ratio: 0.107, 95% CI: 0.86; Risk Ratio: 0.11, 95% CI: 0.89).

**Conclusion:** The intervention of twice daily practice of the Pranayama module for 28 days in HCPs might have made a noteworthy contribution and may have helped in preventing COVID-19 infection.

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## 1. Introduction

COVID-19 pandemic is a global challenge to public health [1]. Among other measures, most countries have enforced lock-downs or stay-at-home orders [1] as a mitigation measure. Health Care Professionals (HCPs) being exposed to cases as a part of their

professional duties have been in particular susceptible to COVID-19 infection.

HCPs being on the front lines of COVID-19 crisis, have reported psychological stress [2], tiredness, sleep problems [2] because of fear, and interruption of normal life due to heavy patient loads [3]. HCPs are under extreme stress due to their long working hours, wearing of Personal Protective Equipment (PPE), lack of specific drugs and being away from their families [4,5].

At present, there is no definite treatment for COVID-19. However, researchers and clinicians are working on various antibiotics and antiviral agents, like monoclonal antibodies, oseltamivir, ganciclovir,

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ribavirin, molnupiravir, favipiravir, nelfinavir, arbidol, remdesivir and galidesivir [6–9]. Since immunity plays an important role in COVID-19 infection, Non-Pharmacological Interventions which have an immune-modulatory effect, could serve as a preventive as well as a therapeutic measure for patients with COVID-19 infection [10–14]. During this outbreak, numerous herbal products have also been explored as alternative therapies [15,16].

Yoga, which originated in ancient India, is also recognized as a form of a Complementary Medicine, as well as an alternative therapy that can positively influence the mind-body continuum [17]. Yoga has been practiced since times immemorial for the prevention of disease and promotion of health. Substantial research has already been done on the effectiveness of Yoga in the management of lifestyle disorders, preventing infection and accelerating healing and recovery. Yoga has two key practices – one of rhythmic, controlled breathing called Pranayama and another is effortless concentration of mind called Dhyana. The former helps to improve lung capacity, cardio-respiratory functions, neuro-endocrine activity and also mental activity [17,18]. Several other studies suggest the effects of various components of Yoga in infectious diseases. A study conducted in a Bangalore sanatorium showed efficacy of Integrated Yoga (IY) protocol as an add-on to Anti Tuberculosis Treatment in reducing symptoms of Tuberculosis [17]. One month of practice of integrated Yoga in patients suffering from HIV-1 infection led to a significant reduction in viral load, increase in the number of CD4 immune cells and improvement in psychological state [18]. Several clinical trials have suggested an overall positive effect of Yoga in improving pulmonary and immune functions in patients with tuberculosis [17], HIV-1 infection [18] and anxiety [19].

Therefore, the present study was conducted to assess the efficacy of Pranayama, which is a part of yoga, in preventing COVID 19 infection in the HCPs exposed to COVID-19 infection [20].

## 2. Methodology

### 2.1. Ethical considerations

After obtaining approval of the Institutional Ethics Committee, the study was registered on Clinical Trials Registry of India (CTRI No. CTRI/2020/07/026667). Five hospitals dedicated for handling COVID-19 cases were included for the study. HCPs meeting inclusion criteria of exposure to COVID-19 suspects or cases, were in quarantine and ready to practice Pranayama, but did not have comorbidities that avert practice of Pranayama or Severe cardiac disease were enrolled for the study and their informed consent obtained. One Yoga instructor was assigned to each of the five identified hospitals to train and guide the study participants in twice daily practice of Pranayama, supervise its practice and collect data on the intervention. The HCPs in the control group were advised to continue their normal daily routine, but no pranayama sessions.

### 2.2. Sample size

Sample size was estimated on the assumption of a prevalence of COVID-19 infection of 10% in the population of HCPs, and expectation that our treatment group will have a 90% lower prevalence i.e. 1%. For a power of 80%, alpha of 0.05, 95% confidence interval, the sample size estimate was 121 in each arm (Table 3).

### 2.3. Study sample

Inclusion criterion was HCPs (age range: 19–65 years, any gender), being on COVID-19 duty (duty cards were taken as proof),

not previously infected with COVID-19 (negative antibody test) but with a recent history of exposure to COVID-19 suspects or cases and who were in quarantine. 288 HCPs were registered for the study. Out of these, 8 were found positive on rapid Antibody tests at baseline. Positive rapid antibody test of HCPs indicates previous infection of COVID-19; therefore, such HCPs were excluded from the study. HCPs like doctors, nursing staff, housekeeping staff/caretaker and Yoga instructors who were directly in contact with COVID-19 positive patients were classed as “directly exposed”. Others like Medical Superintendent, Chief Medical Officers, Pharmacists, Lab technician, Hospital administration staff like Managers, Supervisors, DEO, MTS who were not in close contact with COVID-19 cases were classed as “indirectly (remotely) exposed”.

### 2.4. Randomization

Medical in-charge of the hospitals/COVID-19 care units were authorized to enroll study participants but had no other role in the trial. Eligible HCPs were quasi-randomized on admission through alternate allocation (ratio 1:1) into two groups. Subsequently, the two groups were designated as ‘Intervention group’ and the ‘Control group’ by the coordinator of the study, who was blinded to the initial allocation.

### 2.5. Masking

It is difficult to assess yoga/pranayama practices in double blind trials because the intervention requires active participation of the participants and hence their identities become known after allocation. Soon after enrollment, antibody test was administered by a lab staff who did not otherwise participate in the trial and was blinded to the study groups. In addition, the outcome assessor was blinded to the group of study.

### 2.6. Study groups

Of the 280 enrolled participants, 17 (Intervention – 15, Control – 2) did not adhere to the 80% attendance requirement, and 13 (Intervention – 2, Control – 11) did not give their post-intervention data, and thus 30 study participants (Intervention – 17, Control – 13) were excluded. Thus, 250 participants completed the study which included 123 in the intervention group (administered Pranayama protocols) and 127 in the control group. Profession wise break up of 250 participants was: Resident Doctors-29, Nursing staff-63, Caretakers/House-keeping staff-82, Lab technicians-22, CMOs/Medical Superintendent –20, Pharmacist-15, Yoga Instructors-4, Hospital Administration staff like Accountants, Multi-Tasking Staff, Data Entry Operator, Receptionists-15.

### 2.7. Study parameters and tools

Basic demographic information, medical history and dietary habits were collected at baseline. Antibody test for COVID-19 was done on all the study participants at baseline and on completion of the study at end-line.

### 2.8. Antibody test

An antibody serology test (Accucare COVID-19 kit) approved by ICMR; was used to detect prior COVID-19 infection in all study participants. This test detects two types of antibodies – IgM and IgG. During the study, the participants who developed COVID-19 symptoms were also administered the Rapid Antigen Test/RT-PCR for confirmation of a diagnosis of COVID-19.

**Table 1**  
Pranayama (breathing) protocol for the morning session (30 min).

S. no	Practices	Name of practice	Rounds	Duration (in minutes)
1	Preparatory	Prayer	3 deep breathing or prayer of individual	1
2	Practices for Pranayama (9 min)	Vaata-Neti	3 rounds <sup>a</sup> (30 s/round)	2.5
3		Kapalabhati	3 rounds <sup>a</sup> (30 s/round)	2.5
4		Deep breathing	10 rounds	3
5	Pranayama practices (16 min)	Nadi-shodhana	10 rounds	8
6		Ujjaayee	10 rounds	4
7		Bhramari	10 rounds	4
9	Meditation (5 min)	Dhyana	Awareness of breathing, thoughts and emotions	5
	Total duration			30

This Pranayama protocol was administered with increased intensity gradually to achieve 6:3:6:3 ratio (6 inhalations: 3 retentions: 6 exhalations: 3 retentions).

Day 1: subjects were practiced Inhalation (4 s): Exhalation (4 s).

Day 2: I: E ratio (5 s:5 s).

Day 3: I: E ratio (6 s:6 s).

Day 4 & 5: I: RI: E ratio (6 s:3 s:6 s).

Day 6 & 7: I: RI: E: RO ratio (6 s:3 s:6 s:3 s).

8th day onwards they continuously practiced with 6 s of inhalations: 3 s of retentions: 6 s of exhalations: 3 s of retention ratios.

<sup>a</sup> (2 & 3) Each practice of vaataneti/kapalbhanti has suitable rest/gap time of 20 s to become normal and to experience the impact of the practice.

## 2.9. The intervention: administration of pranayama protocols

Two Pranayama modules lasting 30 min for the morning (Table 1) and 15 min for the evening (Table 2), were developed by the principal investigator. Participants in the intervention group were trained and guided through Video-Conference by Yoga Instructors to practice Pranayama twice a day for 28 days. A daily attendance record was maintained. All the participants were closely monitored by the Yoga Instructors for confirmation to the protocol.

### 2.10. Modules

Specially designed Pranayama modules included preparatory Yoga practices for 9 min, Pranayama practice for 16 min and meditation for 5 min each in the morning session, and 15 min of breathing exercises in the evening session. Detailed procedure to perform the protocol has been provided as [supplementary data \(Annexure-1\)](#)

These modules were also publicly hosted ([https://www.youtube.com/watch?v=RD1huWS\\_7w8&feature=youtu.be](https://www.youtube.com/watch?v=RD1huWS_7w8&feature=youtu.be)). The intervention group was provided this link from the beginning for their better understanding and aid in practice.

### 2.11. Statistical analysis

Data collected was entered in Microsoft Excel and cleaned. In bivariate analysis, categorical variables were presented as

**Table 2**  
Pranayama (breathing) protocol for the evening session (15 min).

S. no	Name of practice	Rounds	Duration (in minutes)
1	Shavasana (corpse pose) (with palm upwards)		1
2	Pristhabhumi Tadasana		
3	Abdominal breathing	15 Rounds <sup>a</sup>	3
4	Thoracic breathing	15 Rounds <sup>a</sup>	3
5	Clavicular breathing	15 Rounds <sup>a</sup>	3
6	Deep breathing (lying down position)	15 Rounds <sup>a</sup>	3
	Relaxation in Shavasana with awareness on abdominal breathing		2
	Total duration		15

Each breathing comprises 6 s inhalation and 6 s exhalation.

There is no retention of breathing in the evening session. For the breathing practices in the evening yoga sessions were designed as follows.

Day 1 & 2: subjects were practiced Inhalation (4 s): exhalation ratio (4 s).

Day 3 & 4: inhalation (5 s): exhalation ratio (5 s).

Day 5 & 6: inhalation (6 s): exhalation ratio (6 s).

Rest/gap has been given between each pranayama.

<sup>a</sup> Initially the practice of all 4 breathing practices started with 10 rounds each and gradually over a period of 5–7 days increased to 15 rounds each.

frequencies (%), continuous data as mean (with Standard Deviation) or median. Mean difference in pre-post intervention was examined for statistical significance using Fisher's exact test. A P-value of 0.01 was considered significant. Data was analyzed using IBM Statistical Package for the Social Sciences (SPSS) Version 20.0 (Armonk, NY: IBM Corp).

## 3. Results

Flowchart diagram of recruitment process of participants and design of the study has been provided in [Fig. 1](#).

Two groups of HCPs had comparable age, socio-demographic characteristics, exposure status and comparable co-morbidities ([Table 4](#)).

During the period of the study, three participants from the control group developed symptoms suggestive of COVID-19 such as fever, cough, etc. They tested positive on Rapid Antigen test/RT-PCR. At the end of the study, one participant from the intervention group and 9 from the control group (including three symptomatic participants who had tested positive on Rapid Antigen Test/RT-PCR) tested positive on COVID-19 Antibody Test. This difference was statistically significant (P-value: 0.01), indicating a protective effect of the intervention of Pranayama in preventing COVID-19 infection (odds ratio: 0.107, 95% CI: 0.86; risk ratio: 0.11, 95% CI: 0.89) ([Table 5](#)). The 10 HCPs who tested positive with COVID-19 at the end line showed no particular socio-demographic pattern ([Table 6](#)). They belonged to both genders, diverse age and professional groups with 80% of them being middle-aged. Of the 10 HCPs (4 females, 6

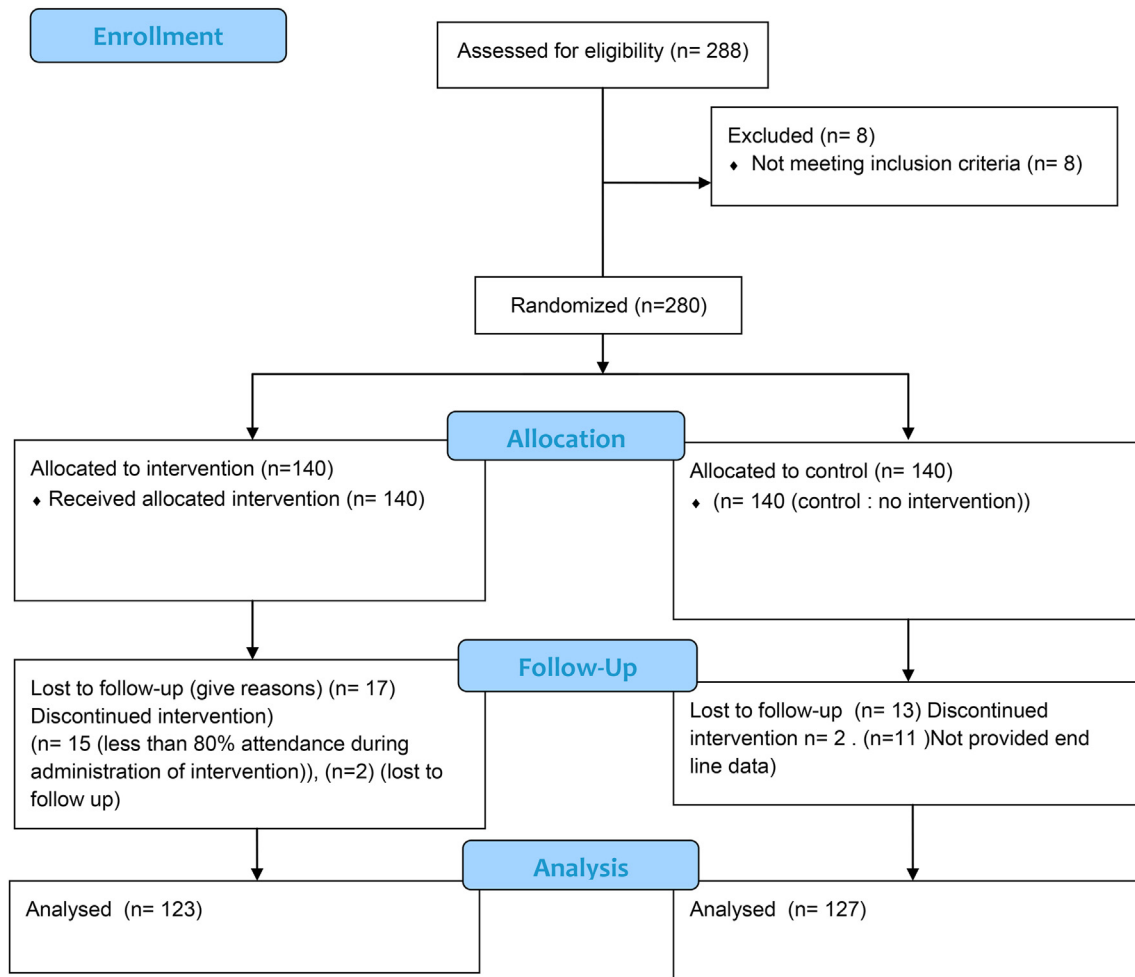


Fig. 1. Flow chart.

males) who contracted COVID-19 infection, nine were from the highly exposed group and 8 were healthy with no comorbidities (Table 6). The lone participant from the experimental group who tested positive on antibody testing at the end of intervention probably had asymptomatic COVID 19 infections.

#### 4. Discussion

The present study was conducted in 5 different hospitals dedicated for COVID-19 patients with a reasonable (250) sample size. To the best of our knowledge, this is the first study to assess the effect

Table 3

Sample size calculation In Stata sampsi 0.1 0.01, power (0.8).

Estimated sample size for two-sample comparison of proportions  
Test Ho:  $p_1 = p_2$ , where  $p_1$  is the proportion in population 1 and  $p_2$  is the proportion in population 2

Assumptions:

alpha = 0.0500 (two-sided)

power = 0.8000

$p_1 = 0.1000$

$p_2 = 0.0100$

$n_2/n_1 = 1.00$

Estimated required sample sizes:

$n_1 = 121$

$n_2 = 121$

of Pranayama in preventing COVID-19. The results of our study suggesting a role of Pranayama in infection is in agreement with earlier studies [11,17,18]. The only participant in the Intervention group who developed COVID-19 was a caretaker (male) in the 35–50 years age group, with no comorbidity, who was in contact with COVID-19 patients. He had no regular exercise routine, but was practicing the Pranayama intervention.

The biological processes underlying the protective effects of Pranayama remain to be fully investigated. Each component of the Pranayama module would have played a role in preventing COVID-19 infection. Vaata-neti helps to clean the nasal passages and maintain the sinuses and helps to get rid of pathogens. Kapalabhati kriya is a process of forceful exhalation and normal inhalation which help to improve pulmonary function and clean the frontal sinuses, removing congestion in nasal and respiratory tract [22] and easing movement of the diaphragm [21]. These two are very useful preparatory practices for Pranayama. Deep breathing helps to improve lung's vital capacity. Nadi-shodhana pranayama helps to reduce sympathetic activity and stimulate the vagal (parasympathetic activity) [23]. It helps to reduce stress and anxiety, thus balancing autonomic function. Ujjayi pranayama increase oxygen ( $O_2$ ) saturation in the body, removal of congestion from the throat and strengthens the larynx and pharynx [23]. Bhramari pranayama is similar to humming that increases nasal Nitric Oxide (NO) by improving blood flow to the ciliary epithelium [24,25]. Meditation helps to reduce stress & anxiety by reducing cortisol

**Table 4**  
Baseline socio demographic profile of 250 HCPs.

Variables	Experimental Grp N (%)	Control Grp N (%)
<b>Total</b>	123 (100.00%)	127 (100.00%)
<b>Age (in years)</b>		
18–35	74 (60.16%)	70 (55.12%)
36–50	40 (32.52%)	49 (38.58%)
51–65	9 (7.32%)	8 (6.30%)
<b>Gender</b>		
Male	67 (54.47%)	65 (51.18%)
Female	56 (45.53%)	62 (48.82%)
<b>Diet</b>		
Veg.	69 (56.10%)	52 (40.94%)
Mixed diet	54 (43.90%)	75 (59.06%)
<b>Exposure</b>		
In-directly exposed	86 (69.92%)	87 (68.50%)
Admin staff	4(3.3%)	11 (8.7%)
Lab technician	14 (11.4%)	8 (6.3%)
Pharmacist	5(4.1%)	10 (7.9%)
Senior officers/CMO	11(8.9%)	9 (7.1%)
Directly exposed	37 (30.08%)	40 (31.50%)
Doctor	17 (13.8%)	12 (9.4%)
Nursing staff	30 (24.4%)	33 (26.0%)
Caretaker/housekeeping	39 (31.7%)	43 (33.9%)
Yoga instructor	3 (2.4%)	1 (0.8%)
<b>Health status</b>		
HCPs (healthy)	102 (83%)	106 (84%)
HCPs (with co-morbidities)	21 (17%)	21 (16%)

Grp: group; N: number; Veg.: vegetarian.

levels in the blood and enhances alpha ( $\alpha$ ) waves in the brain. The above pranayama and Dhyana practices make the body comfortable, keep the mind calm and help to balance the neuro-endocrine system, and thereby the immune system. The preparatory practices for pranayama (eg. Vaataneti & kapalabhati) performed at the rate of one breathing per sec and pranayama practices in the morning session involved a ratio of 6 (inhalation):3 (retention): 6 (exhalation):3 (retention), while those in the evening session followed a breathing ratio of 6:6. At rest, one breath normally lasts 3 s, which gets extended to 18 s during pranayama. In our protocol, emphasis was on deep, slow, rhythmic breath with awareness. The breathing practices for the evening followed by shavasana (with the palm upwards) would have given relaxation to body and mind and improved the quality of sleep. In thoracic breathing, the chest expands and contracts with each breath while the abdominal area does not. The subjects were encouraged to breathe in more oxygen by slow and deep thoracic breathing with total awareness [26]. Practice of thoracic breathing immediately after performing abdominal breathing helps the practitioner to adapt to more chest expansion, before doing the clavicular breathing. Thus, in the next step, i.e., the practice of deep breathing, the subject naturally and effectively expands thorax for effective ventilation. The selected combination of Pranayama modules makes it a comprehensive intervention for the purpose of reducing the possibility of contracting COVID-19 infection.

There is strong evidence on the positive effects of Yoga practice on stress management among HCPs [27]. Stress is known to

suppress immune function and increase susceptibility to infections [28]. Chronic stress is associated with global immuno-suppression, as well as decreases in almost all immune measures. Increased duration of stress can result in a shift from potentially adaptive changes to potentially detrimental changes, initially in cellular immunity and then in broad immune function [29]. Pranayama practices have been found to have a direct impact on reduction in vaata aggravation and Vagus Nerve stimulation [31,32]. Vagus Nerve Stimulation has been found to have a direct effect in managing stress and diseases born out of it [30]. A strong host immune response to the novel coronavirus is a key factor for protection against infection. The efficacy of our especially designed Pranayama protocol could be because of the above-mentioned mechanisms, whose modalities of action need further exploration. This study has also revealed that COVID-19 infection in the intervention group tends to be mild and asymptomatic, thus strengthening the conclusion of a positive, preventive effect of Pranayama.

#### 4.1. Strength, limitations and future recommendations

This study has some limitations. Due to pandemic conditions, the Pranayama protocols could be administered through online mode only. Yoga Practices like Pranayama need Guru-Shishya (Yoga teacher – Yoga student) interaction. HCPs could have had a lowered interest in Pranayama classes due to prolonged working hours. As the control group was not administered with any comparable practice, they might not have had any expectation of a lower chance of contracting the infection. Future studies are required with a set of comparable practices for the control group also. Since the Antibody test alone was used for pre-test assessment of COVID-19 infection, there could be a theoretical probability in both the groups of a prior infection with COVID-19, but without any detectable antibodies. Of the 10 HCPs (9 Control +1 Experimental group) who contacted COVID-19 at the end-line, 6 were from the lower Socio-economic groups. Only 2 of the 10 participants turning covid-19 positive were from the doctors/nurse category, while the rest were from allied and support staff, whose household and social conditions like food intake, home environment, stress of life might not be comparable. The study has not investigated the effect of confounding variables like environmental factors (such as food intake, home environment, stress of life). This is an area of further research. Our intervention lasted 28 days, which is a relatively short length for the study and longer periods of practice of the intervention are critical to knowing the lasting benefits and efficacy of the intervention. Hence, a multi-centric study with a larger sample and longer duration/period is recommended for further testing of our Pranayama Protocol. The pranayama protocol can also be compared to and supplemented with other yoga/pranayama programs. Considering the implications of the study for Health care professionals and the general public living in fear of COVID-19, larger studies across different geographical, ethnic and cultural backgrounds are needed to verify its generalizability.

Despite limitations, the data presented in this study draws attention to the benefits of our Pranayama modules to prevent COVID-19 in HCPs routinely exposed to the virus.

**Table 5**  
Post-intervention COVID-19 assessment results in intervention vs. control groups.

	Total no. of HCPs	COVID-19 positive cases	COVID-19 negative cases	Fisher's exact test score	P-value	Effect size
Experimental grp N (%)	123 (100%)	1 (0.8%)	122 (99.2%)	0.0192	0.01 <sup>a</sup>	Odd's ratio: 9.00, CI: (1.14, 71.03)
Control Grp N (%)	127 (100%)	9 (7.1%)	118 (92.9%)			Risk ratio: 1.83, CI (1.43, 2.3)

<sup>a</sup> Indicate level of significance.

**Table 6**  
Socio-demographic profile of HCPs infected with COVID-19 at post-intervention.

HCPs	Group	Gender	Dietary habits	Age group	Exposure (COVID-19)	Duty in COVID-19 wards
SUB 012	Control	F	Veg	18–35	Direct	Asha worker/care taker/housekeeping
SUB 034	Control	M	Veg	51–65	Direct	Care taker/housekeeping
SUB 084	Control	F	Non-veg	36–50	Direct	Care taker/housekeeping
SUB 114	Control	F	Non-veg	36–50	Direct	Nursing off
SUB 164	Control	M	Veg	36–50	Indirect	Courier boy/admin staff
SUB 171	Control	M	Veg	18–35	Indirect	Lab tech
SUB 173	Control	M	Non-veg	51–65	Direct	Doctor
SUB 186	Control	F	Veg	18–35	Direct	Care taker/housekeeping
SUB 196	Control	M	Non-veg	18–35	Direct	Care taker/housekeeping
SUB 227	Experimental	M	Veg	36–50	Direct	Care taker/housekeeping

The intervention of twice daily practice of Pranayama administered by trained Yoga instructors in HCPs exposed to active cases might have helped and made a noteworthy contribution in significantly preventing COVID-19 infection. The present study suggests that the Pranayama modules can be promoted among all sections of the population to prevent COVID-19.

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#### Declaration of competing interest

No conflicts of interest.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jaim.2022.100586>.

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