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RESEARCH ARTICLE

EFFECT OF PARANYAMA EXERCISES ON FUNCTIONAL CAPACITY IN PATIENT WITH INTERSTITIAL LUNG DISEASE

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ABSTRACT

Background: Interstitial lung disease (ILD) is a heterogeneous group of disorders characterized by a common presentation of cough (mostly dry), breathlessness, and related symptoms with a systemic disorder when present. ILD is also recognized as diffuse parenchymal lung disease (DPLD) and is divided into two categories: idiopathic interstitial pneumonia (IIP) and other than IIP. Interstitial lung disease and pulmonary fibrosis are two types of lung diseases that involve inflammation and fibrosis of the lung parenchyma. **Objective:** This study aimed to investigate the effect of paranyama exercises on functional capacity in patient with interstitial lung disease, to determine its benefit as a simple, safe exercises, and to determine how much paranyama exercises useful in enhancing the functional capacity and quality of life in patient with interstitial lung disease. Methods: Sixty patients of both sex (26 men & 34 women), their age ranged from 40 to 50years, their body mass index (BMI) ranged from 25 to 30 Kg/m2, referred and they were selected from the Outpatient clinic and the chest department of El-Kasr El aini Teaching Hospital, Cairo, Egypt . Patients were randomly assigned into two equal groups; **Group A:** This group included 30 patients received paranyama exercises in addition to medical treatment. **Group B:** This group included 30 patients received medical control only. The treatment session for both groups was conducted for 30 to 45 minutes, three days per week, for eight weeks. Data obtained from both groups regarding measurement of Arterial blood gases (ABG), and anthropometric measurements (weight and BMI), and quality of life (QOL) assessment using the SF-12 Health Survey Questionnaire, were statistically analyzed and compared. **Results:** Comparing both groups post treatment revealed a significant increase of PaO2, SaO2 for group (A) (with P value=0.0001; P<0.05), There was also a significant decrease in HCO3 and PaCO2 for group (A) (with P value=0.0001; P<0.05). **Conclusion:** Pranayama exercises are important in improving blood gases, dypsnea and quality of life in patient with interstitial lung disease (ILD), and also, strengthens respiratory muscles, increases surfactant levels, stimulates stretch receptors, and relieves tension, all of which increase lung volumes and capacities. It aids in the treatment of respiratory diseases. Pranayama aids in the maintenance of vital energy in the body, the maintenance of body rhythms, and the detoxification of internal organs. Pranayama improves the efficiency of the respiratory system and regulates the overall circulatory process of the body. So paranyama adjunct to conventional therapy for pulmonary rehabilitation programs for ILD patients.

INTRODUCTION

Interstitial lung disease (ILD) comprises a heterogeneous group of disorders characterized by multifocal diffuse lung involvement, 1 .These diffuse infiltrative lung disorders are typically characterized by the presence of inflammation and altered lung interstitial, and specific forms of ILD can be differentiated from one another when clinical data, radiologic imaging, and pathologic findings (if lung biopsy is needed) are combined to reach a confident diagnosis , 2 .

A well-performed patient history and physical examination provides invaluable information that can be combined with appropriate laboratory testing, imaging, and, if needed, tissue biopsy to reach a confident ILD diagnosis, and high-resolution computed tomography (HRCT) of the thorax is usually a key component of the diagnostic evaluation, 2. Interstitial lung diseases are a group of similar conditions where the tiny air sacs of the lungs (the alveoli) and the lung tissue next to the alveoli become damaged and scarred.

The development of the scar tissue is called fibrosis. As the lung tissue becomes more scarred and thicker, it becomes more difficult for the lungs to transfer oxygen into the bloodstream. The scarring can get worse over time and this is called progressive fibrosis. This reduces the amount of space in the lungs and makes it more difficult to breathe, 3. Progressive fibrosis may develop in approximately 18–32% of patients with ILDs other than IPF, with the time from symptom onset to death estimated at 61–80 months,4 . In clinical practice, monitoring disease progression includes various components, covering symptoms, patient-reported outcomes, exercise capacity, serial lung function testing, fibrosis measured by high-resolution computed tomography (HRCT) of the chest, serum biomarkers and need for supportive care ,5. Progressive fibrotic lung disease is one of the possible consequences of COVID-19 pulmonary pneumonia, and it is one of the most worrying long-term complications. Pulmonary fibrosis is associated with non-reversible lung dysfunction,6. Pulmonary rehabilitation is often used to improve symptoms, health-related quality of life and functional status in other chronic lung conditions. There is accumulating evidence for comparable effects of pulmonary rehabilitation in people with ILD, 7.

Pranayama is the art of prolongation and control of breath. It helps in reshaping of breathing habits and patterns, 8. Yogic breathing or pranayama is part of all yoga's and is the art of controlling the breath,9. Major benefits of paranyama respiratory system is strengthen respiratory system, Provides fresh oxygen treat asthma and bronchitis and Increases exchange volume. Pranayama can be considered as technique of skull shining breath, clear congestion and improve capacity of lungs. Suppress bloating and provide symptomatic relief in the condition of allergy and bronchitis,10.

MATERIALS AND METHODS

Subjects: Sixty patients from both sexes, underwent the final analysis of the study. Inclusion criteria were patients with interstitial lung disease with age ranged between (40-50)year-old, their BMI ranged from 25 to 30 (kg/m2), and their saturation more than 90 %.Another major inclusion criterion was medically stable when attending the study, Patients free from any acute condition, Post covid from 6 months to 1 year ago (hospitalized in ward)**.** Exclusion criteria were unstable cardiovascular problems, Auditory and visual problems, Peripheral vascular diseases, Any condition of kidney failure, Any acute infection as Flu and Patients with orthopedic or neurological limitations to exercise. , were recruited in this study from chest departments at Al-Kasr AL Ainy Hospital and the Faculty of Medicine, Cairo University.

Design: This study which is a randomized controlled was conducted between July 2021 to Januarey 2022. The study has been approved by the ethical committee of the faculty of physical therapy, Cairo University, Egypt (No. P.T.REC/012/003307. After the study's purpose was stated and informed consent was given, patients were randomly assigned into two equal groups (A and B) based on the envelope method. After patients' consent. Recording data sheet: all data and information of each patient in this study including name, age, gender, CT finding, oxygen saturation was recorded in a recording data sheet. The participants were informed to report any harmful effects throughout the treatment period.

Procedures of the study: Full physical and detailed clinical examination was done on all patients including assessment of the vital signs i.e.: Heart rate (HR), respiratory rate (RR), Blood pressure (BP), oxygen saturation (SaO2)] and temperature were examined before and after each session to exclude any signs or symptoms that may interfere with the continuity of the study. Patients should not eat a heavy meal for two hours before the session.

Measurement method: Arterial blood gases have been assessed for all patients of both groups before and after treatment by using acid base analyzer. This measuring procedure was done to detect the value of pH, PaCo2,PO2, HCO3 and oxygen saturation. This done and reported initially at selecting our sample subjects for both study and group (B)s, then was done after eight weeks. Oxygen Saturation also was measured for each subject from a sitting position using a pulse oximeter attached to finger tip. It was done and reported at the initial assessment before the intervention, after eight weeks . The 12 - item Short- Form Health Survey (SF-12) Questionnaire: it was used to assess the HR-QOL before and after the study in both groups (A and B).

Therapeutic procedures: The average duration of the treatment session ranged from 30 to 45 minutes. For group "A", each exercise should be between two to four breaths. This was repeated 10 to 15 times, , this was classed as one treatment session that was done three times per week.

Paranyama exercises: This approach was done only with the group (A) that included 30 patients who received both the paranyama exercises and medical treatment three times per week for eight weeks.. This exercises is classified into various types:

Nadi Sodhana: For performing Nadi Sodhna, sit in a comfortable position. Now use the right hand to close the right side of your nose, inhale deeply with the left nostril. Repeat the same with left nostril. Practice it for 10 -15 times per day,27.

Shitali Pranayama: This is the most refreshing breathing exercise . this need to inhale through the mouth breath in an "O" shape . Hold your breath. Do exhalation from your nostrils after some time. This can be performed by rolling tongue in o shaped five to ten times per day, 26.

Ujjayi Pranayama: This type of pranayama is about mimicking the sound the ocean or waves by inhaling from the nostrils and making sound from the throat. Seat in a comfortable position, start inhaling, and exhaling from the mouth. Constrict the throat as if something is chocking, it will create an oceanic sound. Repeat it for ten to fifteen times,26.

Kapalabhati Pranayama: This type of pranayama is wholly related to deep inhalation and forceful exhalation of air in comfortable position. Air from the lungs is exhaled forcefully, but inhalation is done involuntarily, 26.this done according to patient's tolerance not exceeding 10 times.

Bhastrika Pranayama: For practicing Bhastrika Pranayama, keeping the spine straight and Inhale deeply with nostrils; fill the lungs with air and then exhale forcefully through nostrils so that the stomach will go deep inside, 26. this done according to patient's tolerance not exceeding 10 times.

Bhramari Pranayama: This is the humming bee pranayama that mimics the sound of a bee. Bhramari Pranayama is done by closing the ears with the thumb and eyes with the help of fingers. Take a deep breath and exhale slowly making a buzzing sound like that of a bee,26.

Anuloma & Viloma Pranayama: It involves pausing of breathing at regular intervals. It is divided into two stages called as paused inhalation and paused exhalation. You need in a comfortable position and relax your body and mind. Now inhale for 2 to 3 seconds and pause, then again restart inhalation and pause after 2 seconds. Repeat the process until the lungs feel full of air. Exhale slowly. It is known as Viloma pranayama. Whereas, Anuloma pranayama is breathing nostrils in an alternative way. Both are almost same and help in cleansing of nasal passages,27.

Sheetkari Pranayama: This is more like the Shitali Pranayama but with changes in practice. In this pranayama, produce "Sheetkar" sound from the mouth. Inhale and hold the breath. Exhale air using the nostrils. This pranayama should be practiced in summer for five to ten times. It will keep the body temperature under control,27.

Statistical analysis: Unpaired t-test were conducted for comparison of subject characteristics between groups. Chi-squared test was conducted for comparison of the sex, CT finding and associated risk factors distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test.

Levene's test for homogeneity of variances was conducted to test the homogeneity between groups.Mixed design MANOVA was performed to compare within and between groups effects on pH, PaO2, PaCO2, HCO3, SaO2 and SF-12. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

RESULTS

***Subject characteristics*:** Table (1) showed the subject characteristics of the group A and B. There was no significant difference between groups in age, BMI, sex, CT findings and risk factors distribution ($p > 0.05$)

Effect of treatment on pH, PaO2, PaCO2, HCO3, SaO2 and SF-12: Mixed MANOVA revealed that there was a significant interaction of treatment and time ($F = 351.14$, $p = 0.001$). There was a significant main effect of time ($F = 340.81$, $p = 0.001$). There was a significant main effect of treatment ($F = 125.25$, $p = 0.001$).

Within group comparison: There was a significant increase in pH, PaO2 and SaO2and a significant decrease in PaCO2 and HCO3 in the group A post treatment compared with that pre treatment ($p < 0.05$). There was a significant increase in SF-12 physical and mental scores in the group A post treatment compared with that pre treatment ($p < 0.001$); while There was no significant difference in pH, PaO2, PaCO2, HCO3, SaO2 and SF-12 of the group B between pre and post treatment ($p > 0.05$).(Table 2,3).

Between group comparison: There was no significant difference between groups pre treatment ($p > 0.05$). There was no significant difference in pH between the group A and B post treatment ($p = 0.11$). There was a significant increase in PaO2 in SaO2 of the group A compared with that of the group B post treatment ($p < 0.001$). There was a significant decrease in PaCO2 and HCO3 of the group A compared with that of the group B post treatment ($p < 0.001$). (Table 2). There was a significant increase in SF-12 physical and mental scores of the group A compared with that of the group B post treatment ($p < 0.001$) (Table 3).

DISCUSSION

This study was conducted to determine the effect of paranyama exercises on arterial blood gases and The 12-Item Short-Form Health Survey (SF-12) in patient with interstitial lung disease. According to these results, it could be concluded there was significant difference in the mean, ±SD values of PO2, PCO2, HCO3 and Sat. O2 at post-treatment between both groups. So, this significant increase in PO2 by 11.56% , Sat. O2 by 1.33% and SF 12 physical scores by 63.8% and mental scores by 55.73 % at post treatment favor of study group than control group and also significant decrease in PCO2 by -8.17 % and HCO3 by -3.93% . and there is significant increase in PH by 0.27% within group pre and post treatment. After data comparison, no significant difference was found in post-intervention PH values between the study and control groups. We will try to explain the resulted improvements through this research Furthermore, this study supports Miyamura *et al*., (2002), who investigated "the Effect of Yoga Respiration on Blood Gases" and concluded that lower chemosensitivity to hypercapnia may be due to long-term adaptation to low arterial PH and high PaCO2. This study found that PaO2, PaCO2, SaO2, and PH during control breathing indicate a relationship between arterial PH and bicarbonate ion concentration obtained during Ujjai breathing, with PH decreasing and PaCO2 increasing,11. Pratap *et al*. (1978) reported that Arterial blood gases in Pranayama practise and results showed that there was no significant change in arterial blood gases produced by alternate nostril breathing,18.

Furthermore, this current study complements Kaminsky *et al*., (2017), who reviewed the " Effect of yoga breathing (pranayama) on exercise tolerance in patients with chronic obstructive pulmonary disease " and found that patients with Forty-three patients with symptomatic, moderate-to-severe COPD had to follow a standard programme of paranyama exercises for Twelve weeks of pranayama plus education. The 6MWD increased in the pranayama group (least square mean = 28 m), and resulted in small improvements in inspiratory capacity and air trapping. that pranayama was linked to improved exercise tolerance in COPD patients.19. These findings are consistent with those of Ranjita *et al*., (2016), who investigated "Yoga-based pulmonary rehabilitation for the management of dyspnea in coal miners with chronic obstructive pulmonary disease." and reported that Yoga can alleviate dyspnea in COPD by improving ventilatory mechanics, concluding that significant reductions in dyspnea and significant improvements in SpO2 percent and 6 minute walk distance As a result, coal miners with COPD benefit from reduced dyspnea, fatigue, and PR, as well as improved functional performance and peripheral capillary SpO2 percent. Yoga can now be used as an adjunct to conventional therapy in COPD pulmonary rehabilitation programmes.14

Table 1. Subject characteristics for the mean age, weight, height and BMI values of the patients for the group A and B:

	Group A	Group B	P value
Age(years), mean ±SD	44 ± 3.11	43.63 ± 2.73	0.62
BMI (kg/m²), mean ±SD	27.43 ± 2.02	27.13 ± 1.73	0.54
Sex, N(%)			
Females	18 (60%)	16 (53%)	0.6
Males	12 (40%)	14 (47)	
CT finding			
Post COVID	12 (40%)	10 (33%)	0.84
IPF	6 (20%)	6 (20%)	
HP	12(40%)	14 (47)	
Risk factors			
Diabetes	12 (40%)	13 (43%)	0.79
Hypertension	15 (50%)	18 (60%)	0.43

SD, Standard deviation; p value, Probability value

Table 2. Mean pH, PaO2, PaCO2, HCO3 and SaO2pre and post treatmentof group A and B:

	Group A	Group B		
	Mean±SD	Mean±SD	MD	p value
pH				
Pre treatment	7.39 ± 0.04	7.38 ± 0.05	0.01	0.37
Post treatment	7.41 ± 0.03	7.39 ± 0.04	0.02	0.11
MD (% of change)	-0.02 (0.27%)	-0.01 (0.14%)		
	p = 0.03	*p = 0.09*		
PaO2 (mmHg)				
Pre treatment	66.16 ± 8.16	68.53 ± 8.33	-2.37	0.27
Post treatment	82.76 ± 9.29	71.2 ± 9.73	11.56	0.001
MD (% of change)	-16.6 (25.09%)	-2.67 (3.9%)		
	p = 0.001	*p = 0.13*		
PaCO2 (mmHg)				
Pre treatment	46.3 ± 7.47	46.29 ± 6.06	0.01	0.99
Post treatment	36.89 ± 3.93	45.06 ± 5.22	-8.17	0.001
MD (% of change)	9.41 (20.32%)	1.23 (2.66%)		
	p = 0.001	*p = 0.24*		
HCO3 (meq/L)				
Pre treatment	29.12 ± 3.88	28.83 ± 3.28	0.29	0.75
Post treatment	23.83 ± 3.22	27.76 ± 3.22	-3.93	0.001
MD (% of change)	5.29 (18.17%)	1.07 (3.71%)		
	p = 0.001	*p = 0.07*		
SaO2 (%)				
Pre treatment	91.73 ± 2.89	92.5 ± 1.45	-0.77	0.2
Post treatment	94.06 ± 1.52	92.73 ± 1.22	1.33	0.001
MD (% of change)	-2.33 (2.54%)	-0.23 (0.25%)		
	p = 0.001	*p = 0.57*		

Table 3. Mean SF-12 physical and mental scores pre and post treatment of group A and B:

	Group A	Group B		
	Mean±SD	Mean±SD	MD	p value
SF-12 physical scores				
Pre treatment	15.29 ± 6.79	16.14 ± 7.47	-0.85	0.64
Post treatment	78.97 ± 8.08	15.17 ± 7.16	63.8	0.001
MD (% of change)	-63.68 (416.48%)	0.97 (6.01)		
	p = 0.001	*p = 0.54*		
SF-12 mental scores				
Pre treatment	22.61 ± 6.13	21.54 ± 5.68	1.07	0.48
Post treatment	76.26 ± 7.95	20.53 ± 5.81	55.73	0.001
MD (%of change)	-53.65 (237.28%)	1.01 (4.69%)		
	p = 0.001	*p = 0.57*		

SD, Standard deviation; MD, mean difference; p value, Probability value

Furthermore, the findings of this study are consistent with the findings of Papp *et al*., (2017), who investigated the "Effects of yogic exercises on functional capacity, lung function, and quality of life in participants with obstructive pulmonary disease" and found that there was a significant improvement in functional capacity as measured by a 6 – min walking test and in disease-specific quality of life (CRQ), as well as improvements in lung function parameters forced vital capacity, respiratory muscle strength and all CRQ-domains.13 Wang *et al*. (2020) studied Physical Medicine and Rehabilitation and Pulmonary Rehabilitation for COVID-19 and concluded that rehabilitation may play a pivotal role in restoring function and limiting disability during this pandemic. PM&R interventions and Pulmonary Rehabilitation provide us with additional tools in the fight against COVID-19, and PM&R will play a critical role in the rehabilitation of COVID-19-affected patients.16

Furthermore, this current study is consistent with Gokhale *et al*., (2018), who investigated "The Influence of Kapalabhati Pranayama on Oxygen Saturation and Blood Pressure" and discovered a significant increase in Diastolic Blood Pressure and SpO2 after practising kapalabhati pranayama. As a result, the practise vigorously exercises the diaphragm and improves oxygenation.20. Furthermore, the findings of this study were supported by other studies that concluded that the effect of a new type of yogic breathing (Pranayama) on arterial haemoglobin saturation of oxygen (measured by pulse oximetry - SpO2) and heart rate was greater than that of normal spontaneous resting breathing. (Spatenkova and colleagues, 2021). 15. Furthermore, the findings of this study are consistent with the findings of Ashok *et al*., (2010), who investigated "The Impact of Asanas and Pranayama on Blood Oxygen Saturation Level" and reported that Improving both lung and heart functions could help increase the lung's airflow, air capacity, efficiency, and reduce stress, physical tension, and muscle tightness. Furthermore, as partial pressure rises, the dissolved fraction of oxygen increases ,3. According to the results of the current study, there is a significant improvement in the Quality of life of both groups after regular yoga practise, as measured by the SF 12 Questionnaire. According to Grabara *et al*., 2017, yoga exercises (paranyama) are a type of recreational physical activity classified as a form of body and mind fitness. This demonstrated the importance of examining the benefits of regular yoga training in the context of scientific studies on the primary and secondary prevention of lifestyle diseases (cardiovascular diseases, respiratory system diseases, type 2 diabetes, obesity, and diseases of the musculoskeletal system in particular). Regular yoga training, including pranayama (breathing exercises), reduced blood pressure and heart rate, improved respiratory functions, decreased blood glucose levels and body mass, and improved functional fitness and self-perceived quality of life, according to the study's findings. As a result, yoga as a form of physical activity can be beneficial,21. Furthermore, this current study found a significant increase in S12 health-related QOL, which aligns with Sarkar *et al*., (2021), who investigated the Psychophysiological Effects of Yoga on Stress Management Among Medical and Allied Health Professional Students During the COVID 19 Pandemic and concluded that Yoga has gained recognition not only for improving mental health and quality of life, but also for improving respiratory and immune health. In response to the COVID 19 crisis, yoga should be considered as a supplement to other treatments for stress reduction and immune modulation, 22.

Chellaa *et al*., (2019) reported on the Impact of Hatha Yoga on Airway Resistances in Healthy Individuals and Allergic Rhinitis Patients, and as a result, the Physical component score (PCS) and Mental component score (MCS) of the SF-12 health survey questionnaire significantly improved,23. Stnescu *et al*., 1981 reported on the pattern of breathing and ventilatory response to CO2 in hatha-yoga practitioners. Yoga practise (ages 4–12 years) entails posture control and breathing manipulation, including slow near-vital capacity manoeuvres accompanied by apnea at end inspiration and end expiration. Furthermore, it was confirmed that the yoga group had a significantly lower ventilatory response to CO2 (rebreathing technique), 24. These findings agreed with the findings of a study by (Spicuzza *et al*., 2000), who studied Yoga and chemoreflex response to hypoxia and hypercapnia and reported that Hypercapnic ventilatory response were significantly lower in YOGA was similar to control) was significantly lower in YOGA during the hypercapnic condition and Conclusion Long-term yoga practise was found to alter the automatic output of the brainstem respiratory centre in resting conditions, as well as reduce hypercapnic respiratory drive, possibly as a result of repetitive exposure to hypercapnia during specific respiratory exercises,25.

CONCLUSION

It could be concluded that paranyama exercises is effective as a simple, safe, and none expensive technique that help to improve functional capacity and quality of life in patient with interstitial lung disease

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Abbreviations

(ILD) Interstitial lung disease
((DPLD) Diffuse parenchymal lung disease.
(IIP) idiopathic interstitial pneumonia
(ABG) Arterial blood gases.
(BMI) Body mass index.
(QOL) Quality of life.
(HRCT) high resolution computed tomography (COVID-19) corona virus disease 2019
(PO2) partial preesure of oxygen.
(PCO2) partial preesure of carbon dioxide.
(HCO3) Bicarbonate
(SaO2) oxygen saturation.
(SPSS)The statistical package for social studies.

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