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"EFFECT OF INSPIRATORY MUSCLE TRAINING ON MAXIMUM INSPIRATORY PRESSURE AND DYSPNOEA RELATED ANXIETY AMONG COVID-19 PATIENTS – AN EXPERIMENTAL STUDY"

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ABSTRACT

BACKGROUND:

Corona Virus is global pandemic disease accord in China and is spread worldwide. Patients suffering from COVID-19 suffer from severe pneumonia develop ARDS. Patients with COVID-19 show clinical features like fever, cough, shortness of breath, chest tightness, hemoptysis, loss of appetite, nausea, vomiting, diarrhea, abdominal pain, muscle pain, headache, smell or taste disfunction. Respiratory muscle weakness is an important issue after a COVID-19 infection.

AIM:

To study the effect of Inspiratory Muscle Training on Maximum Inspiratory Pressure in COVID-19 patients.

METHOD:

Following an explanation of the study to participants, signed agreement was obtained. 34 participants both male and female were included. Pre assessment (MIP measured by using digital manometer and dyspnoea related anxiety using BBQ.) were done. Post assessment (after 2 weeks MIP measured by using digital manometer and dyspnoea related anxiety using BBQ) were done. Treatment was given 2 sessions daily, 5 days a week for 2 consecutive weeks.

RESULT:

The statistical analysis was done using paired t test, which showed significant improvement in post exercise protocol.

CONCLUSION:

The result of the study shows that inspiratory muscle trainer improves inspiratory muscle strength in COVID-19 patients thus improving their dyspnoea related anxiety by giving relatively lesser scores than pre-treatment BBQ result. Hence inspiratory muscle trainer can be effectively used to improve inspiratory muscle strength and dyspnoea related anxiety in COVID-19 patients.

KEY WORDS:

COVID-19, Dyspnoea, inspiratory muscle trainer device, breathlessness belief questionnaire (BBQ), inspiratory muscle strength.

I. INTRODUCTION

In December 2019, a global pandemic disease, Corona Virus also called as COVID-19 occurred in China and is spread worldwide. Patients suffering from COVID-19 suffer from severe pneumonia, develop ARDS and require admission to ICU and oxygen support. Respiratory muscle weakness is an important issue after a COVID-19 infection. The severity of the disease may lead to death because of substantial damage to lung alveoli and a massive failure of the respiratory system to conduct its functional exchange.[1]

Patients with COVID-19 show clinical features like fever, cough, shortness of breath, chest tightness, haemoptysis, loss of appetite, nausea, vomiting, diarrhoea, abdominal pain, muscle pain, fatigue, headache, smell or taste dysfunction, conjunctivitis and confusion. Common complications include ARDS, acute kidney injury, anaemia, heart failure and secondary infection.[2]

Studies suggests that lungs are the organ most affected by COVID-19 disease with different pathophysiological events that contains diffuse alveolar epithelium destruction, hyaline membrane formation, capillary damage and bleeding, alveolar septal fibrous proliferation, and pulmonary consolidation. [3]

In a relatively short period of time, the entire healthcare system had to react to the exponential increase in the number of COVID-19-affected individuals. In these regions hospitals entire buildings and wards have been converted in semi-intensive and intensive care units and trained dedicated COVID-19 teams consisting of physician's intensivists or pneumologist or other trained specialists as well as infectiologist and nurses has been recruited to work on and on with rest. Physiotherapists, mainly respiratory physiotherapist are, among the healthcare professionals involved in the management and care of these patient's population and play a key role in the non-invasive support management, postural changes, mobilization, as well as during the weaning from invasive mechanical ventilator support.[4]

Impaired respiratory muscle performance is an unnoticed factor contributing to poor outcomes unfolding during COVID-19 pandemic. Even though respiratory muscle performance is considered to be rare, it is often encountered in patients with poor health.[5]

Dyspnoea is the sensation of uneasy breathing and is a cardinal symptom of respiratory diseases. In clinical practice patients often avoid dyspnoea-eliciting activities, which interrupts their activities of daily living and may further lead to reduced health-related quality of life and increases in symptoms of anxiety and depression. It can result in significant suffering and is common in many other chronic conditions.[6]

Maximum inspiratory and expiratory pressure reduced at mouth during static efforts shows the respiratory muscle strength. In practice the respiratory muscle strength is measured as PI max and PE max. Normal values of maximal respiratory pressures to age and gender are derived from the regression equations of Black and Hyatt.[7]

Inspiratory muscle training (IMT), a method intended to improve the strength and stamina of the diaphragm and accessory muscles of respiration, is one of these affordable solutions. IMT typically entails taking voluntary inspirations while at rest while a resistive load is applied across the complete range of critical capacity.[8]

IMT, or inspiratory muscle training, is a unique workout that strengthens the muscles that control breathing by placing a heavy load on the inspiratory muscles. When the skeletal muscles are properly trained and loaded, the respiratory muscles exhibit hypertrophy. The function of the lungs can be improved by gradually strengthening the respiratory muscles IMT is typically used to treat patients with airflow limitation, asthma, and chronic obstructive pulmonary disease (COPD). If the inspiratory muscles do not fatigue, breathing energy is reduced, making it possible to maintain a more efficient, deep, and slow breathing pattern. These findings highlight the importance of IMT.[9]

It is claimed that inspiratory muscle trainer is beneficial in patient with respiratory muscle weakness.[10]

Inspiratory muscle trainer is useful device in the treatment to improve respiratory muscle function and help to reduce dyspnoea on exertion.[11]

Clinically, measuring respiratory muscle strength is helpful for keeping an eye on respiratory muscle weakness. In clinical practise, determining the strength of the respiratory muscles is crucial for identifying respiratory muscle weakness in symptomatic patients. Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) are measured to detect, diagnose and treat respiratory weakness. Nowadays, Digital pressure manometer is recommended to use.[12]

II. AIM:

To study the effect of Inspiratory Muscle Training on Maximum Inspiratory Pressure in COVID-19 patients.

III. OBJECTIVES:

- To find out the effect of IMT on MIP among COVID-19 patients using digital manometer.
- To find out the effect of IMT on dyspnoea related anxiety using BBQ.

IV. METHODOLOGY

- Type of study: - Experimental study
- Study setting: - Tertiary care centre, Miraj.
- Study duration: - 6 Months
- Type of sampling: - Purposive sampling
- Sample size: - 34

V. MATERIALS

- Digital Manometer
- Inspiratory Muscle Trainer

VI. INCLUSION CRITERIA

1. Adults aged 40 to 60 years both male and female.
2. Hemodynamically stable patients.
3. Patients diagnosed with COVID – 19 infections.
4. Patients with MIP less than 78.75 ± 19.26 for male and 49.32 ± 14.63 in females.

VII. EXCLUSION CRITERIA

1. Patients with mental and cognitive impairments.
2. Patients with orthopaedic and neurological disease
3. History or presence of any other respiratory and cardiovascular diseases.
4. Recent surgery
5. End-stage of chronic diseases
6. Body mass index > 35 kg/m^2

VIII. PROCEDURE

The Institutional Ethical Committee gave ethical approval. All the subjects were selected according to the inclusion and exclusion criteria. Prior to the study the whole procedure was explained to the subjects. Male and female patients between the ages of 40 years to 60 years with medically diagnosed COVID-19 were taken from tertiary care hospital Miraj. Procedure was explained to the patients and a written consent form was taken from all the subjects selected. The patients received a program of IMT using a threshold inspiratory muscle trainer. 2 sessions daily, 5 days a week for 2 consecutive weeks was given.

INTERVENTION:

Patient was sited. Nose clip was placed around nose. Mouthpiece was placed in mouth making sure that the patient put their lips over outer shield to make a good airtight seal. Then the patient was asked to breath out as far as they can then fast and forceful breath in through mouth was done. Then patient was asked to breath out slowly and with minimal effort, letting their shoulders relax.

2 sessions daily, 5 days a week for 2 consecutive weeks was given. Each session consisted of 6 inspiratory cycles; each cycle remained around 5 min of resisted inspiration, followed by 60-second rest time intending to improve inspiratory muscle strength. At the fifth and sixth cycle, each patient was instructed to breath regularly as much as possible intending to improve inspiratory muscle fitness. The inspiratory threshold controlled by a device loading valve that provides a threshold load of 50% of the maximal pressure (MIP).

Fig no.1. INSPIRATORY MUSCLE TRAINING DEVICE

Fig no.2. Inspiratory muscle training on COVID-19 patient

Fig no.3. Inspiratory muscle training on COVID-19 patient

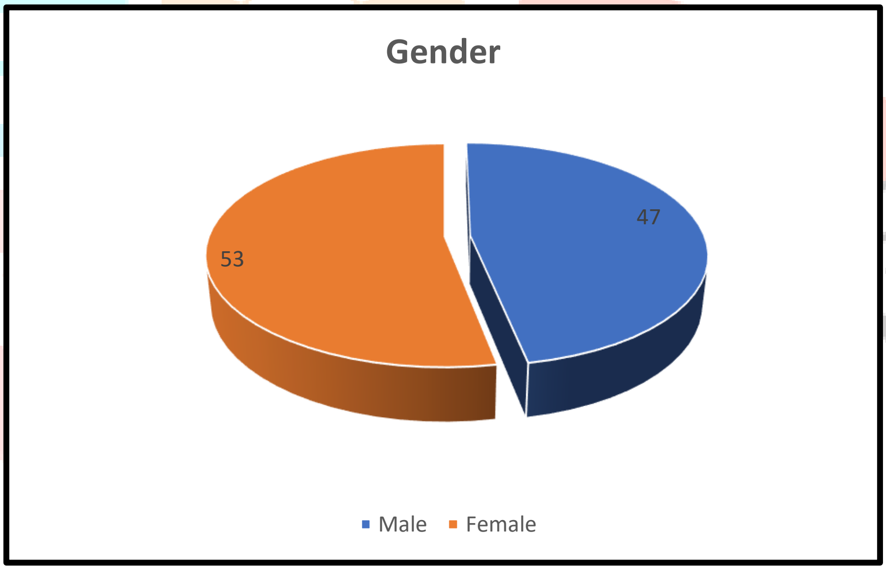
IX. STATISTICAL ANALYSIS

Statistical analysis was performed using paired t test to check pre- and post-data of a group.

X. RESULT

Gender	Frequency	Percent
Male	16	47
Female	18	53
Total	34	100.0

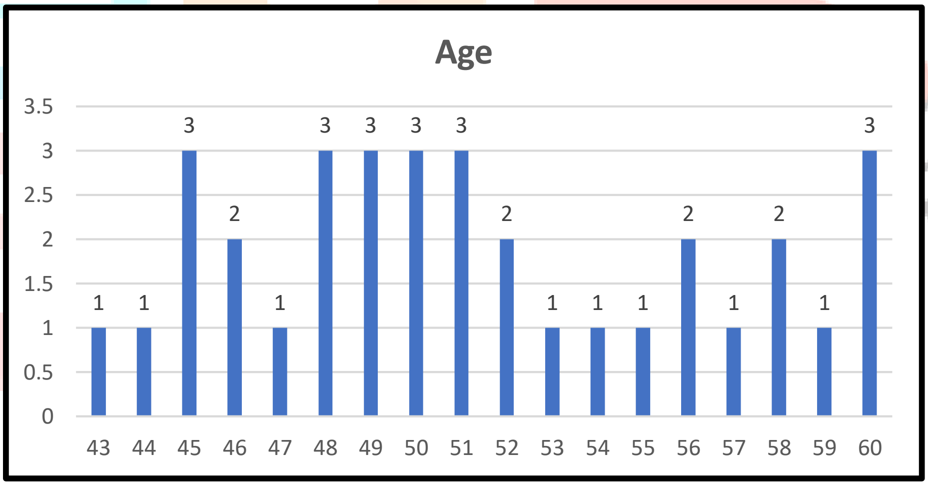
Table no 1: shows the frequency and percentage of gender



Graph No 1: shows the percentage of male and female

Age	**Frequency**	**Percent**
43.00	1	2.9
44.00	1	2.9
45.00	3	8.8
46.00	2	5.9
47.00	1	2.9
48.00	3	8.8
49.00	3	8.8
50.00	3	8.8
51.00	3	8.8
52.00	2	5.9
53.00	1	2.9
54.00	1	2.9
55.00	1	2.9
56.00	2	5.9
57.00	1	2.9
58.00	2	5.9
59.00	1	2.9
60.00	3	8.8
Total	34	100.0

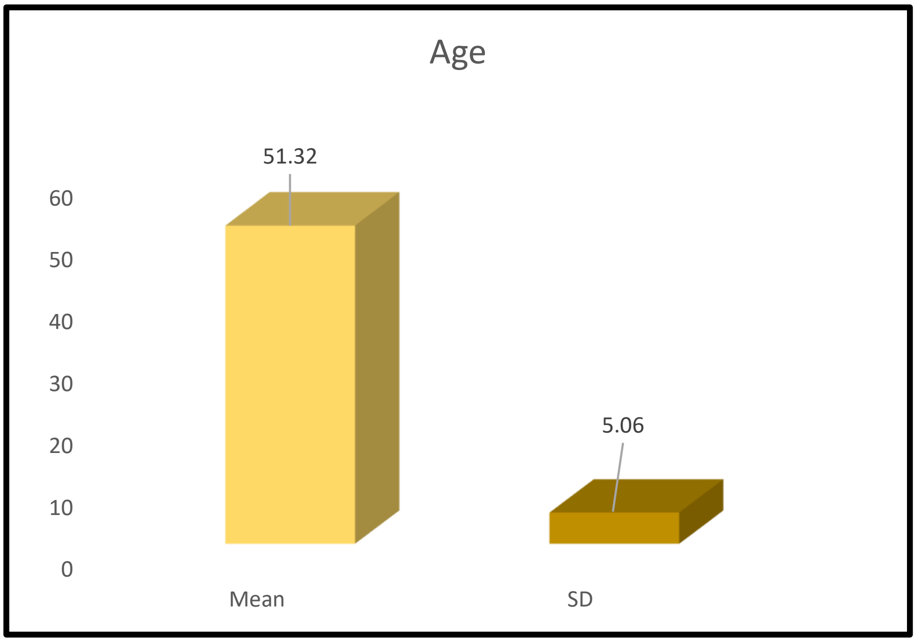
Table no 2: shows the frequency and percentage of age



Graph No 2: shows the percentage of age

Variable	N	Minimum	Maximum	Mean	SD
Age	34	43.00	60.00	51.32	5.06

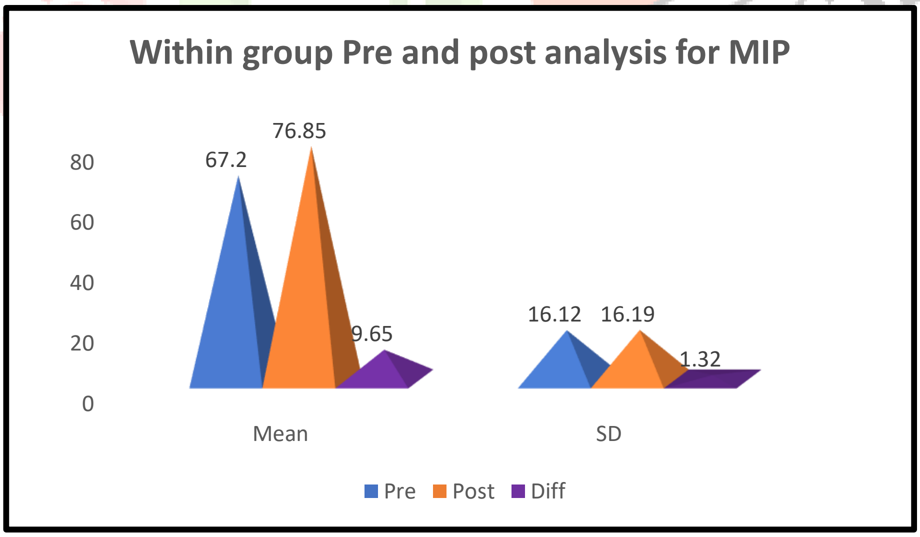
Table no 3: shows the Descriptive Statistics of age



Graph No 3: shows the Descriptive Statistics of age

Variable	Pre		Post		Diff		Effect size	p –value	p –value
	Mean	SD	Mean	SD	Mean	SD			
MIP	67.20	16.12	76.85	16.19	9.65	1.32	7.33	42.753	0.001*

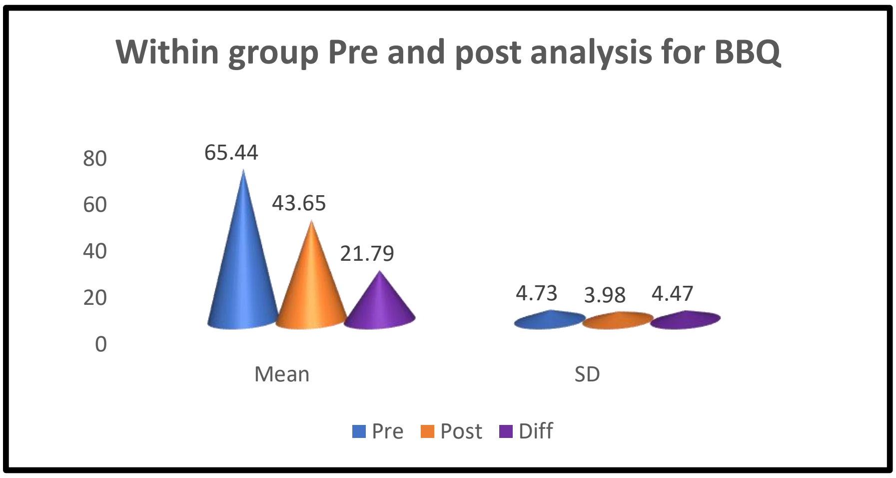
Table no. 4: shows within group pre and post mean, standard deviation, difference, p-value of MIP



Graph no. 4: shows within group pre and post mean, standard deviation and difference of MIP

Variable	Pre		Post		Diff		Effect size	p –value	p –value
	Mean	SD	Mean	SD	Mean	SD			
BBQ	65.44	4.73	43.65	3.98	21.79	4.47	4.87	28.426	0.001*

Table no. 5: shows within group pre and post mean, standard deviation, difference, p-value of BBQ



Graph no. 5: shows within group pre and post mean, standard deviation and difference of BBQ

Results from analysis:

- From the above within groups' analysis using paired sample t test, it is observed that MIP mean value indicated changes post treatment and higher mean values are recorded for post treatment outcome and also the standard deviation shows the slight deviation with post treatment value which is more than pre value (table and graph no. 4).
- The effect size Cohen's D indicates 7.33 value which is assumed to be very high in effect size as per the standard parameters of reference.
- From the above within groups' analysis using paired sample t test, it is observed that BBQ mean value indicated changes post treatment and lower mean values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less than pre value (table and graph no. 5).
- The effect size Cohen's D indicates 4.78 value which is assumed to be very high in effect size as per the standard parameters of reference.
- Thus, reference to the results of the paired sample t test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. $0.001 < 0.05$) in the study and therefore it justifies the improvements in health outcome post intervention.

XI. DISCUSSION

The purpose of the current study was to assess how Inspiratory Muscle Training affected COVID-19 patients' Maximum Inspiratory Pressure. 34 patients were involved in the trial. Both male and female volunteers between the ages of 40 and 60 were included in this study, and the Inspiratory Muscle Strength and Dyspnea Related Anxiety on Covid-19 Patients were assessed by 1.) Manometer and 2.) BBQ, respectively. The COVID-19 patients' inspiratory muscular strength was measured using a manometer, and their anxiety related to dyspnea was measured using a 17-item questionnaire called BBQ.

IMT has shown clinically substantial and useful improvements in individuals with asthma, chronic obstructive pulmonary disease (COPD), and decreased diaphragmatic function who have poor inspiratory muscle functioning.

IMT considerably enhances respiratory muscle strength. Stronger respiratory muscles make it easier to accomplish the required respiratory duties by delaying or eliminating inspiratory muscle exhaustion. 9 In certain patient populations, respiratory muscle training increases diaphragm muscle thickness, exercise capacity, respiratory muscle strength, and dyspnea. Patients with the greatest baseline respiratory muscle weakness typically benefit from respiratory muscle training the most.

Another study by **Ahmed M. Abodonya et al (2021)** with the objective to examine the effects of IMT on COVID-19 after mechanical ventilation hypothesizes that IMT could improve pulmonary functions, dyspnoea, and QOL in COVID patients following the weaning from mechanical ventilation. The main findings of the study showed that FVC, FEV1, DSI, and QOL have improved significantly following 2- a week IMT which confirms our hypothesis. Forty-two recovered COVID-19 patients (33 men and 9 women) weaned from mechanical ventilation with a mean age of 48.05±8.85 years were enrolled in this pilot control clinical study. Twenty-one patients were equipped with 2-week IMT (IMT group) and 21 matched peers were recruited as a control (control group). Forced vital capacity (FVC%), forced expiratory volume in 1 second (FEV1%), dyspnoea severity index (DSI), quality of life (QOL), and six-minute walk test (6-MWT) were assessed initially before starting the study intervention and immediately after intervention. A 2-week IMT improves pulmonary functions, dyspnoea, functional performance, and QOL in recovered intensive care unit (ICU) COVID-19 patients after consecutive weaning from mechanical ventilation.

Using a randomised, double-blind, placebo-controlled trial design, **Ozgür Bostancia, Hakan Mayda, et al. (2019)** investigated the effects of IMT on pulmonary function and respiratory muscle strength in smokers and non-smokers. In the current study, 42 healthy males were divided into three groups: 10 in the placebo group, 16 in the IMT smoking group (IMTs), and 16 in the IMT non-smoking group (IMT_N). Using a randomized, double-blind, placebo-controlled design, IMT_S and IMT_N underwent 4 weeks of 30 breaths twice daily at 50% (+5% increase each week) of maximum inspiratory pressure (MIP), While utilising an IMT device, the placebo group continued to breathe for 30 breaths twice daily at a MIP of 15%. There were 2 major findings of the present study: (1) changes in expiratory muscle strength and pulmonary measurements following IMT were significantly higher in smokers than non-smokers ($p < 0.05$) and (2) respiratory muscle strength and pulmonary functions significantly improved after 4-week IMT program. In this study, after taking part in the IMT programme, the IMT_S and IMT_N groups' respiratory muscle strength and pulmonary functions considerably improved. The study indicates that IMT significantly improves respiratory muscle strength and also increases lung volumes.

Melitta A McNarry et al (2021) COVID-19 is a multisystem disease, with a non-linear evolution and potential long-term implications. The current study's objective was to examine the possible therapeutic value of the inspiratory muscle training (IMT). In this study, 281 adults recovering from self-reported COVID19 were randomized 4:1 to an eight-week IMT or a “usual care” wait list control arm. The Chester Step Test, King's Brief Interstitial Lung Disease (KBILD), and Transition Dyspnoea Index (TDI) were used to measure respiratory muscle strength and fitness before and after the intervention. Although IMT had no impact on KBILD-based health-related quality of life, it did result in clinically significant reductions in the intensity of dyspnoea and chest-related symptoms, as well as improvements in respiratory muscle strength and aerobic fitness, among patients recovering from COVID-19.[1]

XII. CONCLUSION

The result of the study shows that inspiratory muscle trainer improves inspiratory muscle strength in COVID-19 patients thus improving their dyspnoea related anxiety by giving relatively lesser scores than pre-treatment BBQ result.

Hence inspiratory muscle trainer can be effectively used to improve inspiratory muscle strength and dyspnoea related anxiety in COVID-19 patients.

XIII. LIMITATIONS and SUGGESTIONS

Limitations

- The study can be performed on other age groups.
- The study can be done on other populations.

Suggestions

- Comparison between males and females can be done.
- More people can be included in the study.

XIV. REFERENCES

1. Abodonya AM, Abdelbasset WK, Awad EA, Elalfy IE, Salem HA, Elsayed SH. Inspiratory muscle training for recovered COVID-19 patients after weaning from mechanical ventilation: A pilot control clinical study. Medicine. 2021 Apr 2;100(13).
2. Sun T, Guo L, Tian F, Dai T, Xing X, Zhao J, Li Q. Rehabilitation of patients with COVID-19. Expert review of respiratory medicine. 2020 Dec 1;14(12):1249-56.
3. Torres-Castro R, Vasconcello-Castillo L, Alsina-Restoy X, Solís-Navarro L, Burgos F, Puppo H, Vilaro J. Respiratory function in patients post-infection by COVID-19: a systematic review and meta-analysis. Pulmonology. 2021 Jul 1;27(4):328-37.
4. Lazzeri M, Lanza A, Bellini R, Bellofiore A, Cecchetto S, Colombo A, D'Abrosca F, Del Monaco C, Gaudiello G, Paneroni M, Privitera E. Respiratory physiotherapy in patients with COVID-19 infection in acute setting: a Position Paper of the Italian Association of Respiratory Physiotherapists (ARIR). Monaldi Archives for Chest Disease. 2020 Mar 26;90(1).
5. Severin R, Arena R, Lavie CJ, Bond S, Phillips SA. Respiratory muscle performance screening for infectious disease management following COVID-19: a highly pressurized situation. The American journal of medicine. 2020 Sep 1;133(9):1025-32.
6. De Peuter S, Janssens T, Van Diest I, Stans L, Troosters T, Decramer M, Van den Bergh O, Vlaeyen JW. Dyspnea-related anxiety: the Dutch version of the Breathlessness Beliefs Questionnaire. Chronic respiratory disease. 2011 Feb;8(1):11-9.
7. Gopalakrishna A, Vaishali K, Prem V, Aaron P. Normative values for maximal respiratory pressures in an Indian Mangalore population: A cross-sectional pilot study. Lung india: official organ of Indian chest society. 2011 Oct;28(4):247.
8. Shei RJ, Paris HL, Wilhite DP, Chapman RF, Mickleborough TD. The role of inspiratory muscle training in the management of asthma and exercise-induced bronchoconstriction. The Physician and sportsmedicine. 2016 Oct 1;44(4):327-34.
9. Bostanci Ö, Mayda H, Yılmaz C, Kabadayı M, Yılmaz AK, Özdal M. Inspiratory muscle training improves pulmonary functions and respiratory muscle strength in healthy male smokers. Respiratory physiology & neurobiology. 2019 Jun 1;264:28-32.
10. Hart N, Sylvester K, Ward S, Cramer D, Moxham J, Polkey MI. Evaluation of an inspiratory muscle trainer in healthy humans. Respiratory medicine. 2001 Jun 1;95(6):526-31.

11. https://www.physio-pedia.com/Respiratory_Muscle_Training#:~:text=Respiratory%20Muscle%20Training%20(RMT)%20can,to%20reduce%20dyspnoea%20on%20exertion.
12. Torres-Castro R, Sepúlveda-Cáceres N, Garrido-Baquedano R, Barros-Poblete M, Otto-Yáñez M, Vasconcello L, Vera-Uribe R, Puppo H, Fregonezi G. Agreement between clinical and non-clinical digital manometer for assessing maximal respiratory pressures in healthy subjects. Plos one. 2019 Oct 24;14(10):e0224357.
13. Gil Obando LM, López López A, Ávila CL. Normal values of the maximal respiratory pressures in healthy people older than 20 years old in the City of Manizales-Colombia. Colombia Médica. 2012 Apr;43(2):119-25.
14. Ewis AM. Effect of inspiratory muscle training on weaning from mechanical ventilation in acute respiratory failure. Egyptian Journal of Bronchology. 2018 Dec;12(4):461-6.
15. McNarry MA, Berg RM, Shelley J, Hudson J, Saynor ZL, Duckers J, Lewis K, Davies GA, Mackintosh KA. Inspiratory Muscle Training Enhances Recovery Post COVID-19: A Randomised Controlled Trial. European Respiratory Journal. 2022 Jan 1.
16. https://www.scielo.br/j/acb/a/LmFTNgsyLGbMZdQFR5yfMwx/?lang=en