Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/1s46ya62

EVALUATING THE SYNERGISTIC IMPACT OF DIAPHRAGMATIC STIMULATION AND BREATHING EXERCISES ON QUALITY OF LIFE IN RESPIRATORY DYSFUNCTION: A RANDOMIZED CONTROL TRIAL

Ramiza Khalid,[1*] Prof dr Syed Asadullah Arslan,[2] Prof Dr Hamayun Zafar,[3] Prof Dr Ashfaq Ahmad,[4] Prof Dr Amir Gillani,[5] Prof Dr Asif Haneef[6]

[1*]University Institute of Physical Therapy, Faculty of Allied Health Sciences, The University of Lahore, Pakistan
[2]Department of Physical therapy, Riphah International University, Lahore, Pakistan
[3]Department of Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia
[4]University Institute of Physical therapy, Faculty of Allied Health Sciences, The University of Lahore, Pakistan
[5]Ibadat International University, Islamabad, Pakistan
[6]University Institute of Public Health, The University of Lahore, Pakistan

***Corresponding author:** Ramiza Khalid
*Email: drramizakhalid@gcuf.edu.pk

ABSTRACT

Background: Respiratory dysfunctions are the diseases or disorders like Asthma, emphysema, bronchitis, lung cancer, pulmonary hypertension, COPD and tuberculosis and recently COVID19. If they left untreated, they might be fatal and causes respiratory failure and eventually death occurs. Respiratory diseases are mainly occurs due to environmental factors and/or social behaviors that lead to lung inflammation. Among respiratory dysfunctions Symptoms include breathing difficulty, cough, mucus (sputum) production and wheezing Improving the working environment and early intervention can decrease the progression of disease. Exercises can decrease the severity of symptoms in patients with respiratory dysfunction. It can be treated by non-pharmacological and effective physiotherapy interventions like pulmonary rehabilitation. diaphragmatic stimulation and breathing exercises has shown the effective results on patients with respiratory dysfunction. **Objective:** This study is aimed to see the effects of diaphragmatic stimulation with breathing exercises on respiratory rate, chest wall mobility and quality of life in respiratory dysfunction individuals.

Material and methods: A single blind randomized control trial was done on 204 participants of age between 40-60 years. The participants were selected on the basis of inclusion criteria. Informed consent was taken before the start of exercise. Pulse oximeter was used to assess respiratory rate values, chest kinematics was measured by measuring tape, quality of life by for quality of life respiratory illness questionnaire was used respectively. SPSS (version 23) was used for statistical analysis.

Results: Findings show that there is marked improvement in quality of life and respiratory biomechamics. Outcomes after 6 weeks of performing interventions with the p-value <0.001which is highly significant.
Conclusion: The findings revealed that diaphragmatic stimulation, particularly when combined with breathing exercises, significantly improved respiratory rate chest wall mobility and quality of life of individuals with respiratory dysfunction

Keywords: Respiratory dysfunction, Diaphragmatic stimulation, Breathing exercises, Respiratory rate, Chest wall kinematics, Quality of life

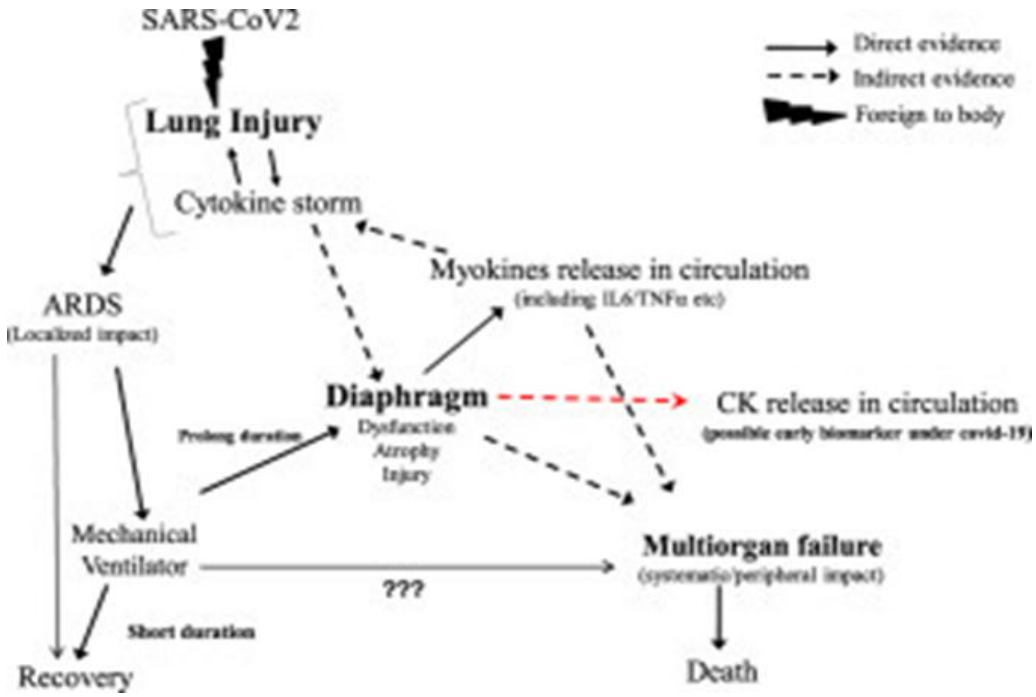
Introduction

Chronic Obstructive Pulmonary Disease (COPD) is progressive disease and leading cause of morbidity and mortality world, [1-2]. COPD mainly caused by cigarette smoke, occupational dusts, chemicals, infections, socio-economic status, indoor and outdoor pollution[3]. The abnormal inflammatory response develops air flow limitation of the lungs which produces an obstruction of mechanical function and the gas exchanging capability of the lungs. The symptoms of COPD is cough with expectoration, wheezing, worsen shortness of breath (SOB), fatigue, chest tightness and mood disturbances. These changes contribute to a decrease in health-related quality of life (HRQL) and in daily physical activities [4–6] . Repeated exacerbations are a risk factor for increased mortality and contribute to the health care burden associated with COPD disease, especially when they result in hospitalization [7–9]. The management of patients with COPD is to minimize frequency and impact of acute exacerbations because COPD results primary impairments of the respiratory system and secondary impairments including skeletal muscle dysfunction[10] .

Disease prevention is the ultimate goal of COPD once the disease is diagnosed the effective management should be carried on. The management of mild to moderate involves the avoidance of risk factors to prevent the disease progression and pharmacotherapy as needed to control the symptoms. Severe disease often requires the integration of a variety of treatment approaches like pharmacotherapy, ventilatory support and counseling[11-12]. Pulmonary rehabilitation a group of exercise and education programme to reduce symptoms, improve exercise performance and prevent exacerbations. PR has been demonstrated to improve the health-related quality of life, dyspnoea and exercise tolerance capacity[15] .

The diaphragm is the main respiratory muscle in humans which accounts for 70% of the resting ventilation so the pulmonary rehabilitation mainly focused to retrain the diaphragm muscle thereby improve the physical efficiency of the COPD patients[14] . Pulmonary rehabilitation consists of chest physiotherapy technique like breathing exercise, postural drainage, spirometry, clapping, vibration and proprioceptive neuromuscular facilitation of respiration (PNF) and breathing techniques are shown to improve the ventilatory capacity and decrease dyspnoea.

In COVID-19 we may experience pneumonia or intense respiratory distress syndrome .in some acute conditions lungs need assistance from ventilator to full fill their responsibility. rate of patients who experience worse effects of COVID-19 due to involvements of both lungs is 14%.with the progression of disease lungs load up with liquid and flotsam and jetsam likewise in pneumonia,in result the air sac load up with liquid and different cells which start attempting to fight against contamination. this process can make harder for body to consume oxygen efficiently and patients start detoriating rapidly.[2]



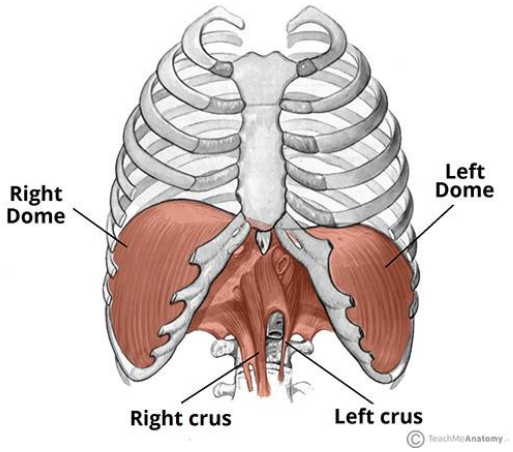
Skeletal muscle has the ability to produce and release a number of cytokines known as myokines. When the SARS-CoV-2 enters the circulatory system and reaches skeletal muscle cells, it interacts with ACE2 receptors on their cell membranes, and diaphragm is also a skeletal muscle. Previous mechanistic studies conducted on healthy volunteers demonstrated that sepsis induced changes in the diaphragm are due to excessive production of proinflammatory cytokine.[6]

Although side effects like fatigue, muscle weakness dyspnea decreased quality of life are frequently reported by patients who recovered from virus but so far not much evidences has been published in this regard. a peer reviewed study reports on long term effects of virus on recovered patients in which 32% exhibit 1 or 2 symptoms and 55% patients had 3 or more symptoms,44.1% patients report worsen quality of life after disease recovery. A high proportion of patients report show sever effects like fatigue (53.1%),dyspnea (43.4%),joint pain(27.3%) and chest pain(21.7%).[4]the aim of physiotherapy treatment in corona virus effected patient is to enable the patient to further increase physical activity ,exercise capacity, improve ventilation and enhance quality of life.it is quite justify to assume that training principles used for chronic lung patients can also be applied in post COVID-19 patients. training parameters like training frequency intensity ,time/duration and type of exercise may slightly vary and gradually increase in post COVID-19 patients.[8]Post COVID-19 Patients goes through the generalize muscular weakness, weakness of lungs and diaphragm (major inspiratory muscle).

Asthma is a chronic airway inflammatory disorder of the lungs that can lead to structural and functional changes, resulting in bronchial hyper responsiveness and airflow obstruction. Symptoms of asthma include recurrent episodes of wheeze, cough, breathlessness and chest tightness, together with episodes of marked worsening of symptoms, known as exacerbations .Exacerbations can be fatal and they are more frequent and more serious in high risk patients or patients with uncontrolled asthma . Factors such as viral infections, allergens, tobacco smoke, physical exercise, stress, certain medications (non steroidal anti inflammatory drugs and beta blockers) may trigger or worsen asthma symptoms Some phenotypes are already identified, such as allergic asthma, non allergic asthma, and late onset asthma.

despite of the inspiratory function diaphragm has another role regarding musculoskeletal system. Diaphragm shows altered position in low back pain patients. Due to lack of diaphragm activation, over activity of lumber paraspinal muscles happens which lead to hyperlordosis of lumber spine or anterior pelvic tilt.it cause pain in the lumber region.[5]

Inhale and exhale your pain away: the diaphragm muscle and how it relates to back pain!



As we know that in process of inhalation /inspiration diaphragm is the primary muscle. diaphrgam is a dome shaped sheet of muscle which inserted into our lower ribs, at base of thorax it separates the abdominal cavity from thoracic cavity. as diaphragm has attachment to both lumber ie L1-L3 and thoracic i.e T7-T12 as well as it attaches to inner xiphoid process means lower sternum. now this is clear fact that dysfunction of diaphragm can have a great effect on back pain.[7]We never think of breathing as an exercise because we do it automatically. We would never think of breathin g incorrectly because, after all, it's just taking air in and out. What we don't realise is that breathing i s both an autonomic response to living and a crucial factor in neck, upper/lower back, and hip pain. It can impact the entire spine and, as a result, the muscle systems that surround it. With separate attachments of the crus tendon on both the right and left side L1 L2. [7]Myers discovered several connections that can influence the body when we have diaphragm dysfunction. this means they can act independently of each other and bring issues separately or together.

The crus tendon attaches fascially to the anterior longitudinal ligament, it also shares attachments with quadratuslumborum, psoas major and has nerve roots innervated by C3-C5 in the cervical spine. As well as musculoskeletal attachments the diaphragm shares connections with kidneys liver and can affect the adrenal glands and even digestion. That's a whole lot more than just something that allows air into and out of the body, in fact it appears that breathing problems can effect the entire body.[12]

Breathing is controlled by our neurological system, which, like any other system, can become slugg ish, wounded, or adapt to its surroundings. To avoid injury when bending to pick something up, we need good lumbar stability.As a result of the injury, the diaphragm will exert upward tension while the psoas major will exert downward tension; this is a balance of static and dynamic restrictions caused by the co-contraction of small segmental stabilizers and massive abdominal musculature.[9] If our diaphragm isn't working properly, our body will put pressure on the other muscles, forcing them to work harder as a result, the environment becomes less stable, which can lead to dysfunction and pain over time. Our bodies almost always adapt to our surroundings, and we may plainly notice altered diaphragm stability and movement in cases of lower back discomfort. Because of its connection, the crus tendon can become more tense when diaphragmatic contraction decreases. As a result, there may be an Increased tension and decreased motion around the lumbar segments (L1-L3), causing the lower segments (L4-L5) to become hypermobile and thus less stable. To prevent anterior glide of these segments, the nervous system shortens the illio-lumbar ligaments, limiting motion at the sacroiliac joints (SIJ). The ultimate result is a dynamically unstable and partially fixed system.[10]

Due to increased load and movement dysfunction, the likelihood of pain in these locations is increasing. Respiratory workouts help you eliminate mucus and other fluids by getting oxygen deep into your lungs. Respiratory exercises help to develop the diaphragm, which is a significant respiratory muscle. Underneath the lungs are a muscle. It can also help you get more oxygen into your circulation by increasing lung capacity.

Deep breathing exercises can also help you relax, which can help you deal with long-term illness and rehabilitation. Breathing exercises, on the other hand, can strengthen your lungs, potentially reducing the influence of respiratory disease on your respiratory system .In a meta-analysis and systematic review Breathing techniques, such as pursed lips breathing, were found to alleviate shortness of breath in 19 randomized controlled experiments, according to Trusted Source. Lung ventilation, or the ability of the lungs to evacuate carbon dioxide and stale air, was also increased by breathing exercises. [15]

Patients who require inpatient rehabilitation following acute hospitalization due to respiratory illness have a very high prevalence of diaphragm dysfunction, which is a primary muscle of respiration, according to US researchers who used a neuromuscular ultrasonography approach. Controlled breathing is another name for neuro physiological stimulation of respiration. Techniques for assisting respiration that use selective external proprioceptive and tactile cues to induce the reflexive movement response. PNF techniques with autogenic stretching (diaphragmatic stimulation) promote respiratory muscle relaxation and improve inspiration and have been used in physiotherapy chest care for over 25 years. by reflex stretching, and expiration in the following inspiration–expiration cycle[18]

With active initiation or more engagement in respiration, the inspiration-expiration graph improves. The contractions of a stretched muscle cause chest expansion as inspiration-expiration improves. The rate and depth of breathing are changed by using PNF procedures. As a result, changes in respiratory rate occur, as well as increased respiratory muscle integrity and chest stability, which improves diaphragm breathing pattern and increases tidal volume.[22]
A wide range of treatment options for are presently available for the conservative management of the low back pain and respiratory issues however, the most effective management strategy still remains an area of exploration. [24] There is no clear evidence to draw conclusions about the effectiveness of diaphragm stimulation when combined with the respiratory exercises as compared to only respiratory exercises of the same duration of treatment for relieving pain and restore back mobility functional capacity and improve quality of life.[23]Therefore this study significantly contribute to the existing level of knowledge for the practitioners that these two different treatment protocols produce comparable outcome and combined treatment technique is more advantageous over the other, so that it could be adopted as the treatment of choice.

Objective
To assess the comparison of diaphragmatic stimulation with and without breathing exercises on respiratory rate,chest kinematics and quality of life among patients with respiratory dysfunction

Operational Definitions
Effects: To assess changes in clinical and functional outcomes
Clinical outcome: respiratory rate
1.Respiratory rate:
Respiratory rate directly impaired by respiratory dysfunction among COPD, asthma and COVID-19 patients.in this study respiratory rate was measured by pulse oximeter to asses the pre and post treatment difference in both groups.

2.Chest wall kinematics:
Analyzing chest wall movements especially in respiratory dysfunction patients helps to understand the involvement of muscles and anatomical structure during breathing and their specific abnormalities due to disease. measuring tape was used to check the chest wall movement during breathing in pre and post intervention situation.

Functional outcomes:

1.Quality of life

Quality of life is the patient's ability to enjoy normal life activities. Quality of life gets impaired in COPD, asthma as well as post COVID 19 patients and it deteriorates considerably due to sever progressive and after effects of diseases. In this study Quality of life for respiratory illness questionnaire (QOL-RIQ) was used to asses the differences in patients' quality of life pre and post treatment. This disease specific quality of life measure is designed by American thoracic society for patients with air way diseases

MATERIAL AND METHODS

Study Design:

Single blinded Randomized Clinical trial

Settings:

Department of Medicine, Allied Hospital Faisalabad

Duration of Study:

Eighteen months after approval of synopsis from Institutional review board committee dated 19-05-2022

Sample Size:

The sample of 170 (85 in each groups) is calculated suing 80% power of study and 95% confidence level, mean Vo2 max L / min in group-T and group-C at 6th week after treatment as 1.1± 0.2 and 1.21 ± 0.3.[12] The following formula was used on base of results of pilot study

$$n = \frac{\{(\delta_1^2 + \delta_2^2) \times (Z_{1-\alpha/2} + Z_{1-\beta})^2\}}{|\mu_2 - \mu_1|^2}$$

Here

n= 85 for each groups

$Z_{1-\alpha/2}$ = Standardized Level of significance = 95% = 1.96

$Z_{1-\beta}$ = Power of test = 80% = 1.28

$\mu_1$and δ_1=Vo2 max L / min in group-T = 1.1 ± 0.2

$\mu_2$and δ_2 = Vo2 max L / min in group-C = 1.21 ± 0.3

by adding 20% drop out rate (17 cases) in each group, so, the final sample size will be 204 (102 in each group). Randomized Controlled Experimental study including 204 patients who will fulfill our inclusion Criteria with age ranging from 40-60 years will be equally divided into 2 groups. Experimental group (respiratory exercises and diaphragm stimulation Techniques) and control group (respiratory exercises only)[12]

Sampling Technique:

The purposive non probability sampling technique was used to recruit the patients and random assignment of patients into both groups

Sample Selection:

Inclusion criteria:

- The diagnosed respiratory dysfunction(COPD, asthma and post COVID) patients aged 40-60 years will be included in this study
- Post COVID (minimum after 3 months of recovery from disease will be included in this study)
- presence of compromised oxygen level
- Limited lumber and cervical range of motion due to pain

- Hemodynamically stable
- Both male and females will be included in this study

Exclusion criteria:

- History of unstable cardiovascular condition
- Recent surgery
- pregnancy
- Joint instability
- Any pathology i.e. infection, osteoporosis, malignancy bony disease i.e. osteosarcoma
- Orthopedic, functional or structural deformity and trauma to chest wall
- Bony fracture of Lumber vertebrae
- Inflammatory disease i.e. rheumatoid arthritis, ankylosing spondylitis, osteomyelitis.
- Patients with pleural disorders
- .Active lung infection like tuberculosis, typhoid, pneumonia
- Spinal cord injuries involved the phrenic nerve

Study Tools:

i. **QOL-RIQ for measuring quality of life (**reliability for the QOL-RIQ-total scale is 0.92.) The Quality of Life for Respiratory Illness Questionnaire (QOL-RIQ) was employed to assess disease-specific quality of life. This tool evaluates how respiratory conditions impact physical functioning, emotional well-being, and social activities.

ii. **Pulse oximeter** for measurement of respiratory rate

iii. **Inch tape** measuring tape used to check the chest wall excursion and kinematics during breathing

Ethical considerations:

The rules and regulations set by the ethical committee of university of Lahore was followed while conducting the research and the rights of the research participants respected.

- Written informed consent (attached) was taken from all the participants.
- All information and data collection was kept confidential
- Participants was remained anonymous throughout the study

Data collection procedure:

Methods for collection of data:

Data was collected by using QOL-RIQ (quality of life for respiratory illness questionnaire) for measuring quality of life, pulse oximeter for respiratory rate and inch tape for chest wall movement from the Patients in allied hospital Faisalabad.

Treatment protocol:

It was follow as under:

GROUP	TREATMENT PROTOCOL
Experimental	**Breathing exercises** for 7 minutes + **diaphragm stimulation** Technique 5 repetitions each for 4 seconds duration 3 times a week for 4 weeks, 2 times a week for subsequent weeks and measurement taken at 6th week
Control	**breathing exercises** for 10 minutes, 3 times a week for 4 weeks, 2 times a week for subsequent weeks measurement taken at 6th week

PROCEDURE OF TREATMENT PROTOCOL:

Diaphragm stimulation:

Techniques of stimulating response and strengthening diaphragm muscle related to respiration by placing the thumbs and palms of the hand along the costal cartilages of the lower ribs. Pressure and stretch is applied with the thumbs pushed up under the rib cage as far possible without producing

pain. The tips of the thumbs are pointed toward the xiphoid process. Repeated contractions may be performed to both sides simultaneously, or one side may emphasize with sustained pressure to the other side. Resistance applied to forced expiration in this area by resisting the downward motion of ribcage so as to prevent the diameter of the lower chest as exhales. Rhythmic stabilization performed as stimulate diaphragm by using the thumbs .the fingers are placed contact with the lower chest walls. The patient is instructed "breathe in, and hold it". The patient sustains breath while physiotherapist applies pressure and stretch alternatively the chest wall and diaphragm .After 2 or 3 alterations, the patients instructed, "Breathe in again, again and again" while the therapist repeats with increasing and decreasing pressure to the diaphragmatic area.

Breathing exercises:

Active cycle of breathing technique was used in breathing exercises. Patient kept his/her chest and shoulders relaxed, Took a long, slow and deep breath in, through his/here nose .At the end of the breath in, hold the air in his/her lungs for 2-3 seconds before breathing out (this is known as an inspiratory hold).Breathe out gently and relaxed, like a sigh

Statistical Analysis:

Analysis of our data of the research was completed by SPSS version 23, Windows 10. Personaldata conclusion was indicated; Mean±SD, minimum and maximum values. Age and gender were expressed as frequencies and percentage. Descriptive statistics was used for Bar and Piegraphs. Paired T test was used to check the association between pre and post values of

Results:

This study included 204 patients 102 patients in experimental group (diaphragmatic stimulation+breathing exercises)102 patients in control group (breathing exercises)

Table1 : Respiratory Rate and Chest Wall Kinematics

Outcome measures	groups	Pre intervention mean(SD)	Post intervention mean(SD)	Mean difference(CI 95%)	P value(paired t test)	Between group difference(CI 95%)	P value (t-test)
Respiratory Rate(breaths /min)	Experimental(n=102) Control(n=102)	24.3(2.1) 24.1(2.2)	18.2(1.8) 21.2(2.0)	-6.1(-6.8to-5.4) -2.9(-3.5to-2.3)	<0.001 <0.001	-2.9(-3.5to-2.3)	<0.001
ChestWall Kinematics(cm)	Experimental(n=102) Control(n=102)	4.2(0.7) 4.1(0.8)	6.5(0.9) 5.3(0.7)	2.3(2.1to2.5) 1.2(1.0to1.4)	<0.001 <0.001	1.1(0.8to1.4)	<0.001

TABLE 2: PRE-POST ANALYSIS OF QUALITY OF LIFE FOR RESPIRATORY ILLNESS QUESTIONAIRE (MODIFIED):

	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 PRQ - POQ	.85000	7.18215	.71822	-.57510	2.27510	1.183	99	.003
Pair 2 PRQ-POQ	.62000	3.18386	.31839	-.01175	1.25175	1.947	99	.054

(PRQ: pre quality of life for respiratory illness questionnaire PRE QOL-RIQ , POQ: post quality of life respiratory illness questionnaire POST QOL-RIQ.This is the comparison of the quality of life

for respiratory illness questionnaire QOL-RIQ before the treatment and after the treatment. There is the difference in the mean of quality of life for respiratory illness questionnaire between these two pairs.

Discussion

According to data interpretation it is concluded that There is more pronounce effect of diaphragm stimulation with breathing exercises as compare to breathing exercises alone on quality of life in respiratory dysfunction patients as p- value is less than 0.05 Majority of respiratory dysfunction patients experienced physical changes including respiratory rate, oxygen saturation rate, chest wall kinematics and compromised quality of life. Results of paired sample T test shows there is a significant difference in means of pre and post QOL-RIQ p-value<0.005 and also shows remarkable difference in p values of both groups ,interventional groups shows more significant result as compare to control group. The evaluation of respiratory rate and chest wall kinematics revealed significant improvements in both the experimental and control groups,with the experimental group showing more pronounced changes. In terms of respiratory rate, the experimental group(n=102) demonstrated a decrease from 24. 3 breaths per minute (SD=2.1) pre-intervention to 18.2 breaths per minute (SD=1.8) post-intervention, resulting in a mean reduction of 6.1breaths perminute (95%CI:-6.8to-5.4,p<0.001).The control group (n=102) experienced a smaller reduction, from 24.1breaths per minute (SD=2.2) to21.2 breaths per minute (SD=2.0), with a mean difference of 2.9 breaths per minute (95%CI:-3.5to-2.3,p<0.001). The between -group comparison indicated a significant difference of -2.9 breaths per minute (95%CI:-3.5to-2.3,p<0.001),favoring the experimental group. Similarly ,chest wall kinematics improved significantly, with the experimental group increasing from 4.2cm (SD=0.7) to 6.5cm(SD=0.9),resulting in a mean difference of 2.3cm(95%CI:2.1to2.5,p<0.001).The control group showed a more modest improvement, from 4.1cm(SD=0.8) to 5.3cm (SD=0.7),with a mean difference of 1.2cm (95%CI:1.0to1.4,p<0.001).The between-group difference in chest wall kinematics was1.1cm(95% CI:0.8to1.4,p <0.001), highlighting the greater improvements achieved by the experimental group. Eleven studies were included in a systematic review on the effectiveness of the active cycle of breathing technique in patients with chronic respiratory diseases and the quality of most of them was moderate to good. The outcomes most frequently assessed were forced expiratory volume in 1 s (FEV_1), sputum wet weight, forced vital capacity (FVC), and peak expiratory flow rate. Secondary outcomes were quality of life and dyspnea. Various comparators were identified and most of them assessed the ACBT as an effective method in comparison with other respiratory treatment modalities. Most studies revealed that ACBT/FET had at least an equally beneficial short-term effect on sputum wet weight, FEV_1 and FVC compared to other treatment methods. The results of this updating review reinforced the data of a previous systematic review regarding the beneficial impact of ACBT for the short-term improvement in respiratory tract secretions clearance and pulmonary function. ACBT is effective in increasing the expectorated sputum volume, in reducing viscoelasticity of the secretion and in relieving symptoms such as dyspnea.[28]Another study investigated effects of diaphragm breathing exercise and feedback breathing exercise on respiratory function. Thirty-one subjects were randomly assigned to two groups; the feedback breathing exercise group and the maneuver-diaphragm exercise group. The feedback breathing exercise group was asked to breathe with feedback breathing device, and the maneuver-diaphragm exercise group was asked to perform diaphragm respiration. Respiratory function was evaluated when a subject sat on a chair comfortably. There was a significant difference in the functional vital capacity and slow vital capacity before and after all breathing exercises. There was a significant between-group difference in functional vital capacity. However, no between-group difference was found in slow vital capacity. Diaphragm breathing exercise and feedback breathing exercise can affect respiratory function.[32]To assess the effects of diaphragmatic breathing and diaphragmatic breathing combined with pursed-lips on chest wall kinematics, breathlessness, and chest wall asynchrony in subjects with COPD, and also to assess whether the combination of both exercises reduces the adverse

effects of diaphragmatic breathing while maintaining its benefits. Seventeen subjects with COPD, mean ± SD, 65 ± 7 y of age, with a history of smoking and clinical stability without hospitalization or symptoms of exacerbation in the past 4 wk, were evaluated. On day 1, participants' characteristics were collected, and they learned diaphragmatic breathing and its combination with pursed-lips breathing. On day 2, the participants were evaluated by optoelectronic plethysmography with the participants in the seated position while performing breathing exercises. Diaphragmatic breathing and diaphragmatic breathing plus pursed-lips breathing promoted a significant increase in chest wall tidal volume and its compartments as well as a reduction in breathing frequency compared with quiet breathing. No significant changes were observed in dyspnea or end-expiratory volume of the chest wall. A significant increase in asynchrony (inspiratory-expiratory phase ratio) was observed during diaphragmatic breathing and diaphragmatic breathing plus pursed-lips breathing compared with quiet breathing, with no differences observed between the exercises. Above study concluded Despite the increase in asynchrony, both breathing exercises were able to improve chest wall volumes without affecting dyspnea. The combination of exercises maintained the benefits but did not reduce the adverse effects of diaphragmatic breathing.[33]

Respiratory rehabilitation is effective in improvement of respiratory dysfunction patients. Pulmonary rehabilitation including diaphragmatic exercises improve quality of life in obstructive pulmonary disease patients. The objective of the study was to see the effects of six week respiratory rehabilitation training on respiratory function, mobility in old patients with respiratory dysfunction. For this purpose 72 members were included in the study. 36 participants were provided with the intervention and the other 36 were given no intervention. Outcome measures were assessed in both groups. It seems that in the intervention group SDS and SAS scores were decreased. It was concluded that quality of life and respiratory function were greatly improved in intervention group but depression is a factor that greatly exist in old population. In the elderly depression was not improved very much. [36]Covid-19 has created a terrific situation all over the world. The most common cause of death is respiratory failure and pneumonia. Therefore it is the need of the hour in pandemic situation to improved the respiration in Covid patients. Stretching exercises, diaphragmatic training and cough exercises all are form of chest Physiotherapy given to patients. During acute stage chest physiotherapy is not recommended because there is no exudation. However, on ventilator chest physiotherapy is quite beneficial in providing the patient both comfort and relief. Infact chest physiotherapy reverse the harmful effects of covid-19 on respiratory system. But individual patient assessment is very important to be done before giving any kind of treatment or any other exercise protocol. [37-38]The purpose of this literature study was to see the effect of breathing or diaphragmatic exercises on the post Covid symptoms. Online databases were selected to search the literature. Inclusion and exclusion criteria was met by the articles. 243 articles were reviewed. It was seen that post Covid symptoms were greatly reduced with the help of diaphragmatic exercises. Lung capacity was also improved in these patients by the diaphragmatic exercises. 4 to 6 weeks were required to check the effects of these breathing exercises. But it showed that it should be taken into account that these exercises must be given by checking individual patient's need. [39]In a study repeated measures analyses revealed that the diaphragmatic breathing pattern (slow and deep breathing) during exercise led to a significant reduction in the sensation of dyspnea ($p = 0.04$) and leg fatigue ($p < 0.001$), compared to the personal breathing pattern. These differences were attributed to the reduction of respiratory rate ($p = 0.03$), and the increase of expiratory time ($p = 0.02$), minute ventilation ($p = 0.048$), tidal volume ($p = 0.047$) and oxygen saturation ($p = 0.03$).Therefore the study showed that diaphragmatic breathing reduced the sensation of dyspnea and fatigue during exercise in COPD patients. As the study showed, the change in breathing pattern can help COPD patients to exercise with less dyspnea and fatigue, increasing their exercise tolerance. By adopting this slower and deeper breathing pattern during the activities of daily living, maybe these patients can perform these activities with the same benefits.[40]A prospective, parallel group, single-blind, randomized controlled trial comparing breathing training with asthma education (to control for non-specific effects of clinician attention)

was performed. Subjects with asthma with impaired health status managed in primary care were randomized to receive three sessions of either physiotherapist-supervised breathing training (n=94) or asthma nurse-delivered asthma education (n=89). The main outcome was Asthma Quality of Life Questionnaire (AQLQ) score, with secondary outcomes including spirometry, bronchial hyper-responsiveness, exhaled nitric oxide, induced sputum eosinophil count and Asthma Control Questionnaire (ACQ), Hospital Anxiety and Depression (HAD) and hyperventilation (Nijmegen) questionnaire scores. One month after the intervention there were similar improvements in AQLQ scores from baseline in both groups but at 6 months there was a significant between-group difference favouring breathing training (0.38 units, 95% CI 0.08 to 0.68). At the 6-month assessment there were significant between-group differences favouring breathing training in HAD anxiety (1.1, 95% CI 0.2 to 1.9), HAD depression (0.8, 95% CI 0.1 to 1.4) and Nijmegen (3.2, 95% CI 1.0 to 5.4) scores, with trends to improved ACQ (0.2, 95% CI 0.0 to 0.4). No significant between-group differences were seen at 1 month. Breathing training was not associated with significant changes in airways physiology, inflammation or hyper-responsiveness. Breathing training resulted in improvements in asthma-specific health status and other patient-centred measures but not in asthma pathophysiology. Such exercises may help patients whose quality of life is impaired by asthma, but they are unlikely to reduce the need for anti-inflammatory medication.[41] Among respiratory dysfunction patients there is substantial link among all the respiratory parameters like breathing rate, oxygen saturation,, quality of life and pain etc. These patients have compromised respiratory parameters. Breathlessness is also the main consequence of respiratory dysfunction.

So the purpose of this study was to compare the effectiveness of diaphragmatic stimulation with breathing exercises and breathing exercises alone on respiratory rate, chest wall kinematics and quality of life in respiratory dysfunction individuals, The pre and post values were measured to assess the improvements in respiratory outcomes by using pulse oximeter, measuring tape for chest wall movement and quality of life for respiratory illness questionnaire (QOL-RIQ).

Conclusion

The findings revealed that diaphragmatic stimulation, particularly when combined with breathing exercises, significantly improved respiratory rate chest wall mobility and quality of life of individuals with respiratory dysfunction. These improvements were more pronounced in the intervention group compared to the control group. The results align well with the study objectives which posited that diaphragmatic stimulation, especially when combined with breathing exercises, would enhance respiratory and musculoskeletal function like chest mobility.

References

1. Mintz M. Asthma update: part I. Diagnosis, monitoring, and prevention of disease progression. American family physician. 2004 Sep 1;70(5):893-8.
2. *https://juniperpublishers.com/ijoprs/pdf/IJOPRS.MS.I D.555599* Respiratory symptoms in India: 100:358- 380.
3. EMCHRC P, Giri JU. Efficacy of Retraining Diaphragm by Proprioceptive Neuromuscular Facilitation versus Diaphragmatic Breathing Exercises in Reducing Dyspnoea in the Copd Patients.
4. Evidence-based health policy from the Global Burden of Disease 1996:274; 740-743
5. MARIN JM, CARRIZO SJ, GASCON M, SANCHEZ A, GALLEGO B, CELLI BR. Inspiratory capacity, dynamic hyperinflation, breathlessness, and exercise performance during the 6-minute-walk test in chronic obstructive pulmonary disease. American journal of respiratory and critical care medicine. 2001 May 1;163(6):1395-9.
6. Weg JG Therapeutic exercise in patient with COPD, 1985:15(2); 261-275.
7. Brown HV and Wasserman K Exercise performance in COPD, 1981:65 (3):525-47.

8. Ambrosino N, Strambi S. New strategies to improve exercise tolerance in chronic obstructive pulmonary disease. European Respiratory Journal. 2004 Aug 1;24(2):313-22.
9. Celli BR,Snider GL,Heffer J Standards for the diagnosis and care patients with COPD American journal of respiratory medicine and critical care medicine 1995;166;559-570.
10. Sanchez Riera H, Montemayor Rubio T,Ortega Ruiz F, Inspiratory muscle training on patient with Chronic Obstructive Pulmonary Disease; effect on dyspnoea exercise performance and quality of life;1995 Nov;75(11):996-1005.
11. Amj. Respir critical care medicine, 159; Pulmonary rehabilitation; American Thoracic society 19991666- 1682.
12. Amdani M, Chakole S. Respiratory Care in Corona. Psychology and Education Journal. 2021 Feb 4;58(2):613-20.
13. Carfì A, Bernabei R, Landi F. Persistent symptoms in patients after acute COVID-19. Jama. 2020 Aug 11;324(6):603-5.
14. Urme NA, Alam F, Rahman E. Effectiveness of Active Cycle of Breathing Technique (ACBT) for the Patients of Bronchiectasis: A Narrative Review Study. J Clin Respir Dis Care. 2019;5(142):2.
15. MARIN JM, CARRIZO SJ, GASCON M, SANCHEZ A, GALLEGO B, CELLI BR. Inspiratory capacity, dynamic hyperinflation, breathlessness, and exercise performance during the 6-minute-walk test in chronic obstructive pulmonary disease. American journal of respiratory and critical care medicine. 2001 May 1;163(6):1395-9.
16. Weg JG. Therapeutic exercise in patients with chronic obstructive pulmonary disease. Cardiovascular clinics. 1985 Jan 1;15(2):261-75.
17. **7** Brown HV, Wasserman K. Exercise performance in chronic obstructive pulmonary diseases. Medical Clinics of North America. 1981 May 1;65(3):525-47.
18. Ambrosino N, Strambi S. New strategies to improve exercise tolerance in chronic obstructive pulmonary disease. European Respiratory Journal. 2004 Aug 1;24(2):313-22.
19. Celli BR, Snider GL, Heffner J, Tiep B, Ziment I, Make B. Standards for the diagnosis and management of patients with COPD. American Thoracic Society. Am J Respir Crit Care Med. 1995;152:S77-121.
20. Riera HS, Rubio TM, Ruiz FO, Ramos PC, Otero DD, Hernandez TE, Gomez JC. Inspiratory muscle training in patients with COPD: effect on dyspnea, exercise performance, and quality of life. Chest. 2001 Sep 1;120(3):748-56.
21. Rehabilitation P. Official Statement of the American Thoracic Society. Am J RespirCritCareMed. 1999 May;159:1662-82.
22. Lisboa C, Villafranca C, Leiva A, Cruz E, Pertuze J, Borzone G. Inspiratory muscle training in chronic airflow limitation: effect on exercise performance. European Respiratory Journal. 1997 Mar 1;10(3):537-42.
23. Ramírez-Sarmiento A, Orozco-Levi M, Güell R, Barreiro E, Hernandez N, Mota S, Sangenis M, Broquetas JM, Casan P, Gea J. Inspiratory muscle training in patients with chronic obstructive pulmonary disease: structural adaptation and physiologic outcomes. American journal of respiratory and critical care medicine. 2002 Dec 1;166(11):1491-7.
24. Colman RJ, Anderson RM. Nonhuman primate calorie restriction. Antioxidants & redox signaling. 2011 Jan 15;14(2):229-39.
25. Chalmers G. Strength training: Re-examination of the possible role of golgi tendon organ and muscle spindle reflexes in proprioceptive neuromuscular facilitation muscle stretching. Sports Biomechanics. 2004 Jan 1;3(1):159-83.
26. Knott M. Proprioceptive neuromuscular facilitation: patterns and techniques. The American Journal of the Medical Sciences. 1957;233(1).
27. Rj C. Fairshter RD. Harrison A, Morrison JT, Blackburn C, Wilson AF. Effects of breathing retraining in patients with chronic obstructive pulmonary disease. Chest. 1981;79:393-8.

28. Cahalin LP, Braga M, Matsuo Y, Hernandez ED. Efficacy of diaphragmatic breathing in persons with chronic obstructive pulmonary disease: a review of the literature. Journal of Cardiopulmonary Rehabilitation and Prevention. 2002 Jan 1;22(1):7-21.
29. Siddiq MA, Rathore FA, Clegg D, Rasker JJ. Pulmonary Rehabilitation in COVID-19 patients: A scoping review of current practice and its application during the pandemic. Turkish journal of physical medicine and rehabilitation. 2020 Dec;66(4):480.
32.Kader M, Hossain M, Reddy V, Perera NK, Rashid M. Effects of short-term breathing exercises on respiratory recovery in patients with COVID-19: a quasi-experimental study. BMC Sports Science, Medicine and Rehabilitation. 2022 Dec;14(1):1-0.
33 . Liu K, Zhang W, Yang Y, Zhang J, Li Y, Chen Y. Respiratory rehabilitation inelderly patients with COVID-19: A randomized controlled study. Complementary therapies in clinical practice. 2020 May 1;39:101166.
34. Abdullahi A. Safety and efficacy of chest physiotherapy in patients withCOVID-19:a critical review. Frontiers in medicine. 2020 Jul 21;7:454.
35. Naralia TW, Permatasari H. The Effectiveness of Breathing Exercises for Post Covid-19 Patients during Rehabilitation: A Literature Review. STRADA Jurnal Ilmiah Kesehatan. 2021 May 16;10(1):844-50.
36.Santana AV, Fontana AD, Pitta F. Pulmonary rehabilitation after COVID-19. J Bras Pneumol. 2021 Feb 24;47(1):e20210034. doi: 10.36416/1806-3756/e20210034. PMID: 33656096; PMCID: PMC8332671.
37.Zisi D, Chryssanthopoulos C, Nanas S, Philippou A. The effectiveness of the active cycle of breathing technique in patients with chronic respiratory diseases: A systematic review. Heart & Lung. 2022 May 1;53:89-98.
38.Yong MS, Lee HY, Lee YS. Effects of diaphragm breathing exercise and feedback breathing exercise on pulmonary function in healthy adults. Journal of physical therapy science. 2017;29(1):85-7.
39.Mendes LP, Moraes KS, Hoffman M, Vieira DS, Ribeiro-Samora GA, Lage SM, Britto RR, Parreira VF. Effects of diaphragmatic breathing with and without pursed-lips breathing in subjects with COPD. Respiratory care. 2019 Feb 1;64(2):136-44.
40.Evangelodimou Afrodite, MS Grammatopoulou Eirini, PhD Skordilis EmmanouilHaniotou Aikaterini, MD The Effect of Diaphragmatic Breathing on Dyspnea and Exercise Tolerance During Exercise in COPD Patients Volume 148, ISSUE 4, SUPPLEMENT , 704A, October 01, 2015