EFFECTIVENESS OF LUNG FLUTE VERSUS PILATES BREATHING EXERCISES TO IMPROVE SYMPTOMS AND QUALITY OF LIFE IN SUBJECT WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Abstract-
Purpose: The purpose of the study was to find the effectiveness of Lung Flute versus Pilates breathing exercises to improve symptoms and quality of life in subject with chronic obstructive pulmonary disease
Methods: prospective study design. In this study, there were 90 subjects with a clinical diagnosis of chronic obstructive pulmonary disease, and who were divided into two groups at randomly. The subjects in Group A (n = 45) received lung flute along with conventional physiotherapy, while the subjects in Group B (n = 45) received pilates breathing exercises along with conventional physiotherapy. Intervention was given to participants twice a day ,3 session per week for three weeks. The CCQ questionnaire for symptoms and the SGRQ questionnaire for quality of life and mMRC for dyspnea and inch tape for chest expansion were used to assess the intervention's effectiveness.
Results: Independent 't' test was used to compare the mean significance difference between continuous variables. Paired 't' test was used to assess the statistical significance difference between pre and post test scores. Statistical analysis of this data revealed that, both groups significantly improved in both parameters when compared within groups, but when compared between groups, the Lung Flute improved better than the Pilates breathing exercises group.
Conclusion: The present study concluded that both Lung Flute and Pilates breathing exercises were effective in improving symptoms and quality of life. However, Lung Flute was more effective when compared to Pilates breathing exercise in terms of improving symptoms and quality of life.

***Key Words*: chronic obstructive pulmonary disease, St. George respiratory questionnaire, clinical COPD questionnaire, modified medical research council, chest expansion.**

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common disease characterized by irreversible airflow obstruction and persistent inflammation to noxious environmental stimuli, usually cigarette smoke. It effects the group of lung diseases that make it hard to breathe in and out of the lungs and get worse over time. [1] Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors including abnormal lung development.[2,]

According to GOLD and other large-scale epidemiological studies, the number of COPD cases was 384 million in 2010, with a global prevalence of 11.7% in 2019. [9]COPD was found to be 7.4% prevalent in the Indian population. COPD was found in 11.4% of males and 7.4% of females, respectively[3]

This heightened response could cause tissue damage, mucous hypersecretion (chronic bronchitis), and destruction (emphysema), as well as interference with regular repair and defence mechanisms, result in inflammation and fibrosis of the small airways (bronchiolitis)[4]

Chronic bronchitis (CB) is a common but variable complication of chronic obstructive pulmonary disease (COPD).It has a number of clinical consequences, including an accelerated decline in lung function, an increased risk of developing airflow obstruction in smokers, for lower respiratory tract infection, a higher frequency of exacerbation, and worse overall mortality. CB is the result of Goblet cell mucus overproduction and hypersecretion leads to worsening airflow obstruction by luminal obstruction of small airways, epithelial remodelling, and alteration of airway surface tension, predisposing to collapse.[5] CB is more prevalent in COPD patients, affecting 14 to 74% of all COPD patients.[6,7]

Emphysema is a lung disease that usually develops after many years of smoking and involves damage to the walls of the lung's air sacs (alveoli). The alveoli and lung tissue are destroyed when emphysema develops. Because of this damage, the bronchial tubes cannot be supported by the alveoli. The tubes collapsing creates a "obstruction" (a blockage), trapping air inside the lungs. Some patients may appear barrel-chested if they have too much air trapped in their lungs.[8]

Every year, there are about three million deaths worldwide. The prevalence of COPD is anticipated to increase over the next 40 years, and by 2060, there may be over 5.4 million annual deaths due to the disease due to rising smoking rates in developing nations and ageing populations in high-income nations. from COPD and associated diseases.[11,12,13]
For people aged 40 and older, the overall incidence of COPD was (95% CI) Men were more likely to have it than women. Ages 40–44 to 75–79 saw an almost ten-fold increase in the incidence. Smokers had a much higher incidence of COPD than non-smokers did, and this was true across all age groups. both genders.[14]
The main risk factor for chronic obstructive pulmonary disease is smoking (COPD). It raises someone chance of getting COPD and dying from it. Smoking is a factor in 85 to 90 percent of COPD cases. Exposure to air pollution is another risk factor for COPD. Working with chemicals, dust, and fumes, inhaling second smoke Alpha-1 deficiency is a genetic condition. A history of respiratory infection in childhood. [,15]
COPD pathological changes include the following. Lung inflammation is caused by inhaling cigarette smoke or other noxious particles, such as smoke from biomass fuels. Is a normal response that appears to be altered in COPD patients. This chronic inflammatory response could lead to destroy parenchymal tissue (resulting in emphysema) and disrupt normal repair and defence mechanisms (resulting in small airway fibrosis).
Additional modifications result in gas entrapment and progressive airflow limitation. include the process of chronic inflammation, which is accompanied by an increase in certain inflammatory cell types in various lung regions and structural changes caused by those inflammatory cell increases in macrophages in peripheral airways.[16]lung parenchyma and pulmonary vessels, as well as more neutrophils that are activated and more lymphocytes, including Tc1, Th1, Th17, and ILC3 cells.
Eosinophils, Th2 cells, or ILC2 cell counts may also rise in some patients. All of these inflammatory cells release numerous inflammatory mediators that have been shown to be increased in chemotactic factors, which attract inflammatory cells from the circulation, amplify the inflammatory process (pro inflammatory cytokines), and induce structural changes in epithelial cells and other structural cells (growth factors) [17]
Pathophysiological changes includes the integrity and movement of air in the bronchioles are primarily dependent on elastic coil pressures induced by surrounding elastic tissue, damage to the elastin in COPD results in significant airway narrowing with a reduction in air-low in the bronchioles and air-trapping in the lungs. Thirdly, extensive alveolar and bronchiolar epithelial cells and pulmonary capillary apoptosis in histological features like emphysema and physiological features like decreased surface area of alveoli for gaseous exchange and ventilation-circulation mismatch (V/Q) result in fixed airway narrowing that causes increased airway resistance that does not fully revert even with bronchodilators. [18]
The current Global initiative for Chronic Obstructive Lung Disease (GOLD) document, which advises evaluating symptom burden (primarily dyspnea) and exacerbation history separately from airflow restriction, recognizes the importance of symptoms in COPD. the most typical respiratory symptoms, such as coughing up sputum, dyspnea, and so on. [19]
Mucus hypersecretion, air flow restriction during expiration, worsening of a gas transfer, hyperinflation (i.e., increase AP diameter), flattening of the diaphragm upon inspiration (hoovers sign), ciliary dysfunction, and pulmonary hypertension.[20] Dyspnea, a defining element sign of COPD, is a major contributor to the illness's incapacity and anxiety. [21]
The first sign of COPD is frequently a chronic cough, which is frequently dismissed by the patient as a normal side effect of smoking and/or environmental exposures. The cough may start out being irregular but later develop into something that occurs daily, frequently all day. In COPD, a persistent cough may be productive or ineffective. [22]
Spirometer measures, the volume of air forcefully exhaled from the point of maximal inspiration (forced vital capacity, FVC) and the volume of air exhaled during the first second of this manoeuvre (forced expiratory volume in one second, FEV1) should be measured, and the ratio of these two measurements (FEV1/FVC) should be calculated[23]. Airflow limitation severity classification in COPD Mild -FEV 1 is less than or equal to 80%, Moderate -FEV 1 is less than or equal to 50% to 80%, Severe -FEV1 is less than or equal to 30% to 50%, Very severe -FEV1 is less than 30%.[24] Signs of lung hyperinflation (flattened diaphragm and an increase in the volume of the retrosternal air space) are among the radiological changes linked to COPD[24]. Early on, the patient shows gas tapping and a rise in residual volume, and hyperinflation raises lung capacities overall.[25]
The Lung Flute is a new small self-powered audio device from the family of oscillatory positive expiratory pressure device (OPEP), which includes flutter device and acapella. however, like traditional oscillatory positive expiratory pressure device that use oscillatory back pressure, the Lung Flute has a unique mechanism of action based on make the reed to occillate, it generates a sound wave of 16 to 22 H_Z with an output of 110 to 115 dB using 2.5 cm H_2O of pressure. [26]
Pilates is a physical fitness system developed in the early 20th century by JOSEPH PILATES during world war two. Breathing is important aspect in the Pilates method[27] Complete inhalation and complete exhalation are key to the breathing.[28] Lateral breathing is the important component in Pilates breathing. Pilates breathing facilitates correct muscle activation .it focuses on directing the breath into the sides of the ribs rather than the lower stomach so that it helps to keep the abdominals activated when performing exercises. Pilates focuses on the exhalation as it cases the activation of the abdominal muscles. During exhalation, the transvers abdominal and oblique contract to increase intra-abdominal pressure has influence on spinal stability.[2] The aim of the study is to compare the effectiveness of Lung Flute and Pilates breathing exercises to improve symptoms and quality of life in subject with chronic obstructive pulmonary disease

MATERIALS AND METHODS:

Study Design: Prospective study design

Ethical Clearance and Informed Consent: The study protocol was approved by the Ethical Committee of GSL Medical College & General Hospital, the investigator explained the purpose of the study and given the patient information sheet. The participants were requested to provide their consent to participate in the study. All the participants signed the informed consent and the rights of the included participants have been secured.

Study Population: Subjects clinically diagnosed as COPD by a Pulmonologist

Study Setting: The study was conducted at Department of Physiotherapy, GSL general hospital, Rajamahendravaram, Andhra Pradesh, India.

Study Duration: The study was conducted during the period of one year.

Intervention Duration: Twice a day, 3 sessions per week for 3 weeks.

Study Sampling Method: Systematic random sampling method.

Sample Size: A total number of 90 subjects, both men and women were included with age group of 40 to 65 years having a symptom of COPD. who are willing to participate in the study were included in this study, all the recruited participants were explained about the study. After obtaining informed consent forms and meeting the criteria, total 90 subjects were allocated into two groups equally by 45 for each group.

A basic Conventional therapy will be given in both the two groups i.e deep breathing exercises, upper limb mobility and lower limb mobility exercises.

Group A – Lung Flute device along with conventional physiotherapy (45 subjects)

Group B – Pilates breathing exercises along with conventional physiotherapy (45 subjects)

MATERIALS USED:

- Arm rest chair
- Stool
- Examination Couch
- Pillows
- Clinical COPD questionnaire
- Inch tape
- St. George respiratory Questionnaire
- mMRC score sheet
- Data collection form
- Lung Flute device
- Kidney tray
- Cotton swab

CRITERIA FOR SAMPLE SELECTION:

INCLUSION CRITERIA:

- Both males & females subjects with COPD were Included in the study
- Patients between 40 to 65 years people
- Both smokers and Passive-smokers were included in the study
- Presence of having a symptoms of COPD most days a week
- Patients with the Ability to vibrate the reed of Lung Flute
- Patients diagnosed with moderate and severe COPD as per GOLD criteria
- Spirometer FEV1/FVC ratio <70% and FEV1 <80% in one second

EXCLUSION CRITERIA:

- Rib fractures
- Recent abdominal and chest surgeries
- Subjects with chronic cardiac problems
- Patients who are unable to follow commands
- Severe Neuro- musculoskeletal abnormalities
- Ischemic ECG changes
- O_2 desaturation with O_2 saturation <80%
- Dizziness or mental confusion or loss of coordination
- Uncontrolled hypertension
- Severe chest wall deformities

STUDY TOOLS AND OUTCOME MEASURES

mMRC (Modified medical research council): is a simple valid method used for grading the effect of breathlessness on daily activities. It is a simple 0-4 graded scale and valid method of categorizing patients with COPD in terms of their disability. The

patients were showed and explained the MMRC scale and were asked their grade of dyspnea. Reliability was 0.82 which indicates good test retest reliability .[1]

SGRQ (St. George Respiratory Questionnaire): The SGRQ questionnaire has 50 items with 76 weighted responses. The SGRQ is a standardized self-administered airways disease-specific questionnaire divided into Part 1 produces the symptoms score, consist of (1-7) questions and part 2 produces the activity and impacts scores, consists of (8- 14) questions. It includes Symptoms (Questions 1-7), Activity (Questions 9 and 12). Impacts (Questions 8, 10, 11, 13, 14), A total scores is also produces. Sum of all positive responses are calculated individually and total score calculated sum of all three domains produces total score. Higher scores indicate worst health status.

CCQ (Clinical Copd Questionnaire) The CCQ consists of 10 items with an overall score and 3 domains: 1. Symptoms (4 items), 2.Functional state (4 items) and 3. Mental state (2 items). All scores range from 0 to 6; (0 = no impairment). Items are scored on a Likert scale (range 0–60). The final score is the sum of all items divided by 10, separate scores for all three domains can be calculated. Higher scores indicate a worse health status CCQ total score = (item 1 + 2 + 3 + 4 +5+6 + 7 + 8 + 9 + 10)/10: Symptom = (item 1 + 2 + 5 + 6)/4; Functional state = (item 7 + 8 + 9 + 10)/4; Mental state = (item 3 + 4)/2.

Chest Expansion: chest expansion was measured circumferentially with a centimeter tape measure and diametrically transversely by means of tape measure. Readings were carried out in one plane at 4th intercostal space, the difference between deep expiration and deep inspiration has been measured for two times and the best reading was taken, the patient in sitting position.

INTERVENTION:

This is a 3 week study which includes Lung Flute device for Group A and Pilates breathing exercises for Group B. the outcome were measure by the clinical COPD questionnaire and st George respiratory questionnaire and mMRC for symptoms and quality of life, respectively. All the subjects who were eligible for the criteria were randomly allocated into Group A and Group B. Clinical assessment and baseline characteristics were checked and recorded. The details of patient were filled in patient assessment sheet and case record form. Patients were divided into Group A (Lung Flute) and Group B (Pilates breathing exercises) based on systematic randomize sampling method. All the outcome measures were assessed before giving the intervention and after completion of 3 weeks of intervention. Vitals like HR, RR, BP and SPO2 were recorded pre and post treatment. Essential medicines and aerosol treatment was continued for all the patients. Both the group were given conventional treatment (Aerosol treatment, deep breathing exercises, pursed lip breathing, Dyspnea reliving positions, Strength training of UL and LL).

GROUP A

LUNG FLUTE ALONG WITH CONVENTIONAL PHYSIOTHERAPY

Subjects in this group receive Lung Flute device exercises. The Lung Flute breathing exercise consist of blow a device vigorously enough to make the reed oscillate along with conventional physiotherapy

POSITION OF THE SUBJECT: Sitting

PROCEDURE

Subject will be in a sitting position with their holding of Lung Flute in their hands, and the therapist standing in front of the subject. Initially the subject instructed to blow five times in to Lung Flute device vigorously to make the reed oscillate, after take five normal breaths and this was done with 10 times followed by coughing to complete 1 cycle. Two cycles are recommended per a day to perform.it was performs twice a day 3 session per week for 3 week along with this a basic conventional physiotherapy were given includes deep breathing exercises, upper limb strengthing exercises and lower limb strengthening exercises and chest physiotherapy

S. no		Modes	Frequency	Duration
1	Lung Flute	Blow 5 times to oscillate reed in the Lung Flute	2 cycles in 1 day for 3 session in a week	3 weeks
2	Chest physiotherapy	Chest percussions followed by coughing	2mins/segments and cough	3 weeks
3	Deep breathing exercises	Take a deep breath and encourage prolonged exhalation	10 minutes per session	3 weeks
4	Upper limb mobility exercises	Asked to lift their arms over head for 10 times using weight cuff	10 repetitions ,3 times in a week	3 weeks
5	Lower limb mobility exercises	Asked to do leg raise in sitting position using weight cuffs	10 repetitions 3 in a week	3 weeks

Fig; subject performing lung flute device

Fig: subject performing conventional physiotherapy

GROUP B

PILATES BREATHING EXERCISES ALONG WITH CONVENTIONAL PHYSIOTHERAPY

Subjects in this group received Pilates breathing exercises. The Pilates breathing exercises are bases on MENEZES [1]. It is a 3week program. It focuses on directing the breath into the sided of the rib rather than the lower stomach. Allowing the respiration to flow, not to holding breath at any point during the exercises.

POSITION OF THE SUBJECT: SUPINE

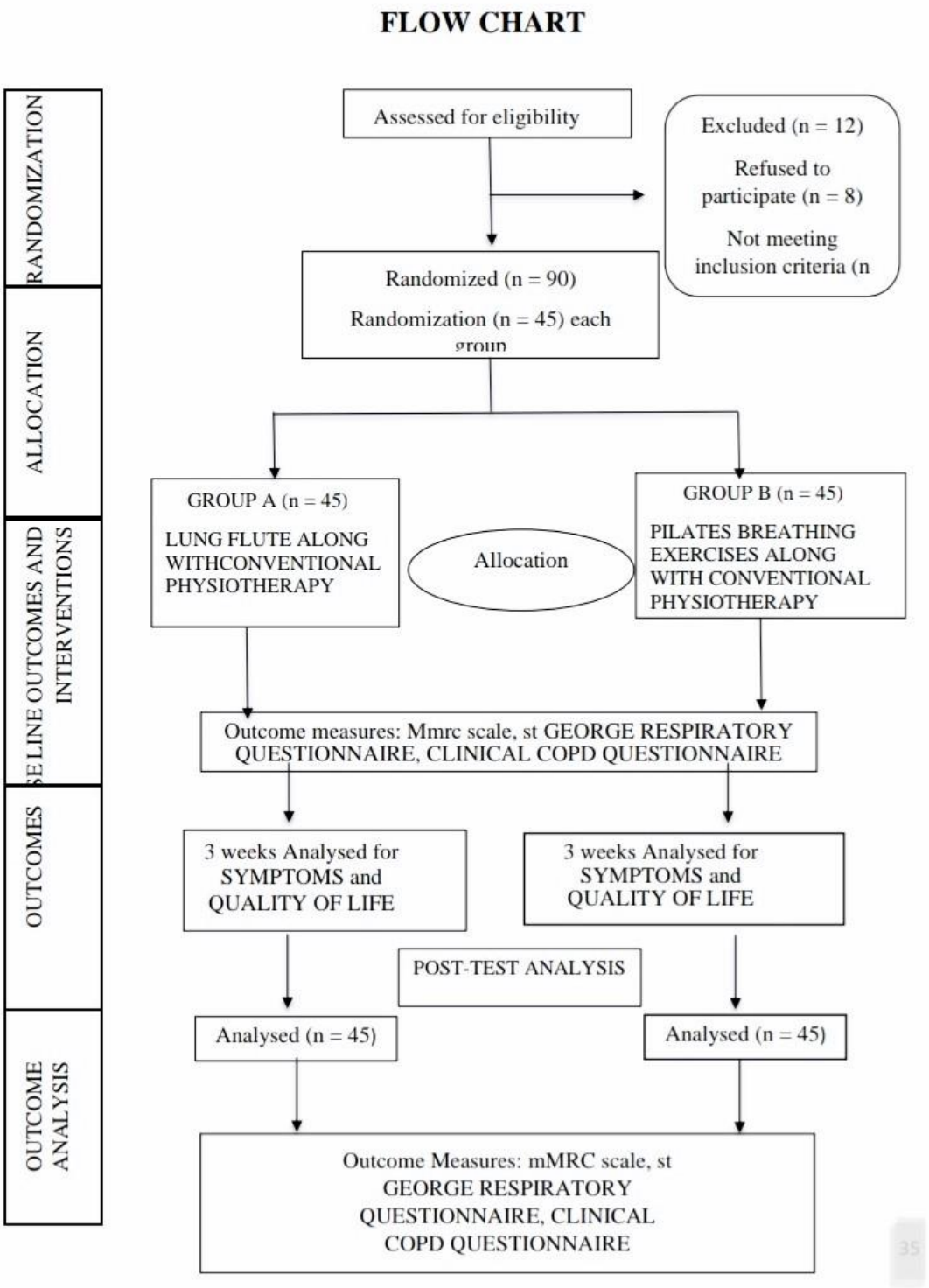
PROCEDURE

Pilates breathing exercises were performed on supine lying. the therapist used to stand on the side of the couch and the therapist hands has to keep on the subject on over the lower posterior lateral rib cage. Patient were instructed to breathe in through nose and breathe out through mouth with lips pursed. Allowing the respiration to flow, not to holding breath at any point during the cycle. In addition to breathing, the abdomen has to be keep pulled in by active contraction of the transvers abdominis and pelvic floor muscles. The patient was asked to hold the pelvic muscles as there trying to hold the urine. Frequency of Pilates breathing exercises is 3 times a week for 3 weeks along with this a conventional physiotherapy were given it included pursed lip breathing, chest physiotherapy, upper limb and lower limb mobility exercises.

1	Pilates breathing exercises	instructed to breathe in through nose and breathe out through mouth with lips pursed	10 minutes per session for twice a day for 3 session per week	3 weeks
2	Chest physiotherapy and Forced expiratory exercises	Chest percussions followed by coughing	2min/segments and cough	3 weeks
3	Upper limb mobility exercises	Asked to lift their arms overhead using weight cuff	10 repetitions 3 times in a week	3 weeks
4	Lower limb mobility exercises	Asked to do straight leg raise using weight cuffs	10 repetitions 3 times in a week	3 weeks

Fig; subject performing pilates breathing exercises

Fig; subject performing conventional physiotherapy



STATISTICAL ANALYSIS:

All Statistical analysis was done by using SPSS software version 21.0 and Microsoft excel-2007. Descriptive data was presented in the form of mean +/- standard deviation and mean difference percentages were calculated and presented.

Within the groups: Paired student "t" test was performed to assess the statistical difference within the groups for symptoms (CCQ), and quality of life (St. GEORGE RESPIRATORY QUESTIONNAIRE) from pre-test and post-test values.

Between the groups: Independent student "t" test was performed to assess the statistically significant difference in mean value between the groups for clinical COPD questionnaire for symptoms, St. George respiratory questionary for quality of life.
For all statistical analysis, $p \leq 0.05$ will be considered as statistically significant

RESULTS:

The results of this study were analysed in terms of reduction of symptoms on clinical COPD questionnaire and improved quality of life on st. George respiratory questionnaire. The consort flow chart of the study showed the study organization in terms of subjects screening, random allocation and analysis following the intervention. Total 102 subjects with chronic obstructive pulmonary disease were screened for eligibility, amongst 90 subjects were included in the study trail. All the 90 subjects who met inclusion criteria have undergone baseline assessment and included subjects were randomized into two equal groups consisting 45 in each group. Comparison was done both within the group as well as in between the two groups. So as to evaluate the intra group and inter group effectiveness of Lung Flute and Pilates exercise which are under considerations in the present study.

ANALYSIS OF MEAN SCORE OF CCQ(TOTAL) WITHIN GROUP A

GROUP A		MEAN	Std. Deviation	p value	inference
CCQ (TOTAL)	Pre	46.353	8.1660	0.001	highly significant
	Post	9.707	2.4444		

TABLE -1

ANALYSIS OF MEAN SCORE OF CCQ(TOTAL) WITHIN GROUP B

GROUP B		Mean	Std. Deviation	p value	Inference
CCQ (TOTAL)	pre	45.516	8.6606	0.001	Highly significant
	post	14.760	3.6651		

TABLES - 2

COMPARISON OF MEAN SCORE OF CCQ (TOTAL) IN BETWEEN THE GROUPS

CCQ (total)		MEAN	Std. Deviation	p value	Inference
pre	GROUP A	46.353	8.1660	0.638003	Insignificant
	GROUP B	45.516	8.6606		
post	GROUP A	9.707	2.4444	0.001	highly significant
	GROUP B	14.760	3.6651		

ANALYSIS OF MEAN SCORE OF SGRQ (TOTAL DOMAIN) WITHIN GROUP A

GROUP A		MEAN	Std. Deviation	p value	inference
SGRQ (TOTAL)	Pre	2081.889	70.7046	0.001	highly significant
	Post	1034.989	48.3865		

ANALYSIS OF MEAN SCORE OF SGRQ (TOTAL DOMAIN) WITHIN GROUP B

GROUP B		MEAN	Std. Deviation	p value	Inference
SGRQ(TOTAL)	pre	2079.751	77.6879	0.001	highly significant
	post	1415.076	102.4964		

COMPARISON OF MEAN SCORE OF SGRQ (TOTAL DOMAIN) IN BETWEEN THE GROUPS

SGRQ (total)		MEAN	Std. Deviation	p value	Inference
pre	GROUP A	2081.889	70.7046	0.891726	Insignificant
	GROUP B	2079.751	77.6879		
Post	GROUP A	1034.989	48.3865	0.001	highly significant
	GROUP B	1415.076	102.4964		

ANALYSIS OF MEAN SCORE OF CHEST EXPANSION WITHIN GROUP A

GROUP A		MEAN	std. deviation	p value	Inference
CHEST EXPANSION	Pre	1.960	0.7187	0.001	highly significant
	Post	2.669	0.6067		

ANALYSIS OF MEAN SCORE OF CHEST EXPANSION WITHIN GROUP B

GROUP B	MEAN	N	Std. Deviation	p- value	Inference
Chest Expansion	1.882	45	.6813	0.001	highly significant
	3.373	45	.7545		

COMPARISON OF MEAN SCORE OF CHEST EXPANSION IN BETWEEN THE GROUPS

CHEST EXPANSIONS		N	MEAN	std. deviation	p value	inference
Pre-test	Group a	45	1.960	.7187	0.599634	Insignificant
	Group b	45	1.882	.6813		
Post test	Group a	45	2.669	.6067	0.001	Highly significant
	Group b	45	3.373	.7545		

ANALYSIS OF MEAN SCORE OF MMRC WITH IN GROUP A

MMRC	N	MEAN	MEAN RANK	Sum of Ranks	P value	Inference
pre	45	3.422	23.00	1035.00	0.001	highly significant
post	45	1.000	0.00	0.00		

ANALYSIS OF MEAN SCORE OF MMRC WITHIN GROUP B

MMRC	MEAN	Std. Deviation	P value	Inference
pre	3.356	.5290	0.001	highly significant
post	.800	.8146		

COMPARISON OF MEAN SCORE OF MMRC IN BETWEEN THE GROUPS

MMRC		N	Mean Rank	Sum of Ranks	p value	Inference
Pre	Group A	45	47.14	2121.50	0.494317	Insignificant
	Group B	45	43.86	1973.50		
Post	Group A	45	49.10	2209.50	0.158906	significant
	Group B	45	41.90	1885.50		

DISSCUSSION:

The aim of our present study was to evaluate the effectiveness of Lung Flute versus Pilates breathing exercises to improve symptom and quality of life in subjects with chronic obstructive pulmonary disease. In the study, subjects were assessed for clinical COPD questionnaire for symptom, mMRC scale for dyspnoea, chest expansion by using inch tap, St. George respiratory questionnaire for quality of life. the main finding of the study is Lung Flute is more effective then Pilates breathing exercises in subject with chronic obstructive pulmonary disease.

The outcome parameters of the present study are CCQ, MMRC scale, Chest expansion, STRQ Which are used to measure before and after the intervention these parameters are used to measure the symptom and quality of life in subjects with chronic obstructive pulmonary disease

The results of the study showed significant difference between Lung Flute and Pilates breathing exercises in subjects with chronic obstructive pulmonary disease who received three weeks of intervention.

The chronic obstructive pulmonary disease (COPD) includes chronic bronchitis, emphysema, and small airway obstruction. incompletely reversible airflow limitation, inflammation, excessive mucus secretion and bronchial mucosal epithelial lesions are the main pathological basis of the disease.[26]

There is core muscle weakness, diaphragmatic dysfunction, spinal muscle weakness and pelvic floor weakness in COPD patients. Mucus hypersecretion and impaired mucociliary clearance is prevalent in many patients with COPD, and contributes significantly to the morbidity and mortality of this disease.

The study supports the previous study of Sanjay sethi, jing yin et.al the Lung Flute improves symptoms and health status in COPD with chronic bronchitis. This study was done in the single centered a 26week study. There concluded that the Lung Flute is a safe and effective treatment in COPD, in the present study to see the shortterm effect of Lung Flute in six weeks with a large number of samples.

The Lung Flute is a new small self-powered audio device that has been classified by the Food and Drug Administration (FDA) to the family of Oscillatory Positive Expiratory Pressure (OPEP) devices, which includes the Flutter and the Acapella. However, unlike traditional OPEP devices that use oscillatory back pressure, the Lung Flute has a unique mechanism of action based on acoustic energy. When blown in to with an exhalation vigorous enough to make the reed oscillate, the Lung Flute generates a sound wave of 16 to 22 Hz with an output of 110 to 115 dB using 2.5 cm s H2O of pressure. This sound wave has the ability to travel down the tracheobronchial tree and vibrate tracheobronchial secretions. This vibration enhances mucociliary clearance of the lower respiratory tract there by resulting in the induction of sputum. This functionality of the Lung Flute has been applied to sputum induction for diagnostic testing and for the enhancement of mucus clearance from the lower airways (Data on file, Medical Acoustics).[27]

Mechanical means to improve mucus clearance in hypersecretory lung conditions include Oscillatory PEP devices such as the Acapella and Flutter, chest vibration and percussion and breathing techniques. However, these have not been tested systematically in stable COPD. This post marketing study confirms the previous regulatory study that the Lung Flute is efficacious in COPD with chronic bronchitis in improving respiratory symptoms and health status. The mechanism of action that results in clinical benefits of Lung Flute in COPD is presumed to be increased mucociliary clearance of tracheobronchial secretions.[27]

Therapeutic use of the Lung Flute was initially tested in a trial that as designed to meet regulatory requirements. In a FDA 510(k) non-inferiority study, the Lung Flute was compared to a FDA cleared OPEP device (Acapella®) in a eight-week, randomized, controlled, two arm open-label parallel study in 40 COPD patients with chronic bronchitis. Both devices improved COPD symptoms and disease specific health status, with trends favoring the Lung Flute (Data on file, Medical Acoustics) study done by Van **Der Molen T, Willemse BW.** [30]

Due to dyspnea and decreased chest expansion, COPD patients are less active in daily life, which leads to a downward spiral of symptom-induced inactivity, deconditioning, and muscle weakness. As a result, patients spend less time walking and standing, which lowers their functional capacity and quality of life.

Pilates breathing is crucially dependent on lateral breathing. A posterior lateral breathing is how it is described. Through the active contraction of transverse abdominal and pelvic floor muscles during both inhalation and expiration, lateral breathing emphasizes the lateral expansion of the rib cage while maintaining a continuous inward pull of the deep abdominal muscles.

Pilates places a strong emphasis on exhaling because it makes the abdominal muscles contract. To raise intraabdominal pressure and stabilise the spine, the transversus abdominis and oblique muscles contract during exhalation. By producing an extensor moment that pulls on the pelvic floor and the diaphragm forward and downward, intra-abdominal pressure affects spinal stability.

Considering the burden, there arises need for finding new significant treatment strategies for treating and preventing COPD along with conventional physiotherapy.
According to Barr et al the diaphragm muscle works as the roof of a cylinder of muscles that surround the spine and assist with stability. Maintaining intra abdominal pressure and preventing displacement of the viscera by contraction mainly of the TrA muscle, is important contribution of diaphragm. Long term benefits can be achieved by the active contraction of the TrA muscle, since it supports descent of diaphragm and provides stabilization of the abdominal compartment.[31]
According to Janaina Rocha Niehues et al Pilates breathing proved effective in obesity in improving chest expansion. Karina M et al also concluded that Pilates breathing led to a breathing pattern which increased thoracic expansibility.[32]
By the end of the 3 weeks of intervention program, the subjects in Group A (Lung Flute) had significantly improved CCQ (p = 0.001), STRQ (p = 0.001), MMRC(p = 0.0010).
After 3 weeks of intervention program, there was a significant difference in subjects of Group B (Pilates breathing exercises) for reducing symptoms CCQ total (P = 0.001) and STRQ total (P = 0.001), MMRC (P=0.001) , chest expansion is more slightly significant then group A (P=0.001).
In terms of comparing the two groups, Lung Flute and Pilates breathing exercise showed statistically significant in post-test results for improving symptoms and quality of life. When post-treatment values of the Lung Flute and Pilates breathing exercises groups were compared, there was no statistically significant difference in the outcome measures, indicating that both treatments were roughly equally effective in improving symptoms and quality of life.
According to the findings of the current study, three weeks of Lung Flute and Pilates breathing exercise interventions significantly improved symptoms and quality of life. However, comparisons between the group's data indicate that both therapies are equally successful. But Lung Flute along with conventional physiotherapy protocol displays marginally superior outcomes.
The current study's findings point to the Lung Flute and Pilates breathing exercise protocol as a potential therapy option for improving symptoms and quality of life as it helped subjects with chronic obstructive pulmonary disease perform better.

LIMITATIONS:

- Less treatment sessions per week.
- No blinding of evaluators.
- No follow up.
- No control group.
- Sputum evaluation was not done.

RECOMMENDATIONS FOR FURTHER RESEARCH:
Further studies follow up may gives the long term effect results

CONCLUSION:
The findings of this study show that both groups' post-test values improved following a 3 -week intervention. However, the Lung Flute group is more effective than the Pilates breathing exercises group which has improved symptoms and quality of life in subjects with chronic obstructive pulmonary disease.

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