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Effectiveness of Upper limb versus Lower limb Exercise training on Pulmonary functions in people with Chronic Obstructive Pulmonary Disease.

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ABSTRACT

Background & Objective: The upper extremities play an important role in many activities of daily living suchas bathing, dressing, and gardening. Patients with COPD frequently experience is marked with dyspnea and fatigue when performing these simple tasks. The effects of lower extremity exercise have been well documented in pulmonary rehabilitation. Exercise training has generally emphasized lower-extremity exercise. In our busy lifestyle, we should make it important to study which kind of exercise training is more beneficial to improving pulmonary function. So, this study has compared the effectiveness of upper extremity versus lower extremity exercise training on pulmonary function in chronic obstructive pulmonary disease patients.

Methods: An experimental design involving the comparative analysis of pre and post-test parameters between two groups treated Group A - with Upper extremity exercise training protocol and Group B - with Lower extremity exercise training protocol. Outcome measurement scales such as pulmonary function- FVC, FEV1, FEV1/FVC, and MVV have been used pre-intervention and post-intervention after six weeks.

Results: The result of this study is a statistically significant improvement in pulmonary functions within Group A and Group B and there is no statistically significant difference in improvement in the means value of FEV1/FVC and MVV between Group A and Group B.

Conclusion: This study concluded that Upper limb exercise training protocol and Lower limb exercise training protocol have an effect on improving pulmonary functions such as FEV1, FVC, FEV1/FVC, and MVV in subjects with COPD. However, the improvement exists in FEV1/FVC and MVV between Groups after UEET and LEET in patients that have similar effects of mild to moderate COPD.

Keywords: Upper limb exercise training, Lower limb exercise training, Chronic obstructive pulmonary disease, forced vital capacity, Forced expiratory volume in one second, Maximum voluntary ventilation, and pulmonaryfunctions.

Introduction

Chronic obstructive pulmonary disease (COPD) is a disorder that is characterized bythe presence of airflow obstruction that is generally slowly progressive, may be accompanied by airway hyperreactivity, and may be partially reversible with limited physical activity. COPD (chronic obstructive pulmonary disease)includes both emphysema and chronic obstructive bronchitis. The most commonly encountered risk factor for COPD is tobacco smoking outdoor and indoor air pollution, occupational and etc... It is the 3rd most common cause of certified illness in India and the fifth greatest cause of disability worldwide and it is the major cause of death increasingin prevalence.

COPD is a preventable and treatable disease with some significant extrapulmonary effects that may contribute to the severity in individual patients. It is characterized by pulmonary component airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response ofthe lungs.[3]Severe inflammation of the small airways and gradual destruction of the alveoli characterize is COPD.[5] Chronic inflammation results in fibrosis, which leads to narrowing of the airways. Neutrophils drive the inflammationobserved in COPD, which is different from the eosinophil-based inflammationof asthma.[5]Various protease enzymes released by neutrophils damage the elasticity and destroy the supporting tissues of the alveoli. These problems areaggravated by excessive mucus, which obstructs the airways, resulting in spasms ofthe muscles. Terminal bronchioles get collapse, and their alveoli die. Causing hyperinflation air becomes trapped in the distal airways, and alveolar dead space is increased. Hyperinflation in combination with narrowed airways which reduces gas exchange from loss of alveoli leads to breathlessness, exercise intolerance, and hypoxia. Hypoxia increases pulmonary vascular resistance, due to pulmonary hypertension and, in severe cases, right-heart failure.

Chronic cough is one of the first symptoms of COPD, and patients often brush this off as the "typical smoker's cough." By the age

of 40to 50 years, the person with COPD may begin to experience progressive shortness of breath that limits activities. Symptoms of COPD include dyspnea, chronic cough, and chronic sputum production. An episode of acuteworsening of these symptoms (exacerbations) often occurs.[3]

Spirometry is used to make a clinical diagnosis of COPD, the presence ofa post-bronchodilator FEV1/FVC < 0.70 confirms the presence of persistent airflow limitation and thus COPD. A spirometer is a direct measure of the volume of air displaced or measures airflow by a flow sensing device. Such as a micro- processor-driven pneumotachometer and then mathematically derive volume.Pulmonary function testing provides valuable information on the mechanical and physiological characteristics of the lung in health and disease. Proper lungfunction is determined by means of a pulmonary function test. So, this study is going to determine the PFT changes of normal healthy individuals with upper and lower extremity exercise training.[13]

Management of COPD includes pharmacological and non- pharmacological intervention. Pharmacological intervention includes the use of drugs such as bronchodilators, long-acting beta-agonist, glucocorticosteroids, antibiotics, antitussives, antiviral agents, Leukotriene Modifiers, and mucolytics. While nonpharmacological intervention includes Oxygen therapy and a Pulmonary rehabilitation program.[3]

The predominant goal of pulmonary rehabilitation is to decrease symptoms,improve quality of life and increase participation in everyday activities. To achieve these goals, pulmonary rehabilitation uses a multidisciplinary approach, including education and exercise training, and should be consideredfor COPD patients at all stages of disease.[4, 6]Exercise training can affect the respiratory system in many different ways depending on the health status of the exercise and the type of exercise that is being executed. Aerobic training can be viewed as an endurance workout thatcan lead to functional and dimensional changes in the cardio-respiratory system.[16]

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METHODOLOGY:

There was atotal of 60 subjects withCOPD between the age group of 30-50 years, 30subjects in Group A and 30 subjects in Group B were studied. This study is an experimental design involving the comparative analysis of pre-post-test est values of parameters studied between two groups treated with Group A - 30 subjects were received upper extremity exercise training. Group B - 30 subjects received lower extremity exercise training. Study populations are selected in Mild to moderate COPD The sampling method has a Simple random sampling method total ratio of study- 6 weeks, 1 session per day for 5 days a week, each day30 minutes (4 sets of 10 repetitions). The samples are collected by the following inclusion and exclusion criteria.

Inclusion criteria :30to 50 years Both males and females. BMI between 18 to 25 kg/meter^2.
They have Clinically diagnosed COPD patients with spirometer evidence of chronic airflow limitation. (Mild to moderate COPD i.e., FEV1/FVC <70%).
Exclusion criteria: persons with other associated diseases like cardiac diseases, restrictive lung diseases, any neurological problems, any musculoskeletal problems in the Upper or lower extremities, and cognitive disorders. Materials used for the collecting data are RMS spirometer Helios 401 and window version 2000/XP, Mouthpiece, Nose clip, Measure tape, Stopwatch Rope, and pulley, Weighing machine, Spirit

PROCEDURE:

All 60 subjects were selected for the study on the basis of inclusion & exclusioncriteria. The subjects will be divided into two groups i.e., Group-A & Group-B. Each group will consist of 30 subjects. Group-A: 30 subjects received upper extremity exercise training. Group-B: 30 subjects received lower extremity exercise training as well.

Pre-intervention measurement of PFT:

Before commencement of training general assessment of the subject was takenincluding the subject's height, weight, BMI, age, smoking history, and PFT was taken. PFT was taken byusing RMS spirometer helios 401 and window version 2000 / XP.

- **Subject preparation**: Before starting the training program the subjects were taken into the experimental room further the PFT procedure. They were instructed to wear comfortable clothing while training.
- **Position of the subject**: comfortable high sitting position on a table without back support and foot placed on floor and face should not focus on a computer screen.
- Subject instructed to place the nose clip in position. Then place the mouthpiece on the mouth and breath into the sensor as prescribed. The best of the three performances were taken into account.
- In each group subject was given 10 minutes of a general warm-up includingstretching and mild intensity of exercise followed by 30 minutes of exercise training in coordination with respiration according to regular format and last 10 minutes of cool down.

EXERCISE PROTOCOL:

Group-A (upper extremity exercise training):

- Immediately after 10 minutes of warm up the Subjects in Group-A had received upper extremity exercise training for 30 minutes, one session perday (4 sets of 10 repetitions), 5 days a week, for 6 weeks. Upper extremityexercises are followed.

1. **Overhead pulley exercise**:
- Subject position: Patients sit on the table with their feet supported on the floor.
- Procedure: subject was explained to perform alternate shoulder flexion andextension in coordination with respiration, while maintaining elbow extension.

2. Push up:
- Subject position: hand and foot supported prone lying (push up position)
- Procedure: lower yourself to the ground during inspiration and explosivelypush up during expiration. The knee should be in extension through push-ups.

3. **Shoulder abduction exercise**:
- Subject position: standing position with the elbow straight and relax
- Procedure: bilateral shoulder abduction with inspiration and adduction with expiration performed.

4. **Arm raise in quadruped position:**
- Subject position: quadruped position.

Procedure: perform alternate arm raise in a quadruped position and take inspiration during arm raise and expiration while coming back to startingposition.

5. **Shoulder flexion exercise**:
- Subject position: standing position with the elbow straight and relax
- Procedure: bilateral shoulder flexion with inspiration and extension withexpiration performed.

6. **Shoulder retraction exercise**:
- Subject position: Sitting position with elbow flexion and fingers clenchedbehind the neck.
- Procedure: Bilateral shoulder retraction with inspiration and protractionwith expiration performed.

7. **Shoulder rotation exercise**:
- Subject position: Sitting position with elbow flexion and hands on the shoulder.
- Procedure: Shoulder rotation in clock vise and anti-clockwise directionwith inspiration and expiration.

Group-B (Lower extremity exercise training):

Immediately after 10 minutes of a warm-up session, the Subjects in Group-B had received lower extremity exercise training for 30 minutes, one session per day (4 sets of 10 repetitions), 5 days a week, for 6 weeks.Lower extremity exercises are following

1. **Partial squats**:

Subject position: standing with feet shoulder distance apart.
- Procedure: slowly bend the knee to degrees and take inspiration, return to a standing position while expiration.

2. **Forward lunges:**
- Starting position: stand forward with feet shoulder distance apart,keeping trunk vertical.
- Procedure: slowly bend the knee to a degree and take inspiration, return tostarting position while expiration.

3. **Side lunges**:
- Starting position: stand sideways with feet shoulder distance apart,keeping trunk vertical.
- Procedure: slowly bend the knee degrees and take inspiration, return tostarting position while expiration.

4. **Leg raise in quadruped position**:
- Subject position: quadruped position
- Procedure: perform alternate leg raise in a quadruped position and take inspiration during lower extremity exercise training for 30 minutes, one session per day (4 sets of 10 repetitions), 5 days a week, for 6 weeks.Lower extremity exercises are following
- leg raise and expiration while coming back to starting position.

5. **Step up and down (height 6 inches):**
- Starting position: stand in front of the step
- Procedure: step up one leg then another leg then step down one leg then another leg in coordination with respiration. Step up with inspiration anddown with expiration.

6. **Straight leg raised in supine lying**:
- Starting position: Supine lying.

- Procedure: perform alternate straight leg raise in supine lying position and take inspiration during leg raise and expiration while coming backto starting position.

7. Hip abduction in supine lying:

- Starting position: supine lying.
- Procedure: perform alternate hip abduction with knee extension and take inspiration during hip abduction and expiration during hip adduction.

Each exercise was repeated for 1 minute, followed by 30 seconds rest for 6 minutes.[23] Training was terminated if the subject experience dyspnea or fatigue.

- ***Post-intervention on measurement of PFT:***
- For both types of training PFT (FVC, FEV1, FEV1/FVC, MVV) readings were taken in the following period.

1. Before training
2. After 6 weeks of training

- Starting position: Supine lying.

Procedure: perform alternate straight leg raise in supine lying position and take inspiration during leg raise and expiration while coming backto starting position

OUTCOME MEASURES:

Tools used for the study:

PFT (pulmonary function test):- PFT is a valuable tool for evaluating the respiratory system. A spirometer provides important graphical and numerical data regarding the mechanical properties of the lungs, including FVC, FEV1, FEV1/FVC, and MVV. It can be used to assess health status before enrolment instrenuous physical activity.[21, 25] PFT was taken pre-and post-training with the use of RMS helios 401 spirometer.

A spirometer is a device used to determine lung volumes and capacities. It comprises flash type sensor with a dismountable Circuit, pressure sensor, amplifier, voltage stabilizer, and analogic to digital converter. Validity for thespirometers was found in the different studies and inter-tester reliability wastested.

1. Force vital capacity:[13, 23]

Forced vital capacity (FVC) is the amount of air that can be maximally and forcibly expelled from the lungs after a maximal inhalation. FVC would be measured in a volume of liters. The subjects were asked to take the deepest breath as much as they can and then they were instructed to place the mouthpiece correctly in their mouth and immediately carry out forceful expiration as hard as possible, for as long as possible, preferably at least 6 seconds. It is directly followed by rapid inspiration. During the test, a soft nose clip is used to prevent air from escaping through nose.

FVC, FEV1, FEV1/FVC were attained from the above maneuver

2. Force expiratory volume in one second:

Force expiratory volume in one second (FEV1) is the amount of air that is forcefully exhaled in the first second of the FVC test. FEV1would be measured inavolume of liters. The subjects were asked to take the deepest breath as much asthey can and then they were instructed to place the mouthpiece correctly in the mouthand immediately carry out forceful expiration as hard as possible.

3. FEV1/FVC ratio:

This number is the ratio of FEV1 to FVC. It indicates what percentage of totalFVC was expelled from the lung during the first second of forced exhalation.This number is called FEV1/FVC ratio, FEV1% or %FEV1. This value is critically important in the diagnosis of obstructive lung disease. This value would be obtained from FEV1 and FVC values. FEV1/FVC would be expressed as a % (percentage)

Maximum voluntary ventilation (MVV):

It is a measure of the maximum amount of air that can be inhaled and exhaled withinone minute. For comfort, this is done over a 15-second time period. The subject was instructed to position the mouthpiece correctly the in mouth and do rapidand deep breathing for 1 minute. The total volume of air moved during the test would be expressed in liter/minute

Statistical tests:

Chi-square (x^2) test has been used to analyze the significance of the basic characteristic of gender, age, and size distribution of the subjects studied

Paired 't-test as a parametric and **Wilcoxon signed rank** test as a non-parametric test have been used to analyze the means of Forced ExpiratoryVolume in one second (FEV1) in a liter, Force vital capacity (FVC) in liter, FEV1/FVC ratio in percentage, and

Maximum voluntary ventilation (MVV) liter per minute from pre-intervention to post-intervention with the calculation of the percentage change.

Independent 't-test as a parametric and **Mann-Whitney U** test as a non-parametric test has been used to compare the means of Forced Expiratory Volume in one second (FEV1) in a liter, Force vital capacity (FVC)in liter, FEV1/FVC ratio in percentage, and Maximum voluntary ventilation (MVV) liter per minute between the groups with the calculation of the percentage of the difference between the means.

RESULTS:

In this study, parameters such as Age, gender, BMI, FEV1, FVC, FEV1/FVC, and MVV were measured and analyzed to find the effect of upper limb exercise training versus lower limb exercise training in COPD patients.

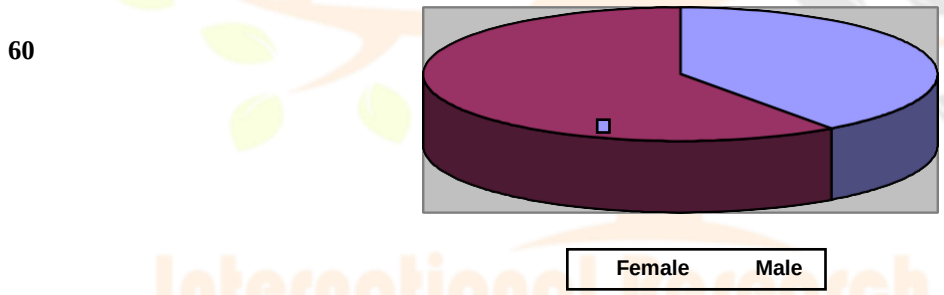
Table 1: Gender distribution of Subjects

Gender	Group A (No. of Subjects)	Percentage of distribution	Group B (No. of Subjects)	Percentage of distribution
Females	12	40%	17	56.67%
Males	18	60%	13	43.33%
Total	30	100%	30	100%
Chi-square	P<0.001		P<0.001	

P=0.197 (NS)

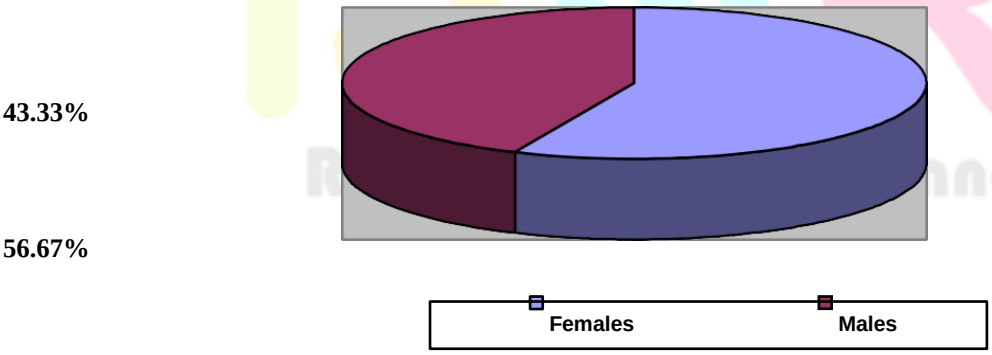
The above table shows that the study was carried out on a total of 3 subjects ineach group consisting of 12 females and 18 male subjects in Group A; 17 femalesand 13 male subjects in Group B with no statistically significant difference insubjects taken with p=0.197

Chart 1a: Gender distribution of the subjects in Group A



The above graph shows that 40% of females and 60 % of males were studiedin Group A.

Chart 1b: Gender distribution of the subjects in Group B



The above graph shows that 43.33% of females and 56.57% of males werestudied in Group B.

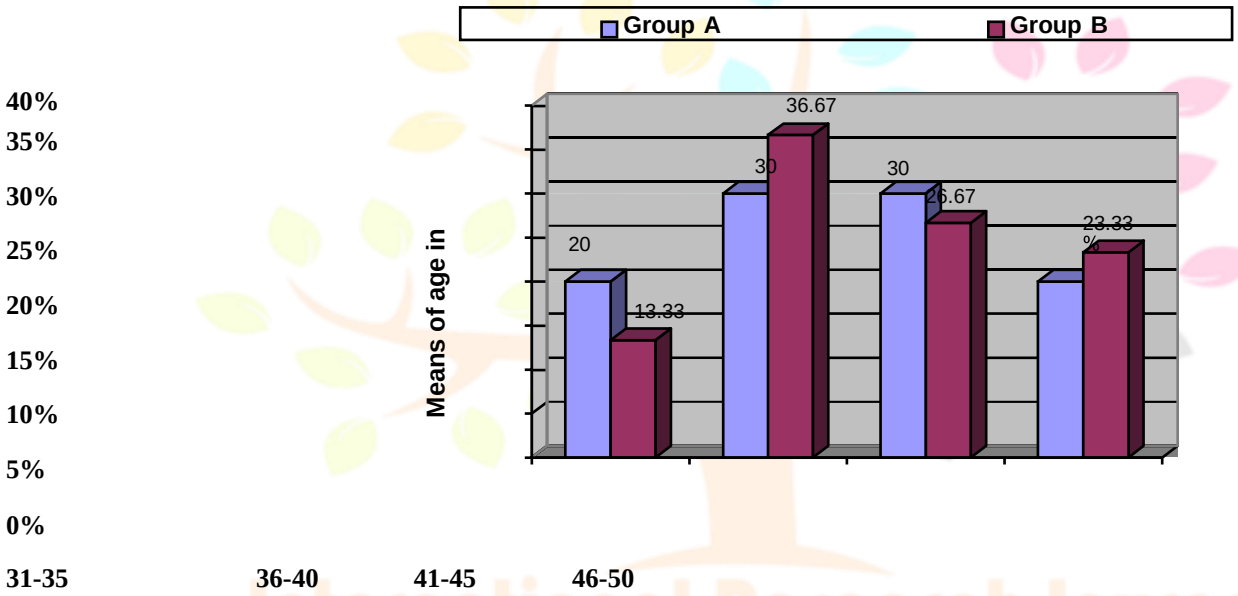
Table 2: Age Distribution of the subjects studied

Age inyears	Group A (No of subjects)	Percentage	Group B (No of subjects)	Percentage
31-35	6	20%	4	13.33%
36-40	9	30%	11	36.67%
41-45	9	30%	8	26.67%
46-50	6	20%	7	23.33%
Total	30	100%	30	100%
Mean	40.40±5.32	-	40.93±5.33	-
Min-Max	31-49	-	31-49	-

P= 0.829 (NS)

The above table shows that in Group A there were 6 subjects in the age group between 31-35 years and 46-50years, and 9 subjects in the age group 36-40 and 41-45 years with the mean age of the subjects studied was 40.40 years. In Group Bthere were 4 subjects in each age group between 31-35, 11 in the age group between 36-40, 8 subjects in age group 41-45years and 7 subjects in the age groupbetween 46-50 years with a mean age of the subjects studied was 40.93 years.

Chart 2: Age Distribution of the subjects studied



The above graph shows that in Group A there were 20% of the subjects were in the age group 31-35 and 46-50 years and 30% of subjects were in 36-40 and41-45 years. In Group B there were 13.33% of the subjects were in 31-35 years, 36.67% of the subjects were in the age group between 36-40years, and 26.67% of subjects were in the age group 41-45years, 23.33% of subjects were in the age group between 46-50 years.

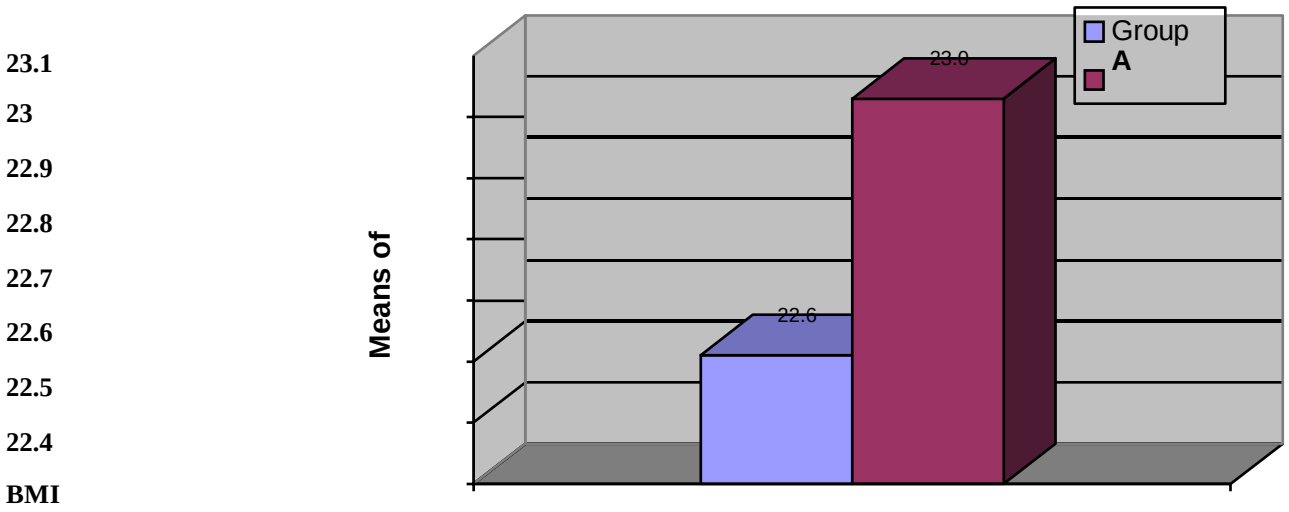
Table 3: Analysis of BMI between the groups

	Group A (Mean±SD in degrees) min-max	Group B (Mean±SD in degrees) min-max	Perecnta ge of difference	Z value(Non parametric)	Significance (2-tailed) P value
BMI	22.61 ± 1.63 (19.40 - 26.40)	23.03 ± 1.40 (20.10 - 25.31)	-1.84%	-1.028	P <0.304 (NS)

NS- No Significant difference

The above table shows that there is no statistically significant difference inmeans of BMI between Group A and Group B.

Chart 3: Analysis of BMI between the groups



The above graph shows that there is a statistically significant difference inmeans of BMI when means are compared between the groups.

Table 4: Analysis of FEV1, FVC, FEV1/FVC, and MVV within the Group A

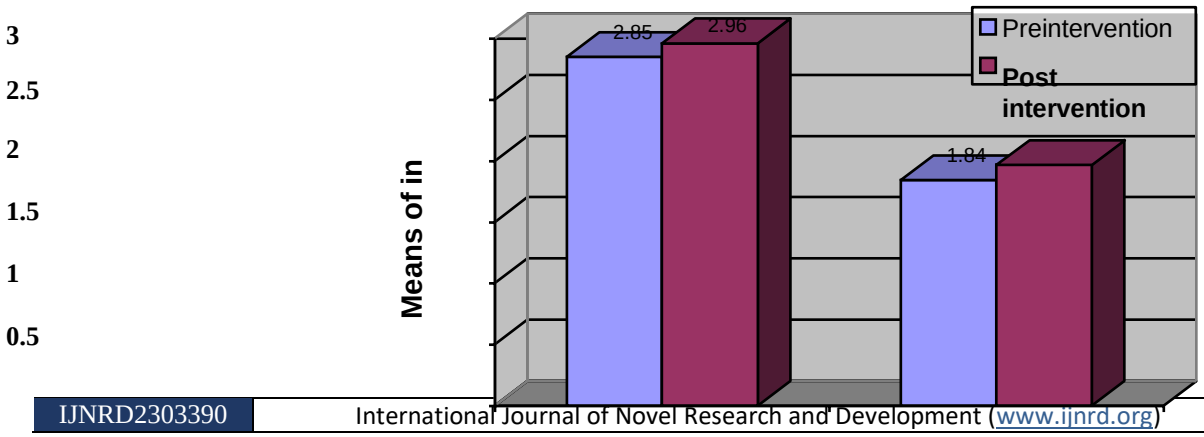
(Pre to post-analysis)

Group A	Pre-intervention (Mean±SD in degrees) min-max	Post-intervention (Mean±SD in degrees) min-max	Percentage of change	t value [a] (Parameter)	Z value (Non parametric)	**95%Confidence interval of the difference**		Significance (2-tailed) P value
						Lower	**Upper**	
FEV1 in l	2.85 ± 0.16 (2.58 - 3.30)	2.96 ± 0 .17 (2.65 - 3.47)	3.85%	-24.358	-4.792	**-0.127**	**-0.107**	P <0.000**
FVC in l	1.84 ± 0 .13 (1.52 - 2.14)	1.97 ± 0 .13 (1.70 - 2.29)	7.06%	-22.800	-4.796	**-0.136**	**-0.113**	P <0.000**
FEV1/FVC %	64.97 ± 2.68 (55- 69)	66.60 ± 2.06 (59 - 70)	2.50%	-8.951	-4.612	**-2.00**	**-1.26**	P <0.000**
MVV l/m	59.63 ± 4.46 (50 – 69)	64.17 ± 4.09 (58 - 73)	7.61%	-19.012	-4.830	**-5.021**	**-4.04**	P <0.000**

** Statistically Significant difference p<0.05 a. Paired t-test. b. Wilcoxon Signed Ranks Test

The above table shows that there is a statistically significant difference in means of Forced Expiratory Volume in one second (FEV1), Force vital capacity (FVC), FEV1/FVC ratio in percentage, and Maximum voluntary ventilation (MVV) liter per minute when means are compared from pre-intervention to post-intervention in Group Awith p<0.000.

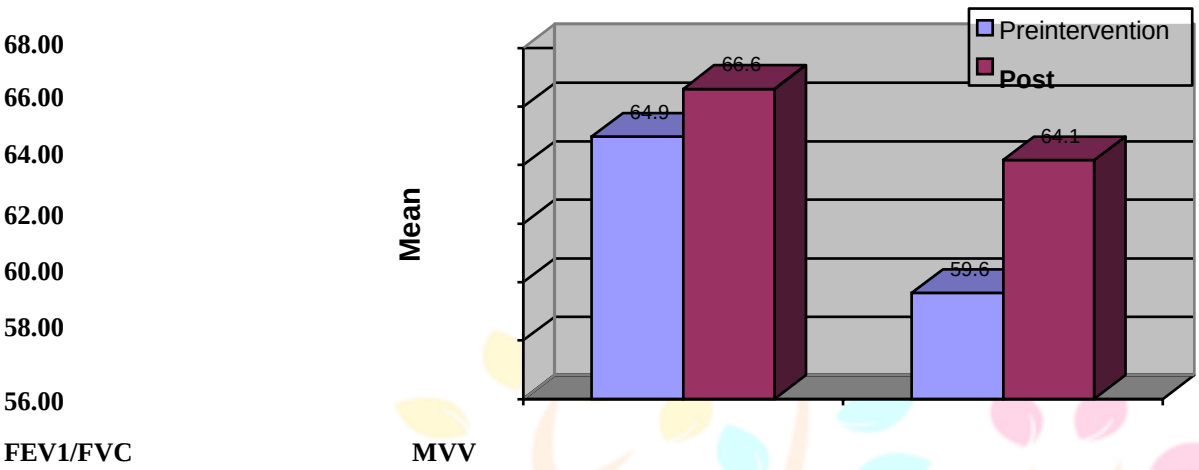
Chart 4a: Analysis of FEV1, and FVC within Group A (Pre to post analysis)



FEV1 **FVC**

The above graph shows that there is a statistically significant difference in means of Forced Expiratory Volume in one second (FEV1), Force vital capacity (FVC) when means are compared from pre-intervention to post-intervention in Group A with p<0.000.

Chart 4b: Analysis of FEV1/FVC and MVV within Group A (Pre to post analysis)



The above graph shows that there is a statistically significant difference in means of FEV1/FVC ratio in percentage, and Maximum voluntary ventilation(MVV) liter per minute, when means are compared from pre-intervention to post-intervention in Group A with p<0.000

Table 5: Analysis of FEV1, FVC, FEV1/FVC, and MVV within the Group B

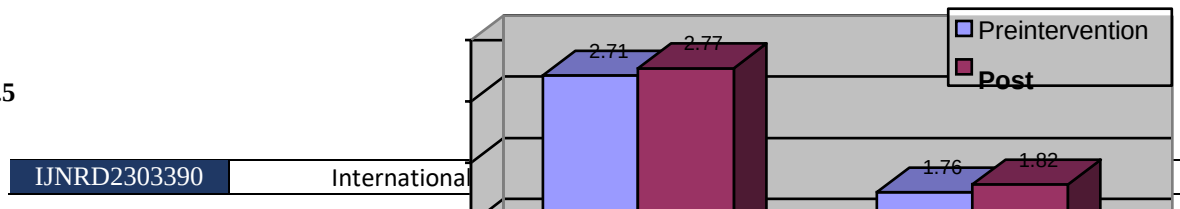
(Pre to post analysis)

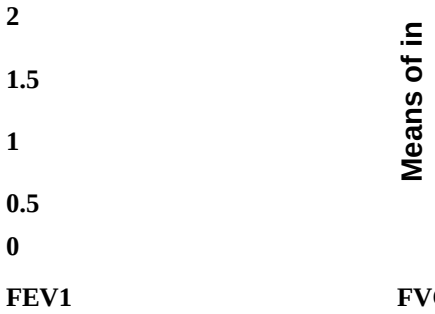
Group B	Pre-intervention (Mean±SD in degrees) min-max	Post-intervention (Mean± SDin degrees) min-max	Percentage of change	t value [a] (Parametric)	Z value (Non parametric)	(95%Confidence interval of the difference		Significance (2-tailed) P value
						Lower	Upper	
FEV1	2.71± 2.56 (2.56 - 3.01)	2.77± 0.12 (2.60- 3.06)	2.21%	-10.224	-4.633	-.07240	-.0482	P <0.000**
FVC	1.76± 0.11 (1.48 - 2.04)	1.82± 0.11 (1.57-2.08)	3.40%	-11.537	-4.721	-0.0678	-0.0474	P <0.000**
FEV1/F VC	65.23± 2.62 (58- 69)	65.87± 2.36 (60 -70)	0.98%	-6.238	-4.146	-0.841	-0.426	P <0.000**
MVV	58.33± 3.38 (50- 66)	60.97± 3.73 (52 - 68)	4.52%	-12.775	-4.767	-3.055	-2.212	P <0.000**

** Statistically Significant difference p<0.05 a. Paired t-test. b. Wilcoxon Signed Ranks Test

The above table shows that there is a statistically significant difference in means of Forced Expiratory Volume in one second (FEV1), Force vital capacity (FVC), FEV1/FVC ratio in percentage, and Maximum voluntary ventilation (MVV) liter per minute when means are compared from pre-intervention to post-intervention in Group B with p<0.000.

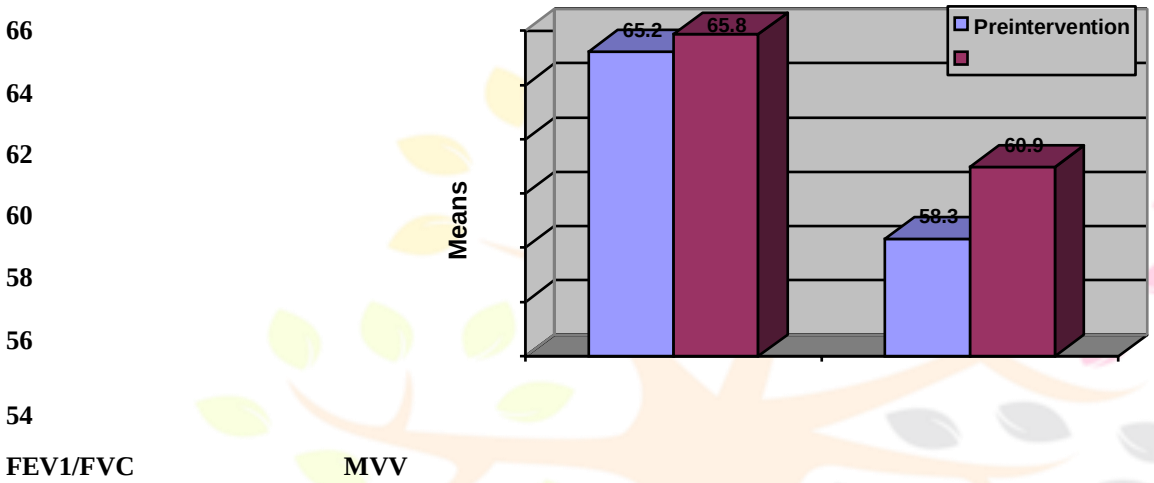
Chart 5a: Analysis of FEV1 and FVC within Group B (Pre to post-analysis)





The above graph shows that there is a statistically significant difference in means of Forced Expiratory Volume in one second (FEV1), Force vital capacity (FVC) when means are compared from pre-intervention to post-intervention in Group B with p<0.000.

Chart 5b: Analysis of FEV1/FVC and MVV within Group B (Pre to post analysis)



The above graph shows that there is a statistically significant difference in means of FEV1/FVC ratio in percentage, and Maximum voluntary ventilation(MVV) liter per minute when means are compared from pre-intervention to post-intervention in Group B with p<0.000.

Table 6: Comparison of FEV1, FVC, FEV1/FVC, and MVV between the Group A and Group B (PRE TEST COMPARATIVE ANALYSIS)

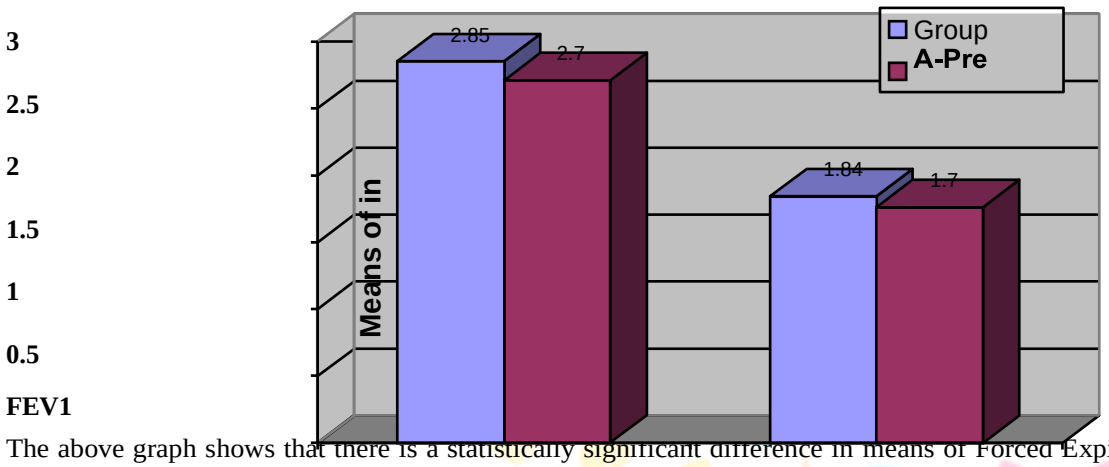
	Group A (Mean±SD in degrees) min-max	Group B (Mean±SD in degrees) min-max	Percentage of difference	t value [a] (Parametric)	Z value (Non parametric)	95% Confidence interval of the difference		Significance (2-tailed) P value
						Lower	Upper	
FEV1	2.85 ± 0.16 (2.58 - 3.30)	2.71± 2.56 (2.56 - 3.01)	5.03%	3.789	-3.484 P <0.000**	0.0660	0.2139	P <0.000**
FVC	1.84 ± 0 .13 (1.52 - 2.14)	1.76± 0.11 (1.48 - 2.04)	4.44%	2.590	-2.522 P=0 .012**	0.0191	0.1495	P <0. 012**
FEV1/F VC	64.97 ± 2.68 (55- 69)	65.23± 2.62 (58- 69)	-0.39%	-0.389	-.426 p=0 .670 (NS)	-1.638	1.105	P <0. 699 (NS)
MVV	59.63 ± 4.46 (50 – 69)	58.33± 3.38 (50- 66)	2.20%	1.270	-1.078 P=0 .281	-0.749	3.349	P <0.209(NS)

** Statistically Significant difference p<0.05 a. Independent t-test. b. Mann-Whitney U Test; NS- No Significant difference.

The above table shows that there is a statistically significant difference in means of Forced Expiratory Volume in one second

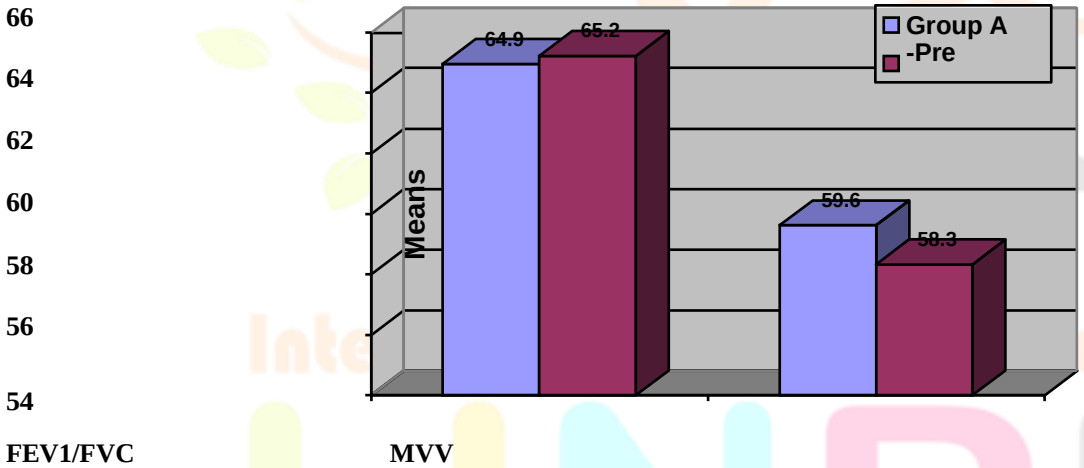
(FEV1), and Force vital capacity (FVC), and there is no statistically significant difference in FEV1/FVC ratio in percentage, and Maximum voluntary ventilation (MVV) liter per minute, when means of pre-intervention were compared between Group A and Group B

Chart 6a: Comparison of FEV1, and FVC, between Group A and Group B (PRE-TEST COMPARATIVE ANALYSIS)



The above graph shows that there is a statistically significant difference in means of Forced Expiratory Volume in one second (FEV1), and Force vital capacity (FVC) when means of pre-intervention were compared between Group A and Group B.

Chart 6b: Comparison of FEV1/FVC and MVV between Group A and Group B (PRE-TEST COMPARATIVE ANALYSIS)



The above graph shows that there is no statistically significant difference in FEV1/FVC ratio in percentage, and Maximum voluntary ventilation (MVV) liter per minute when means of pre-intervention were compared between Group A and Group B.

Table 7: Comparison of FEV1, FVC, FEV1/FVC, and MVV between the Group A and Group B (POST TEST COMPARATIVE ANALYSIS)

	Group A (Mean±SD in degrees) min-max	Group B (Mean±SD in degrees) min-max	Percentage of difference	t value [a] (Parametric)	Z value (Non parametric)	95% Confidence interval of the difference		Significance (2-tailed) P value
						Lower	Upper	
FEV1	2.96 ± 0.17 (2.65 - 3.47)	2.77± 0.12 (2.60- 3.06)	6.63%	-4.927	-4.245 P =0.001**	0.1169	0.277	P =0.001**
FVC	1.97 ± 0.13 (1.70 - 2.29)	1.82± 0.11 (1.57-2.08)	7.91%	4.661	-4.038 P =0.001**	0.0865	0.216	P =0.001**
FEV1/F VC	66.60 ± 2.06 (59 – 70)	65.87± 2.36 (60 -70)	1.10%	1.282	-1.450 P =0.147 (NS)	-0.412	1.878	P =0.205(NS)
MVV	64.17 ± 4.09 (58 – 73)	60.97± 3.73 (52 - 68)	5.11%	3.162	-2.812 P =0.005**	1.174	5.226	P =0.002**

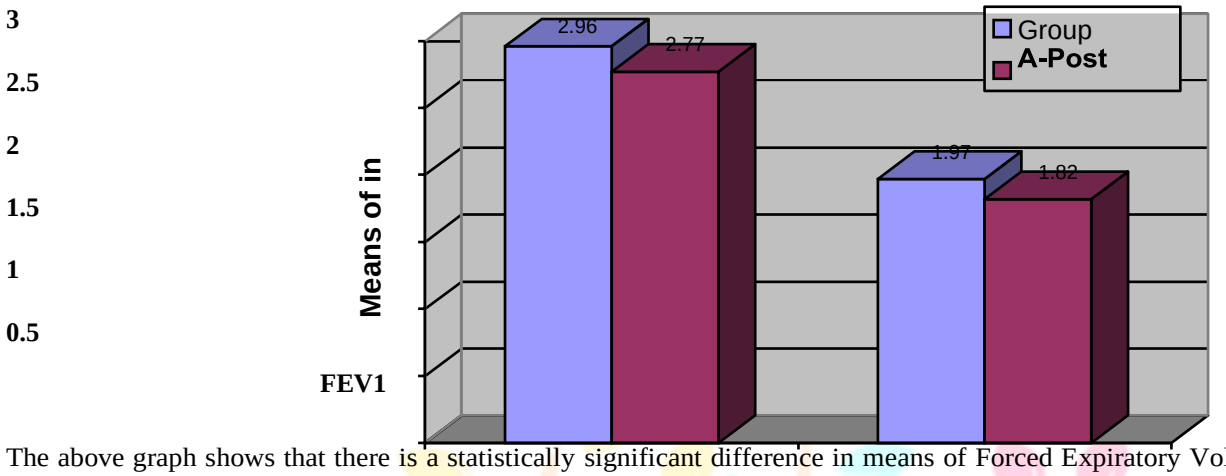
** Statistically Significant difference

p<0.05 a. Independent t-test. b. Mann-Whitney U Test; NS- No Significant difference.

The above table shows that there is a statistically significant difference in means of Forced Expiratory Volume in one second (FEV1), Force vital capacity (FVC), and Maximum voluntary ventilation (MVV) liter per minuteand there is no statistically significant difference in FEV1/FVC ratio inpercentage when means of post-intervention were compared between Group Aand Group B

Chart 7a: Comparison of FEV1, and FVC, between Group A and Group B

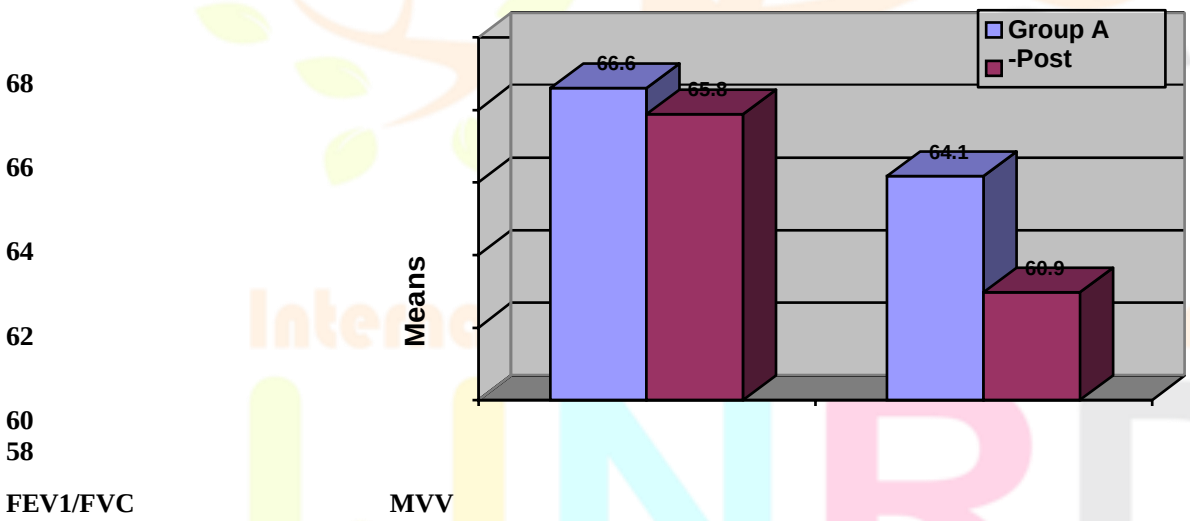
(POST-TEST COMPARATIVE ANALYSIS)



The above graph shows that there is a statistically significant difference in means of Forced Expiratory Volume in one second (FEV1), and Force vital capacity (FVC), when means of post intervention were compared between Group A and Group B.

Chart 7b: Comparison of FEV1/FVC and MVV between the Group A and Group B

(POST TEST COMPARATIVE ANALYSIS)



The above graph shows that there is a statistically significant difference inmeans of Maximum voluntary ventilation (MVV) liter per minute and there isno statistically significant difference in FEV1/FVC ratio in percentage when means of post-intervention were compared between Group A and Group B.

CONCLUSION:

The present study concludes that Upper extremity exercise training and lowerextremity exercise training resulted in significant improvement in pulmonaryfunction tests (FEV1, FVC, FEV1/FVC, and MVV) in COPD patients.

However, the improvement obtained in FEV1/FVC found no significant difference after upper limb exercise and lower limb exercise training betweenthe groups. The use of both methods of intervention has been recommended for clinical application in the rehabilitation of COPD patients if the treatment aimsto improve pulmonary function in the early stage of pulmonary rehabilitation.

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