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EFFECTS OF UPPER LIMB RESISTANCE EXERCISES ON AEROBIC CAPACITY, STRENGTH AND QUALITY OF LIFE (QOL) IN COPD PATIENTS

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Abstract

Background: *Chronic obstructive pulmonary disease (COPD) is a type of lung disease that causes breathing and breathing restrictions. Upper extremity resistance training is used to improve aerobic capacity, muscle strength, and quality of life in patients with lung disease.*

Objective: *To evaluate the effectiveness of passive upper extremity training on aerobic capacity, strength and quality of life in patients with COPD.*

Methodology: *According to the inclusion and exclusion criteria, 58 patients in two groups with equal participants in each group were included. The control group was given warm-up, aerobic exercise, inspiratory muscle training and stretching for one month, three session a week. The treatment group performed a warm-up, aerobic exercise, inspiratory muscle training, three sets of upper body resistance training, and stretching training. In this study a convenience sampling technique and a randomized controlled trial (RCT) study design was used. Patients from Nusrat Fateh Ali Khan Hospital and General Hospital, Faisalabad were selected. Data collection tools used were Modified Borg Scale, Stethoscope, 6 min. walk test, QoL questionnaire, Dynamometer and Spirometer.*

Results: *When examining the results, it is evident that the data breach the conditions of a normality distribution (sig<0.05). The median value of the 6-min walk test, Modified Borg Scale, St. George's Respiratory Questionnaire, grip strength and FEV1/FVC for group A was 450.00, 3.00, 30.00, 16.00, 60.00 prior to the first session and 482.00, 2.00, 25.00, 25.00, 63.00 after intervention of 4 weeks. The median value of the 6-min walk test, Modified Borg Scale, St. George's Respiratory Questionnaire, grip strength and FEV1/FVC for group B was 450.00, 3.00, 30.00, 14.00, 60.00 prior to the first session and 515.00, 2.00, 25.00, 28.00, 63.00 after intervention of 4 weeks.*

Conclusion: *It was demonstrated that the upper extremity exercise group gave better results and should be included in the treatment to improve aerobic capacity and muscle strength in mild and moderate COPD patients. When we evaluate the exercise results and compare them with the control group that received general intervention (warm-up, aerobic exercise, inspiratory muscle training and stretching), it appears that our study encourages physical activity.*

INTRODUCTION

COPD is generally defined as forced expiration in 1 second (FEV1) and the ratio of FEV1 to vital force (FVC). Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity, mortality, and healthcare utilization worldwide. COPD is caused by inhaling pollutants, especially smoke and pollution. However, we are increasingly becoming aware of the many factors that increase the risk of COPD development and progression throughout the life. Morphological features that are thought to cause persistent airflow obstruction also play an important role in the development of other psychological problems of COPD, such as hyperinflation and incoherence.(1)

The role of the pulmonary lungs is to remove oxygen from the environment and provide aerobic respiration at the cellular level. Oxygen is ultimately used to produce ATP and carbon dioxide is excreted along with other metabolic byproducts. These work together to create a vacuum in the lungs and pleural space, allowing air to enter the lungs. Conversely, decreased lung volume increases the pressure in the lungs, causing air to escape. The frequency is adjusted to meet the body's needs. As oxygen demand increases and carbon dioxide accumulates (for example, during exercise), the lungs will switch to carbon monoxide through breathing to facilitate air expulsion. Increase lung capacity (as opposed to lung compliance, where the lung tries to reduce capacity).(2)

The main inspiratory muscles are the diaphragm and external intercostal muscles. Relaxed normal exhalation is a passive process that occurs due to the elastic recoil and surface tension of the lungs. However, there are some muscles that cause labored exhalation, including the abdominal muscles, intercostal muscles, subcostal muscles, and abdominal muscles. Auxiliary inspiratory muscles include the sternocleidomastoid, scalene anterior, middle and posterior muscles, pectoralis major and minor, serratus anterior and latissimus dorsi inferior fibers, serratus superioris posterior also assists inhalation, cervical iliocostalis. Technically, any muscle attached to the upper leg and ribcage can act as a muscle for absorption by the back muscles (muscles that work from the center to the proximal). External oblique, internal oblique and transversus abdominis.(3)

Chronic obstructive pulmonary disease (COPD) is characterized by a group of lung diseases that cause airflow obstruction, including emphysema and chronic bronchitis. The latter represents the innate and adaptive immune system against disease and pollution, especially smog. All smokers have some inflammation in their lungs, but people with COPD have increased or abnormal responses to inhaling toxins. This response can lead to excessive mucus secretion (chronic lung disease), tissue damage (emphysema), and disruption of healing and protective mechanisms, leading to inflammation and fibrosis of the small airways (bronchiolitis). Narrow airways, increased pulmonary compliance, air trapping, and airway obstruction contribute to increased airflow into the small airways in all aspects of COPD. We better understand the cellular and molecular mechanisms underlying pathological changes in COPD.(4)

Muscle dysfunction often occurs in patients with chronic obstructive pulmonary disease (COPD) and may involve respiratory and motor (peripheral) muscles. In the former, loss of energy and/or stamina causes hypoventilation, while in the latter it restricts exercise and daily living activities. Muscle dysfunction is the result of the interaction between local and systemic factors, which often occur together in COPD patients. (Gea, Agustí, and Roca 2013).

Upper body exercises, also known as upper body exercises, are physical activities designed to strengthen and tone the muscles of the arms, shoulders, chest and back. These exercises often involve the use of external resistance, such as free weights (e.g. dumbbells, barbells), resistance bands, or machines, to create tension in the muscles. Upper body exercises are an important part of strength training and help improve muscle tone, endurance and overall health.

METHODOLOGY:

The aim of this study was to evaluate the effect of upper extremity resistance training on aerobic capacity, muscle strength and quality of life in

COPD patients. This study was a Randomized Controlled Trial and convenient technique was used to collect the data. 58 patients were recruited in this study which was collected by epitool.(5) Each group consist of equal number of participants and data was collected from Nusrat Fateh Ali Khan Hospital, Faisalabad and General Hospital, Faisalabad. The duration of the study was six months.

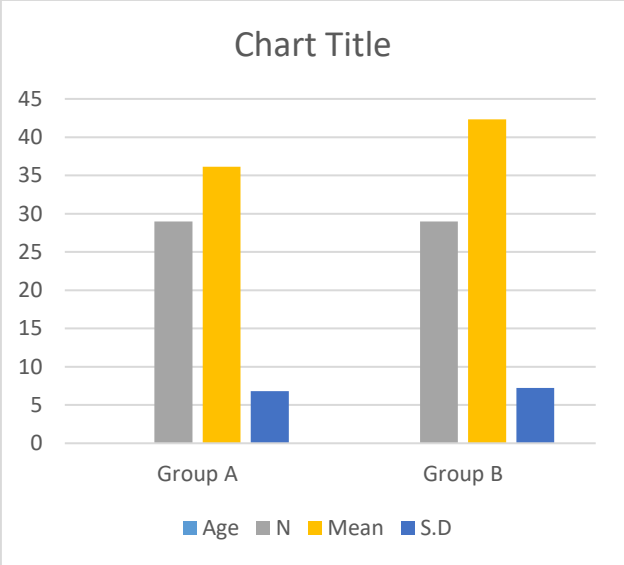
Participants were recruited according to inclusion criteria which includes, age of patients 25-55 years, Patients of both genders, Individuals with stable COPD (Chronic bronchitis, Emphysema, asthma) being monitored by pulmonologist while exclusion criteria consist of MSK (frozen shoulder, osteoarthritis, rheumatoid arthritis, , traumatic fractures, amputation), Cardiac (Angina pectoris, recent MI, severe pulmonary hypertension, CHF, Unstable diabetes, Severe exercise-induced hypoxemia), Surgery (Thoracic surgery, CABG), Cognitively impaired dementia, Peripheral oxygen saturation <90% during 6 min. walk test. (6). Data collection tools consist of Modified Borg Scale (7), Stethoscope (8), 6 min. walk test (7), QoL questionnaire (9), Dynamometer (10), Spirometer (11). Aerobic exercise capacity or fitness level was measured by 6 min walk test. Degree of dyspnea (shortness of breath) during physical activity was measured by Modified Borg Scale. Grip strength was measured by dynamometer. FEV1/FVC was measured by spirometer and quality of life was measured by St. George's Respiratory Questionnaire. Data was obtained twice: first at baseline before employing any intervention, and again after the four weeks of the intervention.

Statistical Analysis:

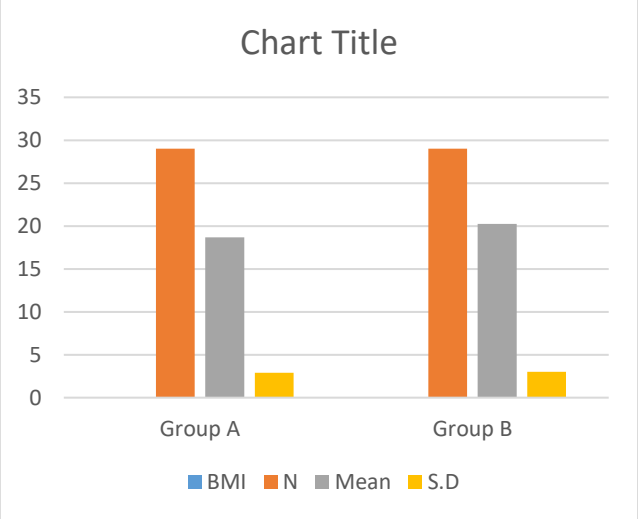
SPSS version 23 was used to analyze the data. The normality of 6 min walk test, Modified Borg Scale, Grip strength, FEV1/FVC and St. George's Respiratory Questionnaire was determined by Kolmogorov-Smirnov test. In order to analyze the data of 6 min walk test, Modified Borg Scale, Grip strength, FEV1/FVC and St. George's Respiratory Questionnaire non-parametric tests were applied. Descriptive statistics including frequency, mean, and standard deviation were used in the study to look at the demographics of the participants in both groups. The Wilcoxon Signed-Rank Test was used for the intragroup comparison while Mann Whitney U test was used for intergroup comparison.

RESULTS:

The participants in group A ranged from 25 to 50 years old, with a mean age of 36.13 ± 6.83 years. Individuals in group B were between the ages of 25 and 54, with a mean age of 42.34 ± 7.23 years, respectively. In group A, there were 14 (48.3%) males and 15 (51.7%) females. Group B also consisted of 14 (48.3%) males and 15 (51.7%) females. In this research the patients with COPD had an average age of 38.57±7.96years.



The participants in group A with COPD had BMI ranged from 15.43 to 23.70, with a mean of 18.67 ± 2.89. Individuals in group B with COPD had BMI between15.48 and 24.30, with a mean of 20.24 ± 7.23, respectively.



Inferential statistics

The normality of 6 min walk test, Modified Borg Scale, Grip strength, FEV1/FVC and St. George's Respiratory Questionnaire was determined by Kolmogorov-Smirnov test.

Table 1: Within the Group Analysis of Group A and Group B.

Variables	Groups	Treatment Values	Mean ± S.D	P-Value
6 min walk test	Group A	Pre	428.72 ± 60.66	0.000
		Post	483.41 ± 87.70	
	Group B	Pre	427.41 ± 66.97	0.000
		Post	501.96 ± 99.05	
Modified Borg Scale	Group A	Pre	3.03 ± 0.77	0.000
		Post	2.34 ± 0.613	
	Group B	Pre	3.00 ± 0.80	0.000
		Post	1.82 ± 0.65	
Grip strength	Group A	Pre	18.24 ± 6.56	0.000
		Post	25.27 ± 5.51	
	Group B	Pre	16.58 ± 6.31	0.000
		Post	27.34 ± 6.359	
St. George's Respiratory Questionnaire	Group A	Pre	31.68 ± 6.79	0.000
		Post	24.96 ± 5.00	
	Group B	Pre	31.86 ± 6.33	0.000
		Post	21.55 ± 4.093	
FEV1/FVC	Group A	Pre	60.37 ± 2.93	0.000
		Post	62.31 ± 3.197	
	Group B	Pre	59.58 ± 3.13	0.000
		Post	62.10 ± 3.508	

Table 2: Across the Group Comparison of Group A and Group B

Outcome Measures	Time Points	Mann-Whitney U	Wilcoxon W	Asymp. Sig. (2-tailed)
6 min walk test	Pre	412.500	847.500	.901
	Post	357.000	792.000	.323
Modified Borg Scale	Pre	416.000	851.000	.940
	Post	258.500	693.500	.004
Grip strength	Pre	336.500	771.500	.190
	Post	339.000	774.000	.203
St. George's Respiratory Questionnaire	Pre	399.000	834.000	.737
	Post	246.500	681.500	.007
FEV1/FVC	Pre	362.500	797.500	.364
	Post	418.000	853.000	.969

Discussion

This study aims to investigate the effectiveness of upper body exercise in improving aerobic capacity, muscle strength and quality of life. The study was conducted in a hospital in Faisalabad. The design of the study was a randomized controlled trial and convenience sampling technique was used. The study was conducted among men and women aged 25 to 55 years at Faisalabad General Hospital and NFAK Hospital, Faisalabad. The sample size was 58 with equal participants in each group (control and treatment groups). After analyzing the before and after results, it was demonstrated that the upper extremity exercise group gave better results and should be included in the treatment to improve aerobic capacity and muscle strength in mild and moderate COPD patients. When we evaluate the exercise results and compare them with the control group that received general intervention (warm-up, aerobic exercise, inspiratory muscle training and stretching), it appears that our study encourages physical activity.

The study which was prospective, interventional single-hospital study conducted over 36 months from February 2016 to February 2019 at the Department of Pulmonology, Tihati Medical College and Hospital, Guwaha, and was approved by the Human Rights Committee. All COPD patients over 40 years of age who gave written informed consent were included in this study. Improves upper limbs, lung capacity and reduces lower back. Therefore, the treatment plan for COPD patients should include upper extremity training as well as drug therapy to improve patients' quality of life and reduce the frequency of exacerbations. This finding supports our research showing that adding passive leg exercises to the treatment of patients with mild to moderate COPD improves quality of life, aerobic capacity, and muscles.(12)

A randomized controlled trial conducted in an outpatient setting. 42 patients with stable COPD were divided into treatment and control groups. The treatment group received an 8-week (23 sessions) training arm. Both groups completed daily breathing exercises at home. Training reduced shortness of breath and arm fatigue when supporting the arm, as well as shortness of breath during ADLs. Arm exercise is a safe and applicable method for COPD patients.**(13)**

A meta-analysis was performed to determine the effectiveness of different resistance training models on FEV1 and exercise capacity in COPD patients. Cochrane, PEDro, Embase, CINAHL, PubMed and Google Scholar databases were searched for articles of interest. All studies determining the effect of exercise training on FEV1 and exercise capacity in COPD patients were included and reported in English. All studies before 2011 were excluded from the review. Five randomized controlled trials included a sample of 180 patients with COPD. The findings showed that resistance training had a slight effect of increasing FEV1 with a magnitude of 0.160, while functional capacity

had a large effect size of 0.886. This study concluded that exercise training had a small to large effect on improving physical performance and force volume.(14)

Stable COPD patients were referred to Nicosia State Hospital for the PR program. Patients were contacted consecutively over 18 months (December 2017 - June 2019). Patients were included in the study if: (1) COPD was confirmed by clinical examination and pulmonary function tests and forced expiratory volume in 1 second (FEV1) was less than 80% of expected and FEV1/forced significant capacity according to the Global Interference Ratio was < 0, 7 Reporting COPD 15 and (2) stable treatment for 4 weeks. Patients under 18 years of age were excluded from the study; Using block randomization (in groups of four), participants were randomly assigned to a combination group (ULET strength and endurance) or a strength group (ULET strength only). Both groups exercised 2 days a week, under supervision, for 12 weeks, in accordance with the latest guidelines. Next is a step by step tutorial on the bicycle ergometer. Lower and upper body training is also done: leg extensions, seated chest presses and lateral pulls. All outcomes were evaluated at baseline and after PR was achieved (12 weeks). The results measured grip strength and biceps and triceps muscle strength. Additionally, the quality of life COPD Assessment (CAT) and St. George's Respiratory Questionnaire. This study shows that the ULET program together with exercise can improve UL muscle function in COPD patients. A combination of endurance and strength training in UL improves ADL performance and reduces fatigue during ADL. These results also demonstrated the effects of ULET on arm strength, function, and self-care in patients with COPD.(15)

A literature search was conducted in OVID, Embase, Cochrane Library, PubMed, Google Scholar through July 2020 for controlled studies reporting the relationship between exercise and exercise in the context of COPD and found 13 studies with 1,286 Subjects. It was a randomized controlled study. 2. The target group was COPD students. 3. The intervention program was to investigate the effects of exercise on exercise. Study 4 involved a comparison of COPD-refractory subjects and COPD subjects without preventive studies. A total of 2031 unique studies were identified, of which 13 met the inclusion and inclusion criteria. In a meta-analysis based on 13 studies with 1286 subjects at baseline, the 6-minute walk test was significantly higher in inactive subjects (learning to manage COPD) than in non-active subjects (learning to manage COPD). However, there was no significant difference between COPD patients who received prevention education and controls who did not receive prevention. This relationship forces us to propose an exercise that will improve the 6-minute walk test as a simple and easy assessment of work capacity in COPD patients.(16)

The aim of this study was to examine the effect of upper extremity rehabilitation on lung function, functional capacity, disability and quality of life in stable COPD patients. This was a quasi-experimental study conducted in 2017 on 22 patients with stable COPD (according to GOLD 2018 criteria). Patients received upper extremity rehabilitation, including breathing exercises, every 8 weeks, twice a week, for 10-20 minutes, under the guidance and supervision of a physiotherapist and therapist. Before and after completion of each training, we measured pulmonary function tests including FEV1 and FVC, working capacity of 6 MWT, dyspnea scale of mMRC, and quality of life of CAT test control. Lung function, FEV1 (p-value: 0.001) and FVC (p-value: 0.207) improved after training. There was a significant change in operating capacity at 6 MWT (p-value: 0.001). Better quality of life after training as measured by reduction in CAT scores (p-value: 0.000). There was no significant change in the mMRC scale (p value: 0.429). After upper respiratory tract infections in patients with chronic obstructive pulmonary disease, lung function, working capacity and quality of life are well frozen in patients with chronic obstructive pulmonary disease. This study also supports the integration of upper extremity training to improve activities of daily living in COPD patients.(17)

This study aimed to determine the respiration effect of upper extremity exercises performed by a specialist nurse without the use of equipment. The study examined 78 COPD patients, 39 in

the exercise group and 39 in the control group. While patients in the exercise group performed upper body exercises for 30 minutes three times a week for 8 weeks, the treatment of patients in the control group was not affected. At the end of 8 weeks, the patients' symptoms were compared with the average score. Patient ID, St. George's Respiratory Questionnaire, Medical Research Council, Modified Borg Scale, COPD Evaluation Test, 6-minute walking distance criteria and oxygen saturation measurement were used to collect data. It was determined that 92.3% of the patients participating in this study were male. At week 8, most patients in the exercise group showed an increase in 6-minute walk distance and a decrease in the mean Clinical Study Modified Borg Scale Dyspnea Score of COPD Assessment Tests.(18)

CONCLUSION

After all is said and done, physical therapy has therapeutics and game changing effects on improving the health status of patients of chronic obstructive pulmonary disease.. As far as concerned essentially both groups' i-e control and treatment group showed results under mentioned protocols. But still through the study upper limb resistance exercises showed more pronounced results to improve the aerobic capacity, muscle strength and quality of life in patients of COPD. It was demonstrated that the upper extremity exercise group gave better results and should be included in the treatment to improve aerobic capacity and muscle strength in mild and moderate COPD patients. When we evaluate the exercise results and compare them with the control group that received general intervention (warm-up, aerobic exercise, inspiratory muscle training and stretching), it appears that our study encourages physical activity.

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