EFFECTS OF COMBINED AEROBIC STRENGTH TRAINING VERSUS FITNESS EDUCATION PROGRAM IN COPD

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Abstract:

Background: Chronic Obstructive Pulmonary Disorder (COPD) is a complex disorder damaging the airway and alveolar wall of the pulmonary structures. Combined aerobic training and Fitness education programs are well-instructed sessions that focused on decreasing the symptoms and improving the health and functional related parameters.

Objective: This study focuses on the comparative effects of combined aerobic strength training vs Fitness education programs in improving functional capacities and health status among COPD patients.

Methodology: A single blinded randomized clinical trial was conducted on 30 subjects (n=15) in the Mayo and Jinnah Hospital of Lahore. Thirty patients were randomly allocated into two groups as Group A received a Fitness education program and Group B received a Combined aerobic strength training program. The total duration of the study was three weeks and assessment was done before treatment and after every week. Pulmonary function test and St' George Questionnaire were used for the assessment of the patient's improvement in lung volumes, health-related parameters and decreasing in the symptoms of COPD respectively.

Results: The results of the study showed that combined aerobic-strength training and Fitness education training are effective in improving post-treatment FEV_1, FVC, FEV_1/FVC and SGRQ score with p = 0.000 but on comparison between the groups confirmed that CAST produce better results in improving FEV_1, FVC, FEV_1/FVC and SGRQ score than FET with p value<0.05.

Conclusion: The study concluded that Combined Aerobic-Strength training was an effective technique in improving lung functions and functional status in people with COPD than Fitness Education Program but Fitness Eduation Program can be used as an alternative protocol.

Index Terms: COPD, Chronic Obstructive Pulmonary Disorder, Combined Aerobic Strength (CAST), Fitness Education program (FEP) , Quality of Life.

I. Introduction:

Chronic obstructive pulmonary disorder (COPD) is a Non-communicable complex and heterogeneous medical pathology because its clinical, functional, and radiological limitations vary from patient to patient causing poorly reversible airflow limitations [1, 2].

According to World Health Organization, there were 62 million people affected by COPD with severity ranging from moderate to severe. According to the 2012 Global Burden of Disease; COPD was responsible

for 5% (76.7 million) of global disability along with 5% of global death (27 million) [3]. COPD is prevalent in young females as compared to men which leads to the development of severe breathing problems, limitation in proper airflow, and increase risk of symptoms exacerbation [4]. it affects about 10% of the population called as a silent killer and it will be predicted as the third leading reason of mortality worldwide with affecting 328 million people especially in low and middle-income countries [5].

Smoking is considered the main cause with 1.45 times higher of developing COPD [6]. Secondary and tertiary smoking, occupational exposure, pollution, burning of biomass fuels, genetic predisposition also increase the occurrence of COPD [7, 8]. Such patients have the basic signs and symptoms including Cough, shortness of breath, and production of sputum affect the normal daily activities in patients, and sometimes it leads to the acute exacerbation of symptoms [9] . Physical therapy is an effective non-pharmacological alternative treatment for COPD patients. A supervised combined training program and fitness education programs are the most used treatment protocols that are use at global level.

Combined exercise training includes aerobic, strength, flexibility, and balance program which improve the clinical and functional capacities of the patients along with Health-related and musculoskeletal abilities among patients [10, 11]. Rohmah et,al (2020) stated that combined program cause the activation of the stretch receptors present in the intercostal muscles of the chest wall and both help increase FEV_1 values and skeletal muscle strength and this also provides additional medical support to the pharmacological treatment [12].

Similarly, Lima. F (2019) and Silva. C (2018) stated that supervised combined training program increases the functional excursive capacity along with the muscular strength in COPD which enables the patient to perform normal activities of daily life easily without having any fear [13] and reduce dyspnea, oxygen consumption, and ventilation per minute in COPD [14]. However; the Fitness education program is a home-based Physical rehabilitation that developed according to the patient perspective and it can produce similar clinical results like a proper training session conducted in the clinical center [15]. This program provide proper guidelines, demonstration, and written manual that helps to understand the quality and exercise consistency to patients [16]. Arnold.M (2020) reported that supervised exercise program produced better results than an unsupervised exercise program but the combination of exercise programs yields better results in COPD than by using the only single exercise protocol ion COPD [17].

The purpose of the study was to determine the role of supervised Combined aerobic training program and Fitness education program in COPD patients and its effects in improving pulmonary functional abilities and functional status and quality of life among COPD patients.

II. Material Methodology:

The Single blinded Randomized Clinical trial was conducted in the Physiotherapy department of the Mayo and Jinnah hospital Lahore after getting the ethical permission from the Research & Ethics Committee of Riphah International University, Lahore with the reference number REC/RCR & AHS/21/0311. In this study, 30 patients were evaluated from the cardiopulmonary department; from 20th June to 21th August 2021 with general examination which include demographic data and severity of symptoms. According to the inclusion criteria of both

genders of age greater than 30 years with clinically stable mild to moderate COPD or having Gold Grade I-II on a daily basis suffered from COPD patients [18]. Participants were excluded from the study who was having any history of unstable cardiac disease, respiratory diseases other than COPD (bronchiectasis, cystic fibrosis, tuberculosis, pneumonia etc), Carcinoma, any bone pathologies and who had not attended a pulmonary rehabilitation program [18]. After collecting the data, the experimental study was conducted.

Thirty patients (95% CI, Effect size d = 1.38 , Power = 0.80) were selected by using Simple convenient sampling technique according to the predefined criteria and they are randomly allocated in two groups as 14 individuals in each group for study for 4 weeks duration. The patients were randomly allocated in two groups though lottery method as chits were prepared and placed in the box. Patients asked to draw one chit from the box randomly. After the drawing of chit, patient recruited into their selected group without disclosing their treatment protocol to prevent from biasness. **Group A** were treated with *Fitness education program along with conventional treatment program* including hot pack that applied on upper and lower limb extremity whereas **Group —B** were treated with *combined aerobic strength-training program along with conventional treatment program* including hot pack that applied on upper and lower limb extremity.

Functional capabilities and health-related quality of life were assessed at the beginning of the study and at the end of the intervention protocol as on the last day of the 4th week. In COPD patients; FEV_1, FVC, and FEV_1/FVC values were assessed by using Electronic Spirometer of COSMED with Ref number C02900-01-04 and S/N 2017050820, provides the numerical values of FEV_1 and FVC while FEV_1/FVC ratio described in decimals, as FEV_1 and ratio are the hallmarks in diagnosing COPD from other respiratory pathologies [19-22]. Furthermore; health status of COPD patients were examined through self-administered questionnaire named St' George Respiration Questioner with MCID equals to -4 unit's minimal clinically important difference [23]. The difference in the improvement and reduction in symptoms was noted and compared before and at the end of the treatment session with no drop out from the study.

Intervention protocol

Fitness education program Group: The Fitness education program was the protocol performed by the (n=15) patients after the measurement of the outcome parameters.

Treatment Technique: Patients instructed to take hot pack therapy for 20 minutes before the session. Hot pack was applied on upper extremity especially shoulder and scapular region for 10 minutes and for next 10 minutes, hot pack was applied on lower extremity especially on thigh and knee region. Patients received the Fitness Education program which was programmed initially with supervised sessions 3 days/ week then 2 days/week, and then with a self-directed exercise program for 1 day/week. The next supervised session given for 1 day/week with self-training for 2 days/week. The last week of the session includes all self-training sessions of 1 for 3 days/week. The whole session lasted for 60 minutes including aerobic classes for 3 to 4 intensity, flexibility, balance exercise, walking, and music-based weight-free exercise. Patient guided to perform walking for 20 minutes and cycling for 10 minutes. Patient then guided to performed four sets of leg press and knee extension, chest press, shoulder press (against a wall), and back extension with abdominal crunches with 50-80% intensity. Patient then performed flexibility or stretching exercises of shoulder and back

muscles and balance exercises performed including tandem walking and sit to stand. The whole exercise had 10-15 repetitions in 2 to 4 circuits with 4 min interval break [18].

Combined aerobic strength-training program Group: A combined aerobic strength-training program was the protocol performed by the (n=15) patients after the measurement of the outcome parameters.

Treatment Technique: Patients instructed to take hot pack therapy for 20 minutes before the session. Hot pack was applied on upper extremity especially shoulder and scapular region for 10 minutes and for next 10 minutes, hot pack was applied on lower extremity especially on thigh and knee region. After that, patients received a structured and supervised combined exercise program of both aerobic and resistance exercises 3 days/ week of 60 min sessions with a 1-day interval. The aerobic exercises include cycling, and 30 min walking. Patient guided to perform walking for 20 minutes and cycling for 10 minutes. The strength training program includes four sets of leg press and knee extension, chest press, shoulder press (against a wall), and back extension with abdominal crunches with 50-80% intensity. . Patient then performed flexibility or stretching exercises of shoulder and back muscles and balance exercises performed including tandem walking and sit to stand. The intensity of the whole session adjusted within 3 to 4 weeks. The whole exercise had 10-15 repetitions in 2 to 4 circuits with 4 min interval break [18].

Statistical analysis

The Data analyzed through 25 SPSS software versions. The descriptive statistics was described through Frequency tables, bar charts, and mean± S.D. The normality of the data was assessed through Shapiro Wilk test's which concluded that in all $\alpha > 0.05$ showing that data was normally distributed. The data was normally distributed and for within and across the group's analysis Paired T-test and Independent T-test had used for the analysis of the difference and the results were shown below.

Table I: Baseline Characteristics of participants of all groups:

Variables	FEP	CAST
	Mean ± S.D	Mean ± S.D
Age	56.2 ± 10.255	54.7± 13.519
Gender	1.40±0.507	1.40±0.507
BMI	20.60± 3.81	20.63± 3.84

Table II: Within Groups Analysis of Both groups:-

Variables	FEP		p-value	CAST		p-value
	Pre	Post		Pre	Post	
FEV_1 (L)	1.212 ±0.153	1.52± 0.150	0.00	1.210 ±0.153	1.93± 0.132	0.00
FVC (L)	2.15± 0.421	2.45± 0.422	0.00	2.35± 0.429	2.88± 0.38	0.00
FEV_1 / FVC	57.03 ±5.55	59.99 ±5.56	0.00	56.46 ±6.42	63.67 ±6.55	0.00
SGRQ	65.23 ±4.19	68.13 ±5.19	0.00	66.4± 4.39	72.26 ±5.39	0.00

Table III: Across Group Analysis of Both groups:

Variables	FEP	CAST	p-value
FEV_1 (L)	1.52±0.150	1.93±0.132	0.000
FVC (L)	2.45±0.422	2.88±0.38	0.004
FEV_1/ FVC	59.99±5.56	63.67±6.55	0.003
SGRQ	68.13±5.19	72.26±5.39	0.002

III. Result:

The aim of the study was to determine the comparative effectiveness of Combined aerobic strength training and Fitness education program in treating functional capacity and health status among COPD patients. The results of current study were described in tabulated form. The demographic analysis of the participants was described in ***Table I.*** The mean age of FEP group was 56.20± 10.25, while in CAST group was 54.73± 13.5. According to the gender distribution; results 9 (60%) were males and 6 (40%) were females in FEP group and CAST group frequency and percentages in male were 9 (60%) While in female frequency and percentages were 6 (40%). *Table I* also described that the mean BMI of both groups were 20.60± 3.81 respectively.

The ***Table II*** describe the detailed statistical analysis about the within group analysis of Fitness education program and Combined aerobic strength training program. The ***Table II*** showed that within group analysis of FEV_1 as FEP had pre-treatment and post-treatment values were 1.212±0.153 and 1.52±0.150 respectively with p-value 0.000 while within group analysis of CAST had pre-treatment and post-treatment values were1.210±0.153 and 1.93±0.132 respectively with p-value 0.000. The value of FVC for FEP had pre-treatment and post-treatment values were 2.15±0.421 and 2.45±0.422respectively with p-value 0.000 while within group analysis of CAST had pre-treatment and post-treatment values were 2.35±0.429 and 2.88±0.38 respectively with p-value 0.000. Similarly; the within group analysis of FEV_1/FVC as FET had pre-treatment and post-treatment values were 57.03±5.55 and 59.99±5.56 respectively with p-value 0.000 while within group analysis of CAST had pre-treatment and post-treatment values were 56.46±6.42 and 63.67±6.55 respectively with p-value 0.000. The within group analysis of SGQR as FET had pre-treatment and post-treatment values were 65.23±4.19 and 68.13±5.19 respectively with p-value 0.000 while within group analysis of CAST had pre-treatment and post-treatment values were 66.4±4.39 and 72.26±5.39 respectively with p-value 0.000

The ***Table III*** provide the statistical analysis about the across group analysis of variables of Fitness education program and Combined aerobic strength training program. The Table III showed that across group analysis of FEV_1 as post treatment FEP was 1.52 ±0.150 while

post-treatment CAST mean FEV1 was 1.93± 0.13 Showing that CAST was significantly effective in improving FEV1 in COPD with p value <0.005. The FVC as post treatment FEP was 2.45±0.422 while post-treatment CAST mean FVC 2.88±0.38 was Showing that CAST was significantly effective in improving FVC in COPD with p value <0.005. Similarly; across group analysis of FEV_1/FVC as post treatment FET was 59.99±5.56 while post-treatment CAST mean FEV_1/FVC was 63.67±6.55 Showing that CAST was significantly effective in improving FEV_1/FVC in COPD with p value <0.005. The across group analysis of SGQR as post treatment FET was 59.99±5.56 while post-treatment CAST mean SGQR was 63.67±6.55 Showing that CAST was significantly effective in improving SGQR in COPD with p value <0.005.

IV. Discussion:

In this study, pulmonary functions including FEV_1, FVC, and FEV_1/FVC assessed by using a spirometer in L (Liters) while functional status was assessed by using SGQR scale. The measured pre and post-treatment values showed significant improvement in functional abilities of the lung and functional status in both groups. However; on comparison there is statistically significant difference among both groups which showed CAST yields better results than FET with p-value <0.05.

Hashmi et.al in 2022 concluded that resistance training had a significant role in improving the FEV1 with a percentile of 62.99% and effect size of 0.160 (95% CI of -0.840 to 0.521) because it helps to improve the exercise capacity, increasing the muscular strength, maximal heart capacity, and inspiratory along with expiratory pressure which ultimately reduces dyspnea and other exertional symptoms in COPD [(24)]. Pereria et.al in 2021 supported that improvement in functional ability is related to muscular performance which further linked with the intensity of exercise which controlled in the supervised session [(25)]. However; Tunkamnerdthai et.al in 2021 on contrary concluded that such upper limb exercises and low intensity aerobic exercises are not played a significant improvement on dynamic lung volumes due to the alleviation of oxidative stress status which stimulate the adaptive response to ROS [(26)].

Furthermore; Nikniaz et.al in 2021 reported that Supervised aerobic and resistance training sessions help to inhibit the secretion of inflammatory factors including NF-Kb, IL-6, TNF-α, CC16, and SP-D by stimulating anti-inflammatory pathways for approximately four weeks after the treatment protocol. So such sessions help to reduce dyspnea, bronchospasm with increased pulmonary endurance and strength capacity along with the functional status of COPD [(27)]. Similarly; McMahon's et.al in 2020 reported that proper exercise protocol including aerobic and resistance training helps to improve FEV_1/FVC with 56±12%, musculoskeletal mass p <0.005, and reduction in body fat with p = 0.017 which eventually enhance lung functions especially FEV1/FVC is mainly decreased in COPD patients [(28)].

Maldonado et.al in 2019 concluded that a supervised training program yields better results as compared to the self-directed program. This is due to having very little to poor description and knowledge of exercises and improper angels of exercises in the un-supervised training program affecting the upcoming results of the whole session [(29)]. However; Liu et.al in 2019 confirmed that Fitness education programs are helpful and can be used as alternative home-based exercise programs than a supervised structured program but the results are not

effective as a structured program which again confirm the results of this study [30].

Similarly; few studies confirmed that fitness education program help to improve FVC and FEV1 but a self-supervised program with two sessions with a therapist help to improve the disease and protocol knowledge but studies failed to prove the significant effect of an education program on the quality status of life of patients which again support this study result [31].

Therefore, this study concluded that CAST and FET are both effective in improving pulmonary functions and quality of life in COPD and Fitness Education training can be used for home-based programs as treatment protocol but still proper education and methods be guided to patients for better results in COPD patients.

Limitation & Recommendation:

Firstly; the study was conducted for in only two hospitals that limit the diversity of the patient's symptoms among different areas. Therefore, it was recommended that future study will be conducted in more than two hospitals for better understanding of patient's symptoms and treatment effect among them. Secondly, the current study had no control group for the comparison of both groups' results. In this way, the effectiveness of Fitness education and Combined aerobic strength training did not describe the difference from the general population. Therefore, it was recommended that future study will be conducted with having the control group so better results of both techniques can be easily compared with control or general population. The other recommendation that the future study should be conducted with the comparison of specific age groups to generalize the results of the study. Thirdly, while describing the fitness education program; patient had the poor understanding of exercise performance among Fitness Education program due to lack of proper visualization and difficulty in performing every movement with accurate angel. The further recommendation was to conduct the study with proper description of exercises, provide the images/ figures or any videos that help patient have to execute exercises more effectively.

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V. Conclusion:

Chronic Obstructive pulmonary disorder is the main social medical problem that affects personal, professional and social life of mankind. Physiotherapy plays important role in treating and rehabilitate COPD patients through chest physiotherapy and patient education. Furthermore, combined aerobic strength training and Fitness education program are also physiotherapy protocols. Combined Aerobic-Strength training was a more effective technique than the Fitness Education Program in improving pulmonary functional abilities and Quality of life in COPD patient but Fitness education program can be used an alternative protocol in specific conditions like in COVID-19.

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