Original Article

Efficacy of Low Impact Aerobic Training Versus Upper Limb Strengthening Exercise in Fatigue Level among Individuals with Chronic Obstructive Pulmonary Disease

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Abstract

Background: A disorder characterized by airway obstruction and breathing difficulty is known as chronic obstructive pulmonary disease. Fatigue is one of the typical signs and symptoms of COPD. Fatigue is the term used to describe a persistent feeling of exhaustion, and it can have a significant negative influence on person's capacity to carry out everyday tasks.

Purpose: The purpose of this study is to analyze how low impact aerobic training and upper limb strengthening exercise is effective in dyspnea and fatigue level among individuals with COPD.

Materials and Methods: The 106 subjects were selected based on inclusion and exclusion criteria from Hepziba Chest Clinic and Spirometry centre, Nagercoil. The pre and post-test values were measured using the BORG scale and Fatigue Severity Scale. The subjects were allocated into two groups. Low impact Aerobic training group:(n=53) received aerobic training with conventional exercise and Upper limb strengthening group:(n=53) received upper limb strengthening exercise with conventional exercise. The study was done for four weeks. The entire procedure was performed from October 2022 to july 2023

Results: When comparing the low impact Aerobic training group with upper limb strengthening group, the low impact Aerobic training group indicates significant ($p<0.0001$) effect in lowering the fatigue level as assessed by Borg scale and Fatigue Severity Scale.

Conclusion: The study concluded that Low impact Aerobic training had a significant effect compared to upper limb strengthening exercise on Dyspnea and Fatigue Severity Scale among individuals with COPD.

Keywords: Chronic Obstructive Pulmonary Disease, Aerobic training, Upper extremity exercise, BORG Scale, Fatigue Severity Scale.

Introduction

Fatigue affects more than half of COPD patients, which has a significant detrimental effect on functional impairment, level of activity, health-related quality of life (HRQL), mortality, morbidity, hospitalization rate, and length of hospital stay.

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Patients with COPD may have lower limb muscles that are less able to withstand stress and are more susceptible to exhaustion as a result of limb muscle dysfunction, lack of use, and other factors. One of the objectives of comprehensive COPD patient care should be to reduce fatigue[1].

The main symptom that prevents patients from exercising and increases their fear of exercise is dyspnea. The importance of exercise training for this patient population cannot be overstated. Recently, COPD patients have employed high-repetition, low-impact aerobic exercise training as a method for peripheral muscle training without straining their respiratory systems[2].

Pulmonary rehabilitation is a crucial non-pharmacological treatment option for persons with chronic obstructive pulmonary disease[3]. Comprehensive pulmonary rehabilitation decreases dyspnea, improves exercise tolerance. Despite being a multimodal treatment, exercise training is the foundation of pulmonary rehabilitation's benefits [4].

International recommendations state that exercise training, which is widely recognized as the foundation of pulmonary rehabilitation, is the greatest approach currently known for improving exercise tolerance and muscular function in persons with chronic obstructive pulmonary disease (COPD)[5]. Aerobic exercise training improves functional status and, if the training intensity is sufficient, it results in a physiological training effect in people with Chronic Obstructive pulmonary disease. [6] As far as we know, there isn't a comprehensive assessment of the literature on the effects of exercise training on fatigue in COPD patients, and it's rare to discover research whose primary goal is to examine these effects[7].

Exercise has been shown to increase the anomalies that CRD patients' peripheral and central nervous systems exhibit[8]. Due to its association with significant clinical outcomes like mortality, quality of life, and exercise intolerance, independent of a reduction in lung function, muscle dysfunction is particularly significant in COPD. Therefore, increasing muscular function is thought to be a key therapeutic objective in the treatment of COPD[9]. It is already advised for patients with aggravated COPD to engage in aerobic exercise after leaving the hospital to boost their activity tolerance, strengthen their skeletal muscles, and lessen their experience of dyspnea[10].

Aim

To determine and compare the effect of low impact Aerobic training and upper limb strengthening exercise in COPD patients.

Materials and Methodology

A total of 106 subjects were selected from Hepziba Chest clinic and Spirometry Center, Convenient sampling method was used to gather the sample.

Inclusion criteria:

- Men and women between the age of 40 – 60 years
- people with mild COPD (Stage II- GOLD criteria)

Exclusion criteria:

- Previous lung surgery
- Malignant disease
- long-term oxygen treatment
- Musculoskeletal, rheumatic, cardiac or neurological disorders
- Patients with cognitive impairment
- Active pulmonary tuberculosis
- Diagnosis of other chronic lung disease

Outcome Measures

1) Borg Scale

The Borg scale measures a person's sense of their exertion, breathlessness, and weariness during physical work. The Borg RPE scale starts at 6, and the extreme measure is 20. On a scale of 6 to 20, the scoring system assesses the extreme levels of effort.

- **6:** rest
- **7:** extremely light
- **8 to 11:** very light to light exertion
- **12 to 16:** somewhat hard to hard exertion
- **17 to 20:** very hard to maximum exertion

2) Fatigue Severity Scale

The Fatigue Severity Scale (FSS) is a 9-item scale which measures the severity of fatigue and its

effect on a person's activities and lifestyle in patients with a variety of disorders. Answers are scored on a seven-point scale where 1 = strongly disagree and 7 = strongly agree. This means the minimum score possible is nine and the highest is 63. The higher the score, the more severe the fatigue is and the more it affects the person's activities.

Procedure

Total of 106 subjects were selected according to the inclusion and exclusion criteria and the participants were explained about the treatment safety and simplicity of the procedure and written consent was obtained. Subjects willing to participate were randomly allocated into two groups, Low impact Aerobic training group and upper limb strengthening exercise group. A routine history collection and detailed assessment was carried out for the patients. The study was done for four weeks. The entire procedure was performed from October 2022 to july 2023.

Low Impact Aerobic Training Group (Group A)

The low impact Aerobic training group received low impact aerobic exercise with conventional exercise like walking and Diaphragmatic breathing for a duration of 40 minutes. Walking was performed for about 30 minutes and Diaphragmatic breathing for 10 minutes.

Walking:

Done for a total duration of 30 minutes.

Warm-up Phase (5 minutes): The Warm-up phase was started with a slow and relaxed pace for the first 2-3 minutes. The subjects were focused on active exercise of upper and lower limbs and gentle movements like arm circle and Toe tap. Walking Phase (20 minutes): The subjects were asked to walk at brisk pace with posture upright, shoulders relaxed, and engage the core muscles and asked to swing their arms naturally as they walk. Cool-down Phase (5 minutes): The subjects were asked to reduce their walking pace and intensity and are asked to perform Quadriceps, Hamstring, Calf, Biceps and Triceps stretching exercises for two repetitions each.

Diaphragmatic Breathing:

The Diaphragmatic breathing exercise was done for a total duration of 10 minutes. The subjects were made to sit comfortably in a chair with relaxed position, feet flat on the floor. The subjects were asked to place one hand on their chest and other hand on the abdomen just below the ribcage. The subjects were asked to take slow and deep breath through their nose and hold it for 2 seconds and exhale slowly through mouth. This pattern was continued for 10 repetitions and 3 sets.

Upper Limb Strengthening Exercise Group (Group B)

The upper limb strengthening group received upper limb strengthening exercise with conventional exercise like thoracic mobility exercise and Diaphragmatic exercise for a total duration of 40 minutes.

Thoracic Mobility Exercise:

The following movement pattern were performed with coordinated breathing exercises.

Shoulder Flexion

- Shoulder Extension
- Shoulder Abduction
- Shoulder Adduction

Shoulder Flexion:

The subject was made to stand with back straight and feet flat on the floor. The subjects were asked to hold a half liter water bottle in each hands with palm facing forwards and they are asked to slowly push the weight towards the ceiling, with arms straightened without locking the elbows and hold that position for few seconds and return back to the normal position. While the weights are raised the subjects were asked to inhale and during lowering the weights the subjects were asked to exhale. Progression was made by gradual increase in weight.

Shoulder Extension:

The subjects were made to stand with back straight and feet flat on the floor. A weight is given on both the hands of the subjects. The subjects were asked to keep the arms straight and slowly raise their arms parallel to the floor. While the weights are raised the subjects were asked to inhale and during lowering the weights the subjects were asked to exhale. Progression was made by gradual increase in weight.

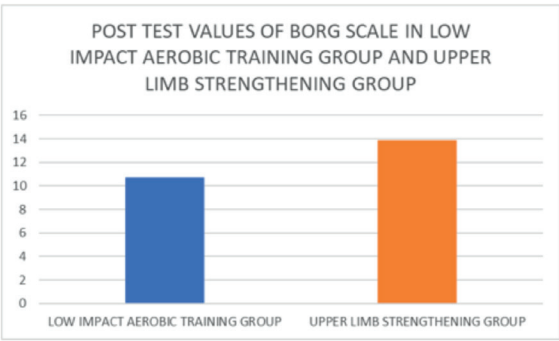
Shoulder Abduction & Adduction:

The subjects were made to stand comfortably with back straight and feet flat on the floor. The subjects were asked to hold the weights in their hands and slowly raise their arm to the side until their shoulder level. While the weights are raised the subjects were asked to inhale and during lowering the weights the subjects were asked to exhale. Progression was made by gradual increase in weight.

Diaphragmatic Breathing:

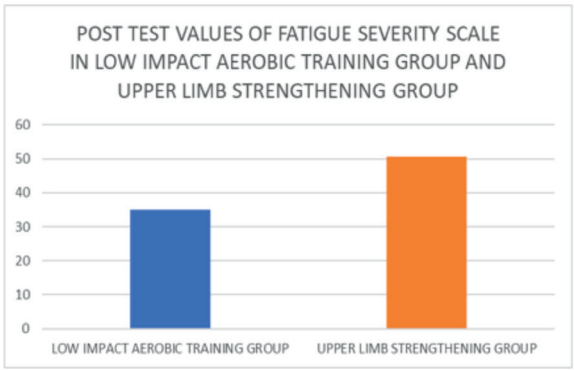
The Diaphragmatic breathing exercise was done for a total duration of 10 minutes. The subjects are made to sit comfortably in a chair with relaxed position, feet flat on the floor. The subjects were asked to place one hand on their chest and other hand on the abdomen just below the ribcage. The subjects were asked to take slow and deep breath through their nose and hold it for 2 seconds and exhale slowly through mouth. This pattern was continued for 10 repetitions and 3 sets.

Data Analysis



Graph No - 1

INTERPRETATION: Graph No - 1 shows that low impact aerobic training group is more effective than upper limb strengthening group in reducing Dyspnea level (BORG Scale)



Graph No - 2

INTERPRETATION: Graph No - 2 shows that low impact aerobic training group is more effective than upper limb strengthening group in reducing Fatigue level (Fatigue Severity Scale)

Result

Statistical analysis of quantitative data showed statistically significant differences between the groups that were the Low impact Aerobic training group and the upper limb strengthening group. The Low impact Aerobic training group's post-test mean value on BORG Scale was 10.74, whereas the upper limb strengthening group was 13.89. This demonstrates that the BORG Scale in Low impact Aerobic training group is lower than in the upper limb strengthening group. In the Low impact Aerobic training group, post-test mean value for Fatigue Severity Scale was 34.87, while in the upper limb strengthening group, it was 50.64. This demonstrates that the Fatigue Severity Scale in Low impact Aerobic training group is lower than the upper limb strengthening group. The post-test results revealed that the Low impact Aerobic training group and the upper limb strengthening group had a substantial statistical difference, according to analysis. Thus Low impact Aerobic training group has high statistical difference than upper limb strengthening group.

Discussion

The aim of the current study is to determine the efficacy of Low impact Aerobic training and upper limb strengthening exercise in fatigue level among individuals with COPD. Before and after the treatment, the outcomes were evaluated using the BORG Scale and the Fatigue Severity Scale. Beneficial effect were significantly greater in Low impact Aerobic training than the upper limb strengthening exercise. When the response were compared between both groups, the result showed significant difference in Low impact aerobic exercise than upper limb strengthening exercise.

An early study by Sankar UG, et al (2020) conducted a study among 30 subjects and are randomized into two groups. Group A (Low impact aerobic exercise) and Group B (Low intensity dynamic flexibility exercise). The study concluded that Low intensity aerobic exercise has better outcome than

Low intensity dynamic flexibility exercise1. Similarly in this study 106 subjects were randomized into two groups. Group A (Low impact aerobic training) and Group B (upper limb strengthening exercise) and concluded that subjects who performed Low intensity aerobic training has an better improvement in Fatigue level than subjects who performed upper limb strengthening exercise.

An early study by Soliman GS, et al (2019) conducted a study among 34 subjects**.** They were allocated into research and control groups. The control group (n=17) did not participate in any exercise training whereas the study group (n=17) performed three sessions of low- to moderate-intensity aerobic activity over the course of twelve weeks. The study's findings demonstrated that low- to moderate-intensity aerobic exercise improved lung function and lowered depressive symptoms in older COPD patients[11]. In this study concludes that fatigue significantly harms both one's physical and mental well-being**.** Thus, Regular exercise can increase energy levels, lower stress levels, and enhance overall stamina.

An early study by Donaire-Gonzalez D et al (2015) concluded that Increased low-intensity physical activity lowers the risk of COPD hospitalization, whereas increased high-intensity physical activity had no risk-reduction effects[12]. People with a variety of medical illnesses frequently experience fatigue, which can be made worse by hospitalization. It is feasible to reduce the necessity for hospitalization or reduce the length of hospital stay by successfully addressing and managing fatigue.

An early study by Stendardi L et al (2007), concluded that operational lung volumes and both the inspiratory and expiratory muscles play a significant role in the development of exercise dyspnea. Dyspnea may be impacted by changes in arterial blood gas content either directly or indirectly[13]. In this study level of Dyspnea is measured using BORG scale and concluded that the level of dyspnea is reduced after Low intensity aerobic exercise.

An early study by Bernard S, et al (1999) conducted a study among 40 subjects and were randomized into two groups. Group A (Aerobic training using calibrated ergocycle) and Group B (Aerobic training with strength training). The study concludes that greater improvement was seen in Aerobic training with strength training group that group with Aerobic training[14]. In this study both Low impact aerobic training and upper limb strengthening exercise on fatigue level was compared. Both have a positive impact on fatigue level among the individuals with Chronic Obstructive Pulmonary Disease.

Conclusion

This study concludes that the both techniques used in the current study that is Low impact Aerobic training and upper limb strengthening exercise are effective in reducing the fatigue level among the individuals with Chronic Obstructive Pulmonary Disease. However, Low impact aerobic training is superior than the upper limb strengthening exercise in fatigue level among individuals with Chronic Obstructive Pulmonary Disease.

Ethical clearance: Approved by Institutional Scientific Review Board. (ISRB Application Number 03/051/2022/ISRB/SR/SCPT)

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Conflict of Interest: Nil

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