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EFFECTIVENESS OF INTERVAL EXERCISE VERSUS CONTINUOUS EXERCISE TO IMPROVE EXERCISE TOLERANCE IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE SUBJECTS

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ABSTRACT

Background: COPD is characterized by chronic airflow limitation and a range of pathological changes in the lung. Chronic inflammation causes structural changes and narrowing of the small airways and destruction of lung parenchyma, leads to the loss of alveolar attachments to the small airways and decreases lung elastic recoil; in turn these changes diminish the expiration and the work of breathing is increased. Scarcity of evidence on continuous and interval exercises is forcing researchers conduct studies on effectiveness of interval exercise with continuous exercise on exercise tolerance in subjects with COPD.

Methods: 60 subjects were selected by lottery method. All the subjects were explained about the condition and mode of assessment and written informed consent were obtained from them and divided into 2 groups interval training group and continuous exercise training group and subjects were scheduled to attend exercise session 5 days a week for 4 weeks with exercise duration 20 min's with cycle ergometer. Outcome measure: six minute walk test and heart rate.

Results: On observing the means of post test parameters of experimental group A and experimental group B Independent t-test was done and the P- value is >0.05 .It shows a no significant difference between the two groups.

Conclusion: The results had shown that both interval exercise group and continuous exercise group who received four weeks of therapy has improved significantly on pre and post test values within the groups but when compared between these groups there is no statistical significance noted. So this study concluded that there is no significant difference between interval exercise group and continuous exercise group in improving exercise tolerance among COPD subjects.

Keywords: COPD, interval training, continues training, exercises, six minutes' walk test.

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD), a common preventable and treatable disease, is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbation and co-morbidities contribute to overall severity in individual patients[1] (GOLD-2014).

According to World Health Organization (WHO) COPD is one of the several chronic diseases that are becoming increasingly problematic which affects more than 400 million people worldwide. COPD accounts for more than 3 million deaths per year globally making it the third leading cause of death worldwide. Total deaths from COPD are projected to increase by more than 30% in the next 10 years.[2] As much as 70% of COPD patients may be affected by peripheral muscle dysfunction. [3, 4,5]

In India prevalence of COPD is about 15 million cases (males and females contributing to 9.1 and 5.8 million respectively). Average around 5% in adult population was suffering with COPD with higher rates in smokers, rural areas depending on the type of domestic fuel and socio economic status. The disease now affects men and women almost equally due to increased tobacco use among women in high income countries.

The characteristic symptoms of COPD are cough, sputum production and dyspnoea on exertion. Chronic cough and sputum production often precede the development of airflow limitation by many years; although not all individuals with cough and sputum production go on to develop COPD. The disease is mainly caused by smoking, but environmental pollution and alpha1-antitrypsin deficiency may also cause the development of COPD. Main entities included in COPD are emphysema and chronic bronchitis.

The chronic airflow limitation is caused by a mixture of small airway disease(obstructive bronchiolitis) and parenchymal destruction(emphysema) ,the relative contribution of which vary from person to person. The reduction of maximum expiratory flow rate and slow forced emptying of lung are common problems seen in COPD that leads to dyspnoea and reduction in exercise tolerance. Impaired exercise capacity, dyspnoea and health related quality of life are common complaints. Major exercise limiting factor in COPD is peripheral muscle dysfunction characterized by atrophic muscles and reduced fatigue resistance due to morphological and metabolic alterations in leg and diaphragm muscles. Avoidance of activity as a strategy to limit the experience of dyspnoea leads to a sedentary lifestyle and exercise intolerance.

Respiratory rehabilitation with physical exercise improves exercise capacity and HRQL (Health related quality of life) although physical exercise is a mandatory component of respiratory rehabilitation programs there is an ongoing debate about what type of exercise at which intensity subjects should perform remain unsolved.[6,7]There is substantial variations in exercise protocols used in practice[8]as well as in clinical trials.

Continuous training, also known as continuous exercise, is a type of physical training that involves activity without rest intervals. Continuous training can be performed at low, moderate, or high exercise intensities Current guidelines recommend continuous exercise at high intensity for lower extremities is beneficial in COPD patients. Less than 20% may be able to sustain high intensity continuous exercise throughout the whole rehabilitation programme.[9] A solution to this dilemma may represent interval exercise.[10]

Interval training is a popular strategy for improving cardio respiratory fitness and exercise tolerance. A standard protocol involves alternating bouts of both high- and low-intensity exercise to increase the amount of high-intensity work performed during an acute bout of training. Interval training consists of high-intensity bout is then followed by a low-intensity recovery period that allows the body to buffer and clear lactic acid from the blood, Thereby allowing the individual enough time to recover and perform another high-intensity interval.

Six minute walk test is simple, easy reproducible outcome measure and requires no apparatus. It is a self paced exercise that patients could perform this test alone. It can be carried out at same time of the day at any time.[11]

METHODOLOGY

A Total of 75 COPD subjects were taken, Out of that a sample of 60 subjects were recruited who are willing to participate in the study after obtained the concern form and subjects who met the inclusion criteria. These 60 subjects were randomized into two groups by simple random sampling, selected by lottery method. All subjects belong to the age group of 40-60 yrs. Both male and female subjects were included. According to GOLD criteria patients in Stage 2 and 3were selected for this study. All subjects were able to complete six minute walk test and cycle ergometer test. Patents with Unstable vital signs, acute exacerbations of COPD, Arrhythmia, Ventricular tachycardia,

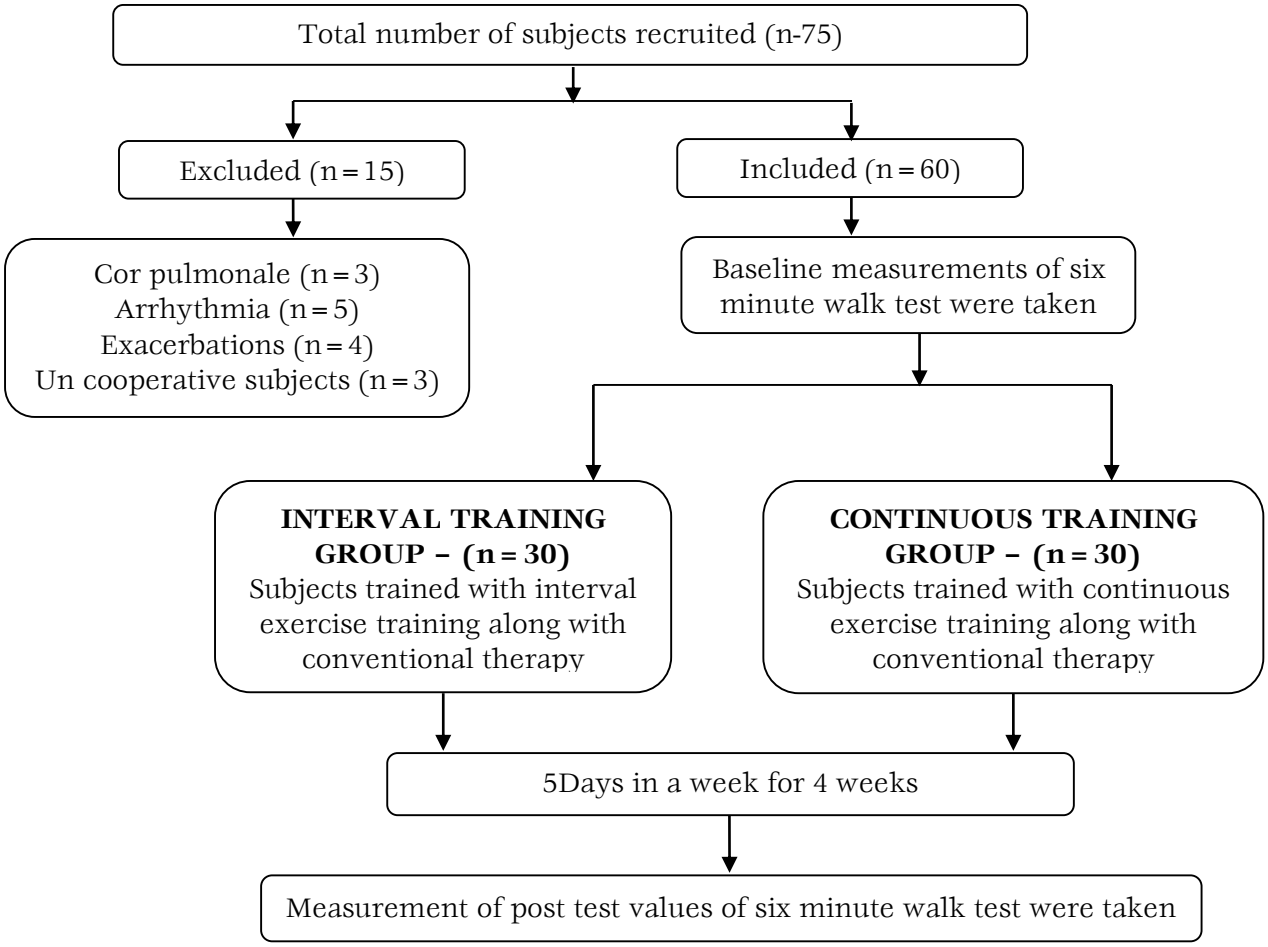
Decompensated Cor-pulmonale or heart failure, untreated neoplasia, history of Lung surgery within the previous three months were excluded. Patients with Psychiatric illness, orthopedic, rheumatologic, vascular or neurological disorders that inhibit exercise training were also excluded.

PROCEDURE

Total of 60 subjects after fulfilled the inclusion criteria was taken by simple random sampling. All the subjects were explained about the condition and mode of assessment and written informed consent were obtained from them and pre test is done and divided into 2 groups A and B interval training group and continuous exercise training group and subjects were scheduled to attend exercise session 5 days a week for 4 weeks with exercise duration 20 min's with cycle ergometer They were treated with inhaled bronchodilators, and most of them were given either short or long-acting anticholinergics. During training program all the patients were allowed to continue their pharmacological therapy, counseling about smoking cessation, food habbits and conventional physiotherapy was given commonly.

Pretest for exercise tolerance is done by six minute walk test before intervention and maximal heart rate was measured by incremental cycle ergometer for both groups.

Chart-1: Flow chart of randomization and intervention Study algorithm



Interval exercise (Group A)

Subjects assigned to this group will perform a steep ramp test to determine the short time muscular maximum exercise capacity. Subjects will start with exercise the day after the steep ramp test. Subjects will perform interval exercise for twenty sessions with a cycle ergometer. In each session, they will have a warm up period of three minutes at 20% of the short time maximum exercise capacity. The subjects were instructed to exercise for 14 minutes at high intensity intervals of 20 seconds at 50% and at low intensity intervals of 40 seconds at 20% of the short time maximum exercise capacity, i.e. with a work/recovery ratio of 1:2.Then they have a slow down period of three minutes before completion of the training session. Pulse oxymetry will be used and oxygen supplementation will be provided if needed.

If subjects cannot sustain exercise intensity because the heart rate exceeds the limits determined after exercise testing or because of perceived dyspnoea or leg fatigue, rest should be given for one minute and then resume exercise. If they have to rest more than twice per session, we will lower the workload from 50% of the short time

maximum exercise capacity by steps of 10% while the length of intervals remains constant. We will increase the training load again as possible for the subject.

In turn, if subject consider the workload to be too low, we will increase workload of the high intensity interval by steps of 10% until subject considers the workload to be appropriate while the length of intervals remains constant.

Continuous exercise (Group B)
Subjects assigned to this group will perform a steep ramp test to determine the short time muscular maximum exercise capacity. The target workload for this group will be >=70% of the maximum exercise capacity expressed in watts and heart rate achieved during the incremental cycle ergometer test.

We will increase training load as soon as possible to >=70% of the maximum exercise or as high as each individual tolerates. In each session, subjects will have a warm-up period of three minutes at 20% of maximum exercise capacity, increase the exercise intensity within two minutes to the target intensity, the subjects were instructed to exercise for 14 minutes at high intensity and then have a decreasing period of three minutes (gradual decrease from 70% to 0%).Pulse oxymetry will be used to supervise subject during exercise. If oxygen saturation falls below 90%, oxygen supplementation will be provided to maintain >=90%.

If subjects cannot sustain the workload because of perceived dyspnoea or leg fatigue or because the heart rate exceeds the limits determined during exercise testing, we will let subject rest for one minute and then resume exercise. If they have to rest more than twice per session, we lower the workload by steps of 10% of baseline maximum exercise capacity. In turn, if subject consider the workload to be too low or if patients do not reach their target heart rate at 70% of the maximum exercise capacity, the workload should increase by steps of 10% of maximum exercise capacity until they consider the workload to be appropriate or until the target heart rate is reached.

Figure 1: Interval Exercise Training

Figure 2: Continuous Exercise Training

Figure 3: Measurement For Six Minute Walk Test

Figure 4: Subject Performing Six Minute Walk Test

RESULTS

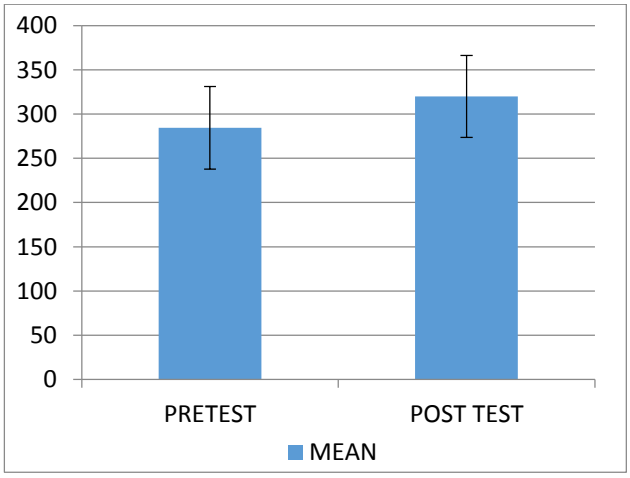
Statistical analysis was done using the using SPSS version 20 with significance level kept at 0.05 for this purpose the data was entered into Microsoft Excel spreadsheet, tabulated and subjected to statistical analysis. All 60 subjects completed the entire study program as defined by 4 weeks in the outpatient basis.

To observe the treatment impact before and after the treatment in the groups, analysis is carried out by using Paired t- test the outcome measure was six minute walk test.

Analysis of EXPERIMENTAL GROUP A- with pre and post intervention.
To compare Pre-Post intervention of parameters, the Paired t-test has been utilized. It is observed that the post intervention have shown some significant impact on subjects.

PARAMETERS	N	MEAN	Standard Deviation	t-value	D f	p-value
Six minute walk test (pre)	30	284.50	46.634	-35.342	29	<0.000
Six minute walk test(post)	30	320.03	45.377			

TABLE-1: Analysis of Experimental Group A- with Pre and Post Intervention



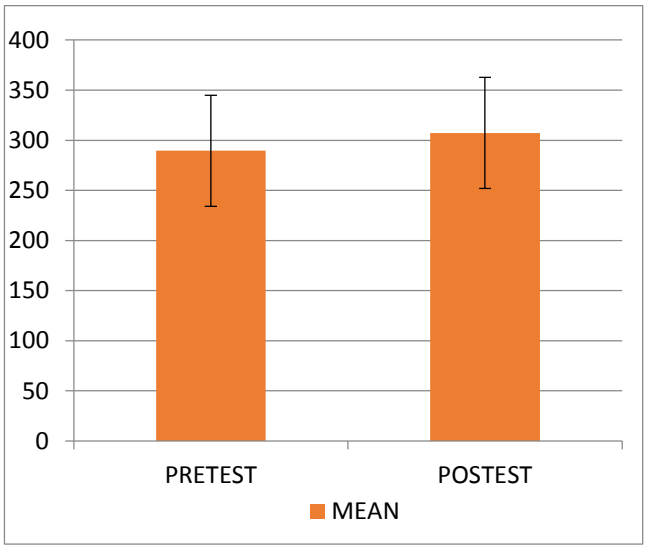
Graph 1: Comparison of mean scores of pre and post test values of six minute walk test of experimental group A

Analysis of EXPERIMENTAL GROUP B with Pre & Post intervention:

To compare Pre-Post intervention of parameters, the Paired t-test has been utilized. It is observed that the post intervention have shown some significant impact on subjects.

PARAMETERS	N	MEAN	STANDARD DEVIATION	t-value	Df	p-value
Six minute walk test (pre)	30	289.50	55.310	-18.828	29	<0.000
Six minute walk test(post	30	307.37	55.332			

TABLE-2: Analysis of Experimental Group B- with Pre and Post Intervention



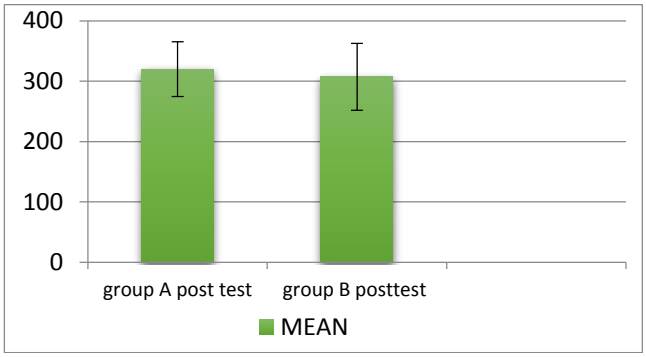
Graph 2: Comparison of mean scores of pre and post six minute walk test of EXPERIMENTAL group B

Analysis of Effectiveness of the TREATMENT among TWO GROUPS

PARAMETERS	N	MEAN	Standard Deviation	t-value	Df	p-value
GROUP A SIX MINUTE WALK TEST POST	30	320.03	45.377	.970	58	<.197
GROUP B SIX MINUTE WALK TEST POST	30	307.37	55.332			

TABLE-3: Analysis of between group post test values

On observing the means of post test parameters of EXPERIMENTAL group A and EXPERIMENTAL group B Independent t-test was done and the P-value is >0.05 .It Shows no significant difference BETWEEN the two groups.



Graph 3: comparison of post test values of six minutes walk test between two groups

DISCUSSION

The results had shown that both interval exercise group and continuous exercise group who received four weeks of therapy has improved significantly on pre and post test values within the groups but when compared between these groups there is no statistical significance noted. So this study concluded that there is no significant difference between interval exercise group and continuous exercise group in improving exercise tolerance among COPD subjects.

Patients with COPD may demonstrate flow limitation even at rest or experience expiratory flow limitations during low and moderate exercise limiting their capacity to exercise continuously at high work rates due to intense dyspnea sensations. Due to these symptoms and alterations in expiratory flow it is difficult for COPD patients in performing activities of daily living which urged me to conduct this study on COPD subjects, whose recovery can be prudent for their family and their social life. In COPD patients there are indications that greater physiological benefits can be obtained through high-intensity continuous training compared to moderate intensity training.

There have been multiple studies and meta-analyses of continuous exercise training in COPD patients. Continuous exercise training is associated with improvement in maximal exercise capacity reflected by increased VO2 peak and peak work rate and greater endurance capacity. Foglo et al in his study concluded that continuous exercise training improves aerobic metabolism of skeletal muscle and reduces the ventilation requirements for a given workload, which increases greater tolerance of daily activities.[12]

Maltais et al in his study concluded that continuous training programme induces enzyme capacity in peripheral muscles in moderate COPD subjects. After continuous training, improvement was observed in exercise capacity accompanied by a significant increase in oxidative enzyme capacity.[13] Interval exercise resembles the daily life activity

pattern in severe COPD patients more closely than continuous exercise .Certain studies have shown that the Small increase in arterial lactate concentration was observed in interval exercise training compared to continuous exercise training, metabolic response during interval exercise is very similar to continuous moderate exercise and, thus, is associated with a stable pattern of cardio respiratory responses and low lactate concentration in the muscle throughout the relatively long exercise and recovery periods.

A study conducted by Eleni A. Kortianou et al pointed the effects of interval training on ventilatory threshold and cardio respiratory responses in elderly COPD individuals showed significant improvement of both maximal aerobic capacity and sub maximal exercise tolerance, with a significant decrease in heart rate after a 3-month program.[14,15]

Vogiatzis et al in his study stated that patients with severe COPD (FEV1: 40% predicted) Although exercised for longer times (32-35 vs 9-12 minutes) at a higher intensity (100% vs 80% WRmax) with the interval mode, they had lower metabolic demands and less ventilatory restrictions than continuous exercise.[16]

Hence interval training induces greater improvement in oxygen consumption, work rate, ventilatory and lactate thresholds compared to continuous training. In this study we have taken a therapy session of 20 min, which is a therapist friendly approach for inpatient treatment program and even cost effective and time saving procedure for both the patient and therapist.

Implementation of interval training has shown to allow exercise to be sustained at a high intensity which otherwise would not be tolerable. Interval training can be applied especially to those patients with advanced COPD, who are unable to sustain exercise intensities sufficiently long enough to obtain a physiological training effect because of ventilatory limitation. Importantly these patients can endure high-intensity interval training in a clinical setting for long periods of time with lower symptoms of dyspnea and leg discomfort compared to the continuous training.

I have taken six minute walk test, as a outcome for measuring exercise tolerance. I have observed improvement in the post test values of the both continuous exercise training group and interval exercise training group. But compare to continuous exercise training group, interval exercise training group got more improvement in exercise tolerance and amount of distance covered was increased during six minute walk test. I also observed that resting intervals or gaps taken by the subjects during six minute test was reduced after the completion of interval exercise training than continuous exercise training .The reason behind this change may be due to leg discomfort after continuous training which limits the ability to walk during six minute test compared to interval training.

The results of present study shows that is no significant difference between interval training method and continuous training method statistically but due to improved distance during six minute walk test, interval training found effective clinically than continuous exercise training in improving exercise tolerance in COPD subjects .

CONCLUSION

The results had shown that both interval exercise group and continuous exercise group who received four weeks of therapy has improved significantly on pre and post test values within the groups but when compared between these groups there is no statistical significance noted. So this study concluded that there is no significant difference between interval exercise group and continuous exercise group in improving exercise tolerance among COPD subjects.

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