

# A Comparative Study of Bode Index in Patients with Moderate to Severe COPD, with and without Pulmonary Rehabilitation Programme

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## ABSTRACT

**Introduction:** Chronic Obstructive Pulmonary Disease (COPD) defined as “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. Exacerbations and comorbidities contribute to the overall severity in individual patients”. Most of the COPD patients show extremely poor exercise performance and the exercise capacity declines over time which affects their quality of life and attributes to the early death. Pulmonary rehabilitation participation by COPD patients improves the variables used to grade the severity of COPD and improves the outcome.

**Material and Methods:** In this study, 60 patients presenting with moderate to severe COPD as per GOLD criteria were included. Two groups were formed of 30 patients each; selected randomly. Patients in Group A were given conventional treatment for COPD and pulmonary rehabilitation. Patients in Group B were given conventional treatment for COPD only. The BODE index scoring were calculated.

**Results:** In the case group significant improvement was observed in the BODE index from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.000) and from the first week till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000).

**Conclusion:** To conclude pulmonary rehabilitation participation by COPD patients improves BODE and is associated with better outcomes. This programme should be included in the management of COPD patients alongside conventional treatment for better results, although more research is needed in this field.

**Keywords:** COPD, BODE Index, Pulmonary Rehabilitation.

## INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) defined as “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. Exacerbations and comorbidities contribute to the overall severity in individual patients”.<sup>1</sup> The Global Burden of Disease Study projects that, by 2020, COPD will become the third leading cause of death worldwide<sup>2</sup>, mostly related to expanded epidemic of smoking and increasingly older population.<sup>3</sup> COPD is caused by a mixture of small airways disease (obstructive bronchiolitis) and parenchymal destruction (emphysema). Patients suffering from COPD are physiologically limited by the inability to engage in the usual activities of daily living due

to reduced pulmonary function and poor exercise capacity.<sup>4</sup> Exercise intolerance progresses relentlessly as the disease advances and can lead to virtual immobility, social isolation and eventually early death.<sup>5</sup>

The risk of morbidity/mortality in patients with COPD is often graded with the use of a single physiological variable, the forced expiratory volume in one second (FEV<sub>1</sub>). However, other risk factors, such as the presence of hypoxemia or hypercapnia, a short distance walked in a fixed time, a high degree of functional breathlessness, and a low body-mass index (the weight in kilograms divided by the square of the height in meters), are also associated with an increased risk of death.<sup>6</sup>

The BODE index, a simple multidimensional grading system is a better tool than FEV<sub>1</sub> alone to evaluate the patients with COPD. Presumably, a higher BODE score correlates with an increased risk of death.<sup>6</sup>

## The bode index

Variables and point values used for the computation of the Body Mass Index, Degree of airflow obstruction and dyspnoea, and exercise capacity (BODE) Index.

Variable	Points on BODE Index			
	0	1	2	3
FEV1 (% of predicted)*	0	50-64	36-49	≤35
Distance walked in 6 min (meters)	≥65	250-349	150-249	≤149
MMRC dyspnoea scale	≥350	2	3	4
Body-mass index	0-1	≤21		

Most of the COPD patients show extremely poor exercise performance and the exercise capacity declines over time<sup>7</sup> which affects their quality of life and attributes to the early death. The pulmonary damages related to COPD are not reversible even by cessation of smoking<sup>8</sup> and thereby the single most important factor to treat the disease and increase life expectancy is to increase patient's aerobic endurance capacity.<sup>9</sup>

Pulmonary rehabilitation participation by COPD patients improves the variables used to grade the severity of COPD and

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improves the outcome.

## MATERIALS AND METHODS

### Study design

This study was conducted in the department of Respiratory Medicine, MMIMSR, Mullana. Sixty patients presenting with COPD in the Respiratory Medicine OPD or admitted in the ward and who fulfilled the criteria for moderate or severe COPD on Pulmonary Function Testing were considered for the study. The patients fulfilling the inclusion criteria and after verifying the exclusion criteria were finally taken up for the study.

### Inclusion Criteria

1. Patients with moderate to severe COPD.

### Exclusion Criteria

1. Patients with any cardiovascular impairment.
2. Patients with any musculoskeletal dysfunction.
3. Patients with any neurological disease.
4. Non-cooperative patients.
5. Patients unable to take the lung function and 6 minute walk test.

### Instruments used:

1. Pulmonary Function Testing Machine
2. Stop watch
3. Weighing machine
4. Inch tape

### Variables used/calculated

1. FEV<sub>1</sub>
2. BMI
3. MMRC dyspnoea score
4. 6 min walking distance

### Study sequence

In this study, 60 patients presenting with moderate to severe COPD as per GOLD criteria were included. Two groups were formed of 30 patients each; selected randomly. Patients in Group A were given conventional treatment for COPD and pulmonary rehabilitation comprising of:

1. Counseling for smoking cessation.
2. Education regarding the disease which included information about chronic lung disease, symptom management, medication usage, benefits of exercise and safety guidelines and environmental irritant avoidance.
3. Nutrition education
4. Chest physiotherapy e.g.
  - a) Diaphragmatic breathing in which the patients consciously expanded the abdominal wall during inspiratory diaphragm descent and exhale slowly through pursed lips while drawing the abdomen inwards,
  - b) Pursed lip breathing which involved a nasal inspiration followed by expiratory blowing against partially closed lips, avoiding forceful exhalation. The exhalation was twice as long as inhalation,
  - c) Chest expansion exercises,
  - d) Active cycle of breathing technique and
  - e) Limb exercises including stationary cycle exercise and ground-based walking. Stationary cycling was started with 3 minutes and gradually increased to a maximum of 15 minutes. Similarly ground-based walking was started with

5 minutes and gradually increased to a maximum of one hour. Patients were encouraged to continue bicycling and ground-based walking at home, gradually increasing the duration of exercise.

- f) Controlled coughing technique in which patients took slow deep breath using diaphragmatic breathing. They then coughed twice after a pause with the mouth slightly open.

Patients in Group B were given conventional treatment for COPD only.

The BODE index scoring were calculated.

The BODE INDEX used was a modification using the FEV<sub>1</sub> variable as per the GOLD guidelines i.e.

Variable	Points on BODE Index			
	0	1	2	3
FEV <sub>1</sub> (% of predicted)*	≥80	50-80	30-50	≤30
Distance walked in 6 min (meters)	≥350	250-349	150-249	≤149
MMRC dyspnoea scale	0-1	2	3	4
Body-mass index	>21	≤21		

The BODE index scoring were again calculated similarly after 7 days of Pulmonary rehabilitation and again after 6 weeks with continued rehabilitation.

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Ethical clearance taken from Institute Ethical committee

## STATISTICAL ANALYSIS

The data collected will be entered into Microsoft Excel and analyzed using statistical package for social sciences (SPSS) version 21 (IBM Chicago, USA). Graphs and descriptive analysis will be done by using Microsoft Excel and SPSS version 21.

## RESULTS

In this study, 60 patients presenting with moderate to severe COPD as per GOLD criteria were included. Two groups were formed of 30 patients each; selected randomly. Patients in Group A (case) were given conventional treatment for COPD and pulmonary rehabilitation. Patients in Group B (control) were given conventional treatment for COPD only. Following results were observed:

In the case group significant improvement was observed in the FEV<sub>1</sub> from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.020) and from the first week till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.00) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.00) (table-1).

Similarly in the control group significant improvement was observed in the FEV<sub>1</sub> from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.001) and from the first week till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.035) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000).

In the case group significant improvement was observed in the MMRC dyspnoea score from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.000) and from the first week till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000) (table-2).

In the control group, however, significant improvement was observed in the MMRC dyspnoea score from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.000) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.00). But the improvement was not statistically significant from the first week till the sixth week of pulmonary rehabilitation programme with p value of >0.05 (0.482).

#### 6 Minute Walk Distance in Control group: Pair wise Comparisons

In the case group significant improvement was observed in the 6 minute walk distance from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.000) and from the first week till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000) (table-3).

In the control group significant improvement was observed in the 6 minute walk distance from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.000) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.001). But from the first week till the sixth week of pulmonary rehabilitation programme, the improvement was not statistically significant with p value of >0.05 (0.797).

In the case group significant improvement was observed in the BODE index from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.000) and from the first week till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000) (table-4).

In the control group significant improvement was observed in the BODE index from the time of diagnosis till first week of pulmonary rehabilitation with p value of <0.05 (0.000) and from the time of diagnosis till the sixth week of pulmonary rehabilitation programme with p value of <0.05 (0.000). But from the first week till the sixth week of pulmonary rehabilitation programme, the improvement in the BODE index was not statistically significant with p value of >0.05 (1.000).

## DISCUSSION

Chronic pulmonary disease is a major cause of morbidity and mortality in our country. Pulmonary rehabilitation is a multidisciplinary programme of care for patients with chronic respiratory impairment that is individually tailored and designed to optimize physical and social performance as well as autonomy. In India, pulmonary rehabilitation programme is available in only limited number of tertiary care hospitals.<sup>10</sup>

The pulmonary rehabilitation programme chosen for this study was based upon the resources available, entailing efficient use of staff and resources, less expensive and one which could be continued by the patient at home.

In this prospective study done in patients with chronic pulmonary disease a total of sixty patients who met the inclusion criteria and who completed the six week follow up were included. Thirty patients who were given pulmonary rehabilitation for six weeks were included in the case group and other thirty who were only given the conventional treatment were included in the control group.

FEV <sub>1</sub> in case group: Pair wise Comparisons				
From	To	Mean Difference	Std. Error	p value
Diagnosis	First week	4.883	1.675	0.020*
Diagnosis	Sixth week	10.975	1.360	0.000*
First week	Sixth week	6.092	0.716	0.000*
FEV <sub>1</sub> in Control group: Pair wise Comparisons				
From	To	Mean Difference	Std. Error	p value
Diagnosis	First week	2.690	0.651	0.001*
Diagnosis	Sixth week	4.391	0.780	0.000*
First week	Sixth week	1.701	0.631	0.035*

Table-1: FEV<sub>1</sub>

MMRC dyspnoea score in Case group: Pair wise Comparisons				
From	To	Mean Difference	Std. Error	p value
Diagnosis	First week	0.667	0.100	0.000*
Diagnosis	Sixth week	1.133	0.104	0.000*
First week	Sixth week	0.467	0.093	0.000*
MMRC dyspnoea score in Control group: Pair wise Comparisons				
From	To	Mean Difference	Std. Error	p value
Diagnosis	First week	0.467	0.093	0.000*
Diagnosis	Sixth week	0.600	0.123	0.000*
First week	Sixth week	0.133	0.093	0.482

Table-2: MMRC Dyspnoea Score

6 Minute Walk Distance in Case group: Pair wise Comparisons				
From	To	Mean Difference	Std. Error	p value
Diagnosis	First week	52.879	6.320	0.000*
Diagnosis	Sixth week	104.487	10.776	0.000*
First week	Sixth week	51.608	6.431	0.000*

Table-3: 6Minute Walk Distance

Bode Index in Case group: Pair wise Comparisons				
From	To	Mean Difference	Std. Error	p value
Diagnosis	First week	1.500	0.243	0.000*
Diagnosis	Sixth week	2.533	0.234	0.000*
First week	Sixth week	1.033	0.148	0.000*
Bode Index in Control group: Pair wise Comparisons				
From	To	Mean Difference	Std. Error	p value
Diagnosis	First week	1.000	0.225	0.000*
Diagnosis	Sixth week	1.200	0.277	0.000*
First week	Sixth week	0.200	0.206	1.000

Table-4: Bode Index

There were a total of 13 dropouts from the study. The reasons for drop-out were mostly non-medical such as illiteracy, ignorance, lack of adherence to drugs and remote location from the hospital. Other reasons were exacerbations of the underlying respiratory illness during rehabilitation and non-respiratory illness. Similar study conducted by C.G. Cote and B.R. Celli et al in 2005 on 246 patients suggested that although pulmonary rehabilitation has minimal effect on lung function, it improves dyspnoea and exercise capacity. They also implied that one unit

change in BODE as being clinically significant.<sup>5</sup>

In this study, improvement in the Bode index was observed in both the case and control group at the end of six weeks, however, persistent improvement between first and sixth week was statistically significant only in the case group; thus showing the importance of pulmonary rehabilitation in COPD. Similar results were observed with all the variables in BODE index.

The health status was significantly improved in the case group only which can be observed by improvement in the BMI and maximum improvement seen between the first and the sixth week of pulmonary rehabilitation. Similar results were observed by C.G. Cote and B.R. Celli et al for the health status after pulmonary rehabilitation.<sup>5</sup>

Improvement in dyspnoea as assessed with MMRC dyspnoea scoring was observed in both the case and control group at the end of six weeks, however, persistent improvement between first and sixth week was statistically significant only in the case group; thus emphasizing the importance of pulmonary rehabilitation in COPD.

Similar results with improvement in dyspnoea were observed by C.G. Cote and B.R. Celli et al in 2005.<sup>5</sup> Andrew L. Ries et al in 2008 conducted a similar study. Although there was no comparison group without rehabilitation, significant improvements in exercise capacity, dyspnea, and health-related quality of life were observed consistently.<sup>10</sup>

Goldstein et al conducted a randomized control trial of respiratory rehabilitation in 1994 in which similar results with improvement in dyspnoea were observed with pulmonary rehabilitation.<sup>11</sup>

Wijkstra et al in 1996 did a similar study and similar results with improvement in dyspnoea were observed with pulmonary rehabilitation.<sup>12</sup>

Six minute walking test is a physical test of disability which is used to assess the patient's ability to perform specific activities of daily living such as walking. In the present study, pulmonary rehabilitation programme led to significant improvement in six minute walking distance in all patients.

These findings are similar with the study done by Goldstein et al, who showed that the COPD patients receiving pulmonary rehabilitation program walked more during a six minute walking test than the patients receiving conventional treatment.<sup>11</sup>

Gosselink et al showed that in COPD patients receiving rehabilitation walked more during a six min walking test than the patients receiving drug treatment.<sup>13</sup>

Thus the observations observed in this study clearly points towards the importance of inclusion of pulmonary rehabilitation programme for the persistent improvement in the clinical parameters as assessed by the BODE index. In patients who were not included in the pulmonary rehabilitation programme, although improvement was observed but this improvement did not continue significantly after the first week of conventional therapy in contrary to the patients included in the pulmonary rehabilitation programme who showed persistent improvement in all the parameters of BODE index.

## CONCLUSION

To conclude pulmonary rehabilitation participation by COPD patients improves BODE and is associated with better outcomes. This programme should be included in the management of COPD patients alongside conventional treatment for better

results, although more research is needed in this field.

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