

## Original Research Article

# A CROSS-SECTIONAL STUDY TO ESTIMATE THE CORRELATION OF SIX MINUTE WALK TEST WITH SPIROMETRIC INDICES IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS AT INSTITUTE OF RESPIRATORY DISEASES, SAWAI MAN SINGH MEDICAL COLLEGE, JAIPUR

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## ABSTRACT

**Background:** Chronic obstructive pulmonary disease is characterized by persistent airflow limitation with variable functional impairment. Spirometry remains essential for diagnosis and grading, while the six-minute walk test provides a practical measure of exercise capacity and clinical limitation.

**Objectives:** The study aimed to estimate the correlation between 6MWT parameters and spirometric indices, including FEV1, FVC, FEV1/FVC ratio and PEFR, in predicting COPD severity, and to compare 6MWT with BODE index for prognosis.

**Materials and Methods:** This hospital-based cross-sectional observational study included 130 COPD patients above 40 years attending the Institute of Respiratory Diseases, Sawai Man Singh Medical College, Jaipur. Post-bronchodilator spirometry, 6MWT and BODE index assessment were performed after informed consent.

**Results:** Mean age was  $60.38 \pm 9.91$  years, with 104 (80.00%) males. Mean post-bronchodilator FEV1 was  $47.53 \pm 17.70\%$ , FVC  $66.40 \pm 22.78\%$ , FEV1/FVC  $0.58 \pm 0.08$  and PEFR  $1.74 \pm 0.86$  L. Mean 6MWD was  $287.66 \pm 37.73$  m. 6MWT showed significant positive correlation with FEV1% ( $r = 0.72$ ), FVC% ( $r = 0.62$ ), FEV1/FVC ( $r = 0.31$ ) and PEFR ( $r = 0.728$ ), all  $p < 0.0001$ .

**Conclusion:** 6MWT correlated significantly with spirometric indices and declined progressively with increasing GOLD stage and BODE risk category. It is a simple, clinically useful functional tool for assessing COPD severity and prognosis alongside spirometry.

**Keywords:** COPD, six-minute walk test, spirometry, FEV1, PEFR, BODE index, GOLD staging.

## INTRODUCTION

Chronic obstructive pulmonary disease, commonly called COPD, is a long-term respiratory disease in which airflow from the lungs becomes persistently limited. It usually presents with breathlessness, chronic cough, sputum production, wheezing, and reduced daily activity. COPD is preventable and treatable, but remains an important cause of illness because it slowly affects lung function and quality

of life.<sup>[1]</sup> Spirometry is the standard test used to diagnose and assess airflow limitation in COPD. It measures forced expiratory volume in one second, forced vital capacity, and the FEV1/FVC ratio. These values help confirm COPD and grade the severity of airway obstruction.<sup>[2]</sup> Although spirometry is very useful, it mainly gives information about lung mechanics and airflow obstruction. Many COPD patients with similar spirometry values may have different exercise

tolerance and daily functional ability. Therefore, functional assessment is also important in clinical practice.<sup>[3]</sup> The six-minute walk test is a simple, safe, and practical test used to assess functional exercise capacity. The patient walks as far as possible for six minutes on a flat surface. The distance covered reflects the combined effect of lung function, heart function, muscle strength, and overall physical condition.<sup>[4]</sup> In COPD patients, reduced walking distance is commonly linked with greater disease severity, increased breathlessness, and poorer functional status. The six-minute walk test gives useful information about how COPD affects daily activities, which may not be fully understood from spirometry alone.<sup>[5]</sup> Several studies have reported a relationship between six-minute walk distance and spirometric parameters in stable COPD patients. Patients with lower FEV1 or more severe airflow obstruction often walk a shorter distance, suggesting that lung function impairment may influence exercise capacity.<sup>[6]</sup> However, the correlation between six-minute walk test and spirometric indices may vary from patient to patient and population to population. Age, nutritional status, muscle weakness, smoking history, breathlessness, and associated illnesses can also affect walking distance in COPD patients.<sup>[7,8]</sup> Indian studies have shown that the six-minute walk test can support COPD assessment by providing functional information along with spirometry. It may help clinicians understand the real-life impact of airflow limitation and identify patients with poor exercise tolerance who need closer care and rehabilitation.<sup>[9,10]</sup>

## MATERIALS AND METHODS

**Study Type and Design:** Hospital based cross sectional observational study.

**Study Location:** Institute of Respiratory Diseases, Sawai Man Singh Medical College, Jaipur.

**Sampling Technique:** Convenience sampling.

**Sample Size:** 130

### Inclusion Criteria

1. Age above 40 years.
2. COPD patients attending the outpatient department.
3. Patients who have given written informed consent.

### Exclusion Criteria

1. Patients with contraindication to Spirometry.
2. Patients with contraindication to 6MWT-
  - Any neuromuscular disease of the lower extremities, peripheral vascular disease, etc.
3. Patients with acute exacerbation of COPD.
4. Pregnant women

**Methodology:** After ethical approval, this hospital-based cross-sectional study enrolled COPD patients using defined criteria and written consent. Spirometry and post-bronchodilator testing were performed per ATS guidelines, followed by 6MWT within one hour. Clinical parameters were recorded, and BODE index calculated.

**Statistical Analysis:** Data were entered in Excel. Quantitative variables were summarized as mean  $\pm$  SD, qualitative variables as frequency and percentage. Appropriate tests included independent t-test and chi-square test.

## RESULTS

The study included a total of 130 COPD patients. The mean age of the participants was  $60.38 \pm 9.91$  years, showing that most patients were older adults. Among them, 104 patients (80.00%) were male and 26 patients (20.00%) were female, indicating male predominance. The mean weight was  $56.04 \pm 8.80$  kg, mean height was  $164.19 \pm 9.23$  cm, and mean BMI was  $20.78 \pm 3.10$  kg/m<sup>2</sup>, suggesting that the overall study population had a low-normal body mass profile.

**Table 1: Mean spirometric parameters of COPD patients**

| Spirometric parameter        | Mean $\pm$ SD     | Minimum | Maximum |
|------------------------------|-------------------|---------|---------|
| Post-bronchodilator FEV1 (%) | $47.53 \pm 17.70$ | 18      | 84      |
| Post-bronchodilator FVC (%)  | $66.40 \pm 22.78$ | 33      | 126     |
| Post-bronchodilator FEV1/FVC | $0.58 \pm 0.08$   | 0.38    | 0.7     |
| Post-bronchodilator PEFR (L) | $1.74 \pm 0.86$   | 0.35    | 4       |

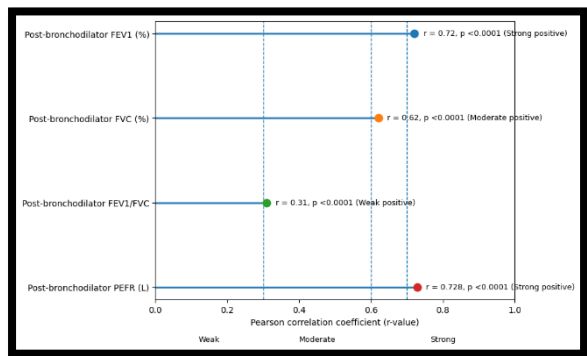
In Table 1 the mean post-bronchodilator FEV1 was  $47.53 \pm 17.70\%$ , ranging from 18% to 84%, indicating reduced airflow in COPD patients. The mean post-bronchodilator FVC was  $66.40 \pm 22.78\%$ , with values between 33% and 126%. The mean FEV1/FVC ratio was  $0.58 \pm 0.08$ , ranging

from 0.38 to 0.70, supporting the presence of obstructive airway disease. The mean post-bronchodilator PEFR was  $1.74 \pm 0.86$  L, with a range of 0.35 to 4 L, showing reduced expiratory flow among the study participants.

**Table 2: GOLD grading and mean 6-minute walk distance**

| GOLD stage          | Post-bronchodilator FEV1% | N   | Percentage | Mean 6MWD $\pm$ SD |
|---------------------|---------------------------|-----|------------|--------------------|
| Stage 1 Mild        | >80                       | 2   | 1.54%      | $400 \pm 0$        |
| Stage 2 Moderate    | 50–80                     | 44  | 33.85%     | $318.19 \pm 24.23$ |
| Stage 3 Severe      | 30–49                     | 61  | 46.92%     | $281.16 \pm 19.62$ |
| Stage 4 Very severe | <30                       | 23  | 17.69%     | $236.73 \pm 17.76$ |
| Total               | —                         | 130 | 100.00%    | $287.66 \pm 37.73$ |

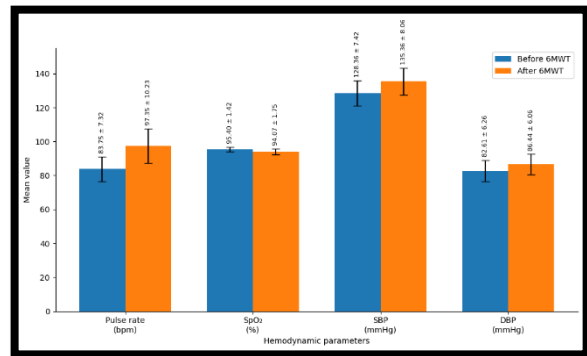
In Table 2 most patients belonged to GOLD Stage 3 severe COPD, with 61 patients (46.92%) and a mean 6MWD of  $281.16 \pm 19.62$  m. This was followed by Stage 2 moderate COPD with 44 patients (33.85%) and mean 6MWD of  $318.19 \pm 24.23$  m. Stage 4 very severe COPD included 23 patients (17.69%) with the lowest mean 6MWD of  $236.73 \pm 17.76$  m, while only 2 patients (1.54%) were in Stage 1 mild COPD, with mean 6MWD of  $400 \pm 0$  m. Overall, the mean 6MWD was  $287.66 \pm 37.73$  m, showing that walking distance decreased as COPD severity increased.



**Figure 1: Correlation of spirometric indices with 6MWT**

Figure 1 Shows the correlation analysis showed that the 6MWT had a strong positive correlation with post-bronchodilator FEV1 (%) with  $r = 0.72$ ,  $p < 0.0001$ , and post-bronchodilator PEFR (L) with  $r = 0.728$ ,  $p < 0.0001$ . This means patients with better FEV1 and PEFR values walked longer distances. Post-bronchodilator FVC (%) showed a moderate

positive correlation with 6MWT, with  $r = 0.62$ ,  $p < 0.0001$ , while post-bronchodilator FEV1/FVC showed a weak positive correlation, with  $r = 0.31$ ,  $p < 0.0001$ . Overall, all spirometric indices were significantly correlated with 6MWT performance.



**Figure 2: Hemodynamic response before and after 6MWT**

Figure 2 Shows after the 6MWT, the mean pulse rate increased from  $83.75 \pm 7.32$  bpm to  $97.35 \pm 10.23$  bpm, while mean  $SpO_2$  decreased from  $95.40 \pm 1.42\%$  to  $94.07 \pm 1.75\%$ . The mean systolic blood pressure increased from  $128.36 \pm 7.42$  mmHg to  $135.36 \pm 8.06$  mmHg, and mean diastolic blood pressure increased from  $82.61 \pm 6.26$  mmHg to  $86.44 \pm 6.06$  mmHg. All these changes were statistically significant with  $p < 0.001$ , showing a significant hemodynamic response after the 6-minute walk test.

**Table 3: BODE index, mean 6MWD and correlation with 6MWT**

| BODE index category   | N   | Percentage | Mean 6MWD $\pm$ SD |
|-----------------------|-----|------------|--------------------|
| Low risk (0–2)        | 23  | 17.69%     | 333 $\pm$ 35.87    |
| Moderate risk (3–4)   | 33  | 25.38%     | 296.51 $\pm$ 23.05 |
| High risk (5–6)       | 51  | 39.23%     | 281.31 $\pm$ 23.33 |
| Very high risk (7–10) | 23  | 17.69%     | 243.39 $\pm$ 23.94 |
| Total                 | 130 | 100.00%    | —                  |

In Table 3 most patients were in the high-risk BODE index category, with 51 patients (39.23%) and a mean 6MWD of  $281.31 \pm 23.33$  m. This was followed by moderate risk with 33 patients (25.38%) and mean 6MWD of  $296.51 \pm 23.05$  m. The low-risk group included 23 patients (17.69%) and had the highest mean 6MWD of  $333 \pm 35.87$  m, while the very high-risk group also included 23 patients (17.69%) and had the lowest mean 6MWD of  $243.39 \pm 23.94$  m. Overall, the table shows that mean 6MWD decreased as the BODE index risk category increased.

## DISCUSSION

In the present study of 130 COPD patients, the mean age was  $60.38 \pm 9.91$  years, with male predominance 104 (80.00%) and females 26 (20.00%); mean weight, height, and BMI were  $56.04 \pm 8.80$  kg,  $164.19 \pm 9.23$  cm, and  $20.78 \pm 3.10$  kg/m<sup>2</sup>, respectively. This age profile was comparable to Krishna et al. (2022),<sup>[11]</sup> who reported a mean age of  $62.99 \pm 6.68$  years with male predominance, and smoking as an important predisposing factor. Spirometrically, our patients showed post-bronchodilator FEV1  $47.53 \pm 17.70\%$ , FVC  $66.40 \pm 22.78\%$ , FEV1/FVC  $0.58 \pm 0.08$ , and PEFR  $1.74 \pm 0.86$  L, indicating predominantly moderate-to-severe airflow limitation. Similar

impairment of spirometric parameters was reported by Das et al. (2023),<sup>[12]</sup> where COPD cases had significantly reduced spirometric values compared with controls ( $P < 0.05$ ). Our GOLD distribution showed Stage 1 mild 2 (1.54%), Stage 2 moderate 44 (33.85%), Stage 3 severe 61 (46.92%), and Stage 4 very severe 23 (17.69%), with mean 6MWD progressively declining from  $400 \pm 0$  in Stage 1 to  $318.19 \pm 24.23$  in Stage 2,  $281.16 \pm 19.62$  in Stage 3, and  $236.73 \pm 17.76$  in Stage 4; total mean 6MWD was  $287.66 \pm 37.73$ . This trend closely aligns with Dinakar et al. (2020),<sup>[8]</sup> who found significant negative correlation of 6MWT with GOLD staging ( $r = -0.536$ ,  $p = 0.00$ ) and positive correlation with post-bronchodilator FEV1 ( $r = 0.608$ ). Shringi et al. (2020),<sup>[9]</sup> similarly observed poorer 6MWT outcomes, desaturation, hospitalization, and mortality more commonly in severe and very severe COPD. 6MWT showed statistically significant positive correlation with post-bronchodilator FEV1% ( $r = 0.72$ ,  $p < 0.0001$ ), FVC% ( $r = 0.62$ ,  $p < 0.0001$ ), FEV1/FVC ( $r = 0.31$ ,  $p < 0.0001$ ), and PEFR ( $r = 0.728$ ,  $p < 0.0001$ ), indicating that functional exercise capacity declined with worsening airflow limitation. Similar findings were reported by Dinakar et al. (2020),<sup>[8]</sup> where 6MWT correlated positively with post-bronchodilator FEV1 ( $r = 0.608$ ), FEV1% ( $r = 0.429$ ), FVC ( $r = 0.514$ ), FVC% ( $r = 0.313$ ), and FEV1/FVC% ( $r = 0.336$ ). Krishna et al. (2022),<sup>[11]</sup> also observed significant positive correlation of 6MWD with FEV1, FEV1%, FVC, and FVC%, supporting 6MWT as a practical functional correlate of spirometric severity. Das et al. (2023),<sup>[12]</sup> similarly reported significant reduction in spirometric parameters among COPD cases ( $P < 0.05$ ) and positive correlation between FVC and 6MWD ( $r = 0.556$ ). Hemodynamically, pulse rate increased from  $83.75 \pm 7.32$  to  $97.35 \pm 10.23$  bpm, SpO<sub>2</sub> decreased from  $95.40 \pm 1.42\%$  to  $94.07 \pm 1.75\%$ , SBP increased from  $128.36 \pm 7.42$  to  $135.36 \pm 8.06$  mmHg, and DBP increased from  $82.61 \pm 6.26$  to  $86.44 \pm 6.06$  mmHg, all with  $p < 0.001$ ; this physiological stress response aligns with Shringi et al. (2020),<sup>[9]</sup> who emphasized exertional desaturation during 6MWT. BODE risk distribution showed low risk 23 (17.69%), moderate risk 33 (25.38%), high risk 51 (39.23%), and very high risk 23 (17.69%), with mean 6MWD declining from  $333 \pm 35.87$  to  $243.39 \pm 23.94$ , uniquely demonstrating graded prognostic worsening in this cohort.

## CONCLUSION

This study concludes that 6-minute walk test parameters show clinically meaningful association with spirometric severity in COPD patients. In 130 patients, mean 6MWD was  $287.66 \pm 37.73$  m, with progressive decline across GOLD stages from  $400 \pm 0$  m in mild COPD to  $236.73 \pm 17.76$  m in very severe COPD. Strong positive correlations were

observed with post-bronchodilator FEV1% ( $r = 0.72$ ,  $p < 0.0001$ ) and PEFR ( $r = 0.728$ ,  $p < 0.0001$ ), while FVC% showed moderate correlation. Declining 6MWD across BODE categories further supports 6MWT as a simple functional and prognostic assessment tool in COPD.

**Conflict of Interest:** None.

**Funding:** None.

**Ethical Approval:** Obtained.

**Consent:** Written consent secured.

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