



EVALUATING THE UTILITY OF SIX – MINUTE WALK TEST IN RELATION TO SPIROMETRIC SEVERITY IN PATIENTS WITH COPD

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation. Spirometry is the gold standard for diagnosis and severity assessment, but it does not fully reflect functional exercise capacity. The Six Minute Walk Test (6MWT) is a simple, cost-effective tool that evaluates functional status and exercise tolerance. This study aimed to correlate spirometric indices with six minute walk distance (6MWD) in COPD patients. **Methods:** This prospective cross-sectional study included 100 stable COPD patients diagnosed according to GOLD criteria. All patients underwent spirometry (FEV1, FVC, FEV1/FVC ratio) and 6MWT as per American Thoracic Society (ATS) guidelines. Spirometric indices were correlated with 6MWD using Pearson correlation. One-way ANOVA was used to compare 6MWD across GOLD stages. **Results:** The mean age was 60.51 ± 9.25 years, with male predominance (88%). Mean FEV1 (% predicted) was $53.02 \pm 21.97\%$. Mean 6MWD was 308.41 ± 103.80 meters. A strong positive correlation was observed between FEV1 (% predicted) and 6MWD ($r = 0.767$, $p < 0.001$). 6MWD declined progressively with advancing GOLD stage ($p < 0.001$). Exercise-induced desaturation occurred in 66% of patients and increased with disease severity (87.5% in GOLD stage IV). **Conclusion:** Six Minute Walk Test shows a strong, statistically significant correlation with spirometric severity in COPD patients. It is a simple, reliable, and practical tool that complements spirometry and may be particularly useful in resource-limited settings where spirometry is unavailable.

KEYWORDS : COPD, Spirometry, Six Minute Walk Test, FEV1, 6MWD, GOLD Classification

1. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a major cause of morbidity, disability, and mortality worldwide, accounting for nearly 3 million deaths annually [1]. The disease is characterized by persistent, progressive airflow limitation due to chronic inflammation of the airways and parenchyma, leading to symptoms such as dyspnea, chronic cough, sputum production, and reduced exercise tolerance [2].

Spirometry has long been regarded as the gold standard for diagnosing COPD and assessing disease severity. The post-bronchodilator FEV1/FVC ratio < 0.70 confirms the diagnosis, and the FEV1 (% predicted) is used to classify severity according to GOLD stages (1 to 4) [3]. However, spirometry has several limitations: it is effort-dependent, requires patient cooperation, specialized equipment, and trained personnel. Moreover, it primarily measures mechanical airflow obstruction and does not adequately capture the functional impact of COPD on daily activities or quality of life [4].

The Six Minute Walk Test (6MWT) is a simple, inexpensive, and reproducible field test that evaluates submaximal functional exercise capacity. It reflects the integrated response of the pulmonary, cardiovascular, and musculoskeletal systems during physical exertion. The distance walked in six minutes (6MWD) has been shown to predict hospitalization risk, mortality, and response to pulmonary rehabilitation [5,6].

In resource-limited settings, where spirometry may not be readily available, the 6MWT could serve as a practical

alternative or adjunct for assessing disease severity. This study was undertaken to correlate spirometric indices (particularly FEV1) with six minute walk distance in patients with COPD.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a prospective cross-sectional study conducted at the Department of Respiratory Medicine, G S Medical College and Hospital, Pilkhuwa, Hapur, Uttar Pradesh, India. The study was carried out over 18 months following approval from the Institutional Research Committee.

2.2 Study Population

Adult patients aged >30 years with a clinical diagnosis of COPD according to GOLD guidelines were included. All patients provided written informed consent.

Inclusion Criteria: Confirmed diagnosis of COPD (post-bronchodilator FEV1/FVC < 0.70), clinically stable for at least 4 weeks, able to perform spirometry and 6MWT.

Exclusion Criteria: Patients with coronary artery disease, ischemic heart disease, active or previously treated pulmonary tuberculosis, any physical disability limiting the test, neurological disease, peripheral vascular disease, and those using non-invasive ventilation.

2.3 Sample Size Calculation

Sample size was calculated using the University of British Columbia web-based calculator. Based on a mean 6MWD of 350 meters in COPD patients, with a common standard deviation of 17.6, 80% power, and α of 0.05, the estimated

sample size was 100 patients.

2.4 Spirometry

Spirometry was performed according to American Thoracic Society (ATS) guidelines. Parameters recorded included FEV1 (liters and % predicted), FVC (liters and % predicted), and FEV1/FVC ratio, both before and 15 minutes after administration of 200-400 micrograms of salbutamol via inhalation. Patients were classified into GOLD stages based on post-bronchodilator FEV1 (% predicted):

- GOLD I (Mild): $FEV1 \geq 80\%$
- GOLD II (Moderate): $50\% \leq FEV1 < 80\%$
- GOLD III (Severe): $30\% \leq FEV1 < 50\%$
- GOLD IV (Very Severe): $FEV1 < 30\%$

2.5 Six Minute Walk Test (6MWT)

The 6MWT was conducted according to ATS guidelines along a 30-meter marked corridor. Baseline heart rate, blood pressure, and oxygen saturation (SpO₂) were recorded. Patients were instructed to walk as far as possible in six minutes, with rest periods allowed if necessary. Standardized encouragement was provided. Post-test heart rate, blood pressure, and SpO₂ were recorded, and the total distance walked (6MWD in meters) was documented. Exercise-induced desaturation was defined as a drop in SpO₂ of $\geq 4\%$ from baseline.

2.6 Statistical Analysis

Data were analyzed using IBM SPSS software. Descriptive statistics were presented as percentages for categorical data and mean $\pm$ standard deviation (SD) for continuous data. Pearson correlation was used to assess the relationship between spirometric indices and 6MWD. One-way ANOVA was used to compare 6MWD across GOLD stages. A p-value < 0.05 was considered statistically significant.

2.7 Ethical Approval

The study was approved by the Institutional Ethics Committee of G S Medical College and Hospital. All procedures followed the Declaration of Helsinki. Written informed consent was obtained from all participants.

3. RESULTS

3.1 Demographic and Clinical Characteristics

A total of 100 stable COPD patients were enrolled. The mean age was 60.51 ± 9.25 years (range 38-82 years). Males comprised 88% (n=88) and females 12% (n=12) of the study population. Regarding smoking status, 44% were ex-smokers, 36% current smokers, and 20% non-smokers. The mean duration of illness was 7.67 ± 3.73 years (range 2-21 years). Dyspnea was present in all patients (100%), followed by chronic cough (79%), sputum production (61%), and wheezing (44%).

Table 1. Baseline Demographic and Clinical Characteristics (N=100)

Mean age (years)	60.51 $\pm$ 9.25
Male gender	88 (88%)
Female gender	12 (12%)
Current smoker	36 (36%)
Ex-smoker	44 (44%)
Non-smoker	20 (20%)
Mean duration of illness (years)	7.67 $\pm$ 3.73
Dyspnea	100 (100%)
Chronic cough	79 (79%)
Sputum production	61 (61%)
Wheezing	44 (44%)

3.2 Spirometric Parameters and GOLD Classification

Mean FEV1 (% predicted) was $53.02 \pm 21.97\%$ (range 15-95%). Mean FVC (% predicted) was $70.35 \pm 9.15\%$ (range 55.1-84.7%). Mean FEV1/FVC ratio was $55.21 \pm 5.71\%$ (range 45.3-64.8%). Based on GOLD criteria, 11% had mild (Stage I), 42%

moderate (Stage II), 31% severe (Stage III), and 16% very severe (Stage IV) COPD.

3.3 Six Minute Walk Test Performance

The mean six minute walk distance (6MWD) was 308.41 ± 103.80 meters (range 120-520 meters). Baseline SpO₂ was $95.29 \pm 1.16\%$, which decreased to $90.72 \pm 1.84\%$ post-6MWT (mean drop $4.57 \pm 1.48\%$, $p < 0.001$). Exercise-induced desaturation occurred in 66% of patients. The proportion of patients desaturating increased with disease severity: 9% in GOLD I, 64.2% in GOLD II, 77.4% in GOLD III, and 87.5% in GOLD IV.

Table 2. Spirometric and 6MWT Parameters Across GOLD Stages

Parameter	GOLD I (Mild) (n=11)	GOLD II (Moderate) (n=42)	GOLD III (Severe) (n=31)	GOLD IV (Very Severe) (n=16)
Mean FEV1 (% predicted)	86.1	65.3	41.5	24.8
Mean 6MWD (meters)	438.9	308.2	231.5	145.1
Exercise-induced desaturation (%)	9%	64.2%	77.4%	87.5%

3.4 Correlation Between Spirometry and 6MWT

Pearson correlation analysis revealed a strong positive correlation between FEV1 (% predicted) and six minute walk distance ($r = 0.767$, $p < 0.001$). In contrast, the correlation between FVC (% predicted) and 6MWD was weak and not statistically significant ($r = 0.104$, $p = 0.301$). Similarly, the FEV1/FVC ratio showed no significant correlation with 6MWD ($r = 0.039$, $p = 0.700$).

Table 3. Correlation Between Spirometric Indices and Six Minute Walk Distance

Parameter	r value	p value
FEV1 (% predicted) vs 6MWD	0.767	< 0.001
FVC (% predicted) vs 6MWD	0.104	0.301
FEV1/FVC ratio vs 6MWD	0.039	0.700

One-way ANOVA demonstrated a statistically significant difference in 6MWD across GOLD stages ($F = 54.02$, $p < 0.001$), with progressive decline in walking distance as disease severity increased.

3.5 Summary of Key Findings

1. Mean 6MWD was 308.41 ± 103.80 meters, with wide interindividual variability.
2. A strong positive correlation was found between FEV1 (% predicted) and 6MWD ($r = 0.767$, $p < 0.001$).
3. 6MWD declined progressively with advancing GOLD stage ($p < 0.001$).
4. Exercise-induced desaturation occurred in 66% of patients and increased with disease severity.
5. FVC and FEV1/FVC ratio did not correlate significantly with 6MWD.

4. DISCUSSION

4.1 Summary of Key Findings

In this prospective cross-sectional study of 100 stable COPD patients, we found a strong positive correlation between FEV1 (% predicted) and six minute walk distance ($r = 0.767$, $p < 0.001$). Six minute walk distance declined progressively with increasing GOLD stage, from 438.9 meters in mild COPD to 145.1 meters in very severe COPD ($p < 0.001$). Exercise-induced desaturation was observed in two-thirds of patients and was more prevalent in advanced disease.

4.2 Comparison with Existing Literature

Our findings are consistent with previous studies. Kundu et al. (2015) reported a significant positive correlation between

6MWD and post-bronchodilator FEV1 ($r = 0.478$, $p < 0.001$) in 80 stable COPD patients [7]. Hajare et al. (2018) found an even stronger correlation ($r = 0.850$, $p < 0.001$) between percent predicted 6MWD and FEV1 [8]. Krishna et al. (2022) demonstrated that 6MWD correlated positively with FEV1 and FVC, while correlating negatively with age and oxygen desaturation [9].

The progressive decline in 6MWD with increasing GOLD stage observed in our study mirrors the findings of Hernandez et al. (2011) and Polkey et al. (2013), who reported that patients with severe COPD walked significantly shorter distances than those with mild disease [10,11]. Our mean 6MWD of 308.41 meters is comparable to values reported in other Indian studies [7-9].

The prevalence of exercise-induced desaturation (66%) in our study is similar to that reported by Waatevik et al. (2016), who found that desaturation during 6MWT was a risk factor for adverse outcomes in COPD [12]. The increasing prevalence of desaturation with higher GOLD stage (from 9% in stage I to 87.5% in stage IV) reflects progressive gas exchange impairment and ventilation-perfusion mismatch.

4.3 Biological and Clinical Explanation

The strong correlation between FEV1 and 6MWD is biologically plausible. FEV1 is a measure of airflow limitation, which directly affects the ability to generate sufficient ventilatory capacity during exercise. In COPD, expiratory flow limitation leads to dynamic hyperinflation, increased work of breathing, and dyspnea, all of which limit exercise performance [13]. However, the correlation is not perfect ($r = 0.767$, explaining only ~59% of the variance), indicating that other factors—such as skeletal muscle dysfunction, cardiovascular comorbidities, nutritional status, and motivation—also influence functional capacity [14].

The weak correlation between FVC and 6MWD ($r = 0.104$, $p = 0.301$) and the absence of correlation with FEV1/FVC ratio ($r = 0.039$, $p = 0.700$) confirm that the FEV1/FVC ratio is primarily a diagnostic parameter, not a measure of functional limitation. This finding supports the concept that multidimensional assessment (combining spirometry, functional tests, and symptom scores) is necessary for comprehensive COPD evaluation.

4.4 Clinical Implications

Our findings have important clinical implications, particularly for resource-limited settings:

1. Alternative to spirometry: In primary care or rural settings where spirometry is unavailable, the 6MWT can serve as a practical alternative for assessing disease severity. A patient who walks <250 meters likely has severe functional impairment, while a distance >400 meters suggests mild disease.
2. Prognostic tool: The 6MWD has been shown to predict hospitalization and mortality in COPD. Our findings support its use for risk stratification [15].
3. Monitoring response to intervention: The 6MWT is sensitive to changes following pulmonary rehabilitation, bronchodilator therapy, and oxygen supplementation, making it valuable for longitudinal follow-up.
4. Identifying desaturators: The 6MWT identifies patients who desaturate during exercise, who may benefit from ambulatory oxygen therapy.

4.5 Strengths and Limitations

Strengths: Adequate sample size ($N=100$), standardized protocols (ATS guidelines), comprehensive data collection including spirometry and 6MWT, and inclusion of patients across all GOLD stages.

Limitations: Cross-sectional design (cannot assess causality

or longitudinal changes), single-center study (limits generalizability), hospital-based cohort (may overrepresent moderate-to-severe COPD), and lack of symptom scores (e.g., mMRC, CAT) and quality of life assessment.

5. CONCLUSION

This study demonstrates a strong, statistically significant positive correlation between FEV1 (% predicted) and six minute walk distance in patients with Chronic Obstructive Pulmonary Disease ($r = 0.767$, $p < 0.001$). Six minute walk distance declines progressively with increasing GOLD stage, from 438.9 meters in mild COPD to 145.1 meters in very severe COPD. Exercise-induced desaturation occurs in the majority of patients with moderate-to-severe COPD and increases in prevalence with disease severity. The Six Minute Walk Test is a simple, safe, inexpensive, and reliable tool for assessing functional exercise capacity in COPD patients. It complements spirometry by capturing the multidimensional effects of the disease that are not reflected by airflow measurements alone. In resource-limited settings where access to spirometry is restricted, the Six Minute Walk Test may serve as a valuable alternative or adjunct for evaluating disease severity and functional impairment. Incorporation of functional exercise testing into routine clinical evaluation may enhance patient assessment, guide management decisions, and improve overall care of patients with COPD.

6. REFERENCES

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