

# Correlation of 6-Minute Walk Test (6MWT) with Spirometric Findings in Patients of COPD

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## ABSTRACT

**Introduction:** Chronic Obstructive Pulmonary Disease (COPD) is a major health problem globally. Spirometry is the Gold standard for the diagnosis of COPD and it also grades its severity. 6MWT is a simple reproducible test to assess the patient's functional capacity. It is of help in management and prediction of prognosis. Objective: This study was done to find correlation between 6MWT results with patient's clinical and spirometric parameters. The study also assessed if 6 minute walk distance (6MWD) can be an alternative to spirometry in predicting severity of COPD in resource poor setup.

**Material and methods:** This was a hospital based cross sectional study. 60 consecutive confirmed patients of COPD (by GOLD guidelines) were included in the study after applying inclusion and exclusion criteria. Severity was assessed by pre and post-bronchodilator spirometry test. This was followed by 6MWT as per ATS guidelines. 6MWD was recorded and % predicted 6MWD was also calculated. Results of 6MWT were correlated with spirometric and clinical parameters of the patients.

**Results:** 6MWD had statistically significant ( $p < .05$ ) positive correlation with following parameters: Height, FEV<sub>1</sub>, % predicted FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC and PEF<sub>R</sub>. Correlation with age, weight and BMI was not significant. % 6MWD significantly correlated with Height, FEV<sub>1</sub>, % predicted FEV<sub>1</sub>, FVC and PEF<sub>R</sub>. Distances in meters walked by different severity groups were as follows: Mild:  $410 \pm 15$ ; Moderate:  $367.66 \pm 57.71$ ; Severe:  $364.60 \pm 62.91$  and Very severe:  $281.21 \pm 55.99$ . On one way analysis of variance (ANOVA) these differences were found significant ( $p < .01$ )

**Conclusion:** In this study 6MWD and percent 6MWD had significant positive correlation with patients' parameters (Height, FEV<sub>1</sub>, %FEV<sub>1</sub>, FVC and PEF<sub>R</sub>). The severity of COPD may be assessed with 6MWT.

**Keywords:** Chronic Obstructive Pulmonary Disease, Spirometry, 6 - Minute Walk Test

## INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a major cause of death and debility globally. It is an irreversible disease characterized by airflow limitation. Spirometry is the GOLD standard for the diagnosis of COPD. This test also grades the severity of the disease which helps in the management.<sup>1</sup>

Many times Spirometry is not available in remote areas. In these situations 6MWT can be done. 6 minute walk test (6MWT) is a simple test to assess patient's functional capacity (ability for day to day activities). The test is reproducible and cost effective requiring minimal equipment.<sup>2-4</sup> Some studies have found results of 6MWT to be more reproducible than

measurement of FEV<sub>1</sub>.<sup>5,6</sup> In 2002 ATS approved 6MWT as standard test for assessment of pulmonary function.

In COPD the patient's lung function deteriorates and disability increases with age. Improvement in patient's symptoms is an important goal in the management of COPD. The management is guided by the severity of airways limitation (GOLD stages). The spirometric results (FEV<sub>1</sub>) may or may not give true picture of patient's exercise capacity. It is important to know whether severity stages based on GOLD guideline correlate with functional capacity of patient.<sup>4</sup> In this context it is worthwhile to know if the flow and volume indices of spirometry correlate with the result of 6MWT.

There are not many published articles in India correlating the severity of COPD (based on FEV<sub>1</sub>) and the exercise capacity of the patient. The present study was done to correlate the spirometric data with result of 6MWT and assess whether 6MWT can be an alternative to spirometry in predicting the disease severity of COPD.

## MATERIAL AND METHODS

This was a cross sectional study conducted in the Department of T.B. & Chest, Nalanda Medical College and Hospital, Patna from October 2019 to January 2020. The project was approved by the Ethics committee of the institution. Consent of the patients was obtained and consecutive patients were selected from among the confirmed cases of COPD (clinical features and GOLD criteria) coming to the T.B. & Chest out-patient door. The patients were included in the test after applying following inclusion and exclusion criterias:

### Inclusion criterias

- All confirmed cases of COPD
- Age >25 years

**Exclusion criterias:** Patients of confirmed COPD but having contraindications as below:

- HR >120/mt
- BP > 180/100
- Evidence of LVF, IHD, other major CV diseases
- Neurological diseases of lower limbs

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- Clinical and radiological features of pneumonia
- Evidence of peripheral vascular diseases
- Patients less than 25 years of age

**Spirometry:** It was performed by an experienced technician and as per guideline of American Thoracic Society. <sup>7</sup> The best result of three attempts were selected for analysis. Spirometry was repeated 15 minutes after administration of short acting bronchodilator. Spirometric indices FEV1, %FEV1, FVC, FEV1/FVC ratio and PEFR were recorded. Patients showing obstructive ventilatory defect were grouped as mild, moderate and severe and very severe as per GOLD guidelines.

**6MWT:** Within one hour of spirometry, 6MWT was done on a 30 meter stretch (according to the ATS guideline)<sup>3</sup> as follows:

- Patient were rested 10 minutes prior to the test.
- Baseline heart rate (HR), Blood pressure (BP), SpO2 and dyspnea status were recorded. These parameters were again recorded at the end of the test.
- Distance walked in 6 minutes was recorded in meters.
- The test was discontinued if any of the following occurred: chest pain, severe dyspnea, spasm of lower extremity muscles or if the patient wanted to quit.
- Post-test the patients were be observed for 15 minutes for any adverse events.

**Percent (%) 6MWD**

This was calculated from published reference equations for Indian population. <sup>8</sup> The following equations were used: Predicted 6MWD (For males) = 561.022 - (2.507 × age {years}) + (1.505 × weight {kg}) - (0.055 × height {cm}); and predicted 6MWD (for females) = 30.325 - (0.809 x age {years}) - (2.074xweight {kg}) + (4.235 x height {cm})

**Other tests and information:**

They included routine haematological tests and Chest X-ray. The patients’ demographic data (age, sex, religion, socio-economic status, occupation, and smoking habit) was also recorded.

**STATISTICAL ANALYSIS**

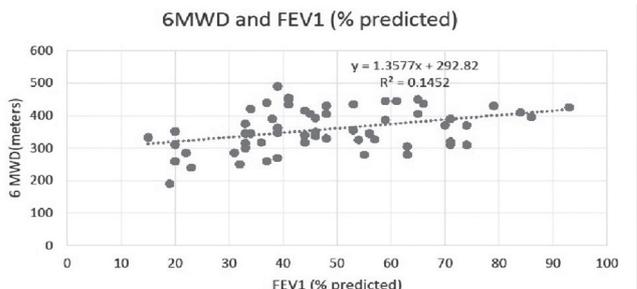
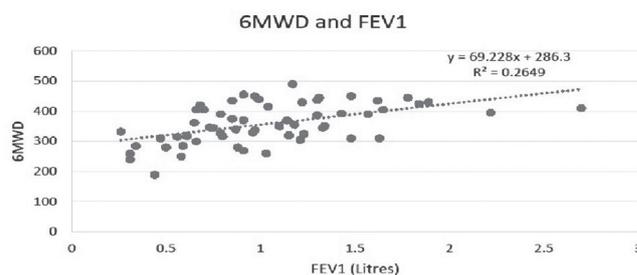
Statistical analysis of the compiled data was done. The correlation was evaluated using Pearson’s correlation coefficient ‘r’. One way analysis of variance (ANOVA) was done to study significance of variation in 6MWD in different severity groups of COPD. The criteria for significant was set at p <.05 and very significant at p <.001. (Statistical calculation were done with software available at website: socscistatistics.com and Microsoft Word Excel 2013 sheet).

**RESULTS**

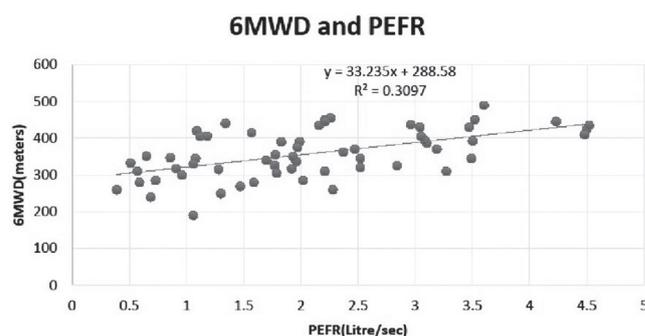
The study population included 60 patients. Among them 36 (60%) were males and 24 (40%) were females. According to age the patients were grouped in five age groups: 25-35, >35 -45, >45 -55, >55 -65 and above 65 years. 23 patients (38.3%) belonged to age group >45 -55 years and 14 patients (23.3%) belonged to age group >55 -65. (Table 1)

Table 2 shows the no. of patients in different severity groups (GOLD stages). 3 patients (5%) were in stage I, 21 patients (35%) were in stage II, 29 patients (48.3%) were in stage III and 7 patients (11.7%) were in stage IV disease.

Statistical analysis of patients demographic characters, spirometric and 6MWT data was done. These have been summarized in Table 3. The mean and standard deviation of demographic parameters are as follows: Age: 50.68 ± 11.31; Height (cms): 154.96 ± 08.96; Weight (Kg): 44.85±11.06; BMI: 18.67±4.43. Spirometric and 6MWT parameters had the following mean and standard deviation: PEFR (liters/sec): 2.10±1.08; FEV1 (liters): 1.04±0.48; FEV1 (% predicted): 48.16±18.24; FVC (liters):1.81±0.70; FEV1/FVC: 55.13±10.79; 6MWD (meters):358.21±65.0; %



**Figure-1:** Scatter diagrams showing co-relations between 6MWD and spirometric indices FEV1 (volume) and FEV1 (% predicted)



**Figure-2:** Scatter diagram showing co-relations between 6MWD and spirometric index PEFR

Age group	Male	Female	Total/ Percentage
25 -35	02	03	05 (08.3%)
>35 -45	08	05	13 (21.7%)
>45 - 55	11	12	23 (38.3%)
>55 -65	10	04	14 (23.3%)
>65	05	0	05 (08.3%)
Total patients:	36	24	60 (100%)

**Table-1:** No. of patients in various age groups

Severity	Male	Female	Total / Percentage
Severity	Male	Female	Total/ Percentage
GOLD I (Mild) FEV1: >80%	03	0	03 (05%)
GOLD II (Moderate) FEV1: ≥50 to <80%	15	06	21 (35%)
GOLD III (Severe) FEV1: ≥30 to <50%	15	14	29(48.3%)
GOLD IV (very Severe) FEV1: <30%	03	04	07(11.7%)
Total no. of patients	36	24	60 (100%)

**Table-2:** No. of Patients in various stages of severity

Characteristics	Value (Mean ± SD)	Range
Age (years)	50.68 ± 11.31	25 - 70
Height (cms.)	154.96 ± 08.96	132 - 173
Weight (Kg.)	44.85 ± 11.06	25 - 86
B M I	18.67 ± 04.43	12.2 - 32.8
P E F R (litres/Sec.)	2.10 ± 01.08	0.39 - 4.52
FEV1 (Litres)	1.04 ± 0.48	0.26 - 2.70
FEV1 (% predicted)	48.16 ± 18.24	15 - 93
F V C (Litres)	1.81 ± 0.70	0.62 - 3.73
F E V 1 / F V C	55.13 ± 10.79	33 - 70.4
6MWD (Meters)	358.21 ± 65.00	190 - 490
6MWD (%Predicted)	71.09 ± 13.37	36.1- 94.7

**Table-3:** Demographic and spirometric Characteristics of patients)

Parameters	6 minute walk distance (6MWD)		% predicted 6MWD	
	'r'	'p'	'r'	'p'
Age (years)	(-)0.21	.720	0.088	.5037
Height (cms.)	0.4117	<.001	0.4072	<.001
Weight (Kg.)	0.0876	.5056	0.0346	.7929
B M I	(-)0.102	.4380	(-)0.1418	.2798
P E F R (litres/Sec)	0.5565	.00001	0.4537	<.001
FEV1 (Litres)	0.5147	<.0001	0.4006	<.001
FEV1 (% predicted)	0.381	<.01	0.3427	<.01
F V C (Litres)	0.4488	<.001	0.3668	<.01
F E V 1 / F V C	0.357	<.01	0.239	.065

**Table-4:** Correlation of 6MWD and % predicted 6MWD with parameters of patients

Gold stage	FEV 1	No. of patients (n=60)	6 minute walk distance (Mean ± SD)
I	>80%	03	410 ± 15
II	≥50 - <80%	21	367.66 ± 57.71
III	≥30 - <50%	29	364.60 ± 62.91
IV	<30%	07	281.21 ± 55.99

F ratio: 4.99, p value: <.01)

**Table-5:** Significance of difference in 6 M W D among patients in different severity stages: ANOVA test

predicted 6MWD: 71.09±13.37.

Table 4 shows correlation of 6MWD and % predicted 6MWD with parameters of patient. There was significant positive correlation of 6MWD and % predicted 6MWD with height and spirometric parameters PEFR, FEV1, % predicted FEV1, FVC. 6MWD also significantly correlated with FEV1/FVC. However no

significant correlation with age, weight and BMI was found.

Distances in meters walked by different severity groups were as follows: Mild: 410 ± 15; Moderate: 367.66 ± 57.71; Severe: 364.60 ± 62.91 and Very severe: 281.21 ± 55.99. (Table-5). The differences in 6MWD of different severity groups were significant in ANOVA test. (F ratio: 4.99;  $p < .01$ ).

## DISCUSSION

Assessment of disease severity is important in the management of COPD. Presently severity is assessed by post-bronchodilator FEV1 (%predicted) as per GOLD guidelines. 6MWT can be a helpful tool in assessing severity of disease where spirometry is not available. The present study showed significant correlation of 6MWD and % 6MWD with spirometric and clinical indices (PEFR, FEV1, %FEV1, FVC and height).

### Correlation with 6MWD (Table 4, Figures 1 and 2)

PEFR: This study showed that PEFR had significant positive correlation with 6MWD ( $r = 0.5565$ ,  $p < .0001$ ). These findings are in conformity with other studies which demonstrated similar correlation between PEFR and 6MWD.<sup>2,9</sup> Some of the authors reported correlation between %PEFR and 6MWD.<sup>9-11</sup>

FEV1: The present study showed moderate but significant correlation between FEV1 and 6MWD ( $r = 0.5147$ ,  $p < .0001$ ). Various previous studies have also observed similar strong correlation between FEV1 and 6MWD.<sup>2,9,10,12,13</sup> The result of this study contradicted the reports of Kodawala et al and Patel A which did not find significant correlation between 6MWD and FEV1.<sup>14,15</sup>

% FEV1: significant correlation between % FEV1 and 6MWD ( $r = 0.381$ ,  $p < .01$ ) was observed in present study. Various previous studies have also found similar correlation between FEV1 and 6MWD.<sup>4,9,10,11,16</sup> One study by Chauhan et al did not find any such correlation.<sup>17</sup>

FVC: Current study showed significant positive correlation between FVC and 6MWD ( $r = 0.4488$ ,  $p < .001$ ). Other studies too reported similar results of correlation between 6MWD and FVC.<sup>2,9,10,12,15,16</sup> Three studies found correlation with % FVC also.<sup>9,10,16</sup> One study by Kodawala et al found no such correlation.<sup>14</sup>

FEV1/FVC: In this study significant correlation was found between FEV1/FVC ratio and 6MWD ( $r = 0.357$ ,  $p < .01$ ). Some of studies have reported similar results.<sup>9,13</sup> But Kundu et al and Nagshin et al did not find any correlation between 6MWD and FEV1/FVC ratio.<sup>2,10</sup>

Height, Weight and BMI: Present study showed significant correlation between height and 6MWD. Another study also found significant correlation with height.<sup>12</sup> Correlation with weight and BMI was not significant in present study. Kumar M et al reported correlation between 6MWD and weight, BMI, but no correlation with height.<sup>9</sup> While others did not find correlation between 6MWD and BMI.<sup>2,11,12,14</sup>

### Correlation with % 6MWD

The current study also found significant correlation between % 6MWD and Height, PEFr, FEV1, %FEV1, FVC. [Table 4] A previous study found correlation between % 6MWD and BMI, %FEV1, FEV1/FVC.<sup>4</sup> Yet another study demonstrated significant correlation with FEV1 and FVC but no correlation with FEV1/FVC.<sup>18</sup>

### Analysis of variance

The differences in the 6 minute walk distances of different severity groups was evaluated with ANOVA test and found to be significant (F ratio:4.99;  $p < .01$ ) (Table 5)

There are certain limitations of our study. There was no control group of healthy people. The test was done after a post-bronchodilator spirometry. This could have improved the walk distance. Repeat test was not done to assess reproducibility.

### CONCLUSION

The present study identified significant correlation of 6MWD with spirometric parameters PEFr, FEV1, %FEV1, FVC, FEV1/FVC and height. This suggests that in the absence of spirometry 6MWT is a reasonable tool for the assessment of disease status in COPD.

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