

## A Correlation Study of 6 – Minute Walk Distance with Spirometry Parameters in Patients with COPD: A Tertiary Care Centre Experience

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### Abstract

**Background:**Chronic obstructive pulmonary disease (COPD) is a common, preventable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.**AIM:** To study the correlation of Six Minutes Walk distance with Spirometric and demographic parameters in COPD patients.**Material and Methods:**Study Design:Hospital based Retrospective observational study.Study area: Dept. of. Pulmonary Medicine. **Study Period:**1 year. **Study population:** Patients who had symptomatology COPD attending OPD or admitted in the Dept. of. Pulmonary Medicine. **Sample size:** study consisted a total of 50 patients. **Sampling method:** Simple Random sampling method. **Study tools and Data collection procedure:** The cases were selected after fulfilling the requirements as mentioned in the inclusion and the exclusion criteria. Secondary data was collected from the records maintained at the department.**Statistical Analysis:** The data was collected, compiled and compared statistically by frequency distribution and percentage proportion. Quantitative data variables were expressed by using Descriptive statistics (Mean  $\pm$  SD). Qualitative data variables were expressed by using frequency and Percentage (%).To assess correlation of 6MWD with demographic and clinical parameters, Pearson correlation was used. **Results:**When tested for the correlation between 6MWD and other variables in the study population, FVC and Severity of the disease were found to be significantly correlated with 6MWD.6MWD was positively correlated with FVC (Forced Vital Capacity) and negatively correlated with severity of the disease in the study population. Other variables were had positive or negative correlation with 6MWD but statistical significance was not observed.**Conclusion:**As 6MWD has statistically significant correlation with FVC & COPD severity, it can be used to grade COPD especially in resource-limited settings as well as in patients who cannot perform spirometry.

**Keywords:**FEV1/FVC ratio, 6 minute walk distance test, GOLD guidelines, desaturation.

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### Introduction

Chronic obstructive pulmonary disease (COPD) is a common, preventable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.<sup>[1]</sup> Chronic obstructive pulmonary disease (COPD) is currently the fourth leading

causes of death in the world but is projected to be the 3<sup>rd</sup> leading cause of death by 2020.<sup>[2]</sup> Globally the Chronic obstructive pulmonary disease (COPD) burden is projected to increase in coming decades because of continued exposure to risk factors and aging of the population. According to GOLD guidelines, spirometry is considered the gold standard for measurement of lung function. The severity of this disease is graded according to the forced expiratory volume in 1 second (FEV1). In COPD, there is airflow obstruction which causes air trapping and hyperinflation due to which patient is unable to exhale forcefully which causes decline in FEV1 values. Also, respiratory muscle weakness contributes to loss in FEV1. FEV1/FVC ratio is generally used to define the presence or absence of airflow obstruction. An impaired exercise tolerance is the main feature in COPD. Because of the hypoxemia there is peripheral muscle weakness which also contributes to impaired exercise tolerance.<sup>[3]</sup>

There are various predictors of exacerbations of COPD which include chronic bronchitis, a reduced forced expiratory volume over 1 second (FEV1), advanced age, long-term oxygen therapy (LTOT), systemic steroid therapy, exacerbation(s) within the previous year, and hospitalizations in past year. The severity of COPD is usually graded on the basis of GOLD criteria with a single parameter – forced expiratory volume in one second (FEV1). The rate of decline in FEV1 is influenced by the number of exacerbations of COPD and it correlates poorly to all the things that matter to COPD patients: symptoms, quality of life, exacerbations frequency, exercise intolerance and systemic manifestations.

The 6 Minute Walk Test (6MWT) is a standardized self-paced walking test that assesses the cardiovascular response during daily activities; it is a submaximal type of exercise in normal individuals but near-maximal in patients with compromised lung functions.<sup>[4]</sup> The 6 Minute Walk Test (6MWT) has been observed to be more sensitive to identify Exercise induced desaturation (EID) in patients of chronic obstructive pulmonary disease (COPD) compared to cardiopulmonary exercise testing.<sup>[5]</sup>

Therefore, the present study was undertaken to find out correlation of Six Minute Walk Test and exercise desaturation with Spirometry findings in COPD patients.

**AIM:** To study the correlation of Six Minute Walk Test with Spirometry and demographical parameters in COPD patients.

### **Material and Methods**

**Study Design:** Hospital based Retrospective observational study.

**Study area:** Dept. of. Pulmonary Medicine

**Study Period:** 1 year.

**Study population:** Patients who had symptomatology COPD attending and admitted in the Dept. of. Pulmonary Medicine.

**Sample size:** study consisted a total of 50 patients.

**Sampling method:** Simple Random sampling method.

### **Inclusion Criteria:**

- Age > 40 years
- A maximal ratio of FEV1/FVC < 0.7 measured 15 min after the administration of inhaled salbutamol
- A stable clinical condition for at least 6 weeks prior to enrolment.
  - All patients in stable condition and receiving appropriate therapy.

### **Exclusion criteria:**

- Uncontrolled co-morbidities.
- A history of asthma
- The inability to perform the required tests

- A myocardial infarction in the recent four months
- Unstable angina, congestive heart failure NYHA CLASS III AND IV
- Patient with acute exacerbation

### Study tools and Data collection procedure:

The cases were selected after fulfilling the requirements as mentioned in the inclusion and the exclusion criteria. Secondary data was obtained from the records kept by department. Following standard procedure for spirometry & 6MWT was performed routinely at the department as per ATS (American Thoracic Society) guidelines.

The individuals were subjected to a pulmonary function test. The subjects with a ratio of forced expiratory volume in the 1st second to the forced vital capacity (FEV1/FVC) < 0.7 are considered. Maximal effort should be entertained, with no cough during the first second or leaks/obstruction of the mouthpiece. Tracing of a minimum of six seconds of exhalation or an obvious plateau, no early termination/cutoff or the subject should not continue to exhale. Three acceptable spiograms should be obtained; two largest FVC values within 150 ml and two largest FEV1 values within 150 ml or less than 5% variability between readings. The spiogram with the highest FVC and FEV1 should be reported and the FEV1/FVC should be calculated from this set of values.

6 minute walk-test was performed according to ATS guidelines<sup>[4]</sup>. The patient was instructed to walk for 6 minutes at his/her own pace in a marked hallway while he/she is allowed to rest if he/she wished to, but the timer continued. The total distance walked was counted & noted along with vitals & oxygen saturation before & after the procedure. The test was terminated prematurely in case of severe chest pain, extreme fatigue, breathlessness or any such circumstances.

### Statistical Analysis:

The data was collected, compiled and compared statistically by frequency distribution and percentage proportion. Quantitative data variables were expressed by using Descriptive statistics (Mean  $\pm$  SD). Qualitative data variables were expressed by using frequency and Percentage (%). To assess correlation of 6MWD with demographic and clinical parameters, Pearson correlation was used. P values of <0.05 were considered statistically significant. Data analysis was performed by using SPSS Version 20.

## Results

**Table 1: Age distribution in the study population**

Age	Frequency(n)	Percentage (%)
30 - 40	2	4
41 - 50	6	12
51 - 60	11	22
61 - 70	18	36
71 - 80	13	26
Total	50	100.0

Out of 50 patients, Majority (36%) of the study population belonged to 61–70 year of age group, followed by 71–80 year age group (26%). Only 4% of the study population belonged to 30–40 years of age group. Mean age was  $62.2 \pm 10.927$  years in the study population.

**Table 2: Sex distribution in the study population**

Sex	Frequency(n)	Percentage (%)
Males	35	70

Females	15	30
Total	50	100.0

In the study group, most (70%) of the patients were males, where females constituted 30% of the study group.

**Table 3: BMI distribution in the study population**

BMI	Frequency(n)	Percentage (%)
<18.5	6	12
18.5 – 24.9	28	56
25 – 29.9	12	24
>30	4	8
Total	50	100.0

According to BMI, most (56%) of the study population belonged to Normal, followed by pre – obese group (24%). Only 8% of the study population belonged to obese group.

**Table 4: Smoking history in the study population**

Smoking	Frequency(n)	Percentage (%)
Yes	21	58
No	29	42
Total	50	100.0

**Table 5: Severity disease in the study population**

Severity	Frequency(n)	Percentage (%)
Mild	9	18
Moderate	22	44
Severe	12	24
Very severe	7	14
Total	50	100.0

Based on severity of the disease, most (44%) of the study subjects belonged to moderate disease group, followed by severe (24%). Only 14% of the study subjects belonged to very severe group.

**Table 6: 6MWD in the study population**

	Mean	SD
6MWD	325.5 (m)	95.17(m)

Mean 6-minute walk distance was 325.5±95.17 meters.

**Table 7: Spirometry analysis in the study population**

Spirometry	Mean	SD
FEV <sub>1</sub>	1.27 L	0.44(L)
FVC	1.963 L	0.548(L)
FEV <sub>1</sub> / FVC	0.682	0.139

Mean FEV1 value was 1.27±0.44 L. Mean FVC value was 1.963±0.548 L while mean FEV1/FVC ratio was 0.682.

**Table 8: Desaturation in the study population**

Desaturation	Frequency(n)	Percentage (%)
Yes	38	76
No	12	24
Total	50	100.0

Out of 50, 38 patients(76%) had oxygen desaturation of at least 4% on 6MWT.

**Table 9: Correlation between 6MWD and other variables in the study population**

Correlation 6MWD with	r-value	p-value
Age	-0.112	0.437(NS)
Sex	-0.010	0.471(NS)
BMI	-0.112	0.437(NS)
Smoking index	-0.069	0.636(NS)
FEV <sub>1</sub>	0.222	0.122(NS)
FVC	0.281	0.048 (S)*
FEV <sub>1</sub> / FVC	0.04	0.782
Desaturation	0.044	0.760
Severity of the disease	-0.210	0.0142 (S)*

S = Significant

When tested for the correlation between 6MWD and other variables in the study population, FVC and Severity of the disease were found to be significantly correlated with 6MWD. 6MWD was positively correlated with FVC and negatively correlated with severity of the disease in the study population. This means that patients with higher FVC could walk longer distance on 6MWT while patients with more severe disease could walk shorter distance on the test. This further supports utility of 6MWT as a substitute for grading severity of COPD in settings where spirometry is not available or patient is unable to perform spirometry. Other variables were positively or negatively had correlated with 6MWD but it was statistically not significant.

## Discussion

Out of 50 patients, Majority 36% of the study population belonged to 61 – 70 year of age group, followed by 71 – 80 (26%) year age group. Only 4% of the study population belonged to 30 – 40 years of age group. Mean  $\pm$  SD was  $62.2 \pm 10.927$  (in years) in the study population. In the study group, most (70%) of the patients were males, where females constituted 30% of the study group.

Andrianopoulos V et al,<sup>[6]</sup> Exercise-induced oxygen desaturation (EID) is related to mortality in patients with chronic obstructive pulmonary disease (COPD). Data from 2050 patients with COPD (age:  $63.3 \pm 7.1$  years; FEV<sub>1</sub>:  $48.7 \pm 15.7\%$  pred.) were analyzed. The occurrence of EID (SpO<sub>2</sub> post 88%) at the six-minute walking test (6MWT) was investigated in association with emphysema quantified by computed-tomography (QCT), and several clinical characteristics. 435 patients (21%) exhibited EID.

In the earliest study from Japan, by Takigawa et al.<sup>[7]</sup> 132 male and 12 female COPD patients were followed for a median 8 years. Desaturation was defined as  $\Delta$ SpO<sub>2</sub> 4%. They included mostly very severely afflicted COPD patients, with the majority (n=88) having a FEV<sub>1</sub> 30% pred.

According to BMI, most (56%) of the study population belonged to Normal, followed by pre – obese group (24%). Only 8% of the study population belonged to obese group. Based on severity of the disease, most (44%) of the study subjects belonged to moderate disease group, followed by severe (24%). Only 14% of the study subjects belonged to very severe group.

When tested for the correlation between 6MWD and other variables in the study population, FVC and Severity of the disease were found to be significantly correlated with 6MWD. Which means 6MWD was positively correlated with FVC and negatively correlated with severity of the disease in the study population. No other variables were statistically correlated with 6MWD in our study population.

In the largest study by CASANOVA et al,<sup>[8]</sup> desaturation was examined either as a decrease >4% or a fall <90%. The risk of death among patients who desaturated during testing was increased approximately twofold for both definitions of desaturation in the univariate and multivariable analyses. Mitra et al,<sup>[9]</sup> study concluded negative correlation between MMRC grade and 6MWD, which was also found in present study.

Mitra et al they found that there was a positive correlation present between BMI and severity of obstruction in COPD patients. While, another study Ischakiet al, demonstrated that there was no correlation between BMI and severity of obstruction in COPD patients. Correlation is significant at the 0.01 level. In present study, it has been found that there is no correlation between BMI and severity of obstruction of COPD.<sup>[9]</sup>

Our study showed the lack of association between the 6MWD and FEV1/FVC ratio previously reported by other researchers and contradicted the data published by Chlumsky et al.<sup>[10]</sup>

Though BMI correlates well with severity of COPD as shown by Landbo et al,<sup>[11]</sup> in their study, we did not find a strong correlation between BMI and 6MWD and this finding was comparable with the study done by Santana et al.<sup>[12]</sup>

In present study, 6MWD significantly correlated with FVC while correlation with FEV1 & FVC was not statistically significant. Other studies by Priya SK et al<sup>[13]</sup> & Hajare et al<sup>[14]</sup> found significant positive correlation between 6MWD & FEV1, FVC & FEV1/FVC ratio while study by Kundu et al found<sup>[16]</sup> significant correlation between 6MWD & FEV1 & FVC but not FEV1/FVC ratio.

COPD is a complex multidimensional disease, and classification schemes that incorporate more parameters than the degree of airflow obstruction are likely to predict outcomes more accurately. FEV1 is known to correlate poorly with symptoms, quality of life, exacerbation frequency, and exercise intolerance. Hence, newer approaches to disease assessment are required and may even supersede the current FEV1-based system of classification of disease severity. The multistage scoring system used in this study incorporated variables that can be easily evaluated in any office setting, and the oxygen desaturated in 6MWT has potential widespread applicability, just like the FEV1.<sup>[16-18]</sup>

## Conclusion

As 6MWD has statistically significant correlation with FVC & COPD severity, it can be used to grade COPD especially in resource-limited settings as well as in patients who cannot perform spirometry.

## Limitations of the study:

The study population was comparatively smaller. A larger study population could have given better results.

This was a cross-sectional observational study. A prospective case-control study with longer follow-up periods can give a better perspective about disease progression & decline in spirometry parameters as well as 6MWD.

## References

1. Global Initiative for Chronic obstructive pulmonary diseases – GOLD 2017 guidelines.
2. Buist AS, McBurnie MA, Vollmer WM, Gillespie S, Burney P, Mannino DM, et al.; BOLD Collaborative Research Group. International variation in the prevalence of COPD (the BOLD Study): A population based prevalence study. *Lancet* 2007;370:741-50.
3. Di Marco F, Terraneo S, Roggi MA, Repossi AC, Pellegrino GM, Veronelli A, et al. Physical activity impairment in depressed COPD subjects. *Res Care*. 2014 May 1;59(5):726-34.
4. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: Guidelines for the six minute walk test. *Am J Respir Crit Care Med* 2002;166:111-7.
5. Poulain M, Durand F, Palomba B, Ceugniet F, Desplan J, Varray A, et al. 6 minute walk testing is more sensitive than maximal incremental cycle testing for detecting oxygen desaturation in patients with COPD. *Chest* 2003;123:1401-7.
6. Andrianopoulos, V., Wouters, E. F. M., Pinto-Plata, V. M., Vanfleteren, L. E. G. W., Bakke, P. S., Franssen, F. M. E., ... Spruit, M. A. (2015). Prognostic value of variables derived from the six-minute walk test in patients with COPD: Results from the ECLIPSE study. *Respiratory Medicine*, 109(9), 1138–1146. doi:10.1016/j.rmed.2014.05.011
7. Takigawa N, Tada A, Soda R, et al. Distance and oxygen desaturation in 6-min walk test predict prognosis in COPD patients. *Respir Med* 2007; 101: 561–567.
8. Casanova C, Cote C, Marin JM, et al. Distance and oxygen desaturation during the 6-min walk test as predictors of long-term mortality in patients with COPD. *Chest* 2008; 134: 746–752.
9. Mitra, et al.: Correlation between BMI and GOLD staging in COPD *The Journal of Association of Chest Physicians* | Jul-Dec 2013 | Vol 1 | Issue 2.
10. Chlumsky J, Sterbova L, Smolikova L, Matous M, Salajka F. Relation between pulmonary ventilation parameters, exercise tolerance and quality of life in patients with chronic obstructive lung disease. *Vnitřní Lékařství* 2002;48:320-4.
11. Landbo C, Prescott E, Lange P, Vestbo J, Almdal TP. Prognostic value of nutritional status in chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 1999;160:1856-61.
12. Santana P, Cintra RM, Rodrigues F. Correlation study on the result from measures of function and functionality test of COPD patients. 2010.
13. Priya SK, Prasanth G, Aarthi R, et al. Correlation of six minute walk test with spirometry indices in chronic obstructive pulmonary disease patients. *J. Evolution Med. Dent. Sci.* 2019;8(50):3749-3753, DOI: 10.14260/jemds/2019/812
14. Hajare RB, Nagarwala R, Shyam A, Sancheti P. Correlation between 6-minute walk distance and spirometry parameters in stable chronic obstructive pulmonary disease patients. *Int J Res Med Sci* 2019;7:34-9
15. Kundu A, Maji A, Sarkar S, Saha K, Jash D, Maikap M. Correlation of six minute walk test with spirometric indices in chronic obstructive pulmonary disease patients: A tertiary care hospital experience. *J Assoc Chest Physicians* 2015;3:9-13.
16. Ramanathan RP, Chandrasekaran B. Reference equations for 6-min walk test in healthy Indian subjects (25-80 years). *Lung India: official organ of Indian Chest Society*. 2014 Jan;31(1):35.
17. Agrawal MB, Awad NT. Correlation between Six minute walk test and spirometry in chronic pulmonary disease. *JCDR*. 2015 Aug;9(8):OC01.

18. Kundu A, Maji A, Sarkar S, Saha K, Jash D, Maikap M, et al. Correlation of six minute walk test with spirometric indices in chronic obstructive pulmonary disease patients: A tertiary care hospital experience. J Assoc Chest Physicians 2015;3:9-13.