SIX MINUTE WALK TEST IN COPD AND ITS CORRELATION WITH SPIROMETRY AND ECHOCARDIOGRAPHY

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a major cause of disability and death all over the world.[1] Spirometry is the present gold standard for diagnosing COPD. FEV1/FVC ratio is used to define the presence or absence of airflow limitation and FEV1 is used to define the severity of the disease. FEV1 correlates weakly with dyspnea, accounting for 12% of the variability in dyspnea. Once FEV1 is reduced to 35% of predicted, there is a wide spectrum of ability; some patients are not limited in their activities, whereas others are confined to wheelchairs.[2]

Pulmonary hypertension (PH) is the major cardiorespiratory complication of the disease.[3] Pulmonary Hypertension due to COPD is a predictor of mortality, independent of the pulmonary obstruction severity. Diagnosis of Pulmonary hypertension is made by transthoracic echocardiography by estimating pulmonary artery (PA) systolic pressure using tricuspid regurgitant jet velocity (TRV).

6-min walk distance (6MWD) test is a sub maximal exercise test, used to assess the functional status of patients with COPD. The 6MWD test has proved to be reliable, inexpensive, safe, and easy to apply. It evaluates global and integrated response of pulmonary, cardiovascular, musculoskeletal and neuromuscular systems involved during exercise.

The purpose of the study is to find the correlation between 6MWD and FEV1 and pulmonary hypertension.

METHODS

- This is a cross sectional study conducted over 1 year which included 50 diagnosed COPD (FEV1/FVC< 0.7) patients aged > 40years.
- Exclusion criteria included;
    1. Patients with ischemic heart disease/ left heart failure.
    2. Patients with resting heart rate>120 bpm.
    3. Patients with systolic bp>180 and diastolic bp>120.
    4. Patients with respiratory failure.
    5. Patients with neurological, musculoskeletal, and peripheral vascular disease in lower extremities.
    6. Patients with asthma, pneumonia, lung cancer, tuberculosis and other respiratory illnesses limiting patient's movements.
    7. Patients unwilling to be a part of the study.

Patients satisfying inclusion and exclusion criteria underwent.

- Basic Investigations
- Spirometry (ATS 2005)
- 6 Minute Walk Test (ATS 2002). The 6MWT was performed indoors, along a long, flat, straight, enclosed corridor with a hard surface. The walking course was 30m in length. Patient was made to walk back and forth in the hallway as far as possible for 6 minutes and was permitted to slow down, to stop, and to rest as necessary. Heart rate, Blood Pressure, Oxygen saturation (SpO2), dyspnoea and fatigue (according to BORG scale) were noted before and after the test.
- Echocardiography (Doppler assisted PASP, LVEF and a complete evaluation of structure and function of right ventricle)
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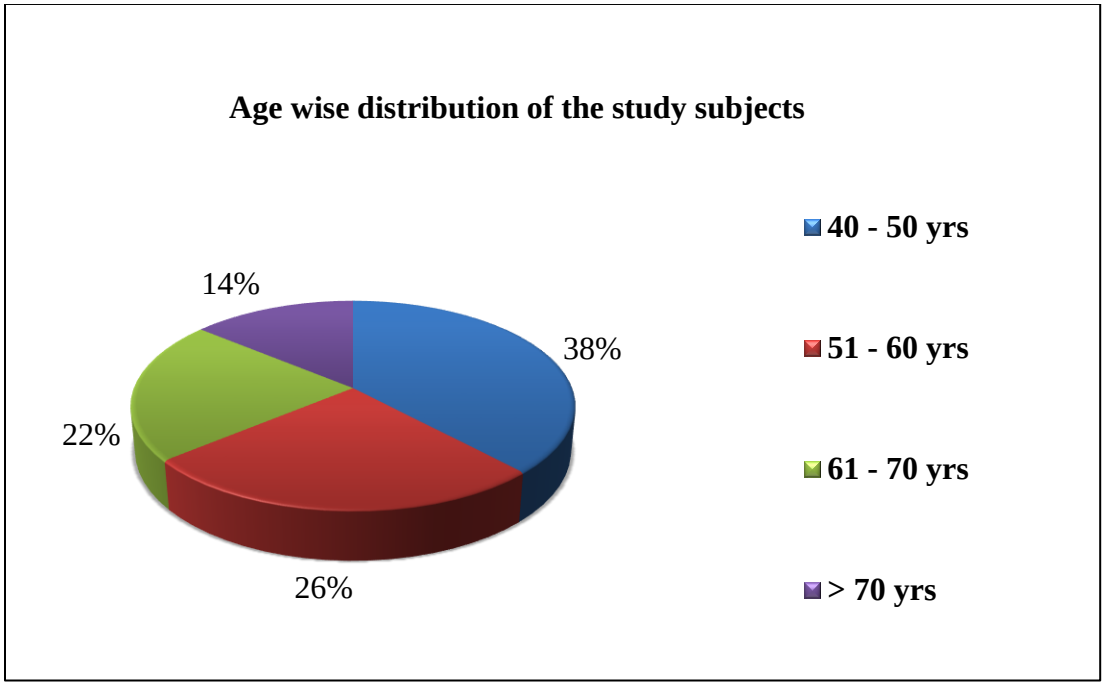
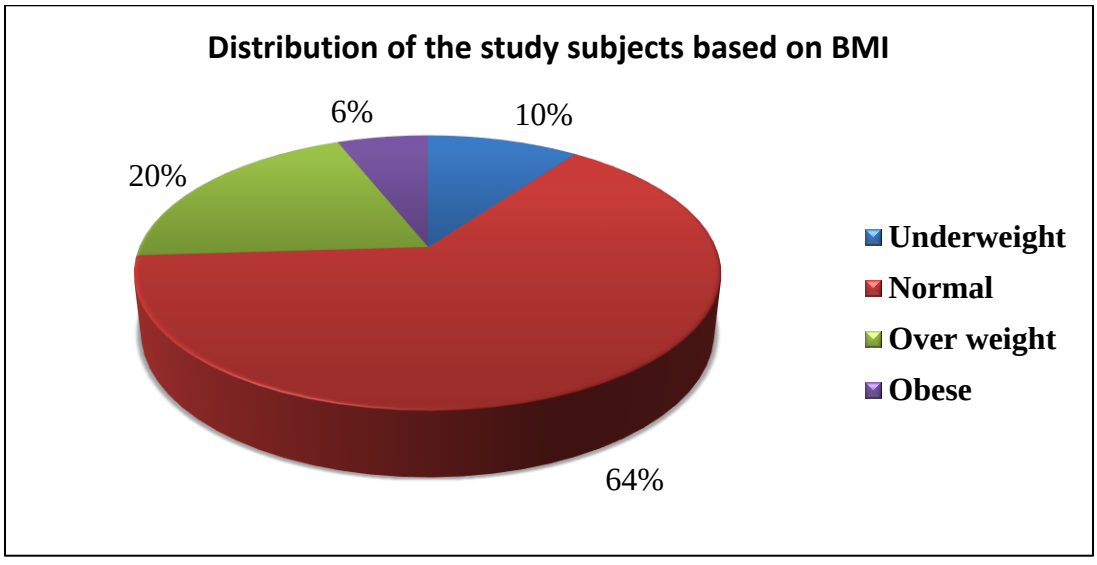
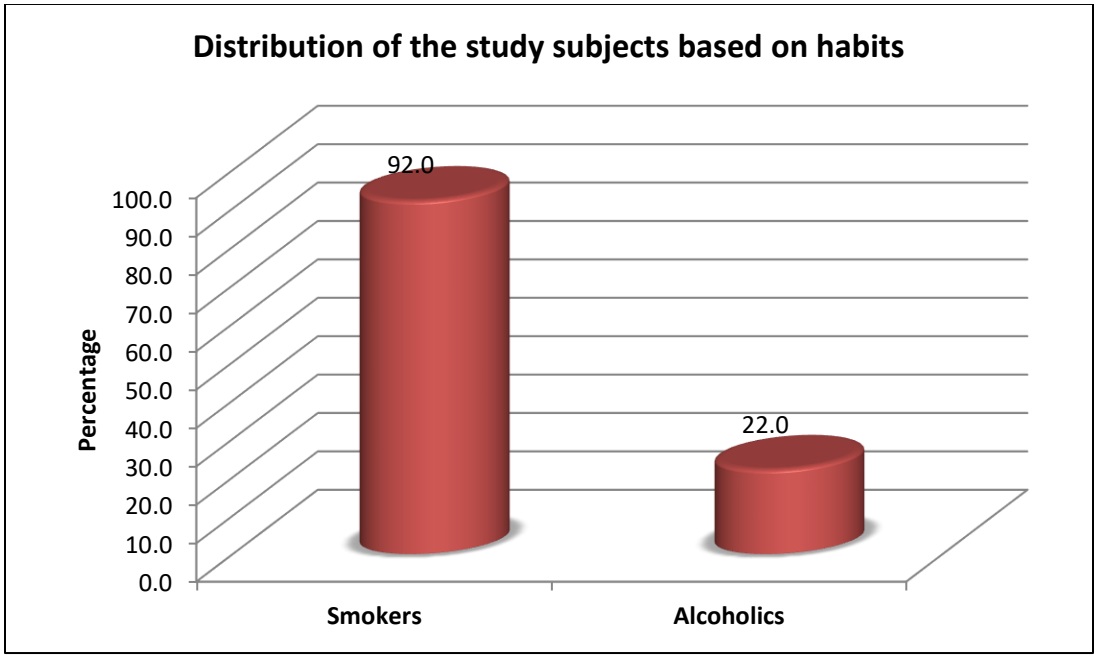
RESULTS

In this study 47 patients (94%) were males and 3 were females (6%). All patients were of more than 40 years with a mean age of 57.12 years



The mean body mass index (BMI) was 23.08; 3 patients were obese (6%), 10 patients (20%) were overweight, 5 patients (10%) were underweight and 32 patients (64%) had normal BMI. 46 patients (92%) were smokers. Among the smokers the mean smoking score was 65.22 pack years. 11(22%) were alcoholics.





8 patients (16%) had systemic hypertension and 7 (14%) had diabetes mellitus.
4 patients (8%) had complication of Pulmonary hypertension (as measured by 2D echo – a PASP > 25 mm Hg) - raised JVP and pedal edema

Co-morbidities among the study subjects		
Variable	Frequency	Percent
Family h/o COPD	0	0.0
Diabetes	7	14.0
Hypertension	8	16.0

All patients (100%) had shortness of breath, all patients had cough (100%) and 47 patients (94%) had sputum production. Duration of symptoms ranged from 2 to 10 years (mean=5.6 years). Patients had exacerbations of 2 to 8 episodes per year (mean = 4.54).

Symptomatology of the study subjects			
Symptomatology		Frequency	Percentage
Respiratory symptoms			
	Breathlessness	50	100.0
	Cough	50	100.0
	Expectoration	47	94.0
Exacerbations per year			
	Minimum	2 episodes	
	Maximum	8 episodes	
	Mean ± SD	4.54 ± 1.89	
Duration of symptoms			
	Minimum	2 years	
	Maximum	10 years	
	Mean ± SD	5.6 ± 2.15	

12(24%) patients had moderate COPD (GOLD stage 2), 13 (26%) patients had severe COPD (GOLD stage 3) and 17 (34%) patients had very severe COPD (GOLD stage 4), according to GOLD spirometry criteria.

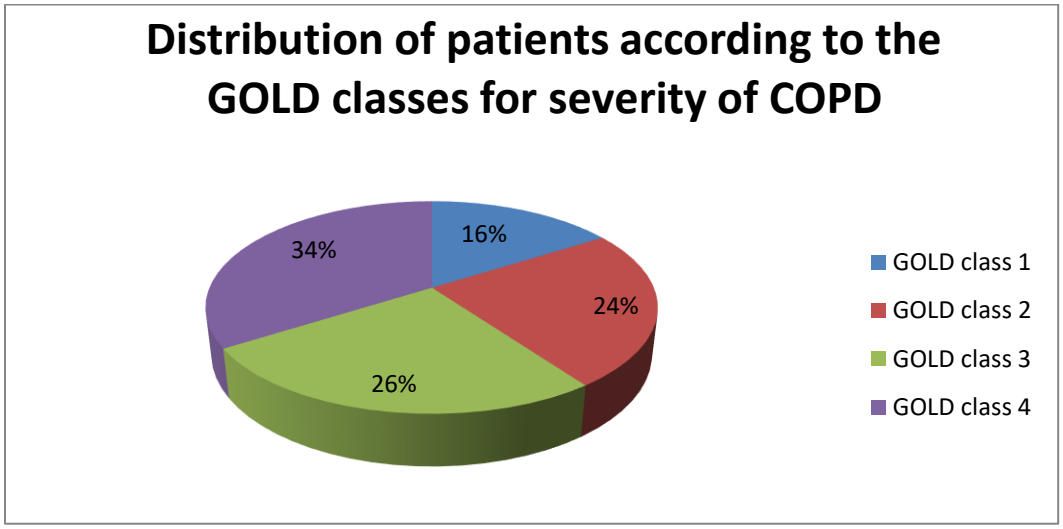
Clinical examination findings among the study subjects		
Signs	Frequency	Percent
Cyanosis	0	0.0
Raised JVP	4	8.0
Pedal edema	3	6.0
Barrel chest	14	28.0
Hyper resonant note on percussion	33	66.0
Wheeze on auscultation	42	84.0

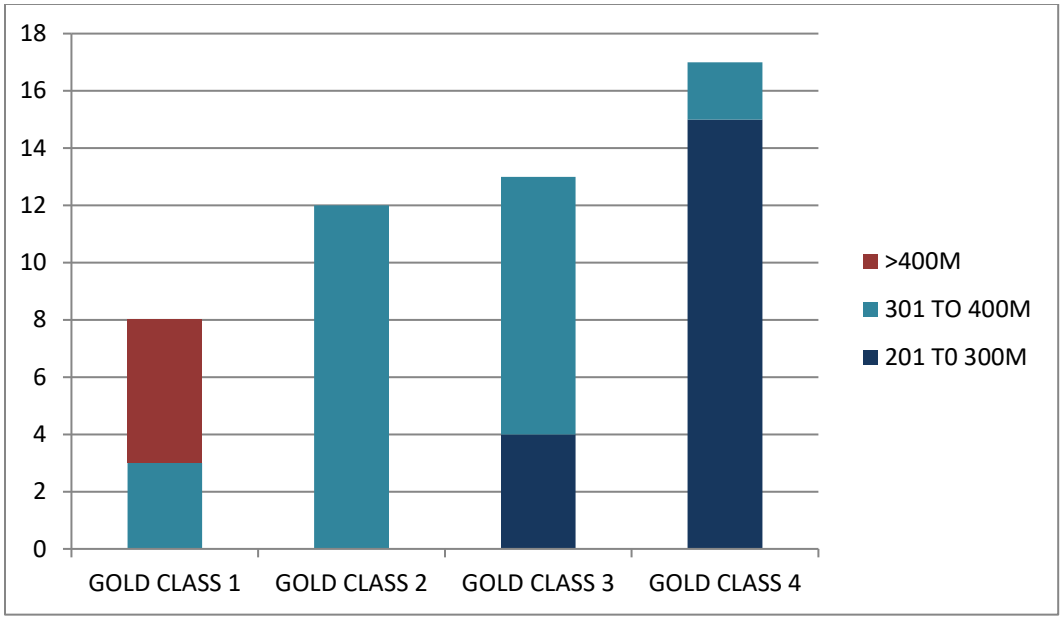
The mean pre-test spo2 was 94.28% and the mean post-test spo2 was 92.58%. A significant desaturation (≥4% fall in spo2) was present in 12 patients. 4 of those had very severe COPD, 5 had severe COPD and 3 had moderate COPD

Mean walking distance of study group was 318.56 meters. The maximum and minimum distance walked were 440 meters and 210 meters respectively

All patients (100%) have walked > 200 meters and 31(62 %) walked more than 300 meters distance. In stage I and II, all patients could walk more than 300 meters while in stage III and IV, 11 patients walked more than 300 meters. All 5 patients who walked more than 400 meters belonged to stage 1 COPD.

Comparison of six-minute walking distance with GOLD staging				
Gold stage	Six minute walking distance			P value
	201 – 300	301 - 400	> 400	
1 (n=8)	0 (0.0)	3 (37.5)	5 (62.5)	<0.001
2 (n=12)	0 (0.0)	12 (100.0)	0 (0.0)	
3 (n=13)	4 (30.8)	9 (69.2)	0 (0.0)	
4 (n=17)	15 (88.2)	2 (11.8)	0 (0.0)	
Total (n=50)	19 (38.0)	26 (52.0)	5 (10.0)	





All 11 patients belonging to MMRC grade 1 dyspnea index walked more than 300 meters. 10 out of 11 patients belonging to MMRC grade 2 walked more than 300 meters.
6 out of 12 (50%) and 12 out of 16 (75%) patients belonging to MMRC grade 3 and grade 4 walked less than 300 meters respectively.

Comparison of six-minute walking distance (6MMWD) with MMRC staging				
MMRC stage	Six minute walking distance			P value
	201 - 300	301 – 400	> 400	
1 (n=11)	0 (0.0)	6 (54.5)	5 (45.5)	
2 (n=11)	1 (9.09)	10 (90.9)	0 (0.0)	< 0.001
3 (n=12)	6 (50.0)	6 (50.0)	0 (0.0)	
4 (n=16)	12 (75.0)	4 (25.0)	0 (0.0)	
Total (n=50)	19 (38.0)	26 (52.0)	5 (10.0)	

6MWD correlated well with MMRC grading ($p < 0.001$).

The mean ejection fraction (EF) was 57.38% and the mean systolic pulmonary artery pressure (PASP) was 19.36 mm Hg in the study population.
Echocardiography parameters like EF (p value= 0.278) and PASP (p value = 0.249) did not correlate with 6-minute walk distance

Correlation between 6MWD and Echocardiography parameters						
Echocardiography parameters	Min	Max	Mean	Std. Deviation	R (corelation coefficient)	P value
EF	50	70	57.28	4.6027	-0.11	0.938
PASP	10	65	19.36	10.1835	-0.071	0.629
	Number absent			Number present		
Right ventricular Hypertrophy	46			4		0.029
Right ventricular Dilatation	46			4		0.029

The mean FEV1 % was 47.34 indicating most of the patients 30(60%) had severe to very severe COPD (FEV1< 50%). Of the spirometry parameters FEV1%, FVC% and PEFR% correlated well with 6-minute walk distance ($p < 0.001$) but the post bronchodilator FEV1/FVC correlated poorly with 6-minute walk distance (p value = 0.187)

Correlation between 6MWD and Spirometry parameters						
Spirometric parameters	Min	Max	Mean	Std. Deviation	R (corelation coefficient)	P value
Post bronchodilator FEV1/FVC	32	69	59.54	9.087	0.19	0.187
FEV1 %	15	94	47.34	23.9503	0.968	<0.001
FVC %	19	106	57.52	24.1621	0.949	<0.001
PEFR %	6	66	30.88	19.0087	0.871	<0.001

Demographic parameters like age, BMI, height and weight were not correlating with 6-minute walk distance (6MWD).

Correlation between 6MWD and Patient's parameters						
Patient's Parameters	Min	Max	Mean	Std. Deviation	R (corelation coefficient)	P value
AGE	40	77	57.12	10.726	-0.427	0.002
Weight	45	77	61.4	8.823	0.038	0.796

Height	152	170	162.76	3.81	-0.143	0.322
BMI	16	32	23.08	3.708	0.082	0.573
MMRC	1	4	2.66	1.154	-0.777	<0.001

Comparison of present study with other studies based on Correlation of COPD stage and 6MWD.

Sl. No.	Study	Correlation between COPD stage and 6MWD
1	Present study	Positive
2	Manoj Kumar Khandelwal et al[33]	Positive
3	Naghshin R et al[38]	Positive

Comparison of present study with other studies based on Correlation of spirometry and 6MWD.

Study	Correlation between 6MWD and spirometry indices			
	FEV1/FVC	FEV1 %	FVC %	PEFR %
Present study	No correlation	Positive	Positive	Positive
Manoj Kumar Khandelwal et al[4]	Positive	Positive	Positive	Positive
Anil Kumar Kodavala et al[2]	No correlation	No correlation	No correlation	No correlation

Comparison of present study with other studies based on Correlation of Age, Height, Weight, Body Mass Index (BMI) and 6MWD

Study	Correlation between 6MWD			
	Age	Height	Weight	BMI
Present study	No correlation	No correlation	No correlation	No correlation
Manoj Kumar Khandelwal et al	No correlation	No correlation	No correlation	No correlation

Ozalevli et al[5]	No correlation	No correlation	No correlation	No correlation
Yi-Hsi Wang et al[6]	Positive	No correlation	No correlation	No correlation

Comparison of present study with other studies based on Correlation of Echocardiography with 6MWD.

Study	Pulmonary hypertension	RV hypertrophy	RV dilation	Ejection fraction (EF)
Present study	No correlation	No correlation	No correlation	No correlation
Miyamoto et al[7]	Positive	Positive	Positive	No correlation
Kudtarkar et al[8]	-	-	-	Positive
Opasich et al[9]	-	-	-	No correlation

CONCLUSION:

The correlation of 6MWT and pulmonary function test (FEV1, FVC, PEFR and grading of dyspnea) in patients with COPD makes this test easy and a simple tool for assessing the disease status and progression and severity of disease.

This test is underutilized by clinicians currently. This test may be easily carried out in hospital settings with adequate space but may be difficult to be carried out in office practice due to time and space constraints. Equipments needed to implement the 6MWT, such as finger pulse-oximeter, sphygmomanometer, stopwatch etc. are all simple medical instruments. After simple training, even non-medical people such as family members could carry out the 6MWT and assess the disease.

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