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A Comparative Study of Six Minute Walk Test (6MWT) amongst Healthy Individuals and COPD Patients

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Abstract: ***Background: Timed walking tests are widely used to evaluate functional exercise performance, as they are likely to measure the ability to undertake the activities of day-to-day life. Six minute walk test (6MWT) is an important tool in screening, management and prognostication of pulmonary and cardiovascular diseases and is considered to provide a reliable and valid measure of functional exercise capacity. The aim of the present study was to compare the six minute walk test (6MWT) amongst healthy individuals and COPD patients in the age group of 40 – 70 years. Methods: An observational case control study was carried out in the department of TB & Chest at Rajendra Institute of Medical Sciences, Ranchi, Jharkhand from 1st January 2017 to 31st March 2018, including 140 subjects (70 healthy individuals and 70 COPD patients) in the age group of 40 – 70 years. The 6MWT was performed as per the guidelines laid by the American Thoracic Society (ATS). Results: We observed that the mean six minute walk distance was significantly less in COPD patients (408.00 ± 74.20 meters) as compared to healthy subjects (626.69 ± 64.67 meters) (p < 0.001). Conclusion: The impairment in functional status affecting COPD patients is multifactorial, reflecting the respiratory and non-respiratory expressions of the disease. Impaired exercise capacity as assessed by the 6MWT better reflects the overall compromise than markers that only reflect the physiological impairment of lung function in COPD patients.***

Keywords: COPD, 6MWT, 6MWD, FEV_1, FVC, ATS, Spirometry.

1. Introduction

The assessment of functional capacity reflects the ability to perform activities of daily living that require sustained aerobic metabolism. The integrated efforts and health of the pulmonary, cardiovascular, and skeletal muscle systems dictate an individual's functional capacity. Numerous investigations have demonstrated that the assessment of functional capacity provides important diagnostic and prognostic information in a wide variety of clinical and research settings[1]. Assessment of functional exercise capacity has gained importance in the evaluation of patients in various disease states.

Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease (COPD) ranks as one of the leading causes of mortality and is predicted to become the number one cause of respiratory related disability in the world by 2020[2-4].

The inability to perform everyday activities due to exercise intolerance affects many COPD patients and is associated with poor health related quality of life[5,6] and decreased survival[7,8].

Six Minute Walk Test

The Six minute walk test (6MWT) is a simple test that measures the distance that a patient can quickly walk on a flat, hard surface in a period of 6 minutes. It assesses the submaximal level of functional capacity. The test evaluates the global and integrated responses of all the systems involved during exercise; including the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism[9].

2. Methods

This study was conducted in the department of TB & Chest at Rajendra Institute of Medical Sciences, Ranchi, Jharkhand from 1st January 2017 to 31st March 2018. This was an observational case control study conducted in 140 subjects (70 healthy individuals and 70 COPD patients) who fulfilled the selection criteria and were randomly selected for the study.

Inclusion Criteria

1) Healthy individuals – subjects free from injury and having no history of hospitalization or chronic disease influencing their exercise capacity and who are lifetime non-smokers in the age group of 40 – 70 years.
2) COPD patients – new and old diagnosed cases of COPD who have FEV_1/FVC ratio less than 70 % of predicted on spirometry in the age group of 40 – 70 years

Exclusion Criteria

1) Age <40 or >70 years
2) Unstable angina during the previous month
3) Myocardial infarction during the previous month
4) Resting heart rate > 120 beats per minute
5) Systolic blood pressure > 180 mm of Hg
6) Diastolic blood pressure > 100 mm of Hg
7) Severe musculo-skeletal disease affecting the lower extremities or the spine
8) Serious cardio-vascular disease
9) Other co-morbidities

The test was performed as per the guidelines laid down by the ATS in 2002[9].

Location
The 6MWT was performed outdoors, along a long, flat, straight corridor with a hard surface. A 100 feet hallway was used, the length of the corridor was marked every 3 meters, turnaround points marked with a cone and the starting line, which marks the beginning and end of each 60 meters lap, was marked with a brightly coloured tape.

Equipments Required
1) Countdown timer (or stopwatch)
2) Mechanical lap counter
3) Two small cones to mark the turnaround points
4) A chair that can be easily moved along the walking course
5) Worksheets on a clipboard
6) A source of oxygen
7) Sphygmomanometer
8) Pulse oximeter
9) Telephone, and
10) Automated electronic defibrillator

Patient Preparation
1) Comfortable clothing was worn.
2) Appropriate shoes for walking were used.
3) The patient was allowed to use his/her usual walking aids during the test.
4) The patient's usual medical regimen was continued.
5) A light meal was acceptable before early morning or early afternoon tests
6) Patient should not have exercised vigorously within 2 hours of beginning the test was taken care of.

Measurements
1) Test was done about the same time of the day to minimize intraday variability as far as possible.
2) Warm up period was not performed
3) Patient was rested in a chair located near the starting position for at least 10 minutes before the test starts
4) Any contraindication was looked for and BP, respiratory rate and pulse was measured
5) Pulse oximetry was done to measure SpO_2
6) Patients baseline dyspnea was assessed using Borg scale
7) Lap counter was set to zero and the timer to 6 minutes; all necessary equipments were assembled and moved to the starting line
8) The subject was given all necessary instructions and made to walk
9) Post test dyspnea was recorded.
10) Pulse oximeter was used and SpO_2 and pulse rate and respiratory rate was measured
11) Number of laps from the counter and the extra distance covered was recorded and finally the total distance covered rounding to the nearest meter was calculated and recorded.

Statistical Methods
Raw data was tabulated in Excel sheet (MS Office 2007). Description of data was carried out. Appropriate graphical representations were done. Statistical analysis was performed by the SPSS program for Windows, version 17.0. Continuous variables are presented as mean ± SD, and categorical variables are presented as absolute numbers and percentage. Data were checked for normality before statistical analysis using Shaipro Wilk test. Normally distributed continuous variables were compared using ANOVA and multiple comparison tests were used to assess the differences between the individual groups using Bonferroni correction. Categorical variables were analyzed using the chi square test. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference.

3. Results

Dyspnea on exercise is one of the basic symptoms of the patients with chronic obstructive pulmonary disease (COPD). It appears in the initial phases of the disease, affects activities of daily living, and determines to a large extent the perception of the degree of illness and the extent of deterioration in quality of life[10].

The subjects were selected randomly from the IPD and OPD. No age and sex distribution was made.

A. Patient Profile

1) Age
The mean age distribution was comparable in both the groups, being 55.91 ± 8.06 years in COPD patients and 53.33 ± 9.08 years in healthy subjects. In COPD group, maximum patients 17 (24.3%) belonged to 56 – 60 years of age and minimum patients 5 (7.1%) to 66 – 70 years. Amongst healthy individuals, maximum patients 21 (30%) belonged to 40 – 45 years and minimum patients 8 (11.4%) to 46 – 50 years and 66 – 70 years respectively. Table 1 shows the age wise distribution of COPD patients and healthy individuals.

Table 1: Age distribution among COPD & Healthy

Age Groups	COPD	Healthy	P value
	Frequency (%)	Frequency (%)	
40 - 45 yrs	12 (17.1%)	21 (30%)	0.748
46 - 50 yrs	12 (17.1%)	8 (11.4%)	
51 - 55 yrs	12 (17.1%)	12 (17.1%)	
56 - 60 yrs	17 (24.3%)	10 (14.3%)	
61 - 65 yrs	12 (17.1%)	11 (15.7%)	
66 - 70 yrs	5 (7.1%)	8 (11.4%)	
Total	70 (100%)	70 (100%)	
Mean ± SD	55.91 ± 8.06	53.33 ± 9.08	0.150

2) Sex
There was male predominance in both the groups. There were 59 (84.3%) males and 11 (15.7%) females in both the groups. Male to female ratio was 6:1. Table 2 shows the sex wise distribution of COPD patients and healthy individuals.

Table 2: Sex distribution among COPD & Healthy

Sex	COPD	Healthy	P value
	Frequency (%)	Frequency (%)	
Female	11 (15.7%)	11 (15.7%)	0.705
Male	59 (84.3%)	59 (84.3%)	
Total	70 (100%)	70 (100%)	

3) Height & Weight
Weight and height were comparable in both the groups. The mean weight and height of COPD patients were 68.37 ± 2.66 kgs and 169.34 ± 2.85 cms and that of healthy individuals were 69.30 ± 2.68 kgs and 167.34 ± 3.02 cms respectively.

Table 3 shows the distribution of weight and height in COPD patients and healthy individuals.

Table 3: Distribution of Weight & Height among COPD & Healthy

	COPD	Healthy	P value
	Mean ± SD	Mean ± SD	
Weight (kgs.)	68.37 ± 2.66	69.30 ± 2.68	0.980
Height (cms.)	169.34 ± 2.85	167.34 ± 3.02	0.626

4) Distribution of subjects based on Spirometry

Spirometry was normal in healthy. In the COPD group, the maximum patients belonged to the moderate group (55.7%) followed by severe (20%), mild (15.7%) and very severe (8.6%) respectively. Table 4 shows the distribution of COPD patients and healthy individuals on the basis of spirometry.

Table 4: Distribution of subjects based on Spirometry

Spiro Result	COPD	Healthy	P value	COPD vs Healthy
	Freq. (%)	Freq. (%)		
Normal	0 (0%)	70 (100%)	<0.001	<0.001
Mild	11 (15.7%)	0 (0%)		
Moderate	39 (55.7%)	0 (0%)		
Severe	14 (20.0%)	0 (0%)		
Very Severe	6 (8.6%)	0 (0%)		
Total	70 (100%)	70 (100%)		

Six Minute Walk Distance (6MWD)

The mean 6MWD covered by the COPD patients was 408.00 ± 74.20 m (200 – 580 m), which was significantly less than that of healthy subjects, 626.69 ± 64.67 m (453 – 710 m), (p value < 0.001). Table 5 shows the comparison of 6MWD amongst COPD patients and healthy individuals.

Table 5: Comparison of 6MWD amongst COPD & Healthy

6MWD	Mean ± SD	Min - Max	P Value	COPD vs Healthy
COPD	408.00 ± 74.20 m	200 – 580 m	<0.001	<0.001
Healthy	626.69 ± 64.67 m	453 – 710 m		

4. Discussion

The impairment in functional status affecting COPD patients is multifactorial, reflecting the respiratory and non-respiratory expressions of the disease[11].

Timed walking tests are widely used to evaluate functional exercise performance, as they are likely to measure the ability to undertake the activities of day-to-day life. The six minute walk test is an important tool in screening, management and prognosis of pulmonary and cardiovascular diseases[12] and is considered to provide a reliable and valid measure of functional exercise capacity[13]. It had been considered as a very important instrument both in clinical practice and research[14].

A problem for clinical application is the paucity of reference data of 6MWT across different disease conditions, population, age and gender that can to be used for clinical evaluation.

The mean age of subjects was comparable in both the groups. It was 55.91 ± 8.06 years in COPD patients and 53.33 ± 9.08 years in the healthy individuals. Majority of patients were in the age group of 40-60 years in both the groups.

Among 140 subjects, 22 were females, 11 (15.7%) and 118 were males, 59 (84.3%) in both the groups respectively. There was male predominance with the male to female ratio of 6:1.

Six Minute Walk Distance in Healthy Subjects

In our study, the mean 6MWD in healthy individuals was 626.69 ± 64.67 m, range 453 - 710 m.

Gibbons et al[15] in multiple repetition 6-minute walk test in healthy adults older than 20 years reported that 6MWD averaged 698 ± 96 m. The reference value of our study is slightly lower as compared to study by Gibbons et al, which could be because of variation in race and ethnicity. One possible reason of difference in 6MWD in our study could be the absence of test repetition, as test repetition provides familiarization and influences the 6MWD[16]. The 6MWD in another study done in healthy elderly subjects averaged 631 ± 93 m[17]. The reference value is comparable to the value of our study. In the study by Bernadine et al[18] in healthy subjects aged 55-75 years, the average 6MWD was 659 ± 62 m. Poh H et al[19] found that the 6MWD in healthy Singaporeans was 560 ± 105 m. In another study in Asian, African-American, Hispanics, Caucasians and Middle-East subjects showed that the average 6MWD in them was 1513 ft (461.16 m), range 980-1980 ft (298.7 – 603.5 m) [20]. Hatem Alameri et al[21] found that the average 6MWD in healthy Saudi adults was 409 ± 51 m. This was much less than the value of our study and those reported for other ethnic groups in different studies. In an Indian study done by Ramanathan et al[22], the mean 6MWD in healthy Indian subjects was 495.09 ± 83.85 m, the value of which is much less than our study. The probable reason could be that they included a wide age group of population ranging from 25 to 80 years. An another Indian study found that the mean 6MWD was 531.1 ± 46.9 m in North Indian adult males[14].

Moreover, variation in the result of our study and other published data could be because of the inclusion of factors such as mood, attitude, motivation and race and several demographic and anthropometric factors which have also been shown to influence 6MWD[16].

Six Minute Walk Distance in COPD Patients

The mean 6MWD in COPD patients in our study was 408.00 ± 74.20 m. This was significantly less than the healthy adults (p value < 0.001). Elie Fiss et al, in his study in COPD patients observed that the mean 6MWD was 478.9 ± 99.2 m[23].

5. Conclusion

There was significant decrease in 6MWD in COPD patients as compared to the healthy subjects.

Impaired exercise capacity better reflects the overall compromise of patients with COPD than markers that only reflect the physiological impairment of lung function.

6MWT fulfills the necessary criteria to be recommended as the reference test in characterizing COPD patients, together with lung function tests measured at rest.

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