ORIGINAL RESEARCH PAPER

Respiratory Medicine

CHANGES IN SIX MINUTE WALK TEST AFTER BRONCHODILATION IN RESPIRATORY PATIENTS.

KEY WORDS: The 6-min walk test (6MWT), Idiopathic pulmonary fibrosis, BODE index., Spirometric indices, Chronic Respiratory Questionnaire (CRQ)

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ABSTRACT

The 6-min walk test (6MWT) is a commonly used test for the objective assessment of functional exercise capacity for the management of patients with moderate-to-severe pulmonary disease. Unlike pulmonary function testing, the 6MWT captures the often-coexisting extrapulmonary manifestations of chronic respiratory disease, including cardiovascular disease, frailty, sarcopenia, and cancer. In contrast with cardiopulmonary exercise stress testing, this test does not require complex equipment or technical expertise. In this low complexity, safe test, the patient is asked to walk as far as possible along a 30-m minimally trafficked corridor for a period of 6 min with the primary outcome measure being the 6-min walk distance (6MWD) measured in meters. There has been interest in other derived indexes, such as distance-desaturation product (the product of nadir oxygen saturation and walk distance), which in small studies has been predictive of morbidity and mortality in certain chronic respiratory conditions. Special attention to methodology is required to produce reliable and reproducible results. Factors that can affect walk distance include track layout (continuous vs straight), track length, oxygen amount and portability, learning effect, and verbal encouragement. The absolute 6MWD and change in 6MWD are predictive of morbidity and mortality in patients with COPD, pulmonary arterial hypertension, and idiopathic pulmonary fibrosis and patients awaiting lung transplant, highlighting its use in management decisions and clinical trials

INTRODUCTION

CMS determination of oxygen need is the time of need, further defined as "during the patient's illness when the presumption is that the provision of oxygen in the home setting will improve the patient's condition."(1)

The need for oxygen supplementation to treat hypoxemia is often assessed in primary and pulmonary outpatient clinics through use of a standardized objective measuring tool recognized by the Centers for Medicare and Medicaid (CMS).(2)

This recognition is used to reimburse practices and patients both in utilization of the tool and in the issuance of oxygen for home use by patients with documented hypoxemia.(3)

Hypoxemia and oxygen need are defined by the CMS and include provider evaluation, timing of determination of oxygen need, and supporting clinical criteria.(4,5)

The first element of provider evaluation is initial oxygen determination assessment and is based on the results of a clinical test that has been ordered and evaluated by the treating practitioner (6)

The 6MWT is a low-intensity, submaximal exercise test used to assess aerobic capacity and endurance and oxygen saturation.(7)

A subsequent literature review and technical standard update by a joint European Respiratory Society and American Thoracic Society collaboration in 2014 that endorsed its continued use in clinical settings.(8)

Current clinical uses of the 6MWT are for patients with chronic obstructive lung disease, idiopathic pulmonary fibrosis, and pulmonary artery hypertension (9)

A newer application of the 6MWT is noted for patients who have had COVID-19 pneumonia with prolonged respiratory symptoms.(10,11)

Standardization of a 6MWT is essential for reproducible and reliable results. The 6MWT is to be performed along a minimally trafficked flat, straight corridor ideally 30 m in length to be consistent with established reference equations. Reference equations exist for shorter tracks, including 20- and 10-m lengths, to reflect space limitations in practice.(12)

Study documentation of adverse effects reveal oxygen desaturation as the most common adverse effect, with desaturation to less than or equal to 80% in approximately 5% of testing, and patient symptoms prematurely terminating the test in 1% of testing.(13)

The 6MWT is a practical, simple test that requires, in ideal circumstances, a 100- foot hallway, no exercise equipment, and no advanced training for technicians. (14)

Walking is a daily activity for all but severely impaired patients and so can be used by most patients in a practice. Patient involvement is based on voluntary participation, is self directed, and is easily terminated in the event of a complication. (15)

In 2018, with an appropriate modifier when used in conjunction with a provider visit. It provides a platform for the use of oxygen for home and for long-term pulmonary management.(16)

The recent pandemic has created a relatively new patient population that requires assessment and evaluation for hypoxemia and further management as these individuals recover from COVID19 pneumonia.(17)

B Celli et al conducted a study to analyse the original data from several large observational studies and from randomized clinical trials with bronchodilators to support the

qualification of the 6MWD test as a drug development tool in COPD from six observational and five interventional studies.(18)

V Andrianopoulos et al conducted a study to know the association between 6 MWT-derived variables and mortality as well as hospitalization in COPD patients and compared it with the BODE index. The 6 MWW, EID and the BODE index refine the prognosis of hospitalization(19)

N Saiphoklang et al conducted a study to compare between the distances of 20 and 30 m long corridor affecting 6MWT in Fifty COPD patients. The 6MWD in a 20-m and a 30-m walkway were 337.82±71.80 m and 359.85±77.25 m, respectively (P<0.001). Mean distance difference was 22.03 m, (P<0.001(20)

G Güngör et al conducted a study to assess whether the actual 6-min walk distance (6MWD) or the percent predicted 6MWD is a better reflection of the respiratory function of patients using home noninvasive ventilation (NIV) due to chronic hypercapnic respiratory failure in 144 subjects.(21)

A Nicolini et al conducted a study in one hundred consecutive in and out- patients with moderate to severe COPD to assess the benefit of a simple positive expiratory pressure (PEP) device. PEP device consisted of a PEP valve 5 cmH_2O connected to 1-meter tube and a mouthpiece. All the enrolled patients performed a 6MWT before randomization. (22)

Pimentel MR et al conducted a study to know whether the 6-minute walking test can evaluate all patients with respiratory disease in 32 patients with SSc, 32 with IPF and 50 with COPD. All patients underwent the 6MWT and a respiratory function test. Patients with ILD did not present significant differences when compared with each other. (23)

A Kundu et al conducted a study to find out correlation between spirometric indices (forced expiratory volume in 1 s (FEV_1), forced vital capacity (FVC), and peak expiratory flow rate (PEFR)) and 6-minute walk distance (6MWD) in COPD patients, and thus to assess whether 6MWT can replace spirometry (24)

R Gloeckl et al compared the accuracy of the 2MWT to the 6MWT in detecting exercise-induced oxygen desaturation in twenty six patients with severe COPD. Average walking distances were 150 m and 397 m for the 2MWT and 6MWT, respectively.(25).

T Wibmer et al conducted a study to compare the correlations of walk distance and lung volumes measured before and after a 6-min walk test (6MWT) in forty-five subjects with COPD. Body plethysmography was performed immediately pre- and post-6MWT. (26)

B Thomas et al conducted a study to find out the efficacy of the 6MWT in assessing response to medical intervention in patients suffering from COPD. The 6 minute walk test (6MWT) was performed in a secured 30 meter. (27)

L Jayaram et al conducted a study to quantify the benefit of this therapy on the six minute walk test and changes in lung function, symptoms, the BODE index and QOL in 38 participants with moderate to severe COPD on tiotropium were randomised to receive either formoterol or placebo for 6 weeks.(28)

RS Rao et al conducted a study to evaluate its efficacy in severe chronic obstructive pulmonary disease (COPD) in 37 patients with severe COPD received either sildenafil or placebo for 12 weeks. Distance covered in six-minute walk test (6MWD) was taken as primary end-point (29)

PS Tej et al conducted a study Comparison of correlation of six minute walk test and Incremental shuttle walk test with the severity of airflow obstruction in COPD patients. One hundred and twelve spirometrically confirmed COPD patients underwent 6MWT and ISWT. (30)

RB Hajare et al conducted a study to assess correlation of six minute walk test with spirometry parameters in fifty patients diagnosed with chronic obstructive pulmonary disease (GOLD criteria). Spirometric indices including FEV1, FVC, FEV1/FVC and MVV were tested using computerized spirometer. 6MWT was performed following American Thoracic Society (ATS) guidelines. (31)

C Brophy et al conducted a study that compared intermediate (120mcg ipratropium bromide and 600mcg of salbutamol using metered dose inhaler (MDI) and spacer) and high dose (nebulized 500 mcg ipratropium bromide and 2.5 mg salbutamol) bronchodilator therapy, on physiological, functional and quality of life-related measurements in patients with COPD (32)

WA Altenburg et al conducted a study to establish the MID of the ESWT in patients with severe COPD. Six minute walking distance (6MWD), peak work rate on bicycle ergometry (Wpeak) and Chronic Respiratory Questionnaire (CRQ) were used as anchors and Cohen's effect size was used as distribution based method.(33)

C. Brouillard et al conducted a study to evaluate, in patients with COPD, the responsiveness of the ESWT in detecting improvement in walking performance after a single dose of salmeterol in 20 patients with COPD performed two ESWT at 80% of peak capacity 2.5 h after inhaling either a placebo or 50 μg of salmeterol. (34)

Aim And Objectives Of The Study

Aim:

To study the changes in Six Minute Walk Test after Bronchodilation in Pulmonary Medicine OPD Patients.

OBJECTIVES:

1. To show the effectiveness of Bronchodilation in exercise capacity of Chronic Respiratory Patients.
2. To Analyze the effectiveness of Bronchodilation in different Obstructive Airway disease.

MATERIALS AND METHODS

Sample Size: 50 Patients

Study Design: Prospective Cross Sectional Study.

Study Period: November2022 to August 2024.

Place Of Study: Department Of Pulmonary Medicine OPD, MNR Medical College And Hospital, Sangareddy.

Sampling Technique: Convenient Technique

METHODOLOGY

Patient Height and weight is checked and recorded. Pulse and Saturation is checked by Pulse Oximeter before making patient to walk for 6 minutes and recorded. BP is measured by sphygmomanometer and recorded.

Patient is made to walk between two marked points of known distance for 6 minutes and vitals recorded.

Patient is given Bronchodilator (SABA-Asthalin) in inhaled form and asked to wait for 1 O min for it's onset of action.

Again patient's Vitals are recorded before test and made to walk for 6 minutes.

Vitals recorded post test and compared.

Distance walked pre and post bronchodilator is measured And compared.

Inclusion Criteria

1. Patients above 12 years of age visiting the
2. Pulmonary Medicine OPD

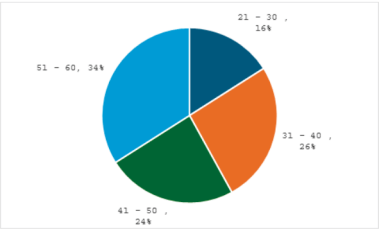
Exclusion Criteria

1. Person with a recent H/o of Angina not less than 3 months.
2. Patients who are continuously on NIV
3. Patients with Psychiatric abnormality

RESULTS

Table 1: Distribution Based on Age

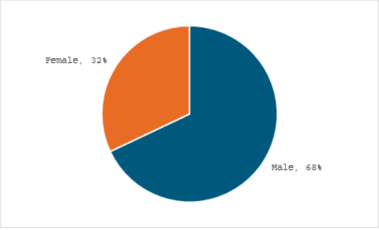
	Frequency	Percentage
21 – 30	8	16%
31 – 40	13	26%
41 – 50	12	24%
51 – 60	17	34%
Total	50	100%



This table presents the age distribution of participants. The data is divided into four age groups: 21-30 years, 31-40 years, 41-50 years, and 51-60 years. The majority of participants fall into the 51-60 years category, accounting for 34% (17 individuals). This is followed by the 31-40 years group with 26% (13 individuals), the 41-50 years group with 24% (12 individuals), and the 21-30 years group with 16% (8 individuals).

Table 2: Distribution Based on Gender

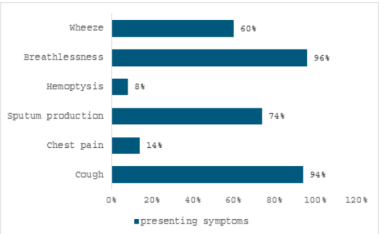
	Frequency	Percentage
Male	34	68%
Female	16	32%
Total	50	100%



This table shows the gender distribution among the participants. Out of 50 individuals, 34 are male, making up 68% of the total sample, while 16 are female, constituting 32%. This indicates a higher prevalence of male participants in the study.

Table 3: Distribution Based on Presenting Symptoms

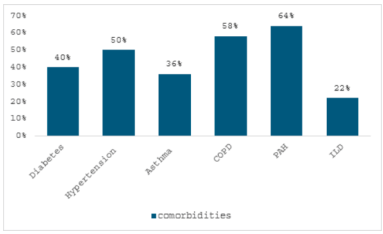
	Frequency	Percentage
Cough	47	94%
Chest pain	7	14%
Sputum production	37	74%
Hemoptysis	4	8%
Breathlessness	48	96%
Wheeze	30	60%



The table lists the frequency and percentage of various symptoms reported by participants. Breathlessness is the most common symptom, experienced by 96% (48 individuals). This is followed by cough, reported by 94% (47 individuals), sputum production by 74% (37 individuals), wheeze by 60% (30 individuals), chest pain by 14% (7 individuals), and hemoptysis by 8% (4 individuals).

Table 4: Distribution Based on Comorbidities

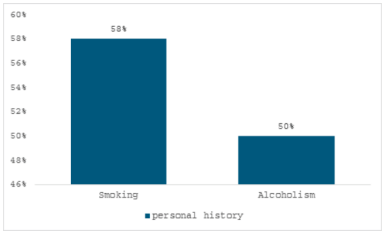
	Frequency	Percentage
Diabetes	20	40%
Hypertension	25	50%
Asthma	18	36%
COPD	29	58%
PAH	27	64%
ILD	11	22%



This table outlines the comorbidities present among the participants. Hypertension is the most prevalent comorbidity, affecting 50% (25 individuals). Other common comorbidities include COPD at 58% (29 individuals), PAH at 64% (27 individuals), diabetes at 40% (20 individuals), asthma at 36% (18 individuals), and ILD at 22% (11 individuals).

Table 5: Distribution Based on Personal History

	Frequency	Percentage
Smoking	29	58%
Alcoholism	25	50%

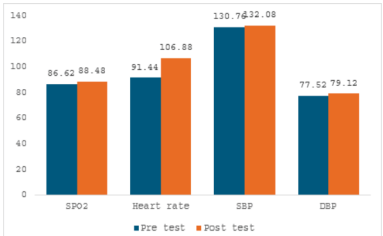


The personal history of participants regarding smoking and alcoholism is documented in this table. Smoking is reported by 58% (29 individuals), while alcoholism is noted by 50% (25 individuals), indicating a significant presence of these habits among the participants

Table 6: Six Minute Walk Test Before Bronchodilation

	Pre test	Post test	P value
SPO2	86.62 ± 1.03	88.48 ± 1.23	0.0001*
Heart rate	91.44 ±7.51	106.88 ± 8.03	0.001*
SBP	130.76 ±6.11	132.08 ± 6.17	0.18
DBP	77.52 ±4.38	79.12 ± 4.59	0.06

*Statistically significant ; paired t test

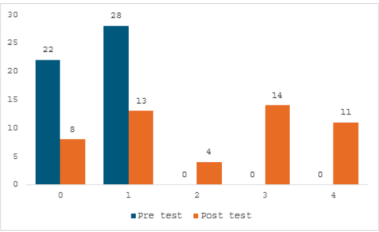


This table provides the results of the six-minute walk test conducted before bronchodilation. Key metrics include SPO2, heart rate, systolic blood pressure (SBP), and diastolic

blood pressure (DBP). Pre-test SPO2 averages at 86.62 ± 1.03, increasing to 88.48 ± 1.23 post-test. Heart rate rises from 91.44 ± 7.51 pre-test to 106.88 ± 8.03 post-test. SBP shows a slight increase from 130.76 ± 6.11 to 132.08 ± 6.17, and DBP increases from 77.52 ± 4.38 to 79.12 ± 4.59.

Table 7: MMRC Grade - Six Minute Walk Test Before Bronchodilation

MMRC grade	Pre test	Post test
0	22	8
1	28	13
2	0	4
3	0	14
4	0	11

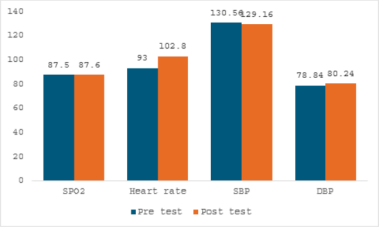


This table presents the MMRC grades of participants before and after the six-minute walk test prior to bronchodilation. Before the test, 22 individuals were at grade 0, 28 at grade 1, and none at higher grades. Post-test, the distribution shifts with 8 individuals at grade 0, 13 at grade 1, 4 at grade 2, 14 at grade 3, and 11 at grade 4.

Table 8:Six Minute Walk Test After Bronchodilation

	Pre test	Post test	P value
SPO2	87.5 ± 1.72	87.6 ± 1.77	0.79
Heart rate	93 ± 8.17	102.8 ± 8.53	0.0001*
SBP	130.56 ± 6.05	129.16 ± 6.05	0.0001*
DBP	78.84 ± 4.64	80.24 ± 4.72	0.0001*

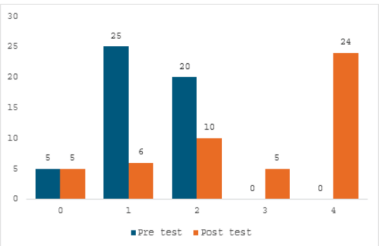
*Statistically significant ; paired t test



This table details the results of the six-minute walk test after bronchodilation. Key measurements include SPO2, heart rate, and blood pressure. The pre-test SPO2 is 87.5 ± 1.72, and the post-test value is 87.6 ± 1.77. Heart rate increases from 93 ± 8.17 pre-test to 102.8 ± 8.53 post-test. SBP shows a slight decrease from 130.56 ± 6.05 to 129.16 ± 6.05 post-test.

Table 9: MMRC Grade - Six Minute Walk Test Before Bronchodilation

MMRC grade	Pre test	Post test
0	5	5
1	25	6
2	20	10
3	0	5
4	0	24



This table shows the MMRC grades before and after the six-minute walk test following bronchodilation. Initially, 5 individuals were at grade 0, 25 at grade 1, 20 at grade 2, and none at grades 3 and 4. Post-test, 5 individuals remain at grade 0, 6 at grade 1, 10 at grade 2, 5 at grade 3, and 24 at grade 4.

Table 10: Distance Walked

	Distance walked among female		Distance walked among male	
	Before broncho-dilation	After broncho-dilation	Before broncho-dilation	After broncho-dilation
Asthma	384.4 ± 22.6	424.6 ± 36.7	540.56 ± 44.7	574.5 ± 31.9
Asthma with COPD	-	-	411.4 ± 29.7	458.6 ± 41.8
ILD with PAH	267.9 ± 27.8	275.8 ± 25.9	287.9 ± 37.8	292.7 ± 34.8
COPD with PAH	292.1 ± 51.9	297.8 ± 44.4	312.7 ± 43.8	356.3 ± 24.8
COPD	-	-	416.1 ± 38.2	457.6 ± 44.4

For females, the distance walked by patients with asthma before bronchodilation is 384.4 ± 22.6 meters, which increases to 424.6 ± 36.7 meters after bronchodilation. Females with ILD and PAH walk 267.9 ± 27.8 meters before bronchodilation and 275.8 ± 25.9 meters after bronchodilation. Females with COPD and PAH walk 292.1 ± 51.9 meters before bronchodilation, improving slightly to 297.8 ± 44.4 meters after the procedure.

For males, those with asthma walk 540.56 ± 44.7 meters before bronchodilation and 574.5 ± 31.9 meters after bronchodilation. Males with both asthma and COPD walk 411.4 ± 29.7 meters before bronchodilation, increasing to 458.6 ± 41.8 meters afterward. Males with ILD and PAH walk 287.9 ± 37.8 meters before bronchodilation and 292.7 ± 34.8 meters after bronchodilation. Those with COPD and PAH walk 312.7 ± 43.8 meters before bronchodilation, with a significant increase to 356.3 ± 24.8 meters post-bronchodilation. Lastly, males with only COPD walk 416.1 ± 38.2 meters before bronchodilation, improving to 457.6 ± 44.4 meters after the procedure. This data highlights the impact of bronchodilation on walking distance among different patient groups, with varying degrees of improvement noted across conditions and genders.

DISCUSSION

Age Distribution

In analyzing the age distribution in the study, it is clear that the majority of participants are in the 51-60 age group, representing 34% of the sample, followed by 31-40 (26%), 41-50 (24%), and 21-30 (16%). This demographic profile indicates a middle-aged to senior population, which is relevant when considering the implications for chronic obstructive pulmonary disease (COPD) and related pulmonary conditions, as age is a critical factor influencing disease prevalence and progression.

Comparing these findings with the referenced studies, particularly Pepin et al. (2007) and Lee et al (35,36)

We observed similar age trends in patient populations. For instance, the study by Pepin et al. involved patients with a mean age of 64 years, ranging from 51 to 73 years, which aligns with the older age distribution seen in our study . This similarity underscores the relevance of age in studies focused on pulmonary function and exercise capacity, as older adults are more likely to experience significant impairments in these areas due to age-related physiological changes and the cumulative impact of chronic diseases.

This variation might influence the generalizability of findings

related to exercise capacity and responsiveness to interventions like bronchodilation . Additionally, the younger age in Lee et al. study might account for potentially better baseline functional capacity and different responses to therapeutic interventions compared to older populations.

Furthermore, in Pitzner-Fabricius et al. (2022), the median age was 59 years for severe asthma patients, which is consistent with our study's age range, reinforcing the importance of targeting middle-aged to older adults in pulmonary rehabilitation programs and clinical trials. This demographic consistency across studies highlights the critical need for tailored interventions that address the specific challenges faced by older adults with chronic respiratory conditions.(37)

Gender Distribution

shows a higher proportion of male participants (68%) compared to females (32%). This gender disparity is important to consider as it may influence the interpretation of results and the generalizability of findings to the broader population.

In contrast, Lee et al. (2008) reported a more balanced gender distribution, with 16 females and 11 males participating in their study on bronchiectasis and exercise tolerance . This balanced representation may provide a more comprehensive understanding of gender-specific responses to interventions and the impact of chronic respiratory conditions. The gender distribution in our study, however, highlights the need for more inclusive recruitment strategies to ensure that findings are applicable to both men and women.

Overall, the gender distribution in our study aligns with common trends in COPD research but differs from studies on other pulmonary conditions like bronchiectasis and severe asthma. These differences underscore the importance of gender-specific analyses to understand fully how chronic respiratory diseases and their treatments affect men and women differently. Addressing gender disparities in research participation can enhance the applicability of findings and improve clinical care for all patients.

Presenting Symptoms

The distribution of presenting symptoms in our study highlights that breathlessness (96%) and cough (94%) are the most common symptoms, followed by sputum production (74%), wheeze (60%), chest pain (14%), and hemoptysis (8%). This symptom profile is indicative of the typical clinical presentation of patients with chronic obstructive pulmonary disease (COPD) and other chronic respiratory conditions.

The symptom distribution in our study aligns well with the existing literature on COPD and other chronic respiratory diseases, underscoring the importance of symptom management in these patient populations. Effective interventions targeting the predominant symptoms of breathlessness, cough, and sputum production can significantly enhance patient outcomes and quality of life. Moreover, recognizing the variability in symptom profiles across different studies can help tailor treatment approaches to the specific needs of patients with diverse respiratory conditions.

CONCLUSION

The study highlights that the 6MWT and MMRC scale are valuable tools for assessing functional capacity and symptom severity, although they may need to be complemented with other measures to fully capture the benefits of interventions like bronchodilation. The findings underscore the need for integrated care approaches that consider the complex health profiles of patients with chronic respiratory diseases to improve outcomes and quality of life.

This comprehensive analysis provides insights into the demographic and clinical characteristics of patients with chronic respiratory diseases and reinforces the value of using standardized assessment tools in clinical practice to monitor and enhance patient care.

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