



Original Research Article

Comparison of Cardiorespiratory Performances to Incremental Shuttle Walk Test And Six Minute Walk Test In COPD Patients- Cross Sectional Comparative Study

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ABSTRACT

Introduction- Field walking test such as the 6 minute walk test and incremental shuttle walk test are usually used in pulmonary rehabilitation as both assessment tools for exercise capacity as well as outcome measures in pulmonary rehabilitation program. **Design:** - 40 patients were selected, Selection was made out of patients with COPD that had required hospitalization and examined before hospital discharge after acute exacerbation of COPD. **Methods:** Pulmonary function tests was performed the day before the study protocol. Pretest measurement of Resting heart rate, Rate of perceived exertion, Oxygen saturation. 6MWT or ISWT done less than 24 hours apart. Difference in Peak HR, Heart Rate Recovery, RPE, Distance Covered and Oxygen Saturation between the 6MWT and ISWT were tested by using 'Z' test. Coefficient of Variance was used to conclude which test is better than the other. **Results:** By applying Coefficient of Variation Technique it is seen that coefficient of variance of ISWT for Peak HR, RPE, and oxygen saturation is equal to coefficient of variance of 6MWT. **Conclusion-** ISWT and 6MWT induces a similar cardio-respiratory performance in patients of COPD, both test can be used to challenge patient to a certain level of cardio-respiratory stress.

Keyword: - COPD, Incremental Shuttle Walk Test, Six Minute Walk Test

INTRODUCTION

Diseases of respiratory system are the major causes of illness affecting a

greater part of population worldwide.⁽¹⁾ Chronic obstructive pulmonary disease (COPD) is the internationally preferred term encompassing chronic bronchitis (airway

disease) and emphysema (alveolar disease).⁽²⁾ Chronic obstructive pulmonary disease (COPD) is common chronic pulmonary disorder afflicting 10 to 15% adults over age of 45. COPD is a disorder characterized by the presence of airflow obstruction that is generally progressive accompanied by airway hyper reactivity and may be partially reversible.⁽³⁾ A review of population studies from India, estimated that total number of COPD patients aged 40 years and above in 1996 were 8.15 million males and 4.21 million females.⁽⁴⁾

Impairments of patients with COPD-

- 1) Dyspnea on exertion- Patients with COPD experience frequent episodes of shortness of breath with minimal physical activity.
- 2) Decreased exercise tolerance- Patients have a decreased capacity for exercise and inadequate endurance for daily activities.
- 3) Chronic productive cough-due to excessive production and chronic accumulation of pulmonary secretion.^[5]

Exercise limitation is a prominent complaint in patients with chronic obstructive pulmonary disease (COPD). The reduction in exercise tolerance is due to different factors: abnormal lung mechanics (e.g. airflow limitation or dynamic hyperinflation), inefficient pulmonary gas exchange, peripheral muscle weakness, abnormal oxygen transport and energy production in exercising muscle. It is widely known that pulmonary rehabilitation can improve exercise tolerance and consequently the quality of life and daily living.^[6]

Laboratory-based tests are the gold standard by which cardiorespiratory fitness should be assessed. However, for practical reasons, this is not always possible.

Equipment is expensive and it requires technical support to conduct the test and interpret the results. As an alternative to laboratory testing, simpler field-based exercise tests were, therefore, developed.⁽⁷⁾

Field walking test such as the 6 minute walk test and incremental shuttle walk test are usually used in pulmonary rehabilitation as both assessment tools for exercise capacity as well as outcome measures (Cooper 2001; Steele 1996) in pulmonary rehabilitation program.^(8,9) Distance walked during field walking test have been used to indicate the disability, to prescribe the intensity of a walking programme and to assess outcome following rehabilitation.^(10,11)

The 6-Minute Walking Test (6MWT) is time-limited walk test and frequently used to evaluate the functional status as well as the effects of pharmacologic therapy and rehabilitation programs in COPD patients. 6-MWT is a self-paced test, and the degree of the therapist encouragement can be crucial in setting walking speed. The test is reliable, safe and inexpensive^[6]

More recently, an incremental shuttle walking test (SWT) has been developed

It is a symptom limited walk test, an externally paced test, less influenced by the therapist encouragement, and it has been proposed as a more reproducible test to evaluate exercise tolerance. In the shuttle test effort may be maximal from the start, stresses the patient progressively to a symptom limited maximum. This gradual increase in exercise intensity increases the safety of the test. The defined speeds of walking in the shuttle test ensure that the work load increases in a manner that provides an incremental and quantitatively similar cardiorespiratory stress for all the patients.^[6]

AIM-

To Compare Cardio-respiratory Performances during 6Min Walk Test and Incremental Shuttle Walk test in COPD patients.

NEED OF STUDY:-

To date, mostly 6 min walk test is used clinically to assess the functional capacity, the incremental shuttle walk test which also assess the same outcomes but which is not frequently used. Secondly most of studies of field walking test have done in stable COPD patients^(12,13) but only one study has done in moderate to severe COPD patients recovering from acute exacerbation with a training test.^[6] To our knowledge, no study has compared heart rate recovery responses during 6 min walk test and incremental shuttle walk test in moderate to severe COPD patients recovering from acute exacerbation. Therefore, the need of my study was to compare these two test in moderate to severe COPD patients recovering from acute exacerbation using different protocol without a training test and see which gives better outcomes efficiently and quickly which will used for assessment of exercise capacity as well as outcome measures in pulmonary rehabilitation program.

METHODOLOGY

Patient Selection

Inclusion Criteria

1. Moderate to severe COPD patients recovering from acute exacerbation.
2. Both gender
3. Age group – 40 – 70 yrs.

Exclusion Criteria:

1. Patients with requirement for supplement oxygen therapy.
2. History of cardiovascular diseases

Material Used:

Spirometer with computer interface machine, source of oxygen, Stopwatch, Pulse Oxymeter, Measuring Tape, 30 m and 10 m corridor, Two small cones, chair.

Methodology: Data collection- After approval of Ethical committee of Pravara Institute of Medical Sciences and with permission from the medicine department 40 patients of either gender of COPD who met inclusion criteria were selected for the study. Informed consent was taken from the selected patients.

Procedure: Patient Preparation: A Pulmonary function test was performed the day before the study protocol. Check for [medical history](#), [contraindications to exercise testing](#). Comfortable clothing should be worn. Patient's usual medical regimen should be continued. Each test done less than 24 hours apart

Measurements: Pretest measurement of Resting heart rate, Rate of perceived exertion, Oxygen saturation. The six-minute walk test was done according to ATS guidelines.⁽¹⁴⁾ The incremental shuttle walk test was performed according to the original protocol proposed by Singh et al⁽¹⁵⁾. Post-test measurements of SpO₂, peak heart rate and heart rate was measured immediately after testing till next 1 min and until heart rate returned to baseline and then remove the sensor with the patient seated, Record Rate of perceived exertion, number of laps.

DATA ANALYSIS

Data was analyzed by using mean values and standard deviation of each parameter. Difference in Peak HR, Heart Rate Recovery, RPE, Distance Covered and Oxygen Saturation between the 6MWT and ISWT were tested by using 'Z' test.

Coefficient of Variance was used to conclude which test is better than the other.

DATA INTERPRETATION AND RESULT

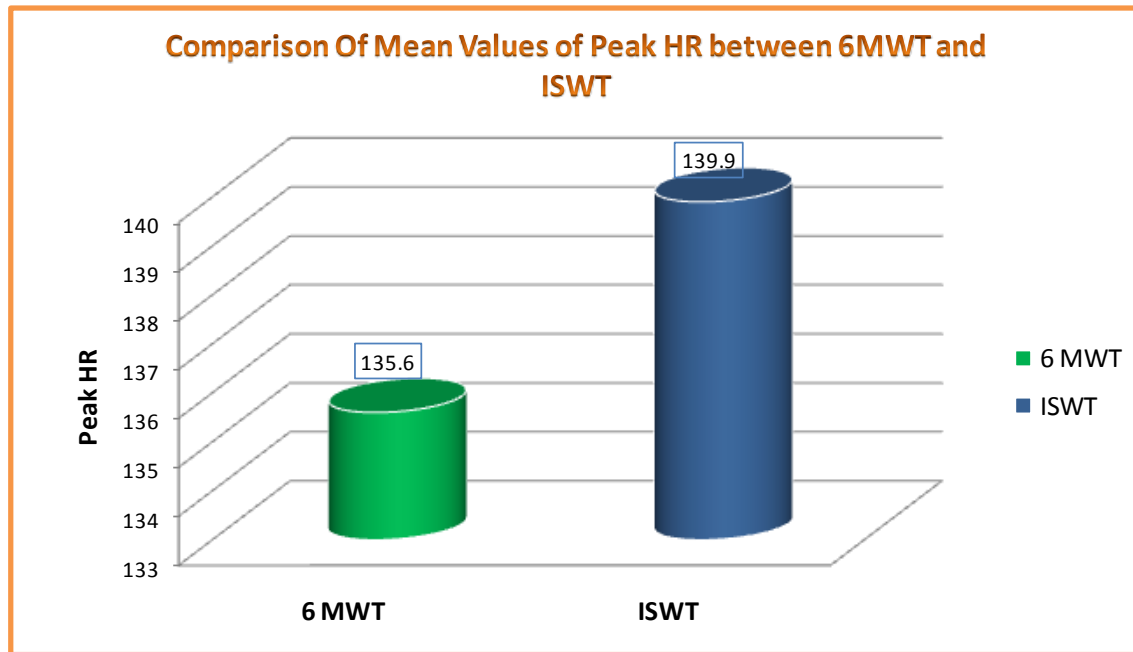
Table 1- Baseline Characteristics of participants are shown in

Age, means (SD),years	53 (± 8)
Males / Females, Numbers (%)	20 (50)/ 20(50)
Smokers (%)	20 (50)
Non-smokers (%)	20 (50)
FEV1 % predicted Mean (SD)	33 (± 7)
COPD, no. (%)	
Moderate	20 (50)
Severe	20 (50)

In this study, 40 subjects were taken and all of them completed the 6 MWT study protocol but no one completed 12 levels of ISWT. Among 40 subjects, 21 subjects were completed level 5, 17 were completed level 6, 2 were completed level 7.

Table-2 Comparison Of Mean Values of Peak HR between 6MWT and ISWT.

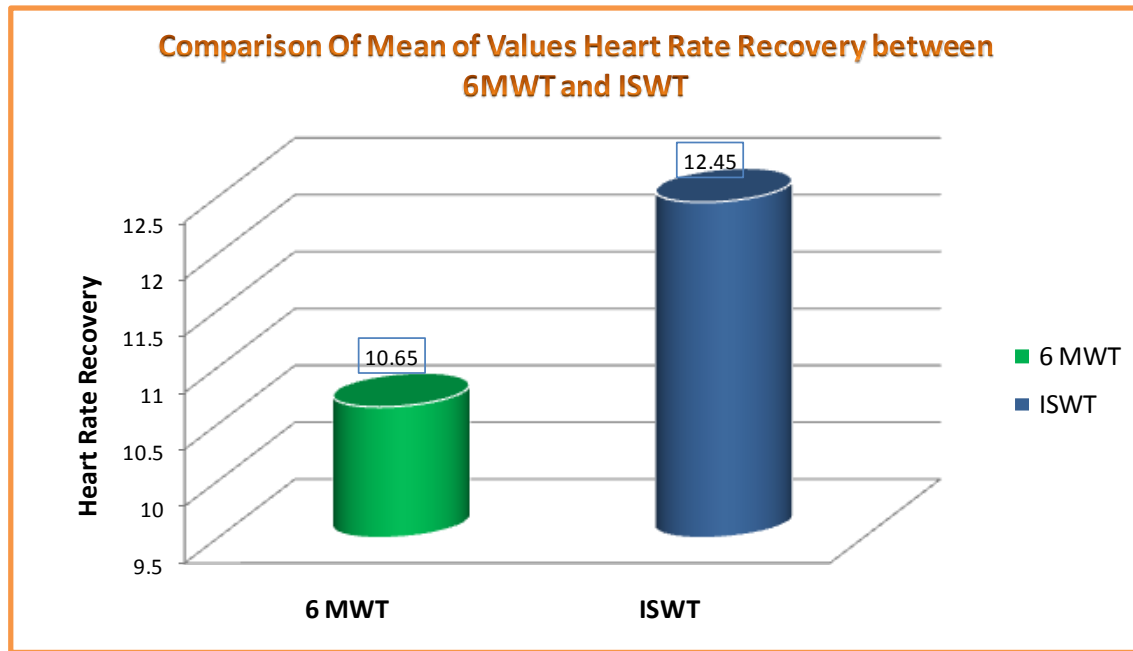
	Mean \pm SD	Z value	P Value	Result
6 MWT	135.6 \pm 9.015	2.208	P <0.05	Significant
ISWT	139.9 \pm 8.499			



Result- there is significant difference between mean peak HR in 6MWT and ISWT.

Table – 3 Comparison of Mean of Values Heart Rate Recovery between 6MWT and ISWT.

	Mean ± SD	Z value	P Value	Result
6 MWT	10.65 ± 3.8	2.09	P <0.05	Significant
ISWT	12.45 ± 3.9			



Result- there is significant difference between mean values of Heart Rate Recovery in 6MWT and ISWT.

Comparison of Cardio-respiratory Performances between 6MWT and ISWT.

Result- after applying Coefficient of Variation Technique it is seen that coefficient of variance of ISWT for Peak HR, RPE, and oxygen saturation is equal to coefficient of variance of 6MWT.

DISCUSSION

➤ **Incremental Shuttle Walk Test and 6 Min elicited better Peak Heart Rate Responses** - Heart rate is one of the

objective parameters in determining the cardio respiratory responses. (16) The increased Heart Rate during both the test is mainly because of vagal withdrawal and increase sympathetic tone. This is due to impulses from proprioceptors, which are present in the exercising muscle; these impulses act through higher centers and increase the heart rate, increased carbon dioxide tension; it act through medullary centers and rise in body temperature, which acts on cardiac centers via hypothalamus: increased temperature stimulates SA node directly also. This finding is consistent with previous studies by Casas et al. 2002; Vagaggini et al. 2003.

- **Heart rate recovery after both field walking test-** Normal HRR was categorized as a fall in heart rate during first minute after exercise of ≥ 18 beats/min. Intermediate HRR was categorized as a fall in heart rate during first minute after exercise of > 12 and < 18 beats/min. Abnormal HRR was categorized as a fall in heart rate during first minute after exercise of ≤ 12 beats/min. Heart rate recovery, specifically the failure of the heart rate to decline at 1 or 2 min post exercise, is associated with increased mortality.^(17 - 19) In this study, abnormal HRR was seen in 35 patients and rest of 5 patients showed normal HRR. Among all abnormal HRR subjects 15 subjects was from moderate and 20 subjects from severe category. Abnormal HRR suggesting altered autonomic tone in patients with COPD. The mechanism for altered autonomic tone is due to loss of normal parasympathetic function. Thus, afferent activity from diseased lungs and cardiovascular structures integrates, causing autonomic dysfunction leading to abnormal heart rate recovery. Patients with severe COPD had more abnormal HRR in both field walking tests which implies that abnormal HRR may lead to abnormal cardiac function in severe disease when compared to moderate disease. HRR measures in ISWT and 6 MWT may be useful for routine risk stratification in clinical setting.
- **Incremental Shuttle Walk Test and 6 MWT elicited better dyspnea score -** Dyspnea score is a tool that is widely used in assessing the exertion level subjectively among COPD patients. After an acute exacerbation of COPD, dyspnea and lower limb muscular weakness may add to the cardio respiratory limitation. During exercise and vigorous activity, the COPD patient's inability to adequately release carbon dioxide and the inadequate intake of oxygen can lead to symptoms such as shortness of breath. Thus affecting the results of performance, affects activities of daily living, and determines to a large extent, the perception of the degree of illness and extent of deterioration in quality of life. Tolerance to exercise in these patients is an indicator of severity, regardless of forced expiratory volume in the first second. In fact, the evaluation of both factors severity of obstructive ventilation and the limitation of tolerance to exercise are vital in controlling the progression of COPD.
- **Significantly more Distance Covered in 6MWT and ISWT:** Maximum distance was longer in the 6MWT but not in the ISWT. ISWT is more difficult, and the 'learning effect' is thus more pronounced than in the 6MWT. However, this 'learning effect' for both tests has been reported previously^(3,20) but it is considered to be marginal for SWT because of the lack of encouragement by the therapist, which could influence patient response. When 6MWT is performed in a standardized manner, as in the present study, with similar encouragement by the therapist, the reproducibility is quite high and probably similar to that of SWT.
- **Oxygen desaturation at the end of both field walking tests:** Findings suggested significant oxygen desaturation at the end of each tests were parallel and consistent with previous studies (Palange et al. 2000; Poulain). Individuals with COPD were found to have incidents of large desaturation after walking exercises either walking at a constant speed and resistance or walking

with increment. O₂ desaturation as a fall in SpO₂ of > 4% below resting value that persists for at least the last 3 min of the exercise test. This 4% fall was defined as a fall of 2% to account for potential inaccuracy of oximetry plus another fall of 2% to account for the right shift of the hemoglobin saturation curve induced by exercise metabolic acidosis. These findings lead us to question a published guidelines for 6mwt which states that the use of pulse oximetry is optional. Hence, implication of our findings is that a field walking test is used for identifying those who may benefit from oxygen therapy during walking, is often the assessment upon which the prescription of ambulatory oxygen is based, and ambulatory oxygen should be considered if a patient shows desaturation on exercise and an improvement in exercise performance and/or dyspnoea with oxygen, and is motivated to use it.

CONCLUSION

ISWT and 6MWT induces a similar cardio-respiratory performance in patients recovering from an acute exacerbation of COPD suggesting both test could be used to challenge patient to a certain level of cardio-respiratory stress.

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