RESEARCH ARTICLE

COMPARISON OF THE SIT-TO-STAND TEST WITH SIX MINUTE WALK TEST IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

*,1Hetshri Shah, 2Falgun Bhatt, 3Abhik Patel, 4Dharmendra Solanki and 5Megha Chavda

1,5Assistant Professor, Ashok & Rita Patel Institute of Physiotherapy, CHARUSAT, Changa, Gujarat, India
2,3,4 BPT, Ashok & Rita Patel Institute of Physiotherapy, CHARUSAT, Changa, Gujarat, India

ARTICLE INFO

ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is defined as a diseased state characterized by poorly reversible airflow limitation that is usually both progressive and associated with an abnormal inflammatory response of the lung. As a sub maximal exercise test, the 6 min walking test (6MWT) is a good predictor of functional status for patients with chronic respiratory disease. The 6MWT is easy to administer, well tolerated and more reflective of activities of daily life than the other walk tests and cardiopulmonary exercise tests. The ability to stand up from a chair is an important component for maintaining independence in elderly people and in individuals with disabilities. For this reason, Sit-to-Stand Test (STST) has been accepted as an indicator of functional status for elderly people. Therefore, we concluded that, similar to the 6MWT, STST can also be used to determine the functional status in patients with COPD.

Objective: The objective of the present study is to evaluate the functional status by the STST and the 6MWT in patients with COPD, and to compare the results of both tests according to some outcome parameters of the patients in order to investigate the utility of STST for patients with COPD.

Method: The chosen subjects who agreed to participate in the study, pulmonary function test will be done before starting exercises. Subjects will be asked to pick a token numbered "1" and "2". Patients with token "1" are asked to perform sit to stand test and token "2" are asked to perform 6 minute walk test. Patients were taught sit to stand test and 6 minute walk test prior to testing.

Result: HR, SBP and DBP shows significant difference of 0.000 ($p<0.005$) at the end of both SMWT and STST. Whereas, subjective exertion also shows significant difference of 0.000($p<0.05$) .Strong correlation was found with $r=0.418$ ($p<0.05$) between SMWT distance and STST repetitions. At the end of both tests we found significant correlation of HR, SBP and DBP with $r=0.705$, 0.607 and 0.446 respectively. ($p < 0.05$). Whereas significant correlation with $r=0.882$ (p 0.05) was obtained for subjective exertion at the end of both SMWT and STST

Conclusion: Both the tests were found to be effective in measuring cardio-vascular endurance in COPD patients. We also found significant difference for performance variable and criterion measures in both tests clinically and statistically. Therefore, we conclude STST can be an alternative of SMWT to assess cardio-vascular endurance in patients with COPD.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is defined as a diseased state characterized by poorly reversible airflow limitation that is usually both progressive and associated with an abnormal inflammatory response of the lung. (Global Initiative for Chronic Obstructive Lung Disease (GOLD)) The reduction in flow observed in COPD has two main components: increased resistance, which is due to airway obstruction, and a loss of the elastic recoil pressure of the lung,

Corresponding author: Hetshri Shah.
Assistant Professor, Ashok & Rita Patel Institute of Physiotherapy, CHARUSAT, Changa, Gujarat, India.

Which is due to parenchymal destruction.(Graziella Turato Renz, 2001) In patients with Chronic Obstructive Pulmonary Disease (COPD), pulmonary problems and peripheral muscle weakness leads to sedentary life which reduces functional status (Bowen *et al*., 2000). So evaluating the functional status is very important for prescribing correct medical therapy and pulmonary rehabilitation programmes for these patients. (Stel *et al*., 2001; Foglio *et al*., 2000; Torres *et al*., 2002) As a submaximal exercise test, the Six Minute Walking Test (SMWT) is a good predictor of functional status for patients with chronic respiratory disease. (Bowen *et al*., 2000; Stel *et al*., 2001; Foglio *et al*., 2000; Torres *et al*., 2002; Pinto-Plata *et al*., 2004) The SMWT is easy to administer, well tolerated and more reflective of activities of daily life than the other walk tests and cardiopulmonary exercise tests (Guyatt *et al*., 1985).

Standing up from sitting position is a very common and essential activity which enables other vital activities possible, such as walking in daily life. The ability to stand up from a chair is an important component for maintaining independence in elderly people and in individuals with disabilities. (Kotake *et al.*, 1993; Millington *et al.*, 1992) For this reason, Sit-to-Stand Test (STST) has been accepted as an indicator of functional status for elderly people (Gross *et al.*, 1998). Therefore, we concluded that, similar to the SMWT, STST can also be used to determine the functional status in patients with COPD.

Cardiopulmonary exercise testing (CPET) should be considered the gold standard for evaluating the causes of exercise intolerance in patients with pulmonary and cardiac disease, and it is based on the principle that system failure typically occurs while the system (e.g. muscle–energetic, cardiovascular or pulmonary) is under stress. The cardiopulmonary stress resistance training is lower than during whole-body exercise and results in fewer symptoms. In addition, exercise testing based on guidelines using the American College of Sports Medicine. The CPET comprises the imposition of symptom-limited incremental exercise, commonly in combination with comprehensive breath-by-breath monitoring of cardiopulmonary variables. Such as VO2, pulmonary CO2 output (VCO2), minute ventilation (VE), cardiac frequency (CF), perceptual responses- dyspnea, leg discomfort. Thus, the support systems are ''forced'', over their tolerable range which shows indices of aerobic function. Variety of tests are available, each being more or less suitable as a stressor of a particular component of a patient's patho-physiology, the appropriateness of the integrated physiological-system response is best studied by means of a symptom-limited incremental test. This is typically established by means of a progressive increase in work-rate with gradual increase in fixed frequency (e.g. each minute or less). Exercise intolerance can be defined as an inability to complete a required physical task successfully. Everyone who exercises has at some level, ''exercise intolerance''. However, exercise intolerance often considered in terms of peak oxygen uptake (peak VO2). Pulmonary and cardiac disease patients cannot be confidently predicted from physiological variables, determined at rest, such as forced expiratory volume in one second (FEV1), pulmonary diffusing capacity for carbon monoxide (DLCO), ejection fraction (EF) or body mass index (BMI). It is necessary, therefore, to actually assess an individual's exercise intolerance. (Palange *et al.*, 2007) The multifactorial functional impairment in patients with COPD frequently reduces their tolerance to exertion (disablement): this in turn increases sedentary, a process long recognized as representative of "dyspnea spiral" or, more properly, an "incapacity spiral." Exercise intolerance is therefore a hallmark of the disease and commonly associated with reduced quality of life, and even increased mortality. (Alberto Neder *et al.*, 2000) Therefore the aim of the present study is to evaluate the functional status by the STST and the SMWT in patients with COPD, and to compare the results of both tests according to some outcome parameters of the patients (pulmonary function, severity of dyspnea and hemodynamic stress and quality of life and peripheral muscle strength) in order to investigate the utility of STST for patients with COPD. Sit to stand test is very easy to administer with very less expensive equipments and it consumes less time than SMWT. So it is very important to know whether sit to stand test can be used in place of SMWT to check functional status in COPD patients. Therefore objective of the study is to evaluate the utility of sit to stand test in place of 6 minute walk test in patients with COPD.

MATERIALS AND METHODS

Total 50 subjects were included in the study from outpatient department of various hospitals in central Gujarat. Subjects diagnosed with moderate to severe COPD (GOLD criteria – 2003) between 40 – 60 years and both males and females who were clinically stable state for a minimum of 2 weeks with no recent infection were included in this study. Subjects were excluded if they were diagnosed with severe COPD, any chest deformity, who underwent any recent abdominal or thoracic surgery, diabetics any cardiovascular or neurological disease and who were not co operative. The chosen subjects who had agreed to participate in the training and willing to participate in test, pulmonary function test will be done before starting exercises. Subjects were asked to pick a token numbered "1" and "2". Patients with token "1" were asked to perform sit to stand test and token "2" were asked to perform 6 minute walk test. Patients were taught sit to stand test and 6 minute walk test prior to testing.

Sit To Stand Test

In sit to stand test then the patients were asked to first sit in the middle of the chair and place hands on the opposite shoulder crossed at the wrists. The patients were also asked to keep feet flat on the floor, back straight and arms against the chest. On "go" the patient rises to a full standing position and then sat back down again. This had to be repeated for 1 minute. At the end of the test total repetitions were noted down.

Starting position of STST   End position of STST

Six Minute Walk Test

SMWT measures the distance a patient can walk of a 30 meter course on flat, hard surface in a period of 6 minutes. Standing rests were allowed if needed with the request then participants resume walking as soon as possible so they could cover as much ground as able over the 6 minutes. At one-minute intervals the participants were told "you are doing well" or "keep up the good work" and were informed of the time remaining.

30 meter long flat walk way

DATA ANALYSIS

Data analysis was done using the Statistical Package for Social Sciences (SPSS) version 21.0. Standard description statistics was calculated for participants who completed both tests. Comparison of the criterion variables, those are SMWT distance and STST repetitions was done using spearman's correlation coefficient. Whereas, within subjects comparison of performance variables before test and at the end of the test was done using paired t-test. Comparison of performance variables, which are heart rate, systolic blood pressure, diastolic blood pressure and subjective exertion at the end of both tests, were done by using Pearson's correlation coefficient test. Significance level for all the tests was set at 0.05.

RESULTS

Total 50 (82% males and 18% females) participants completed both SMWT and STST. 04 participants were excluded from the study after completing SMWT because they did not report for STST on next day of completing SMWT on next day of completing SMWT. The outcome measures were HR, SBP, DBP and subjective exertion using Modified Borg Scale (MBS). Analysis of data was carried out using SPSS 21.0. Mean and SD was calculated. Within participants comparison of participant variables was done by using paired sample t-test and criterion variables in-between tests correlation was done by using Pearson's correlation test and spearman's rank correlation coefficient.

Table 1. Descriptive statistics of the participants

Variables	Mean ±SD
Age(years)	49.96±5.43
Height(in)	1.66±0.06
Weight(kg)	71.00± 9.89
BMI(kg/m²)	25.46± 2.77
SMWT distance(m)	330.26±29.15
STST repetition	21.08± 9.77

Table 2. Within subject's comparison of performance variables

		Mean	Std. deviation	95% CI of the difference Lower	95% CI of the difference Upper	SIG-(2-tailed) t(p)
MBS	SMWT	-4.04	1.56	-4.48	-3.59	-18.26(0.000)
	STST	-2.96	1.22	-3.30	-2.611	-17.04(0.000)
HR	SMWT	-48.1	9.41	-50.85	-45.50	-36.16(0.000)
	STST	-43.4	13.36	-47.19	-39.60	-22.96(0.000)
SBP	SMWT	-17.00	4.70	-18.34	-15.67	-25.58(0.000)
	STST	-13.84	5.58	-15.43	-12.25	-17.53(0.000)
DBP	SMWT	-8.74	5.93	-10.43	-7.06	-10.43(0.000)
	STST	-7.16	4.16	-8.34	-5.98	-12.17(0.000)

The table Indicates paired t- test of HR and subjective exertion at beginning and at the end of SMWT and STST. We found significant difference of 0.000 (p< 0.05) for MBS, HR, SBP and DBP at the end of both SMWT and STST when compared with pre test values.

Table 3. Correlation between performance variables of the SMWT & STST

Comparison	Spearman's/ Pearson's correlation (p)
SMWT distance × STST repetition	0.418**(0.003)
Post SMWT HR × post STST HR	0.705**(0.000)
Post SMWT SBP × post STST SBP	0.607** (0.000)
Post SMST DBP × post STST DBP	0.446** (0.000)
Post SMWT MBS× Post STST MBS	0.882**(0.000)

** Significant co relation at the 0.05 level

The table summarizes Pearson's correlation between performance variables of the SMWT & STST which shows strong correlation with r=0.418 (p<0.05) between SMWT distance and STST repetitions. There was a significant correlation with r=0.705, 0.607 and 0.446 (p<0.05) for performance variables that is HR, SBP and DBP respectively when compared at the end of both SMWT and STST. Whereas significant correlation with r=0.882 (p<0.05) was obtained for subjective exertion at the end of both SMWT and STST.

DISCUSSION

We compared 2 relatively brief, portable, low cost test of CV endurance & functional status with the potential for broad field application. Although the SMWT is well established and highly recommended in clinical setting, but many clinical setting but many clinical settings may look on unobstructed corridor of adequate length even the course is shortened to 30feet (ATS, 2002). We made efforts to examine the result of SMWT & STST, which requires less space when compared to SMWT. Therefore, the purpose of the study was to compare the utility of the STST to that of SMWT in the evaluation of the CV endurance in patient with COPD. In the literature STST is generally used to determine the functional status of elderly patient with orthopedic diseases (Millington *et al*., 1992; Gross *et al*., 1998; Lord Sr *et al*., 2002; Lindemann *et al*., 2003; Jones *et al*., 1999; Scarborough *et al*., 1999). The SMWT is usually used for patients with COPD. The timed walk distance has been demonstrated to be a strong predictor (Bowen *et al*., 2000; Stel *et al*., 2001; Torres *et al*., 2002; Pinto- Plata *et al*., 2004; Guyatt *et al*., 1985; Scarborough *et al*., 1999) & survival in patient with COPD, therefore, we consider that STST would determine the CV endurance as the SMWT in patient with COPD.

Within subject's comparison of performance variables

Within subject's comparison of HR, SBP, DBP and subjective exertion using MBS before and after both SMWT & STST were done by paired t- test. This result led us to an assumption that the two tests are consistent with one another. As a result we demonstrated that cardio respiratory stress after STST was lower than the response that was obtained after the SMWT. This result supports the result of MILO *et al*, which concluded

that STST may close an important gap in the evaluation of exercise capacity and prognosis of COPD patient Across practical settings (Milo *et al*., 2013). Whereas statistically both test found significant difference of 0.000(P 0.05) for both HR,SBP, DBP and subjective exertion when compared baseline result with past test results.

Criterion measures comparison between two tests

The criterion measures used for the SMWT (distance walked) and STST (repetition) are different. A comparison of the measures was limited to correlation analysis. The significant correlation was found between the variables r =0.418 (P 0.003, P 0.05). This result was supported by the study done by Mjid *et al*, 2015 who found significant co relation between six minute walk test distance and sit to stand repetitions.

Performance variable comparison at the end of two tests

HR, SBP, DBP and subjective exertion were measured at the end of the STST and SMWT tests. Lower post test HR, SBP, DBP and lower subjective exertion at the end of STST showed that the STST was less demanding than the SMWT for COPD patient. Stel *et al* determined a relationship between the SMWT & desaturation & HR in COPD patients increase in the HR and subjective exertion at the end of SMWT, supports a study done by Vagaggini *et al*, who found that in COPD patient, systolic BP, HR, Dyspnea were significantly increased and pulsed saturation was significantly decreased at the end of the SMWT. Since STST does not cause an increase in HR, SBP, DBP and subjective exertion as in the SMWT its application is easier and it produces stress. It is widely known that standing from a sitting position is a very common, essential activity in daily life. Our efforts were made to see which exercise test is more likely to be a better option for field testing endurance. Both SMWT & STST are practical methods for measuring CV endurance while STST requires less space, less hemodynamically stressful and easier to apply, therefore we recommended use of STST as an alternative of SMWT in COPD.

CONCLUSION

In this study, the participants had to perform SMWT followed by STST with rest period of at least an hour between two tests. Both the tests were found to be effective in measuring cardio-vascular endurance in COPD patients. We also found significant difference for performance variable and criterion measures in both tests clinically and therefore, we conclude STST can be an alternative of SMWT to assess cardio-vascular endurance in patients with COPD as it is less stressful and easier to apply compared to SMWT. Further study can be done with large sample size and on a wide age group.

CONFLICT OF INTEREST

The author reports no conflict of interest.

REFERENCES

Alberto NJ, Jones PW, Nery LE, *et al*. Determinants of the Exercise Endurance Capacity in Patients with Chronic Obstructive Pulmonary Disease, The Power–Duration Relationship. Am J Respir Crit Care Med.2000; 162.497–504.

Andrea SG, Jeremiah H, Ruth C *et al*. Patient and Physician Factors associated with pulmonary function testing for COPD: A population study. Chest 2014; 145 (2):272- 278.

ATS Statement: Guidelines for the Six-Minute Walk Test. This official statement of the American thoracic society was approved by the board of directors MARCH 2002.

ERS task Force, Palange P, Ward SA *et al*.Recommendations on the use of exercise testing in clinical practice. Eur Respir J 2007; 29: 185–209.

Foglio K, Carone M, Pagani M, *et al*.Physiological and symptom determinants of exercise performance in patients with chronic airway obstruction. Respir Med. 2000, 94:256–63.

Global Initiative for Chronic Obstructive Lung Disease (GOLD): A collaborative project of the National Health, Lung, and Blood Institute, NIH and the World Health Organisation.

Gross MM, Stevenson PJ, Charette SL *et al*. Effect of muscle strength and movement speed on the biomechanics of rising from a chair in healthy elderly and young women. Gait Posture 1998, 8:175–85.

Guyatt GH, Sullivan MJ, Thompson PJ *et al*. The 6 min walk: a new measure of exercise capacity in patients with chronic heart failure. Can Med Assoc J 1985, 132:919–23.

Janet B. Bowen, Votto JJ, thrall SS *et al*. Functional Status and Survival Following Pulmonary Rehabilitation, Chest 2000; 118:697–703.

Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Quart Exerc Sport 1999; 70:113–9.

Kotake T, Dohi N, Kajiwara T *et al*. An analysis of sit-to-stand movements. Arch Phys Med Rehab 1993; 74: 1095–9.

Lindemann U, Claus H, Stuber M, *et al*. Measuring power during the sit-to-stand transfer. Eur J Appl Physiol 2003; 89:466–470.

Lord SR, Murray SM, Chapman K *et al*. Sit to-stand performance depends on sensation, speed, balance, and psychological status in addition to strength in older people. J Gerontol A BiolSci Med Sci 2002; 57: 539–43.

Magali P,Durand F, Palomba B *et al*. 6-Minute Walk Testing Is More Sensitive Than Maximal Incremental Cycle Testing for Detecting Oxygen Desaturation in Patients With COPD. Chest 2003; 123:1401–1407.

Maria Angela Fontoura Moreira, Gabriel Arriola de Medeiros, Francesco Pinto Boeno *et al*. Oxygen desaturation during the six minute walk test in COPD patients. J. Bras.Pneumol 2014; 40(3): 222-228.

Mjid M, Jouda C, Sonia T *et al*. Sit-to-stand test and 6-min walking test correlation in patients with chronic obstructive pulmonary disease. Ann Thoracic Med 2015;10(4):269-274.

Millington PJ, Myklebust BM, Shambes GM. Biomechanical analysis of the sit-to-stand motion in elderly persons. Arch Phys Med Rehab 1992; 73:609–617.

Milo AP, Lara S, Marco Z *et al*. Simple functional performance tests and mortality in COPD. Eur Respir J 2013; 42:956-963.

Pinto-Plata VM, Cote C, Cabral H *et al*. The 6 min walk distance: change over time and value as a predictor of survival in severe COPD. EurRespir J 2004 ;23:28–33.

Poulain M, Durand F, Palomba B *et al*. 6 min walk testing is more sensitive than maximal incremental cycle testing for detecting oxygendesaturation in patients with COPD. Chest 2003;123:1401–7.

Reshma RK, Dhiraj RS. Comparison of Cardio respiratory Performances to Incremental Shuttle Walk Test And Six Minute Walk Test In COPD Patients- Cross Sectional Comparative Study, International Journal of Health Sciences & Research 2012;1(2): 1228-1232.

Rick Carter, David B. Holiday, Chiagozie Nwasuruba *et al*. 6-Minute Walk Work for Assessment of Functional Capacity in Patients With COPD comparisons. Chest 2003, 123:1408–1415.

Scarborough DM, Krebs DE, Harris BA. 1999. Quadriceps muscle strength and dynamic stability in elderly persons. Gait Posture, 10:10–20.

SE Jones, SSC Kon, JL Canavan *et al*. Five-repetition sit-to-stand test: reliability, validity and response to pulmonary rehabilitation in COPD. Thorax 2012; 67(2):A1–A204.

Stel HF, Bogaard JM, Rijssenbeek-Nouwens LHM *et al*. Multivariable assessment of the 6 min walking test in patients with chronic obstructive pulmonary disease. Am JRespirCrit Care Med 2001; 163: 1567–71.

Torres JP, Pinto-Plata V, Ingenito E *et al*. Power of outcome measurements to detect clinically significant changes in pulmonary rehabilitation of patients with COPD. Chest2002; 121: 1092–1098.

Turato G. Zuin R. Saetta M. Pathogenesis and Pathology of COPD. Respiration 2001, 68: 117–128.

Vagaggini B, Taccola M, Severino S, *et al*. Shuttle walking test and 6 min walking test induce a similar cardiorespiratory performance in patients recovering from an acute exacerbation of chronic obstructive pulmonary disease. Respiration 2003; 70:579–84.

****