

# Sit to Stand Test: A Simple Functional Performance Test to Assess the Exercise Capacity in Chronic Obstructive Pulmonary Disease Patients and its Correlation with Severity of the Disease

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## ABSTRACT

**Introduction:** Chronic obstructive pulmonary disease (COPD) is an obstructive lung disease. It occurs due to increased activity of oxidants combined with reduced activity of antioxidants. It is currently the 4th leading cause of death worldwide, projected to be 3rd by 2020. It has been proven that individual who develops COPD, gradually develops reduction in the strength of the peripheral muscles that will lead to further decrement in the physical activity and impaired mobility. These events gradually develop a vicious cycle.

In the recent years we have developed many tools to evaluate or quantify the impaired physical activity which will help us to take certain measures to limit these and to improve the overall physical and mental health.

There are various exercise performance test available to assume the physical activity impairment in COPD patients, like 6 minute walk test, incremental workload test, but lacunae with these test is that they require skilled personnel and various equipments. So, due to these reasons these tests could not be performed in many of the centers, to overcome these lacunae a simple test has been derived, i.e. sit to stand (STS) test. The advantage with this test is that it is easier to perform and does not require huge space and personnel.

**Aim and objectives:** The goal of our study is to assess:

- Exercise capacity in COPD patients
- Correlation of STS test with severity of disease (COPD)

**Methods:** Consecutives, stable COPD patients were examined in outpatient department of Chest and Tuberculosis (TB), a tertiary care hospital (Rohilkhand Medical College) during a period of 6 months (March–August 2017). The diagnosis and severity of COPD were assessed by spirometry and the global initiative for chronic obstructive lung disease (GOLD) guidelines. STS test was executed according to a standardised protocol.

Patient was asked to sit without any assistance and to stand completely straight. Patient was asked to perform as many repetitions as feasible in 30 seconds. During the tests performed, the severity of dyspnea (modified Borg scale), oxygen saturation, heart rate were measured. Statistical analysis was done using EpilInfo version 7.2.

**Results:** Total 46 stable COPD patients (mean age 59.69±11.77 years, mean forced expiratory volume (FEV<sub>1</sub>) 40.02% ± 19.41%) were analyzed. During STS test, there was rise in heart rate, fall in oxygen saturation, and increase in dyspnea score which was statistically significant (p < 0.05). Mean repetitions in GOLD I and II COPD patients was 11, in GOLD III and IV COPD patients was 9.7886 in 30 seconds STS test (number of repetitions) was significantly correlated with FEV<sub>1</sub> (p < 0.05).

**Keywords:** Chronic obstructive pulmonary disease, Forced expiratory volume<sub>1</sub>, Sit to stand test.

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## INTRODUCTION

Chronic obstructive pulmonary disease is an obstructive lung disease. It occurs due to increased activity of oxidants combined with reduced activity of antioxidants.<sup>1</sup> It is currently the 4th leading cause of death worldwide, projected to be 3rd by 2020.<sup>2</sup> It has been proven that individuals who develop COPD, gradually develops reduction in the strength of the peripheral muscles that will lead to further decrement in the physical activity and impaired mobility.<sup>3,4</sup> These events develop a vicious cycle.<sup>5</sup>

In the recent years we have developed many tools to evaluate or quantify the variable impaired activity which will help us to take certain measures to limit these and to improve the overall physical and mental health.

There are various exercise performance test available to assume the physical activity impairment in COPD, like 6 minute walk test, increase ventral workload test, but lacunae with these test is that they require skilled personnel and various equipments.<sup>6,7</sup> So due to these reasons

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these tests could not be performed in many of the centers, to overcome these lacunae a simple test has been derived STS test. The advantage with this test is that it is easier to perform and does not require huge space and personnel.

## AIM AND OBJECTIVES

The goal of our study is to assess:

- Exercise capacity in COPD patients
- Correlation of STS with severity of disease (COPD)

## METHODS

Consecutives, stable COPD patients were examined in outpatient department of chest and TB, a tertiary care hospital (Rohilkhand Medical College) during a period of 6 months (March–August 2017). The diagnosis and severity of COPD were assessed by spirometry and GOLD guidelines. STS test was executed according to a standardised protocol.

### Inclusion Criteria

- All COPD stable cases

### Exclusion Criteria

- AE of COPD (within sequelae)
- Other obstructive airway disease
- Cardiac comorbidity
- Neurological and locomotor disability
- Negative consent

All included patients were given a written informed consent.

### Sit to Stand Test Protocol

- Time duration–30 second
- Equipment required–Chair (flat seat without arm rest), pulse oximeter, stopwatch
- Performed in OPD room
- Modified BORG scale

### Procedure

#### Thirty seconds STS Test Protocol

All 30 seconds STS tests were executed according to a standardized protocol by trained study staff. We used a standard chair (height 46–48 cm) with a flat seat and no armrests, stabilised against a wall. Patients were asked to sit with their legs hip-width apart and flexed to 90°, with their hands stationary on the hips without using the hands or arms to assist movement. They were instructed to stand completely straight and touch the chair with their bottom when sitting, but that they need not sit fully back on the chair. Patients were asked to perform as many repetitions as feasible in 30 seconds. During the tests

performed, the severity of dyspnea (modified Borg scale), oxygen saturation, heart rate were measured.

## Statistical Analysis

Statistical calculations were done using EpiInfo version 7.2. Descriptive data were reported as mean  $\pm$  SD or numbers and proportions. We calculated Pearson correlation coefficients for 30 second STS test scores with FEV<sub>1</sub>.

## RESULTS

Total 46 stable COPD patients (mean age 59.69  $\pm$  11.77 years, mean FEV<sub>1</sub> 40.02%  $\pm$  19.41%) were analyzed (Tables 1 to 10).

There were 2.2% patients of GOLD I, 19.6% in GOLD II, 37% in GOLD III, 41.2% in GOLD IV.

**Table 1:** Mean score of different variables (N = 46)

Variables	Mean	Std. deviation
Age (years)	59.6957	11.77544
FEV <sub>1</sub> (L)	40.02174	19.418764

**Table 2:** Distribution of study participants

Gender	No. (N = 46)	%
Male	37	80.4
Female	9	19.6

**Table 3:** distribution according to GOLD stage

GOLD stage	No. (N = 46)	%
I	1	2.2
II	9	19.6
III	17	37.0
IV	19	41.2

**Table 4:** Changes seen in Spo<sub>2</sub>, HR, and dyspnea scale during the STS test

Parameters	Baseline (mean $\pm$ std. dev.)	After 30 STS test (mean $\pm$ std. dev.)	Significance (p-value)
SPO <sub>2</sub>	96.630 $\pm$ 1.913	94.280 $\pm$ 1.858	0.0001
Heart rate	94.935 $\pm$ 10.0009	100.370 $\pm$ 10.4591	0.0001
Dyspnea (mBorg scale)	1.348 $\pm$ .5257	2.935 $\pm$ 1.0199	0.0001

Significant increase in dyspnea severity, heart rate and drop in SPO<sub>2</sub> (oxygen saturation) were noted during STS test (p < 0.05)

**Table 5:** Changes in Spo<sub>2</sub>, HR, dyspnea scale during the STS Test in GOLD stages I and II (N = 10)

Para- meters	Baseline (mean $\pm$ std. dev.)	After 30 STS test (men $\pm$ std. dev.)	Correla- tion	Signi- ficance (p-value)
SPO <sub>2</sub>	96.800 $\pm$ 0.919	94.500 $\pm$ 1.1785	0.718	0.019
Heart rate	93.100 $\pm$ 11.8082	96.900 $\pm$ 12.4047	0.982	0.0001
Dyspnea (mBorg scale)	1.200 $\pm$ 0.6325	1.900 $\pm$ 0.7379	0.762	0.010

**Table 6:** Changes in SPO<sub>2</sub>, HR, dyspnea scale during the STS test in GOLD stages III and IV (N = 36)

Parameters	Baseline (mean ± std. dev.)	After 30 STS test (mean ± std. dev.)	Correlation	Significance (p-value)
SPO <sub>2</sub>	95.070 ± 9.453	94.222 ± 2.0158	0.860	0.0001
Heart rate	95.444 ± 9.5661	101.333 ± 9.8329	0.986	0.0001
Dyspnea (mBorg scale)	1.389 ± 0.4944	3.222 ± 0.8980	0.572	0.0001

**Table 8:** Mean repetitions according to GOLD stage

GOLD stage	Number of repetitions
II	11
III	10.29
IV	9.26

Mean repetitions in GOLD I and GOLD II patients is 11, in GOLD III and GOLD IV patients is 9.7886 in 30 second

## DISCUSSION

In our study, mean age of subjects was 59.69 ± 11.77 years (Table 1). Similarly, in a study conducted by Meriem et al.,<sup>8</sup> mean age of subjects was 67.06 ± 8.4 years which was inconsistent with our study. Of 46 patients 37 (80.4%) were males and 9 (19.26%) were females (Table 2). Similarly, in a study conducted by Zanini et al.<sup>9</sup> 81.66% were males and 18.33% were females. There were 2.2% patients of GOLD I, 19.6% in GOLD II, 37% in GOLD III, 41.2% in GOLD IV (Table 3). Also, in a study conducted by Meriem et al.<sup>8</sup> 6% of the patients were in GOLD I, 36% in GOLD II, 34% in GOLD III, and 24% in GOLD IV stage.

Over the last few years, studies regarding measuring the functional status in COPD patients have increased.<sup>10</sup> Now a day, the most relevant clinical issue in the management of COPD is the improvement of daily physical activity of the patient.<sup>11</sup> Several authors searched for the test which are simple and less time consuming than 6 MWT for measuring the daily activity of COPD patients. And they found that number of repetitions during STS test can be compared to daily physical activity of COPD patients as can be done with 6 MWT.<sup>12,13</sup> As seen in our study the mean number of repetitions was 11, 10.29 and 9.26 in GOLD II, III and IV stage patients respectively (Table 8).

The COPD patients have skeletal muscle dysfunction.<sup>14</sup> And the performance of COPD patients in their daily routine activity is influenced by weakness of peripheral muscles.<sup>15</sup> STS test have the ability to recognise the weakness of peripheral muscles in COPD patients.<sup>16-19</sup> This is also seen in our study as the number of repetition was less by patients of GOLD III, IV than GOLD I and II. In COPD patients, impaired exercise performance is also the result of dyspnea.<sup>20</sup> Unlike dyspnea, FEV<sub>1</sub> is not

**Table 7:** Mean repetitions during the STS test (N = 46) mean number of repetitions was 10.02 during the test

Parameters	Mean	Std. dev.
Mean repetitions	10.02	2.444851

**Table 9:** Number of repetitions in GOLD I, II group and GOLD III, IV group patients

Parameters	No. of repetitions (mean ± std. dev.)
Gold stage I and II	11.0000 ± 3.49603
Gold stage III and IV	9.7886 ± 6.63262

**Table 10:** Pearson correlation coefficients for number of repetitions with FEV<sub>1</sub> (N = 46)

Variables	Pearson correlation coefficients	Significance (p-value)
FEV <sub>1</sub>	0.351	0.017

Number of repetitions is notably corresponded with FEV<sub>1</sub> (p < 0.05)

a good measure of symptoms and physical disability of COPD patients.<sup>21-23</sup> But in our study, significant correlation (p < 0.05) was found between number of repetitions and FEV<sub>1</sub> (Table 9) indicating that exercise capacity was more in patients having higher FEV<sub>1</sub> values. Above results demonstrate that 30 second STS test is a reliable and practical method for measuring the exercise capacity in COPD patients.

## CONCLUSION

- It is an easy way to detect the severity of the disease in COPD patients.
- It will be beneficial in the treatment of COPD patients.
- It will also help to determine the rough estimation physical activity of the COPD patients and will help in guiding the pulmonary rehabilitation of the COPD patients.

## Future Prospective

With certain modifications, this test can be useful in the follow up and early detection of severity of the disease.

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