

# Retrospective Analysis of Functional Capacity of Patients with COVID-19 using 1 Minute Sit to Stand Test: A Physiotherapist's Perspective

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## ABSTRACT

Coronavirus disease 2019 (COVID-19) caused by SARS-CoV-2 has spread at an alarming rate worldwide. Its dominant feature is arterial hypoxemia seen due to ventilation perfusion mismatch. This causes reduced oxygen diffusion that affects functional capacity. Six-minute walk test is one of the commonly used test which is used to assess functional ability. However, it is more time-consuming and requires a 30-m corridor which is not always easily available. Studies have shown that the 1-minute sit to stand test (1-MSTST) is also useful for assessing functional capacity of patients with respiratory dysfunction. The aim of the study was to understand COVID-19 patient's response to 1-MSTST with respect to number of repetitions, oxygen saturation, heart rate and perceived rate of exertion. Statistically significant difference was seen in pre and post parameters of heart rate (Pre:  $91.73 \pm 17.12$ , Post:  $116.06 \pm 20.18$ ,  $p < 0.0001$ ); SpO<sub>2</sub> (Pre:  $97.04 \pm 3.37$ , Post:  $95.40 \pm 3.93$ ,  $p = 0.005$ ) and RPE (Pre:  $0.07 \pm 0.25$ , Post:  $1.49 \pm 1.22$ ,  $p < 0.0001$ ). A mean of  $21.26 \pm 6.84$  repetitions of sit to stand were performed in a minute. COVID-19 patients, thus, have significantly reduced functional capacity similar to that of patients with other respiratory dysfunctions. Thus, results of this study will enable therapist to plan the rehabilitation in COVID-19 patients to improve their functional capacity. This will enhance their ability to perform in activities of daily living and to participate in societal work and therefore will help in improving their quality of life.

**Keywords:** COVID-19, Physiotherapy, Sit to stand test, Functional Capacity Rehabilitation

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) caused by SARS-CoV-2 was first recognized in Wuhan, China, in December 2019.<sup>[1]</sup> This infection has spread worldwide at an alarming rate including in India.<sup>[2]</sup> To date there are a total of 22 Million confirmed cases and over 2 lakh deaths with

recovery rate being at 99 % in India as of May, 2021.<sup>[3,4]</sup>

These patients clinically present with myriad of symptoms ranging from asymptomatic to symptomatic affection.<sup>[1]</sup> Symptomatic patients show mainly respiratory tract infection related symptoms such as fever, dyspnoea and dry cough.<sup>[1,5]</sup>

Along with it other symptoms such as fatigue, headache, vomiting and diarrhoea have also been observed.<sup>[5,6]</sup> The dominant feature of COVID 19 is arterial hypoxemia seen due to ventilation perfusion mismatch.<sup>[7]</sup> This causes reduced oxygen diffusion which in turn results in breathlessness and exercise intolerance that has an impact on their physical activities of daily living. Activities like walking, climbing stairs and even a simple task such as sit to stand becomes laborious as oxygen diffusion to the muscles is reduced. This results in overall reduction in exercise tolerance.<sup>[6,8]</sup>

Depending on severity, patients are managed for their symptoms either in ICU or ward and as their oxygen saturation levels start improving they are transferred to Step down unit for discharge.<sup>[9]</sup> Literature shows that therapeutic positioning and breathing exercises helps in improving oxygen saturation and exercise tolerance and thereby indirectly improving functional capacity in COVID-19.<sup>[10-12]</sup> This functional capacity is further enhanced by giving upper limb and lower limb mobility, strengthening and endurance exercise. Walking program advised depending on patient's exercise tolerance further improves functional capacity. It is, therefore, essential to know the functional capacity in these patients so that it will help in planning an appropriate exercise program wherein optimum level of oxygen saturation is maintained during their exercises and also in their activities of daily living.

Functional capacity testing is evaluation of a person's ability to function in variety of circumstances. One of the commonly used test to assess this functional capacity is six-minute walk test (6MWT).<sup>[13]</sup> It is sensitive, reproducible & easy to perform. However it could not be done on each and every patient as it is more time-consuming and the number of patients are more as compared to the therapist.<sup>[8,13-15]</sup> It also requires a 30-m corridor which is not always easily available in health centres.<sup>[16]</sup> Gurses et al have reported that in healthy

young adults, assessment of functional capacity can be done using 1-Minute sit to stand (1-MSTST) where 6MWT cannot be performed.<sup>[22]</sup> It is quick, easy to administer test and can be done even in small spaces such as hospital room or in a small examination room in an outpatient setting.<sup>[18,20]</sup> Metabolic equivalent (MET) required for 6MWT and 1-MSTST are the same (4.5 METs).<sup>[21]</sup> Literature shows that the 1-MSTST can also be used to assess functional capacity of patients with respiratory dysfunction such as interstitial lung disease (ILD) and chronic obstructive pulmonary disease (COPD).<sup>[16-19]</sup> In ILD, there is impaired gas exchange due to interstitial inflammation and fibrosis. This results in reduced functional capacity which can be assessed using 1- MSTST.<sup>[16]</sup> This is similar to the gaseous exchange impairment seen in COVID-19 patients due to ventilation perfusion mismatch.<sup>[7]</sup> In view of these aforementioned merits, 1-MSTST was decided to be used to assess functional capacity of these patients. Till date, no such study has been done on COVID-19 patients in Indian population. So, the aim of the study was to understand COVID-19 patient's response to 1-MSTST with respect to number of repetitions, oxygen saturation, heart rate and perceived rate of exertion.

## **METHODS**

### **Subjects:**

A retrospective cross-sectional study was carried out involving 53 participants (males), between 20-79 years of age with COVID-19. The study received approval from institutional ethics committee.

The following electronic data sheets of patients in male step down unit were included in the study: Confirmed diagnosis of COVID-19 on laboratory diagnosis by RT PCR test, received physiotherapy treatment in the step down unit from mid-September to mid-October, hemodynamical stable (HR<120bpm and Spo<sub>2</sub>> 95% at rest), absence of dyspnoea at rest, onset of symptoms ≥8 days.

Individuals with presence of any unstable cardiac, respiratory, neurological or musculoskeletal impairment that may limit 1-min STS test performance, incomplete documentation of physiotherapy practices in medical records or COVID-19 patients not referred for physiotherapy services were excluded.

**Clinical measures:**

- One minute sit to stand with following pre and post parameters was taken:
  1. Number of repetitions.
  2. SpO2 levels.
  3. Heart rate.
  4. Rate of Perceived Exertion (RPE) by Modified Borg's Scale.

**Procedure:**

Patients were positioned on a stool of standard height (48 cm) which was stabilized against a wall. They were instructed to come forward on seating surface far enough for feet to be flat on the floor and with arms crossed over his chest. They were asked to perform as many repetitions as possible in one minute and only complete sit to stand repetitions were counted. Pre and post 1 MSTs SpO2 and Heart rate were noted down using pulse oximeter. Pre and post RPE was assessed using modified Borg's scale. Numbers of complete sit to stand repetitions were noted.



Figure 1 and 2 Assessment of 1-minute Sit to stand in COVID-19 patient.

**Statistical Analysis:**

MS- Excel 2016 was used to enter the data. Shapiro-Wilk test was used to determine the normality of the data. Descriptive statistics was used to analyse responsiveness of patients with COVID-19 to 1 Minute sit to stand test by change in oxygen saturation levels, heart rate and rate of perceived exertion. To compare changes in oxygen saturation levels, heart rate and rate of perceived exertion due to 1 Minute sit to stand test paired t test was used as the data is normally distributed.

**RESULTS**

The characteristics of the subjects are displayed in table 1. A total of 53 male

patients were included in this study with the mean age of 45 years. Of 53 patients, 4 were on oxygen support through nasal prongs. 73% (n=39) subject had comorbidities such as diabetes, hypertension or ischaemic heart disease.

**Table 1: Characteristics of subjects with COVID-19**

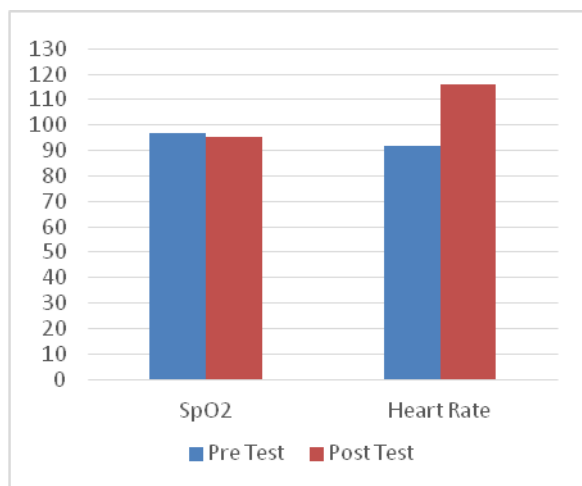
Characteristic	Mean ± SD	
Age (years)	45.83 ± 14.37	
Gender	Male	
Co morbidities	Total	39
	Hypertension	17
	Diabetes	11
	Ischaemic Heart Disease	3
	Others	8
Oxygen requirement	On room air	49
	On nasal prongs	4

Descriptive statistics of pre and post parameters of 1 minute sit to stand test are

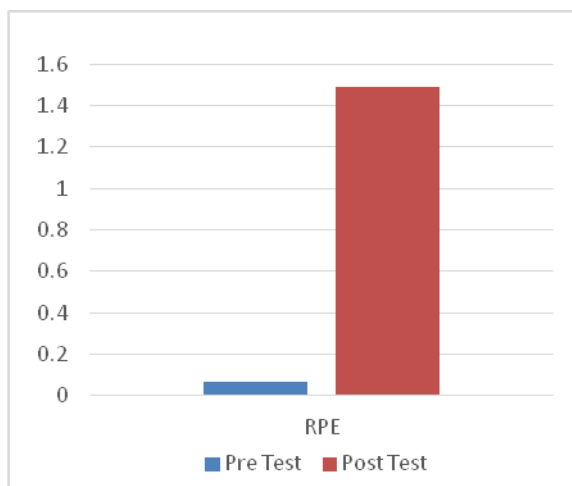
depicted in table 2. Statistically significant difference was seen in pre and post parameters of heart rate (Pre:  $91.73 \pm 17.12$ , Post:  $116.06 \pm 20.18$ ,  $p < 0.0001$ ); SpO2 (Pre:  $97.04 \pm 3.37$ , Post:  $95.40 \pm 3.93$ ,  $p=0.005$ ) and RPE (Pre:  $0.07 \pm 0.25$ , Post:  $1.49 \pm 1.22$ ,  $p < 0.0001$ ). Subjects performed a mean of  $21.26 \pm 6.84$  repetitions of sit to stand in a minute.

**Table 2: Descriptive statistics of pre and post parameters of 1 MSTs test.**

Tests	1 MSTs (53 participants)			
	Mean±SD	SEM	Range	P value
Pre HR	$91.73 \pm 17.12$	2.37	79	< 0.0001
Post HR	$116.06 \pm 20.18$	2.77	96	
Pre SpO2	$97.04 \pm 3.37$	0.46	23	0.005
Post SpO2	$95.40 \pm 3.93$	0.54	20	
Pre RPE	$0.07 \pm 0.25$	0.03	1	< 0.0001
Post RPE	$1.49 \pm 1.22$	0.17	5	
Repetitions	$21.26 \pm 6.84$	0.94	33	-



**Graph 1: Pre and post SpO2 and heart rate**



**Graph 2: Pre and post RPE**

## DISCUSSION

The purpose of this study was to retrospectively assess functional capacity of patients with COVID-19 using 1-MSTST test in terms of number of repetitions, oxygen saturation, heart rate and RPE.

The results revealed that the patients were able to perform a mean of  $21.26 \pm 6.84$  sit to stand repetitions in a minute. A cross sectional study done by Strassmann et al revealed the population-based reference value for 1-MSTS for males falling in the age group of 40-44 years and 45-49 years was 45 and 44 respectively.<sup>[23]</sup> This shows that patients with COVID-19 were able to perform about 50% of the sit to stand repetitions as compared to normal healthy individuals. A similar study was done in Itlay in COVID-19 patients in 2020 were they performed a mean number of  $14 \pm 6$  sit to stand repetitions in one minute which was below percentile 2.5 for almost 75% of population. However, their majority (78.6%) of population was on O2 supplementation. They concluded that physical functioning and performance of

ADLS was markedly affected in COVID-19 patients during post acute hospitalization as well as at the time of discharge emphasizing the need of physiotherapeutic intervention.<sup>[24]</sup>

Literature done on ILD patients showed that the patients had reduced functional capacity as they were able to perform a mean of  $21 \pm 6$  repetitions of sit to stand in a minute similar to that of our study. They concluded that this test can be used to detect exercise induced desaturation effectively in ILD patients. Their mean SpO2 was  $97 \pm 1\%$  at baseline and was markedly reduced during exercise (SpO2 nadir  $92\% \pm 5\%$ ). Significant reduction in oxygen saturation was also seen in our study following sit to stand test ( $p=0.005$ ). Their baseline HR was  $84 \pm 14$  which increased to  $112 \pm 17$  and their RPE showed significant increase ( $p < 0.0001$ ).<sup>[16]</sup> Similarly, significant increase in heart rate and RPE ( $p < 0.0001$ ) was seen in our study after 1 minute sit to stand test. Literature done on COPD patients also showed results in accordance to our study. 49 COPD patients



were able to perform a mean of  $19.31 \pm 5.56$  repetitions. Significant increase in heart rate and dyspnoea was seen following the 1-MSTS test ( $p < 0.05$ ).<sup>[25]</sup>

This shows that COVID-19 patients have significantly reduced functional capacity similar to that of patients with other respiratory dysfunctions. This will have an effect on their activities of daily living and their participation in society and thus quality of life. COVID-19 infection also has an alarming effect on patient's mental health. Literature has shown high prevalence of psychological disorders such as depression and anxiety in these patients further affecting their quality of life.<sup>[26]</sup> Studies have shown that pulmonary rehabilitation had a positive impact on functional status and quality of life in ILD and COPD patients.<sup>[27-29]</sup> Thus, results from this study will enable therapist to plan the rehabilitation in COVID-19 patients to improve their functional capacity. This will enhance their ability to perform in activities of daily living and to participate in societal work and therefore will help in improving their quality of life.

## CONCLUSION

One minute sit to stand is a simple and easy test which has been used to assess functional capacity in patients with ILD and COPD. COVID-19 patients showed reduced functional capacity as compared to that of normal healthy population with one minute sit to stand. Baseline readings from this study will help in planning physiotherapeutic intervention of COVID-19 patients which will improve their functional capacity. This will help in their performance of activities of daily living and improve their participation in society and thus will have a positive impact on their quality of life.

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**Ethical Approval:** Approved

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