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Agreement between the one-minute sit-to-stand test and the six-minute walk test in assessing exercise capacity in patients with interstitial lung disease

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Abstract

The six-minute walk test (6-MWT) assesses functional exercise capacity in interstitial lung disease (ILD), providing key prognostic and functional insights. Logistical challenges, such as space and time limitations, limit its clinical use. The one-minute sit-to-stand test (1-MSTST) has emerged as a practical, space- and time-efficient alternative reflecting similar functional capacity. This study examined 1-MSTST and 6-MWT agreement in ILD patients and their correlations with pulmonary function tests and physiological responses. A prospective observational study was conducted on patients diagnosed with ILD at a tertiary care center. Patients underwent both 6-MWT and 1-MSTST at baseline, with follow-ups at 3 and 6 months. The agreement between these two tests was assessed using Lin's concordance correlation coefficient (CCC). Secondary outcomes included correlations with pulmonary function parameters, such as forced vital capacity (FVC) and diffusion lung capacity for carbon monoxide, and physiological responses, including oxygen desaturation, heart rate variation, blood pressure variation, and perceived exertion measured by the Modified Borg Dyspnea Score. They were assessed using the Spearman correlation coefficient. A total of 59 patients completed the study. At baseline, a moderate agreement between 1-MSTST and 6-MWT was observed (CCC=0.37), which improved over time with CCC values of 0.49 at 3 months and 0.54 at 6 months, indicating increasing concordance. Both tests demonstrated similar oxygen desaturation responses and Borg score variations, highlighting their utility in detecting exercise-induced hypoxemia. While 6-MWT showed significant correlations with FVC (r=0.34, p=0.009) and peak expiratory flow rate (PEFR, r=0.39, p=0.002), 1-MSTST exhibited weaker associations with lung function parameters. The 1-MSTST is a feasible and practical alternative to the 6-MWT for assessing exercise capacity in ILD patients, particularly in resource-limited settings where space and time constraints hinder using the 6-MWT. Its ease of implementation and ability to detect exercise-induced desaturation make it a valuable tool for routine clinical assessment and follow-up of ILD patients.

Key words: interstitial lung disease, six-minute walk test, one-minute sit-to-stand test, exercise capacity, oxygen desaturation.

Introduction

Interstitial lung disease (ILD) is a group of diseases with different aetiologies manifesting with similar clinical and radiological features. They are characterized by fibrosis and/or inflammation of the alveolar interstitium [1]. Among ILDs, idiopathic pulmonary fibrosis (IPF) has a global prevalence of 7 to 1650 per 100000 persons. Studies show varied prevalence of non-IPF ILD [2]. It leads to progressive respiratory limitation, presenting with shortness of breath and cough. Most ILDs present with a restrictive lung pattern, characterized by a reduction in forced vital capacity (FVC) and diffusing capacity for carbon monoxide (DLCO). These parameters along with assessment of exercise capacity, are crucial in assessing disease severity, with lower values strongly correlating with increased mortality risk. As the disease progresses, these tests are essential for disease monitoring [3].

The six-minute walk test (6-MWT) is widely used to evaluate exercise capacity in ILD patients, providing insight into functional status, disease progression, response to therapy and mortality risk. The test measures the total distance walked by a patient in six minutes, while assessing physiological responses such as heart rate, oxygen saturation, and perceived dyspnea [4]. Studies have demonstrated a significant association between reduced 6-MWT distance and increased mortality, particularly in conditions like IPF [5]. Despite its clinical utility, the 6-MWT has notable limitations like requirement of a dedicated 30-meter corridor, and it takes six minutes per patient, limiting its efficiency in high-volume clinical environments.

The 1-MSTST is a simple, reliable, and space-efficient tool for assessing exercise capacity. The test involves repeated sit-to-stand movements for one minute, engaging the lower limb muscles and assessing functional capacity. Studies, including a recent systematic review, have shown that the 1-MSTST demonstrates strong test-retest reliability, validity, and responsiveness across various populations, including those with ILD. It primarily assesses lower limb endurance, and the test results correlated moderately with the 6-MWT. When combined with the Modified Borg dyspnea score and pulmonary function tests like spirometry and DLCO, the 1-MSTST offered valuable clinical insights into functional status and disease severity in patients with ILD [6].

Given the growing interest in 1-MSTST as a practical substitute for 6-MWT, this study's aim was to assess the level of agreement between these two tests in detecting exercise-induced desaturation in ILD patients. By comparing their effectiveness in evaluating functional status and prognosis, this study aimed to provide insight into whether the 1-MSTST can be a reliable and efficient alternative to the 6-MWT for assessing disease severity, mortality risk, and overall patient outcomes in ILD.

Materials and Methods

A prospective cohort study was conducted at AIIMS Bhubaneswar from March 2023 to December 2024 after obtaining the ethics committee approval of the institution. Patients more than or equal to 18 years with ILD were enrolled. Exclusion criteria included unstable cardiac conditions (Myocardial infarction or unstable angina within a month) and inability to perform tests (patients with rheumatoid associated joint pain, inability to stand, requirement of oxygen, or severely ill patient). Severely ill patients, defined as those with modified Medical Research Council (mMRC) dyspnea grade IV, resting peripheral saturation <90% on room air, or those who were bed-bound or requiring intensive unit care.

The 6-MWT was conducted as per American Thoracic Society guidelines [7]. Patients were instructed to walk back and forth in a hallway between two orange traffic cones placed 30 meters apart, with standard verbal encouragement and instructions provided at each minute mark. The timer was set to stop at six minutes. No warm-up was allowed, and resting was permitted without stopping the timer. Six-minute Walk distance (6-MWD) was recorded as a primary parameter. Secondary parameters recorded were oxygen saturation nadir, and variability, heart rate and blood pressure changes, and the Modified Borg dyspnea score (MBDS) before and after the test.

The 1-MSTST was performed using a 46 cm high armless chair, positioned against a wall. Patients were instructed to perform as many full sit-to-stand repetitions as possible within one minute. The total number of repetitions in one-minute (1-NR) was recorded as a primary parameter. The secondary parameters measured were similar to 6-MWT.

The tests were conducted by a trained respiratory technician under the guidance of a physician. Both the 6-MWT and 1-MSTST were conducted with at least a one-hour gap or when the patient felt comfortable. The order of 6-MWT and 1-MSTST was randomized using a colour chit selected by the patients. Both the tests used a finger pulse oximeter secured with micropore tape to continuously monitor oxygen saturation. Vital signs and MBDS were systematically assessed to evaluate physiological response and perceived dyspnea. Exercise-induced desaturation was defined as a reduction in saturation of more than four percent from the baseline saturation of the patient.

Patients were followed up at three-month and six-month intervals after the baseline assessment. During each follow-up visit, spirometry, DLCO, 6-MWT, and 1-MSTST were performed, by the baseline protocol. The study flow diagram is mentioned below.

Data was analysed using R software (v4.1.1). Agreement between primary parameters (6-MWD and 1-NR) was assessed using Lin's concordance correlation coefficient (CCC). Agreement between the 1-MSTST and 6-MWT was assessed using Bland-Altman analysis. The mean difference (bias) and 95% limits of agreement were calculated. A Bland-Altman plot was used to visualize the agreement and detect any proportional bias. Normality was tested between the parameters. As they were not normally distributed, correlations of primary parameters with spirometry (FVC, DLCO) and peak expiratory flow rate (PEFR) were analyzed using Spearman correlation. The relationship between 6-MWT and 1-MSTST was assessed using regression analysis. A two-sided p-value <0.05 was considered as significant.

Results

The study flow is mentioned in Figure 1. Reasons for exclusion included death (n=2), loss to follow-up (n=12), and inability to complete tests (n=7) due to desaturation, dyspnea, or chest pain. The final cohort (59) had a mean age of 49 ± 11 years, with male predominance (54%) and a mean BMI of 23.2 ± 4.86. Table 1 shows the baseline sociodemographic and clinical characteristics of the enrolled subjects. Smoking (42.37%) was the most common addiction, while hypertension (16.94%) and diabetes (8.47%) were frequent comorbidities. The most common primary diagnosis was CTD-ILD (59.2%), followed by IPF (27.1%). HRCT findings predominantly showed NSIP (45.76%) and UIP (27.11%) patterns. Steroids (55.93%) were the most used treatment, followed by immunosuppressants (42.37%) and antifibrotics (38.98%).

Table 2 presents the mean and standard deviation of 6-MWD and 1-NR at baseline, first, and second follow-ups. The results indicate a slight improvement in exercise capacity over time. However, the 6-MWT showed greater variability, as reflected in its higher standard deviation, suggesting more variation in performance compared to the 1-MSTST.

Lin's concordance correlation coefficient (CCC) demonstrated moderate agreement between 6MWD and 1-NR repetitions at baseline (CCC = 0.37, 95% CI: 0.14–0.57), which strengthened over follow-ups (CCC = 0.49 at 3 months, CCC = 0.54 at 6 months), reinforcing the increasing comparability of both tests in ILD patients. Spearman correlation also showed a similar correlation between the two tests. The baseline correlation between 6-MWD distance and 1-NR was weak (rho = 0.378, p = 0.003) but strengthened over time (rho = 0.443 at first follow-up, rho = 0.531 at second follow-up, both p < 0.001), suggesting increasing agreement between the tests.

Physiological parameters between the two tests were compared as shown in Table 3. Saturation variation showed a significant correlation between the two tests, but heart rate, Borg score, and blood pressure variations did not occur, indicating different physiological responses. Other parameters had weak baseline correlations, which improved with follow-ups.

A weak but significant correlation was observed between FVC and 6MWT distance at baseline (rho = 0.297, p = 0.022) and second follow-up (rho = 0.339, p = 0.009), while DLCO did not correlate with either test. FVC% and DLCO% showed poor agreement with both 1-MSTST repetitions and 6MWT distance at baseline and follow-ups (Table 4).

In Bland-Altman Analysis (Figures 2-4), the mean difference between 6-MWT and 1-MSTST remained close to zero across all time points, suggesting minimal systematic differences between tests. Baseline agreement was poor, as indicated by wider limits of agreement (greater spread of dots). Agreement improved over time, with reduced variability and narrower limits of agreement at further follow-ups, indicating increased comparability of the two tests.

Regression analysis showed a strengthening association between 6-MWT and 1-MSTST over time, with R^2 increasing from 15% at baseline to 33% at six months, indicating improved predictive value of one test for the other.

Discussion

ILD encompasses a diverse group of pulmonary disorders characterized by varying degrees of inflammation and fibrosis of the lung parenchyma. Patients often exhibit normal oxygen saturation at rest in the early stages of ILD. However, exercise-induced gas exchange impairment can indicate disease severity and progression early, manifesting before detectable changes in spirometry and DLCO. Exercise testing plays a critical role in detecting this impairment. There are several established exercise tests, such as 6-MWT and cardiopulmonary exercise testing (CPET). Along with these tests, 1-MSTST has been utilized in various chronic lung diseases both as a prognostic indicator and to evaluate the severity of the disease [8,9]. These tests also predict exertional dyspnea and exercise limitation and assess quality of life. In IPF patients, it is shown that desaturation during exercise tests independently predicts mortality. Monitoring the exercise-induced gas exchange impairment alongside FVC and DLCO helps guide the treatment of ILD.

This study evaluated the agreement between the 6-MWT and 1-MSTST in assessing exercise capacity among patients with ILD. We evaluated the agreement using Lin's concordance correlation coefficient (CCC), a statistical measure that evaluates concordance between two continuous variables. This metric is particularly relevant for validating a new test against an established gold standard, which is crucial for validating the use of 1-MSTST as an alternative to the 6-MWT in clinical practice. The study also explored cardiorespiratory responses, the correlation of exercise tests with pulmonary function tests like FVC, DLCO, and PEFR, and the implications of these findings for clinical practice.

In our study, CCC between the two tests showed mild agreement at the baseline which improved over time. This trend suggests increased reliability as patients became more familiar with the tests. Additionally, the improvement may be attributed to therapeutic interventions like steroids, immunosuppressants, and antifibrotics. A similar result was obtained in a study by Meng-Yun Tsai et al, who conducted a prospective cohort study on patients with ILD comparing the two tests. The 1-MSTST showed good prediction of 18-month mortality and showed moderate correlation with gender, age, physiology (GAP score), dyspnea score and 6-MWD. Also, Bland-Altman analysis demonstrated good agreement between the two tests. The study also showed that the mortality of patient was 76.4% at a cut off less than or equal to 23 repetitions [10]. Previous studies have reported similar levels of agreement between the two tests in patients with chronic lung diseases like COPD (r = 0.47-0.86) [11,12]. In patients with ILD, a comparable correlation was observed in studies (r = 0.50) [13]. Consistent with findings by Oishi et al., our study also demonstrated that the 1-MSTST reliably detected exercise-induced desaturation, with a strong correlation to the 6-MWT in terms of saturation nadir and exertion levels. Moreover, the frequency of patients having desaturation with both tests was similar, further validating the utility of the 1-MSTST as a practical alternative to the 6-MWT in clinical settings [14]. This finding was supported by another study in which area under the receiver operating characteristic curve (AUC) was used to determine the utility of 1-MSTST to predict the desaturation by 6-MWT. The result showed a good sensitivity and specificity of 100% and 87% respectively for the predictability of desaturation [15].

Similar to a study by Araujo et al., our study showed comparable responses for key parameters of cardiorespiratory reactions, such as saturation nadir and Borg dyspnea score, indicating comparable exertion levels [16]. This consistency further supports the reliability of the 1-MSTST in assessing functional exercise capacity. Additionally, the variance in performance was observed to be lower for the 1-MSTST compared to the 6-MWT, reflecting a lesser learning effect. The minimal learning effect of the 1-MSTST enhances its feasibility for regular use in clinical and research contexts, ensuring dependable outcomes with repeated evaluations.

Our study demonstrated a consistent but moderate positive correlation between 6-MWD and FVC values obtained from spirometry. This finding implies that higher lung volumes are generally associated with better functional exercise capacity. However, the correlation between the 1-MSTST and FVC% was weak, suggesting differing physiological attributes assessed by the two tests. These observations were similar to previous studies comparing lung function with 6-MWT. For instance, Chetta et al. demonstrated a significant correlation between 6-MWD and FVC [17]. Significant correlation between 6-MWT and lung functions was also observed by Hallstrand et al. and Eaton et al [18,19]. However, some variability in the strength of these correlations across studies may be attributed to differences in patient population and disease severity. While spirometry provides crucial information on pulmonary mechanics, functional tests like the 6MWT and 1MSTST offer complementary insights into exercise capacity and overall patient functionality. Together, they provide a more comprehensive understanding of disease impact and guide tailored management strategies.

Similarly, it was observed that both 6-MWT and 1-MSTST had weak or no correlation with DLCO values. This observation contrasted with a cross-sectional study in ILD patients by

Prashanth et al., where the correlation of spirometry with 6-MWT was insignificant, but there was a strong correlation observed between 6-MWT and DLCO. This result also contrasted with another study by Seema S et al., where a significant correlation was observed between 6-MWT, spirometry, and DLCO values [20]. However, our findings were similar to a study conducted by Sangmee et al., where 6-MWD in patients with myositis-associated ILD had a weak correlation with spirometry parameters. At the same time, there was no correlation with DLCO values [4].

Our study showed a strong and statistically significant correlation between the 6-MWD and peak expiratory flow rate (PEFR). As the exercise capacity increases, as seen by the increase in walking distance, airway function also shows improvement. In contrast, the lack of significant correlation between 1-MSTST and PEFR signifies that 1-MSTST is a better measure of strength and endurance than pulmonary function. Similar findings were observed in a study by Maji et al., where COPD patients showed a good correlation between 6-MWT and spirometry [21].

The linear regression between 6-MWT and 1-MSTST demonstrated a stronger association between exercise capacity and functional performance. In this study, the dependent variable was the number of repetitions measured through 1-MSTST. The independent variable was the 6-MWD measured through 6-MWT, which was used to predict changes in the number of repetitions. R^2 in this study was a statistical measure representing the proportion of variance in the number of repetitions that the distance walked can explain. The beta coefficient represented the amount of change in several repetitions for each unit change in the distance walked. This implied that regular assessment of both 6-MWT and 1-MSTST can effectively track treatment effectiveness, helping clinicians to decide on rehabilitation strategies.

Functional tests such as the 6-MWT and 1-MSTST primarily assess exercise capacity, reflecting a combination of physiological factors, including cardiovascular health, skeletal muscle strength, and oxygen delivery and utilization efficiency. Pulmonary function tests, on the other hand, evaluate specific aspects of lung mechanics and gas exchange: FVC% measures the total volume of air that can be forcefully exhaled, reflecting lung volume and airway patency, while DLCO% assesses the ability of the lungs to transfer oxygen from inhaled air into the bloodstream, providing insights into gas exchange efficiency. The weak correlation between these tests underscores their complementary nature, emphasizing the need for a multidimensional approach to ILD assessment.

The observed mild to moderate correlation suggests that these two types of tests measure different dimensions of a patient's condition. For instance, while pulmonary function parameters provide critical information about lung mechanics and gas exchange, they may not fully explain a patient's ability to perform physical tasks or exercise. Similarly, impairments in exercise capacity might arise from systemic factors such as muscle deconditioning, cardiovascular dysfunction, or other non-pulmonary limitations, which are not captured by pulmonary function tests.

Prior studies in chronic lung diseases, including COPD, cystic fibrosis, etc., reported moderate agreement between the two tests, with a correlation coefficient ranging from 0.5-0.7 [11,22-24]. Our findings align with these results, with a correlation coefficient of 0.3 at baseline, improving over time in successive follow-ups. However, the correlation does not indicate replaceability [8]. Hence, Lin's CCC was used in our study to see the agreement between the tests, demonstrating comparable agreement levels.

Unlike some studies that reported significant correlations between 6-MWT and DLCO, this study found weak or no significant correlation for either test. Similarly, earlier research highlighted strong associations between spirometry measures and 6-MWT [20,25]. Differences in patient populations and ILD subtypes across studies may contribute to inconsistent findings. In addition, variation in disease etiology and progression among patients could have influenced test outcomes, introducing variability.

Many prior studies lacked follow-up data, making it difficult to assess test reliability or therapeutic impact over time. We followed the patients at frequent intervals of three and six months and repeated the tests. Our study showed consistent results for the agreement between the two tests, suggesting that 1-MSTST can be reliably utilized in ILD patients to assess mortality and morbidity. Our findings were supported by a study by Aylin et al., where excellent test-retest reliability was documented with an intraclass correlation of 0.932 (95% CI: 0.874-0.963_. This study also showed a good correlation between 1-MSTST and 6-MWT, further supporting our finding [26].

Additionally, the 1-MSTST has been proposed as a valuable tool in home monitoring programs in ILD patients, owing to the simplicity of the test. It can serve as an easy, self-administered test to detect early desaturation and can support treatment adjustments and timely interventions [27].

The findings are most applicable to resource-constrained clinical settings where the 6-MWT may be impractical. However, single-centre design and limited sample size may restrict broader applicability. The study emphasizes the multidimensional nature of ILD assessment, combining functional and pulmonary evaluations for a comprehensive understanding of the disease process. The 1-MSTST offers a feasible, space-efficient alternative to the 6-MWT, enabling regular monitoring of exercise capacity in outpatient and resource-limited settings.

The longitudinal design of this study, with assessments conducted at baseline, three months, and six months, enhances the validity of the findings by tracking changes over time. This comprehensive follow-up strengthens the reliability of the results and demonstrates the feasibility of using the 1-MSTST as an alternative to the 6-MWT in resource-limited settings.

However, the small sample size limited the ability to perform subgroup analysis, reducing the generalizability of findings to specific ILD subtypes. Further, this study did not stratify patients based on CTD subtype or steroid use, both of which can influence proximal muscle strength and thus disproportionately affect 1-MSTST performance. Similarly, osteoporosis, which is common in elderly patients and patients who received steroid treatment, may have contributed to the reduction of 1-MSTST. These potential confounding factors were not accounted for in our study, which represents a potential area for further research.

Conclusions

This study demonstrates a moderate level of agreement between the 6-MWT and the 1-MSTST in assessing exercise capacity in ILD patients. The agreement between the tests increased over time, suggesting the reliability of 1-MSTST. The study supports the potential feasibility of the 1-MSTST as an alternative method for assessing exercise capacity in patients with ILD, particularly in clinical settings where the 6-MWT may be impractical or challenging to implement. These findings support the growing interest in adopting more straightforward yet effective functional exercise tests to monitor ILD patients.

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Table 1. Baseline sociodemographic characteristics.

Descriptive parameter	Value
Demographic and clinical characters	
Age (mean, (SD))	49(11)
Male: Female (number, (percentage))	32(54%):27(46%)
BMI (mean, SD)	23.2(4.9)
Smoking (number, (percentage))	25(42.4%)
Alcohol (number, (percentage))	3(5.1%)
Diabetes (number, (percentage))	5(8.5%)
Hypertension (number, (percentage))	10(16.9%)
Hypothyroid (number, (percentage))	3(5.1%)
Cardiac illness (number, (percentage))	2(3.4%)
Renal disease (number, (percentage))	1(1.7%)
Tuberculosis history (number, (percentage))	8(13.6%)
Exposure history (number, (percentage))	20(34%)
Primary diagnosis	
CTD-ILD (number, (percentage))	30(59%)
IPF (number, (percentage))	16(27%)
Exposure-related ILD (number, (percentage))	7(12%)
Granulomatous ILD (number, (percentage))	4(6.8%)
Others (number, (percentage))	2(3.4%)
HRCT findings	
UIP (number, (percentage))	16(27%)
NSIP (number, (percentage))	27(45.8%)
Undifferentiated (number, (percentage))	11(18.6%)
Others (number, (percentage))	5(8.5%)
Treatment received	
Steroids (number, (percentage))	33(56%)
Immunosuppressive drugs (number, (percentage))	25(42.4%)
Anti-fibrotic medications (number, (percentage))	23(39%)

SD, standard deviation; BMI, body mass index; CTD-ILD, connective tissue disease-interstitial lung disease; IPF, Idiopathic pulmonary fibrosis; HRCT, high resolution computed tomography; UIP, usual interstitial pneumonia; NSIP, nonspecific interstitial pneumonia.

Table 2. Agreement between 1-NR and 6-MWD.

Time-point	**1-NR (mean $\pm$ SD)**	**6-MWD (meters) (mean $\pm$ SD)**	**Lin's CCC (95% CI)**
Baseline	19.67 $\pm$ 3.8	341.35 $\pm$ 75.6	0.37 (0.14-0.57)
3rd month	20.49 $\pm$ 3.5	355.51 $\pm$ 67.36	0.49 (0.28-0.66)
6th month	20.42 $\pm$ 3.5	357.96 $\pm$ 60.6	0.54 (0.34-0.69)

1-NR, number of repetitions in one-minute; 6-MWD, distance walked in 6-minutes; SD, standard deviation, CCC-Concordance correlation coefficient.

Table 3. Correlation between physiological parameters of 6-MWT and 1-MSTST.

Outcomes	Timeline	ICC	95% CI	p-value
Saturation nadir	Baseline	0.42	0.18-0.61	0.0004
	3rd month	0.59	0.4-0.74	2.44
	6th month	0.65	0.48-0.78	6.12
Saturation Difference	Baseline	0.15	-0.11-0.39	0.13
	3rd month	0.46	0.24-0.64	8.3
	6th month	0.55	0.34-0.7	2.7
Systolic BP difference	Baseline	0.14	-0.12-0.38	0.15
	3rd month	0.40	0.17-0.6	0.0006
	6th month	0.48	0.26-0.65	5.05
Diastolic BP difference	Baseline	0.19	-0.07-0.42	0.07
	3rd month	0.06	-0.19-0.31	0.314
	6th month	0.21	-0.05-0.44	0.05
Heart rate difference	Baseline	0.23	-0.03-0.45	0.04
	3rd month	0.20	-0.05-0.43	0.06
	6th month	0.58	0.38-0.73	4.78
Borg score difference	Baseline	0.5	0.29-0.67	1.8
	3rd month	0.61	0.42-0.74	1.22
	6th month	0.61	0.42-0.75	1.04

6-MWT, six-minute walk test; 1-MSTST, one-minute sit-to-stand test, ICC, Intra-class correlation; CI, Confidence interval; BP, Blood pressure.

Table 4. Correlation between 1-NR and 6-MWD with pulmonary function tests (FVC% and DLCO%):

Parameter 1	Parameter 2	Spearman correlation coefficient (rho)	p-value
Baseline			
6-MWD	FVC%	0.297	0.02
6-MWD	DLCO%	0.11	0.43
1-NR	FVC%	0.13	0.30
1-NR	DLCO%	0.28	0.03
3RD month			
6-MWD	FVC%	0.29	0.03
6-MWD	DLCO%	0.11	0.43
1-NR	FVC%	0.05	0.73
1-NR	DLCO%	0.05	0.73
6th month			
6-MWD	FVC%	0.34	0.009
6-MWD	DLCO%	0.07	0.57
1-NR	FVC%	0.13	0.34
1-NR	DLCO%	0.12	0.35

1-NR, number of repetitions in one-minute; 6-MWD, distance walked in 6-minutes; FVC; Forced vital capacity; DLCO, Diffusion capacity of the lungs for carbon monoxide

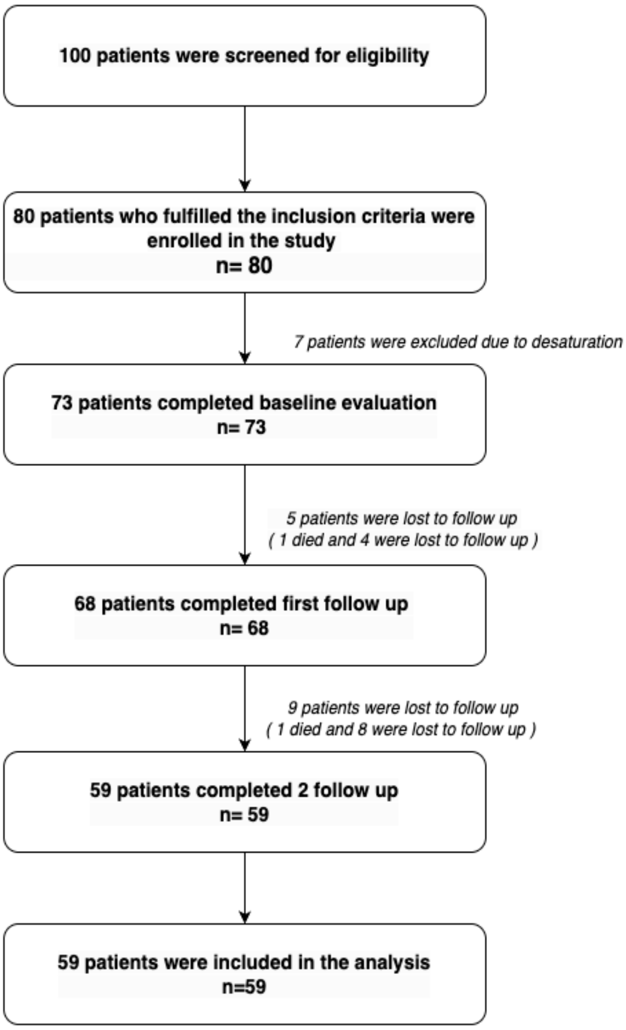

Figure 1. Consort diagram showing study flow.

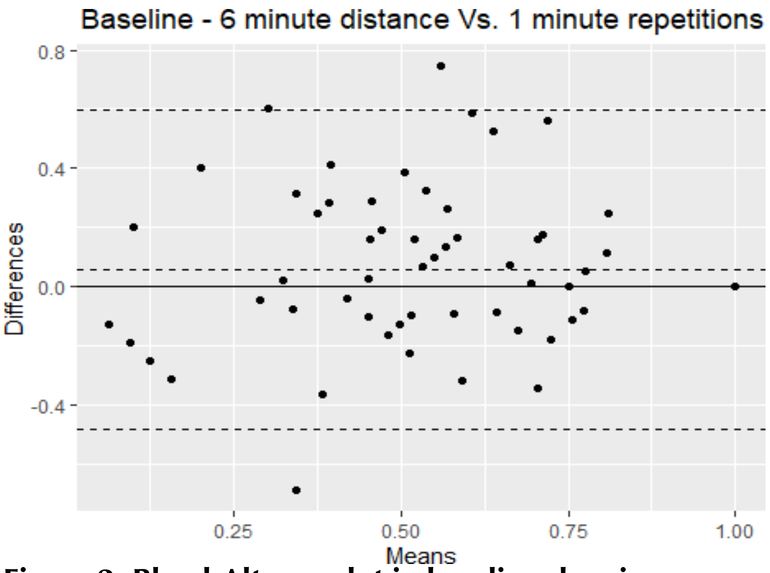

Figure 2. Bland-Altman plot in baseline showing agreement between 6-MWD and 1-NR in baseline.

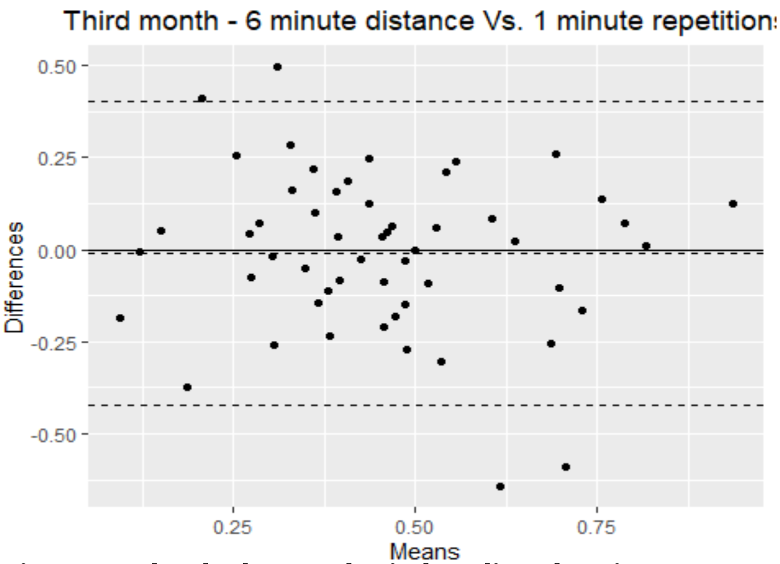

Figure 3. Bland-Altman plot in baseline showing agreement between 6-MWD and 1-NR in third-month follow up.

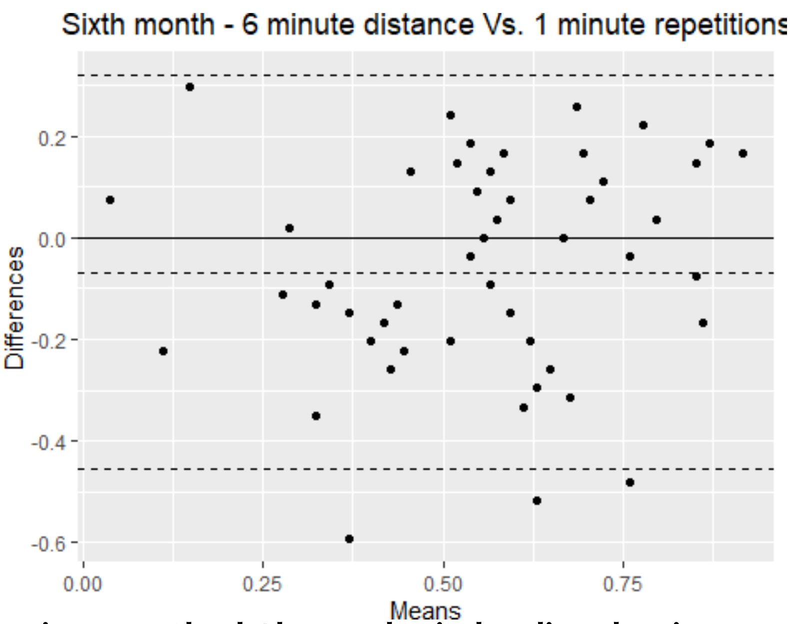

Figure 4. Bland-Altman plot in baseline showing agreement between 6-MWD and 1-NR in sixth month follow up.