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Review Article

Correlation between 1-min-sit-to-stand test and 6-min walk test in patients with cardiorespiratory disorders: a brief review

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ABSTRACT

Cardiorespiratory disorders, including cardiovascular and respiratory conditions, are significant global health issues, with millions of deaths annually attributed to these causes. Environmental factors play a substantial role in increasing the risk of these diseases. Children and adolescents with low cardiorespiratory fitness are at a higher risk of developing cardiovascular diseases later in life, and their fitness levels tend to remain low over the years. The 6-minute walk test (6MWT) is commonly used to assess exercise tolerance in patients with chronic lung diseases and cardiac conditions, while the 1-minute sit-to-stand test (1STS) measures a participant's ability to perform daily activities. This brief review was conducted on databases from Pubmed, Google scholar and Research Gate to find out the correlation between 1-min-sit-to-stand test and 6-min walk test in patients with cardiorespiratory disorders. This review included 10 studies on the comparison between 1-min-sit-to-stand and 6-min walk test in patients with cardiorespiratory disorders so as to frame a definite conclusion as to whether 1STST can be a valid alternative to 6MWT in the cardiorespiratory disorders.

Keywords: Cardiorespiratory diseases, 6MWT, 1STST

INTRODUCTION

Cardiorespiratory disorders are a global public health concern that is getting worse. According to estimates from the World Health Organization (WHO), respiratory and cardiovascular illnesses caused 4 million and 17.5 million deaths worldwide in 2012, respectively. Extensive evidence indicates that environmental factors are associated with several adverse health effects, including cardiorespiratory disease risk.[1] Almost one-half of deaths are from pneumonia in children under the age of 5 years. This estimate of nearly 2 million deaths annually is probably low, and the updated global burden of disease estimate due to be published later this year is expected to be much higher, due primarily to inclusion of the additional risk of morbidity and mortality from cardiovascular diseases.[2] Early studies identifying risk factors for all-cause and cardiorespiratory mortality included only middle-aged men.[3] Cardiorespiratory fitness reflects the overall capacity of the cardiovascular and respiratory systems and the ability to carry out prolonged, rhythmic, and dynamic exercise involving large muscles of the body. It is a direct measure of aerobic functional capacity. In children and adolescents, there is a clear correlation between cardiovascular disease risk factors and inadequate cardiorespiratory fitness. Children and adolescents with low cardiorespiratory fitness have higher risk of cardiovascular disease and myocardial infarction during adulthood. Years later, children and adolescents with poor levels of cardiorespiratory fitness also have low levels of fitness. Cardiorespiratory fitness has historically been included in almost all children and adolescent fitness test batteries. Scores from cardiorespiratory fitness tests were once monitored as performance indicators, but due to

the growing emphasis on fitness for health, they are now used as a screening tool to identify kids and teenagers who are more likely to develop cardiovascular disease.[4] There are numerous causes of dyspnoea although patient diagnosed with cardiovascular and cardiorespiratory diseases account for approximately two-third of all cases.[5] The 6-min walk test (6MWT) is the gold standard exercise test and has been validated for most chronic lung diseases.[6] The 6-minute-walk test (6MWT) is a practical and clinically meaningful measure of exercise tolerance with favourable performance characteristics in various cardiac and pulmonary diseases.[7] The goal of the self-paced 1STST test is to have participants stand up and sit down from a chair as many times as they can in one minute, mimicking a regular daily behavior.[8] Several studies have shown that patients with respiratory conditions such as COPD and Idiopathic pulmonary fibrosis have significant correlations in their physical performance as measured by the 6-minute walk test (6MWT) and the Sit-to-Stand Test (STST) (Table 1).[9-16] Studies were searched from the following engine PubMed, Google Scholar, ResearchGate to review the literature. Studies include COPD, ILD, 6MWT, 1STST. Keywords used to search studies were 6MWT, 1STST and cardiorespiratory diseases.

Table 1: Summary of studies conducted on patients with cardiorespiratory disorders correlating 6-minute walk test and 1-min-sit-to-stand test.

Authors, Journal, year	Objectives	Design	Characteristics of participants Sample size	Material and methods	Outcome measures	Results
Ozalevli S et al. Respiratory Medicine (2007)[9]	To discuss the utility of Sit-to-Stand Test (STST) compared to the 6 min walking test (6MWT) for the evaluation of functional status in patients with chronic obstructive pulmonary disease (COPD)	Randomized	Fifty-three consecutive respiratory patients, 33 male and 20 female. According to the GOLD-2003, the clinical histories of all these patients were consistent with moderate-to-severe COPD. Healthy individuals 15 with normal respiratory capacity in PFT	In the same afternoon, each subject performed STST and 6MWT, with an interval of at least 2 hours between each test. The Nottingham health profile survey (PMC of NHPS) assessed the quadriceps femoris (QF) muscle strength by manual muscle test, the pulmonary function by spirometry, and the quality of life by physical mobility category.	Evaluation of exercise capacity by 1-min-sit-stand, 6-min walk test and rating of dyspnea. Evaluation of lung function-PFT, Peripheral muscle strength and quality of life.	COPD patients had lower lung functions, showed worse performance on the Sit-to-Stand Test (STST) and 6-Minute Walk Test (6MWT) compared to healthy subjects, experienced increased heart rate and blood pressure during the 6MWT, worse quality of life scores. There was a significant correlation between STST and 6MWT results, but no link between these tests and lung function.
Bois RM et al. American journal of respiratory and critical care medicine (2011)[10]	To assess the reliability, validity, and responsiveness of the 6MWT and estimate the minimal clinically important difference (MCID) in patients with IPF.	Randomized	Consisted of all randomized subjects in a placebo-controlled Phase 3 clinical trial of interferon gamma-1b who completed the 6MWT at the baseline study visit (n=822). eligible patients had a confident IPF diagnosis according to the criteria of the American thoracic society	Physiologic function: Included measurements of FVC, DlCO, and resting A-a gradient. Dyspnea: Assessed using the University of California San Diego Shortness of Breath Questionnaire (range: 0–120, higher scores indicate worse dyspnea). Health-related quality of life	6MWT, FVC, D_{LCO}, Resting $AaPo_2$, UCSD SOBQ Score, SGRQ Score	The 6MWT showed good reliability in patients with IPF. Correlations between 6MWD and physiologic function, dyspnea, and HRQL were weak but in the expected direction. Changes in 6MWD correlated weakly with changes in physiologic function, dyspnea, and HRQL

Continued.

Authors, Journal, year	Objectives	Design	Characteristics of participants Sample size	Material and methods	Outcome measures	Results
				(HRQL): Evaluated using the SGRQ		
Adsett J et al. European Journal of Cardiovascular Prevention & Rehabilitation (2011)[11]	To determine whether repeat performance of 6MWTs in patients with CHF is related to between-test interval or baseline performance.	Multisite observational study	Individuals with stable CHF. 88 Individuals	Participants performed two 6MWTs with randomly allocated inter-test intervals between 15 and 90 minutes. Distance walked in the second test was compared with the first test	Blood pressure, heart rate, oxygen saturation and RPE recorded every minute.	For individuals whose baseline distance was less than 300 meters, there was no discernible difference between test 1 and test 2. The distance walked was not significantly affected by the time between experiments.
Meriem M et al. Annals of thoracic medicine (2015)[12]	To demonstrate the feasibility of STST, in comparison to 6MWT, for the evaluation of functional status in Tunisian COPD patients and evaluate its correlation to the severity of the disease.	Randomized	Male/female (49) subjects aged from 40 to 75 years with confirmed COPD according to GOLD-guidelines. Clinically stable state for a minimum of 2 weeks	6-minute walk test and 1 minute sit to stand test performed	Pulmonary function test-FVC, FEV1, FEV1/FVC, total pulmonary capacity and residual volumes Peripheral muscle strength.	Significant increases in dyspnea, heart rate, and systolic blood pressure observed during both tests, though STST was less stressful than 6MWT. A positive correlation was found between 6MWT distance and STST stand. Negative correlations existed between 6MWT distance and both dyspnea severity and BODE index. A positive correlation was also noted between 6MWT distance and FVC.
Briand J et al. Therapeutic advances in respiratory disease. (2018)[13]	Compare the 1-min sit-to-stand test (1STST) with the 6MWT for the ability to assess exercise-induced oxygen desaturation in patients with interstitial lung diseases (ILDs)	Randomized	Three groups of patients—sarcoidosis, fibrotic idiopathic interstitial pneumonia (f-IIP), and other kinds of ILD—were identified from the total number of 107 enrolled individuals	On the same day, the 6MWT and 1STST were conducted.	Assessments included pulmonary function tests, pulse oxygen saturation (SpO2), and the modified Borg scale for dyspnea and tiredness. SpO_2 desaturation was evaluated by intraclass correlation coefficient (ICC), Bland–Altman	The SpO_2 nadir during the 1STST and 6MWT showed good consistency and correlated strongly. Frequency of patients with oxygen desaturation also consistent for the two exercise tests. The number of repetitions in the 1STST correlated with the 6MWT distance, but the dyspnea scores higher during the 1STST

Continued.

Authors, Journal, year	Objectives	Design	Characteristics of participants Sample size	Material and methods	Outcome measures	Results
					analysis, and kappa (κ) coefficient in the whole population and the patient subgroups	
Gonçalves E et al. O Mundo da Saúde (2019)[14]	To correlate STST and preoperative physical-functional variables and secondarily to correlate with gender, clinical and surgical variables, comorbidities, risk factors and postoperative complications	Cross-sectional and analytic study	154 individuals, individuals who underwent elective CABG and/or TVR surgical procedures	On the day before surgery, an evaluation performed to quantify performance of the STST and the functional physical variables (6MWT, respiratory muscle strength assessed by maximal inspiratory (MIP) and expiratory (MEP) pressure and waist circumference)	Clinical and surgical variables (ejection fraction, time on mechanical ventilation, length of stay in the intensive care unit and total length of stay), comorbidities and risk factors (hypertension, DM, COPD, MI, smoking, alcoholism, physical inactivity and stress) and postoperative complications collected	There was a direct correlation with the 6MWT, the percentage of MIP and MEP and an inverse correlation with waist circumference and age. There was a better performance of STST correlated with males and those with lower stress level

DISCUSSION

Evaluations of exercise testing methods, including the 6-Minute Walk Test (6MWT) and the Sit-to-Stand Test (STST), have provided valuable insights into their utility for individuals with chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD) and idiopathic pulmonary fibrosis (IPF). Both the 6MWT and STST, including the 1-minute variation, are dependable tools for assessing functional capacity and physiological response in individuals with COPD and IPF.

The 6MWT is recognized for its reliability, while the STST provides a less strenuous alternative with comparable utility. These results emphasize the need for personalized selection of exercise tests based on patient-specific factors and clinical goals.[1]

The 6MWT is time consuming test and guidelines suggest that test ought to be performed in at least a 30m long corridor, which is not always available in every testing centre. So, as to overcome these limitations of time and space, the 1-min sit-to-stand (1STS) test is currently being used to assess exercise tolerance and exercise effects on cardiorespiratory parameters in respiratory diseases. Reflecting the activities of daily living, the 1STS is a self-paced test which needs that participant has to stand-up and sit down from a chair as many times as possible in 1 min. In chronic pulmonary obstructive disease (COPD), the 1STST has been shown to be strongly correlated with the distance walked during a 6MWT and quadriceps strength. Other studies done in this patent population of COPD, also demonstrated that the 1STST is an independent predictor of mortality and quality of life and is responsive to pulmonary rehabilitation. In interstitial lung disease (ILD) patients, the number of repetitions performed and oxygen desaturation during the 1STST were correlated to the distance walked and oxygen desaturation during the 6MWT.

However, no studies have been conducted till date about the 1STST reliability and validity nor the magnitude of the cardiorespiratory stress elicited by this test in the ILD population. Data is lacking on the recovery of the cardiorespiratory variables during the 1STST in ILD.[8]

To the best of our knowledge studies conducted till date could not conclude definitive guidelines for correlation of 6MWT and 1STST in patients with cardiorespiratory disorders due to multiple limitations in all the studies like insufficient sample size, no serial repetitions of 6MWT and 1STST on same day and proper outcome measures were not used.

Till date there are no definitive guidelines present for correlation of 6MWT and 1STST with repetitions in patients with cardiorespiratory disorders. Hence, in order to establish a definitive correlation between 6MWT and 1STST with serial repetition in patients with cardiorespiratory disorders specially in ILD, further research needs to be conducted.

CONCLUSION

STST, can be a practical alternative to the 6MWT for assessing functional status in specific patient populations, such as those with COPD. However, its correlation between 1STST and 6MWT needs to be explored further to establish definitive guidelines.

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