

ONE-MINUTE SIT-TO-STAND TEST – A USEFUL TESTING TOOL FOR THE PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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ONE-MINUTE SIT-TO-STAND TEST—A USEFUL TESTING TOOL FOR THE PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE (Abstract): Exercise tolerance of patients with chronic obstructive pulmonary disease (COPD) should be carefully assessed in order to gain an optimal quality of life through pulmonary rehabilitation programs. The 1-minute sit-to-stand test (1-min STST) is part of the larger family of sit-to-stand tests which were developed recently as feasible options to evaluate the physical capacity in COPD patients, based either on the time needed to perform a preset number of repetitions or on measuring the number of repetitions performed in a preset period of time. 1-min STST is easy to perform in clinical practice and the results are similar in estimating physical capacity as those generated by other tests, like the 6-minute walk test (6MWT). The 1-min STST performance is predicted by age, sex, smoking status, body mass index, and level of perspiration during physical activity. The results of the test are correlated with the quality of life scores and prognostic indices. The studies to date proved that 1-min STST is an alternative reliable tool to more traditional but also more exhausting exercise capacity tests in COPD patients. **Keywords:** SIT-TO-STAND TEST, CHRONIC OBSTRUCTIVE PULMONARY DISEASE, EXERCISE CAPACITY.

For the chronic obstructive pulmonary disease (COPD) patients the daily physical tasks can be a target sometimes too difficult to achieve. Thus, in order to gain an optimal quality of life for these patients, their exercise tolerance should be carefully assessed, and pulmonary rehabilitation programs should be included in optimal disease management along with smoking cessation (1-4).

In daily practice, exercise tests as the

incremental shuttle walk test, endurance shuttle walk test, stair climbing test, 6-min walk test (6MWT), step test or sit-to-stand (chair rise) test (STST) should assess functional capacity, in addition to lung function tests. The gold standard of these usual tests for evaluating exercise tolerance in terms of dyspnea and oxygen desaturation as well as aerobic capacity in terms of walked distance or fatigue is the 6MWT (5).

In 1985, the sit-to-stand test (STST)

was described for the first time (6) and then was associated with increased popularity among researchers mainly due to the simplicity of the movement – standing up from a chair (7). There are several versions of STST available, the main difference being the number of repetitions performed and, as a consequence, the duration of the test. As a result, the mobilized physical resources of the patient and the exercise-induced symptoms and perceived difficulty are variables. The most accepted variant of the STST is the 1-minute sit-to-stand test (1-min STST) that outlasted the variant consisting of 5 repetitions.

MATERIAL AND METHODS

We performed a search of the medical literature, to find out the role and usefulness of 1-min STST in COPD patients. Data sources were represented by several renowned electronic medical databases-MEDLINE, Cochrane Library, Google Scholar and the search terms were SIT-TO-STAND TEST, CHRONIC OBSTRUCTIVE PULMONARY DISEASE, and EXERCISE CAPACITY. We have identified and critically selected relevant research (systematic reviews, meta-analysis, narrative reviews, clinical guidelines, randomized controlled trials and non-randomized but meeting scientific quality criteria) from the last ten years, written in English language, full text available, regarding STST (1-minute and other variants, like 30 seconds or 3-minute) (8, 9).

RESULTS AND DISCUSSION

1. A general view of STS.

Different versions of the test

Due to the fact that for COPD patients the two commonly accepted and used exercise capacity tests (6MWT and incremental shuttle walk test) are difficult to use in

outpatient settings and primary care due to special requirements needed (time, space and resources) (10), the development of a much simpler and easier to achieve evaluation tool was needed. A movement used in everyday life – the sit-to-stand movement, was the base for the development of a new family of tests by Csuka and McCarty (6). These tests are based either on the time needed to perform a preset number of repetitions (5 repetitions - STST) or on measuring the number of repetitions performed in a preset period of time (1-min STST). Over time, different versions of the STST were used in various populations, to assess lower extremity muscle strength and evaluate the functional capacity of the disabled patients, in order to provide useful information on their independence or disability in daily life (11).

2. Measurements and reference values for 1-min STST

1-min STST requires simple conditions: a chair and a stopwatch. Usually, to perform a 1-min STS test, a trained nurse has to ask the patient to sit down on a chair without armrests, height usually about 46-48 cm, the same chair used for all the patients. The height of the chair should be adapted to the morphology of the patient performing the test. The subject is invited to keep the feet parallel (the legs should not touch the chair) at least as wide apart as the hips and to have the arms hang down loosely, on the hips or crossed on chest (12). The assisted use of the arms is not allowed during the 1-min STST. The patient is asked to fully stand up with the legs straightened entirely (complete knee extension) and then to sit down the chair, which had to be touched by the buttocks.

The nurse asks the patient to complete as many as possible sit-to-stand cycles within 60 seconds at a self-determined speed. Usually, the person who supervises

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the test informs the patient when 30 and respectively 15 seconds were left and is counting the number of fully completed STS cycles; not completed or incorrectly performed STS cycles are not counted. There should be a motivation of the patient to perform as many cycles as possible but without any pressure on participants with musculoskeletal or neurological conditions, who felt unable to complete the 1-min STST. The results of a Swiss population-based study (13), which included 6,926 participants which completed the test, have determined the sex- and age-stratified reference values for the 1-min STST for a European adult population, up to the age of 79 years old (tab. I).

TABLE I
Reference values of 1-min STST
(adapted from Strassmann *et al.*) (13)

| Age group (years) | Number of STS repetitions Men (p 97,5*) | Number of STS repetitions Women (p 97,5') |
|-------------------|---|---|
| 20-24 | 72 | 70 |
| 25-29 | 74 | 68 |
| 30-34 | 72 | 68 |
| 35-39 | 72 | 63 |
| 40-44 | 69 | 65 |
| 45-49 | 70 | 63 |
| 50-54 | 67 | 60 |
| 55-59 | 63 | 61 |
| 60-64 | 63 | 55 |
| 65-69 | 60 | 53 |
| 70-74 | 59 | 51 |
| 75-79 | 56 | 43 |

*97,5 percentile

The 1-min STST performance was predicted by age, sex, smoking status, body mass index, and level of perspiration during physical activity. Usually, there is a small learning effect, thus some researchers are suggesting that, if possible, the test should be performed twice, and the higher scores obtained to be used. However, other studies suggest that the learning effect is

not important and reliable results can be obtained with a single performance of the 1-min STST (9).

3. 1-min STST vs. other functional tests in COPD patients

Only recently STS tests started to be used in COPD patients and their use increased markedly during the last decade, being also associated with the first studies analyzing the efficiency of STST use in COPD patients (12). These studies were designed to assess the relevance of STST in the evaluation of the functional status of COPD patients when compared with 6MWT. Many studies found significant correlations in terms of functional performance, dyspnea, and quadriceps strength between 6MWT and 1-min STST (6, 14-16). For other parameters, like heart rate, systolic blood pressure, and oxygen saturation, some studies found 1-min STST less stressful than 6MWT. These parameters were significantly modified during 6MWT, a situation not encountered in 1-min STST.

Data published by some researchers (9, 12) indicated that only the 3-min STST is equivalent with 6MWT from the point of hemodynamic stress of the patient during the test but similar results of 6MWT and 1-min STST were recorded when quadriceps strength, end-exercise oxygen consumption, carbon dioxide output, ventilation, breathing frequency, and heart rate were analyzed. These results demonstrated that 1-min STST can be considered a useful tool to assess functional status and lower limb activity in COPD patients, but the different versions of the STST are not equivalent, due to the fact that the length of the exercise is associated with different physiological processes (17).

4. STST in other pulmonary diseases

Radtke *et al.* (18) analyzed the use of 1-min STST in other respiratory diseases. In cystic fibrosis, the 1-min STST was

designed as a cheap, valid and promising alternative to assess muscle function of the patients. Due to the fact that these conclusions were obtained by a study realized on 14 patients with CF, the results must be confirmed by larger studies in different populations.

5. Value of STS in evaluation of the morbidity and prognosis in COPD

Van Gestel *et al.* (19) have confirmed that in patients with COPD, the ability to exert physical effort is correlated with the survival.

Except for the role in the evaluation of the functional status in COPD patients, the 1-min STST test has proved its utility as a tool for survival prognosis in these patients. A study (20) realized on 409 patients, showed that a lower number of rises on 1-min STST test correlates with a higher mortality rate at 2 years. The patients who weren't able to perform more than 12 rises in a 1-min STST have a lower metabolic power, which is associated with a higher risk of mortality. The 1-min STST performance is inversely correlated with the BODE index (21-23), that encompasses four variables: body mass index (BMI), dyspnea, obstruction, and exercise capacity and is proved to be associated with the

mortality in COPD at 52 months (23).

Researchers (9, 15, 24) confirmed also that 1-min STST is an effective tool for measuring the efficiency of a pulmonary rehabilitation program; an improvement of 3 rises in 1-min STST is consistent with the benefits of a pulmonary rehabilitation program.

CONCLUSIONS

Our evaluation of the 1-min STST revealed that this test, based on a simple movement, can be realized in almost every clinical setting. Even under the conditions of COPD patients whose walking distance is reduced, this type of requested movement - sit-and-stand, can be performed several times during the day. The necessary equipment is not expensive, and the patients easily understand how to perform correctly the test. Recent studies indicate a good correlation between 1-min STST parameters and other functional tests or prognostic indices. Based on our research of the literature, we concluded that in COPD patients, the 1-min STST elicited a physiological response similar to that of the 6MWT, a more traditional but also more exhausting exercise capacity test in chronic respiratory patients.

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