Respiratory Medicine 128 (2017) 70–77

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Review article

Sit-to-stand tests for COPD: A literature review

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ARTICLE INFO

Article history:
Received 29 September 2016
Received in revised form
23 March 2017
Accepted 13 May 2017
Available online 15 May 2017

Keywords:
Sit-to-stand test
Field test
Evaluation
COPD
Exercise tolerance
Functional capacity

ABSTRACT

Background: Sit-to-stand tests (STST) have recently been developed as easy-to-use field tests to evaluate exercise tolerance in COPD patients. As several modalities of the test exist, this review presents a synthesis of the advantages and limitations of these tools with the objective of helping health professionals to identify the STST modality most appropriate for their patients.
Method: Seventeen original articles dealing with STST in COPD patients have been identified and analysed including eleven on 1min-STST and four other versions of the test (ranging from 5 to 10 repetitions and from 30 s to 3 min). In these studies the results obtained in sit-to-stand tests and the recorded physiological variables have been correlated with the results reported in other functional tests.
Results: A good set of correlations was achieved between STST performances and the results reported in other functional tests, as well as quality of life scores and prognostic index. According to the different STST versions the processes involved in performance are different and consistent with more or less pronounced associations with various physical qualities. These tests are easy to use in a home environment, with excellent metrological properties and responsiveness to pulmonary rehabilitation, even though repetition of the same movement remains a fragmented and restrictive approach to overall physical evaluation.
Conclusions: The STST appears to be a relevant and valid tool to assess functional status in COPD patients. While all versions of STST have been tested in COPD patients, they should not be considered as equivalent or interchangeable.

Contents

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http://dx.doi.org/10.1016/j.rmed.2017.05.003
0954-6111/

1. Introduction

The daily life of COPD patients is characterized not only by chronic respiratory symptoms but also by exercise intolerance due to their breathlessness. Proper diagnosis and management of this disease consequently includes evaluation of exercise tolerance aimed at improved orientation towards pulmonary rehabilitation [1] [2].

Numerous testing protocols are used throughout the world in different health centers ranging from sophisticated tools with somewhat restricted access such as an equipped lung function laboratory [3] to simpler and more extensively available tools known as “field-testing” [4]. The most widely used tests are the 6-min walk test (6MWT) [5], the incremental shuttle walk test [6], the endurance shuttle walk test [7], the stair climbing test [8] the step test [9] and the sit-to-stand [10] or chair rise test. Up until now, the 6MWT remains the gold standard for the field tests designed to assess exercise tolerance in terms of respiratory manifestations such as dyspnea and desaturation and the aerobic capacity assessed in terms of distance and fatigue. As a simpler and more economical test consuming in terms of time and equipment, the sit-to-stand test (STST) first described in the literature in 1985 has aroused interest among researchers [11]. Based on a simple movement -standing up from a chair, an essential activity of daily living - sit-to-stand and stand-to-sit appear to be gestures relevant to evaluation of independence in elderly people [12]. More broadly, STST could be viewed as a functional capacity assessment tool addressed to disabled patients and providing useful information on their independence/disability in daily life. Numerous versions of STST have been developed, ranging from a few seconds (5 repetitions) to a few minutes. The physical aptitudes mobilized in performance and the overall determinants of performance are consequently quite different, as are exercise-induced symptoms and perceived difficulty.

The objective of this review was to focus on the range of sit-to-stand tests developed and used in cases of COPD to evaluate functional capacity. As they do not seem to share the same properties, advantages and limitations, one may wonder whether or not these different STST modalities are interchangeable and able to evaluate the same functional dimensions and prognostic issues. It also might be interesting to assess whether one of these modalities would be more appropriate to recommend in the daily practice of clinicians caring for of COPD patients.

2. Method

2.1. Data sources and study selection

While the search field was limited mainly to STST in COPD patients, other studies were also consulted in order to more precisely identify overall use of the test. Seventeen original articles dealing with STST in COPD patients have been identified. Among these studies, 11 used the STST in the 1-min version (1 min-STST) [10,13–22], 4 used the 5 or 10 repetitions STST (5R-STST and 10R-STST) [23–26], and the others used the sit-to-stand test in 30 s (30sec-STST) [20,27] and in 3 min (3 min-STST) [28]. All of these studies correlated STST results with a number of other parameters, opening this review to different perspectives facilitating understanding of the STST.

3. Results

3.1. STST overview

Csuka & McCarty [11], first introduced the STST to examine lower extremity muscle strength among 139 healthy adults aged 20–85 years, as a method that could also be applied in patients with neuromuscular diseases. Their version of STST required the subject to perform 10 repetitions of sit-to-stand from a standard chair. Over the years, different versions of the test have been used in different populations. Jones et al. [29] introduced a new version of STST conducted over a time period of 30 s designed to measure lower body strength in 76 older adults. Since then, STST has been referenced more than 80 times in the literature. Currently, there exist multiple, less systematically validated references to STST as a method of exercise testing. The different available modalities of STST are not well-differentiated in terms of their uses. One thing we do know is that it assesses lower extremity muscle strength; more specifically, it has been used to examine functional status among older women [30], to examine balance [31] to predict equations for lower body muscle power [32], to evaluate frailty [33] and to differentiate between fallers and non-fallers [33,34]. Similarly, it has been used in traumatic brain-injured patients to examine the effectiveness of intensive practice of sit-to-stand movement [35].

3.2. STST as compared with other functional tests in COPD

Although this test has been widely accepted as an indicator of functional status among elderly people, there are few data concerning the COPD population [36]. The first studies using STST in COPD patients are quite recent [10]and only over the last ten years has its use increased considerably (Table 1). Several versions can be found, ranging from 30 s [27], 5 repetitions [24] to the 1 min test [10]. Aguilaniu et al. [28] recently introduced a longer, 3-min version of this test in which the 1st minute consisted in pace-defined stand-ups, followed by self-paced repetitions for the next 2 min.

Several studies [10,19,21,22,28,37] have compared the STST with the 6MWT in order to assess its relevance as a tool for evaluation of functional status in COPD patients and healthy subjects. The results obtained by Ozalevli et al. in COPD showed a strong correlation between performance in the 1 min-STST and distance walked in the 6-min ($r = 0.75$, $p < 0.001$). Significant correlations were also found in these two tests between functional performance, dyspnea (at rest and at exercise) and quadriceps strength. However, while heart rate, systolic blood pressure and oxygen saturation were significantly modified during exercise in the 6MWT ($p < 0.05$), this was not the case in 1min-STST, which may consequently appear less hemodynamically stressful. Similar physiological responses were reported in other studies [19,21,22]. Conversely, the physiological responses measured by Aguilaniu et al. at the end of 3 min-STST were similar and interchangeable with those obtained at the end of 6MWT, rendering it, at least as successful as 6MWT as a means of evaluating exercise tolerance [28]. To assess neurophysiological effectiveness, Canuto et al. investigated quadriceps electromyography during STST and 6MWT. They found significant correlations between the two tests that led them to conclude that they both may determine functional status [37].

Other researchers have also confirmed the validity of this test as a surrogate to evaluate muscle strength by presenting good correlations between 5R-STST and handgrip strength ($r = 0.85$) [13] or quadriceps strength ($\beta = 0.50$, 95% CI 0.11 to 0.86) [14]. Applying