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Research Article

Comparison of the Sit-to-Stand and Stand-to-Sit Activities between Patients with COPD and Healthy Subjects: A Pilot Study

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Abstract

Subjects with Chronic Obstructive Pulmonary Disease (COPD) usually present muscle weakness as an extra-pulmonary consequence of the disease, which can impair physical function. Our goal was to investigate the Sit-to-Stand and Stand-to-Sit (STSTS) performance in individuals with COPD compared with healthy subjects. A pilot study was conducted on 25 patients with COPD and 27 healthy adults. Videos of the STSTS activities were recorded on Anterior View (AV) and Lateral View (LV). The STSTS activities were compared between groups through an Expert System (ES) according to an evaluation protocol with a classification score from 0 (adequate condition) to 4 (inadequate condition level IV). Data analyses were performed with Statistical Package for the Social Sciences (SPSS) 22.0 version. A p value of <0.05 was considered significant. There were significant differences in the STSTS activities in both views between both groups (Stand-to-Sit AV, p=0.000; Stand-to-Sit LV p=0.001; Sit-to-Stand AV, p=0.000; Sit-to-Stand LV, p=0.000). COPD patients presented the worse scores (median) in the Stand-to-Sit activities (2.44 AV; 2.28 LV). Individuals with COPD showed worse functional condition compared to healthy subjects, especially in the Stand-to-Sit activity.

Keywords: Activities of daily living; Musculoskeletal abnormalities; Disability evaluation; Chronic obstructive pulmonary disease

Abbreviations

STSTS: Sit-to-Stand and Stand-to-Sit; COPD: Chronic Obstructive Pulmonary Disease; AV: Anterior View; LV: Lateral View; ES: Expert System; BMI: Body Mass Index; mMRC: Modified Medical Research Council; CAT: COPD Assessment Test; SPSS: Statistical Package for the Social Sciences; SD: Standard Deviation; FCV: Forced Vital Capacity; FEV1: Forced Expiratory Volume in the first second

Introduction

Individuals with Chronic Obstructive Pulmonary Disease (COPD) frequently restrict their performance of daily activities like walking [1]. These functional limitations have not been only attributed to their respiratory impairment, but also to the many extra-pulmonary consequences of the disease [2].

The ability to rise and sit down on a chair shows the functional status of individuals because these are essential daily activities [3]. There are age-related factors affecting the performance of Sit-to-Stand [4] and Stand-to-Sit [5,6] activities. For example, the decrease in muscle strength [7] and motor coordination [8] in elderly subjects compared to younger subjects.

It has been demonstrated that individuals with COPD have a worse performance in the Sit-to-Stand and Stand-to-Sit (STSTS) movements compared to healthy controls [9-11]. In patients with COPD, pulmonary problems and peripheral muscle weakness lead to sedentary life, which reduces functional status [12]. They often present severe muscle wasting, which may be due to skeletal muscle dysfunction, deconditioning/ disuse, systemic inflammation, poor nutrition and energy conservation, and/or corticosteroid use [13].Leg strength has even been shown to be a better predictor of mortality than measures of lung function in this population [14]. COPD patients also exhibit significant reductions in functional mobility and balance that may affect their ability to perform activities of daily living [15] and postural control [16]. It has been suggested that these limitations in functional performance are related to the peripheral muscle weakness present in these patients [15,17]. Therefore, individuals with COPD need significantly more time to complete the STSTS activities [16] due balance and musculoskeletal disorders, which makes the STSTS activities strong predictors of mortality in this population [18].

Many studies have demonstrated the association between functional limitation and walking restrictions in COPD patients [1,19,20]. However, few studies have investigated the relationship between functional limitation and STSTS movements [9-11]. The aim of this study was to investigate the STSTS performance in individuals with COPD compared to healthy subjects.

Materials and Methods

The research protocol was approved by the Institution's Ethics Committee for Research with Human Beings (approval 889.031).

Anthropometric parameters, including height, body weight, Body Mass Index (BMI) were measured in 25 patients with COPD and 27 healthy adults, who were characterized by not presenting any

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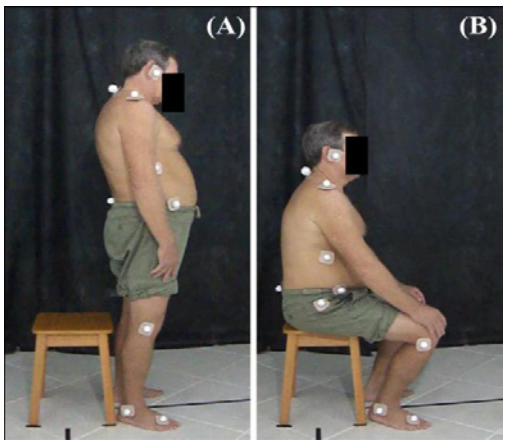

Figure 1: (A) Initial position of the stand-to-sit activity. (B) Initial position of the sit-to-stand activity.

respiratory disease.

Spirometry was performed by the COPD patients through a digital spirometer (NDD Easy One®) according to the American Thoracic Society recommendation [13]. The largest Forced Vital Capacity (FVC) and Forced Expiratory Volume in the first second (FEV1) values were recorded after examining the data from all the acceptable curves. Dyspnea was evaluated by the modified Medical Research Council (mMRC) [21,22], the COPD Assessment Test (CAT) [23,24] to evaluate symptoms and health status in COPD patients.

Videos of the COPD patients and healthy subjects performing the STSTS were recorded on Anterior View (AV) and Lateral View (LV). First, it was requested the motor task of stand-to-sit. The starting position was the standing posture (Figure 1A). Afterwards, it was asked the Sit-to-Stand activity. The start position was the sitting posture without support of the trunk and upper limbs (Figure 1B). A beep was used to indicate the movement start.

The comparison of STSTS movements between groups was made through an Expert System (ES) [25]. Questions regarding the conditions of each phase of STSTS activities for all body segments were made by the ES with their respective options of answers. After answering the questions, the system suggested the result about the condition of the body segment for adequacy in accordance with the description of each activity. After making the sum of the situations for each phase, the ES suggested the condition corresponding to each segment according to the legend of the points [26]. The degree of inadequacy corresponds the number of phases that the segment showed a different situation from what is described in the protocol, which ranges from 0 (adequate condition) to 4 (inadequate condition level IV) [25].

Data analyses were performed with Statistical Package for the Social Sciences (SPSS) 22.0 version. It was used the normality Shapiro-Wilk test. The variables with normal distribution were described as mean and standard deviation, and the nonparametric variables were described as median, minimum and maximum values. The comparison between mean variables with normal distribution was performed using the Student t test. The comparison of means between two groups was performed using Mann-Whitney test, and Kruskal-Wallis test was used for more than two groups. A p value of <0.05 was considered significant.

Results

This study consisted of 52 subjects, with 28 (53.8%) woman and 24 (46.2%) men with a mean age of 45.71 ± 18.73 (yrs), mean weight of 70.83 ± 12.85 (kg), mean height of 1.65 ± 0.08 (m) and mean Body Mass Index (BMI) of 26.11 ± 4.59 (kg/m^2).

The sample consisted of 25 (48.1%)subjects with COPD (mean age 60.7 yrs [SD±9.40]; mean height 1.63 m [SD±0.08]; mean weight 69.47 kg [SD±14.03]; mean BMI 26.11 [SD±6.33]) and 27 (51.9%) healthy subjects (mean age 31.37 yrs [SD±12.52], p=0.000; mean height 1.65 m [SD±0.08], p=0.993; mean weight 66.67 kg [SD±12.49], p=0.009; mean BMI 24.65 [SD±4.32], p=0.007).

Among the participants with COPD, 5 (20%) were classified as group A (low risk, less symptoms), 11 (44%) were classified as group B (low risk, more symptoms), 2 (8%) belong group C (high risk, less symptoms) and 7 (28%) were group D (high risk, more symptoms). The mean %FEV1 pre bronchodilator was 1.68 (SD±0.75) and %FEV1 pros bronchodilator was 63.04 (SD±28.20). The mean mMRC score was 1.16 (SD±0.89) and mean CAT score was 15.80 (SD±9.98).

The median scores in the whole sample were 1.27 and 1.45 in the Stand-to-Sit activity on LV and AV, respectively. For the Sit-to-Stand activity were 0.97 and 1.17 on LV and AV, respectively.

There was statistically significant difference in the STST activities between the GOLD stages (p=0.000).

There were significant differences in the STSTS activities in both views between both groups. The mean differences are presented on Table 1.

Discussion

The differences found in all the activities show the worse functional condition in COPD subjects. This may due to the skeletal muscle dysfunction which is one of the main extra pulmonary characteristics in COPD patients [27].

The higher levels of inadequacy occurred in the Stand-to-Sit activity for both views [28] compared the Stand-to-Sit activity between young adults and healthy older adults, and found that compared to young adults, healthy older adults demonstrated a forward head posture, with increased lower cervical spine flexion and increased upper cervical extension in both positions. Older adults also sat with significantly increased thoracic kyphosis and decreased lumbar spine flexion. Thus, change in the stand-to-sit activity appears to be a characteristic of aging and it seems to be compounded in COPD patients.

Table 1: Mean differences of the sit-to-stand and stand-to-sit activities on anterior and lateral views.

	COPD group (25)	Control group (27)	p-value
Stand-to-Sit (AV)	2.44 (1.55/3.88)	0.48 (0/1.66)	0
Stand-to-Sit (LV)	2.28 (0.85/3.57)	0.28 (0/0.71)	0
Sit-to-Stand (AV)	1.88 (0.88/3.33)	0.44 (0/1.44)	0
Sit-to-Stand (LV)	1.77 (0.77/2.77)	0.33 (0/0.66)	0

People with COPD have a high rate of falls [28,29] and usually present balance disorders [29] compared to healthy individuals on the same age. Recently, it was shown that individuals with COPD are not able to reach the number of repetitions of STSTS for 1 minute as healthy individuals [30]. In addition, these activities seem to be strongly associated with mortality in patients with COPD [6]. These functional limitations have been attributed to airflow restrictions and peripheral muscle weakness [17], which is predominant in the lower limbs [31]. Therefore, the findings of this study indicate aspects related to the functionality of these individuals, which may represent their physical limitation related to symptoms and musculoskeletal abnormalities.

The difference age between groups (60.7 yrs [SD±9.40] COPD versus 31.37 yrs [SD±12.52] healthy subjects, p=0.000) should be considered because it is well established that aging is related with the loss of muscle strength [32,33], which can affect movements and limit performance of the tasks [34]. The decrease in muscle strength can play a detrimental role in physical function impairments [33,35], such as rising from a chair [36], walking [37], climbing stairs [38] and the capacity to recuperate after a loss of balance [39]. Dubost et al. [6] found that healthy older adults between 71 and 80 years have a reduction of 10º in the anterior flexion of the trunk in the activity of sitting compared with young adults between 22 and 35 years. The authors concluded that this strategy might occur due to an adjustment mechanism to reduce the risk of anterior balance disorder. In the present study, the fact that individuals with COPD were older may have influenced the results, once that the decreased muscle strength is directly related to age, so it was probably a confusion factor on the functionality aspects. However, Schultz et al. [40] found that muscle strength is not a limiting factor in generating the joint torques required for slow chair rises in healthy elderly individuals, which shows that the difference age may not have influenced the scores of STSTS activities.

Few studies have investigated the functionality of these individuals through sit-to-stand and stand-to-sit activities [9,16]. However, data are presented according to the capacity and number of times reached, which is not sufficient to characterize the functional status of these individuals. An advantage of this study was to use SEs [25] to support the evaluation of Sit-to-Stand and Stand-to-Sit activities (AV and LV). This methodological strategy allowed the identification of the characteristics related to the execution of these activities, which demonstrated the functional condition of this population.

Conclusion

This pilot study showed the worse functional condition of COPD subjects compared to healthy subjects, especially in the Stand-to-Sit activity. These activities may show their physical limitation related to symptoms and musculoskeletal abnormalities.

The performance of STSTS activities appear to be related to reduce muscle strength and others functional aspects as difference of age between groups, which will be further explored on the continuity of the study.

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