



Six-minute gait test in chronic obstructive pulmonary disease with different degrees of obstruction*

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ABSTRACT

Introduction: Some functional tests are used as a complement to the dynamic evaluation in the Chronic Obstructive Pulmonary Disease (COPD), such as the six-minute gait test (GT6). **Objectives:** To verify how much the degree of obstruction compromises the tolerance to the exertion evaluated by the GT6 and to compare the distances completed and expected through the equation by Enright and Sherrill (1998) for healthy individuals as well as the ones with COPD presenting mild, moderate and severe degrees of obstruction, besides to compare the completed distance among groups. **Materials and methods:** 90 male individuals were evaluated, being 19 healthy (group 1-G1, mean age 67 ± 6.6 years); 24 individuals with COPD presenting mild obstruction (group 2-G2, mean age 69 ± 11.3 years); 26 with moderate COPD (group 3-G3, mean age 71 ± 9.1 years) and 21 with severe COPD (group 4-G4, mean age 70 ± 9.4 years) concerning the completed distance, besides the distance expected through the equation. **Results:** Significant difference was observed (t-Student test, ≤ 0.05) when comparing completed and expected distances for G3 (387 ± 71 m vs 456 ± 56 m) and G4 (318 ± 97 m vs 477 ± 52 m), being the completed distance shorter than the expected one for both. In the inter group analysis, concerning the completed distance significant difference was verified (ANOVA, ≤ 0.05), where G1 (506 ± 56 m) and G2 (452 ± 60 m) presented higher values (Newman-Keuls, ≤ 0.05) than G3 (387 ± 71 m) and G4 (318 ± 97 m), as well as G3 higher than G4. **Conclusion:** It was concluded that the higher the limitation to the air flow, the lower the tolerance to physical exertion. However, healthy individuals and the ones with mild COPD obtained similar performance, besides having similar completed and expected distances. Thus, the GT6 allows us to evaluate the functional capacity of healthy individuals and the ones with COPD, estimating how much the degree of obstruction of the air flow compromises physical performance.

INTRODUCTION

Individuals with Chronic Obstructive Pulmonary Disease (COPD) may present an important reduction of physical performance due to several factors such as dynamic hyperinflation and increase in the glycolytic muscular metabolism, followed by progressive physical deconditioning associated with inactivity⁽¹⁾, triggering phys-

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ical and social limitations which lead to deterioration of their life quality⁽²⁾.

Decrease of physical exercise tolerance in individuals with COPD occurs as result of ventilatory limitation, deconditioning and abnormalities in the muscles involved for walking performance⁽³⁾. These individuals usually present skeletal muscular dysfunction⁽⁴⁾; low oxidative uptake; normal or increased glycolytic capacity as well as decreased alactic anaerobic metabolism⁽⁵⁾; reinforcing thus, the predominance of the lactic anaerobic system⁽⁶⁾, contributing for the limitation of functional capacity and life quality.

The individuals with COPD presented a decrease of muscular strength, especially of lower limbs (MMII), being the upper limbs one (MMSS) relatively preserved⁽⁷⁾. Such fact occurs once the activities concerned with the walk development are commonly avoided by these individuals due to dyspnea sensation, with predominance in daily life activities (DLA) with the MMSS. Moreover, a large number of muscles of the scapular waist act in the arms elevation, concomitantly participating in the accessory breathing when the primary respiratory muscles are not sufficiently able to keep a suitable ventilatory demand⁽⁸⁾.

Due to these alterations, the physical fitness evaluation or exercise fitness in individuals with COPD has become the target of several studies. Functional physical tests such as the Six-Minute Walk Test (WT6) are frequently used for the physical fitness evaluation, which is applied with the aim to complement the dynamic evaluation of individuals with COPD⁽⁹⁾, to monitor the treatment's efficiency as well as to establish the prognostic of these individuals⁽¹⁰⁾.

The walk test is an adaptation of the test introduced by Cooper⁽¹¹⁾, with the aim to determine the relationship between physical fitness and oxygen maximal uptake. This test is based on a routine activity of easy acceptance by the patients. It was initially devised for healthy individuals, but it has been currently used for individuals with pathologies. It is a reproducible and reliable method which is characterized as the main evaluation test of exercise capacity for its simplicity, performance as well as interpretation easiness.

Moreover, the WT6 is used in order to evaluate submaximal exertion⁽¹²⁻¹³⁾, showing the performance capacity of DLA, and can be performed by the elderly and in severe conditions such as COPD⁽⁸⁾.

In 2002, the American Thoracic Society (ATS)⁽¹⁴⁾ proposed a standardization for the WT6 performance with the purpose to minimize the results' variability of the countless scientific papers which have been currently published. Besides that, Enright and Sherrill⁽¹⁵⁾ have proposed a reference equation in order to predict the completed distance, considering variables such as age, body weight and height. Nonetheless, there is a lack of work which verifies the amount of obstruction which compromises physical performance of individuals with COPD.

Thus, the aims of the present study were:

– to verify the amount of obstruction which compromises physical performance evaluated by the WT6;

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– to compare the completed and predicted distances in the WT6 through the equation proposed by Enright and Sherrill⁽¹⁵⁾ for healthy and with COPD individuals presenting mild, moderate and severe obstruction, in the same age group;

– to compare the completed distance among the four different evaluated groups.

MATERIAL AND METHODS

Ninety male individuals were evaluated in this study based on the ventilatory function. They were intentionally sorted in four groups, being 19 healthy (Group 1 – G1, mean age of 67 ± 6.6 years); 24 individuals with COPD presenting mild obstruction degree (Group 2 – G2, mean age of 69 ± 11.3 years); 26 with moderate COPD (Group 3 – G3, mean age of 71 ± 9.1 years) and 21 with severe COPD (Group 4 – G4, mean age of 70 ± 9.4 years).

The individuals with clinical diagnosis of COPD were taken from the pneumologist in charge to the respiratory physical therapy infirmary of the institution, being an evaluation conducted there.

The healthy individuals presenting ventilatory function within the predicted values and individuals with COPD presenting Tiffeneau Index (forced expiratory volume at the first second (VEF₁)/CVF) below 70% of the prediction, being classified under mild obstruction degree (80% ≤ VEF₁ ≤ 60% of the prediction); moderate (59% ≤ VEF₁ ≤ 41% of the prediction); and severe (VEF₁ ≤ 40% of the prediction)⁽¹⁶⁾ verified through spirometer Master Scope® (Jaeger – Leibnizstrasse 7, 97204, Hoechberg, Germany) were considered able to participate in the study as inclusion criteria. The individuals with COPD should present stable clinical report and lack of acute periods for at least two months.

Smokers; individuals with exacerbated pulmonary disease; individuals with cardiovascular, systemic, neuromuscular or orthopedic pathologies which would hamper them to perform the test due to exercise limitation; dyspnea and oxygen peripheral saturation (SpO₂) < 80%; besides those who did not conclude the test, were excluded.

The individuals signed a consent form after having received orientation about the proposed protocol, according to the resolution 196/96 from the CNS. This study was approved by the Ethics Committee of the Institution.

The WT6 was performed on a 30 meters long and 1.5 meters wide flat corridor. The participants were instructed to walk as fast as possible during 6 minutes, receiving standardized phrases stimulation at every minute⁽¹⁴⁾. The SpO₂ and heart rate (HR) variables were measured through a portable wrist oximeter (Nonin®, 8500A – Fernbrook Lane North Plymouth, MN) and dyspnea sensation by the CR10 Borg Scale with the purpose to monitor the individual, registering the completed distance at the end of the test. If necessary, the individuals could rest; however, the timer remained on and individuals were instructed to continue the test as soon as possible until the end of the sixth minute.

Each participant performed two tests at alternated days. The first one had the purpose to adapt the individuals to the procedure, being the learning effect eliminated, and the second had the purpose to measure the completed distance during the test.

The [(7.57 x height_{cm}) – (5.02 x age) – (1.76 x weight_{kg}) – 309m]⁽¹⁵⁾, formula was used for the calculation of the predicted distance, with knowledge of the weight, height and age of the evaluated groups.

Statistical analysis

In this study, the data presented homogeneous distribution after the application of the Shapiro Wilk's test, being used the parametric statistical analysis. The data were expressed in mean and standard deviation, using the *t*-Student test for comparison of the completed and predicted distances for each of the groups. The ANOVA test and the post-hoc test by Newman-Keuls were applied

for comparison of completed distance among the different groups. The significance level chosen was of $p \leq 0.05$.

RESULTS

Table 1 demonstrates the anthropometric and spirometric characteristics of the four evaluated groups. They were similar concerning anthropometric variables; however, differences in pulmonary function which characterized the groups division, were observed.

TABLE 1
Anthropometric and spirometric characteristics of the evaluated groups

| Variables | Group 1 | Group 2 | Group 3 | Group 4 |
|---------------------------|--------------|--------------|--------------------------|---------------|
| Sex | 13 males | 16 males | 20 males | 18 males |
| Age (years) | 67 ± 6.6 | 70 ± 11.8 | 74 ± 6.5 | 70 ± 9.4 |
| Weight (Kg) | 76 ± 6.5 | 67 ± 13.2 | 68 ± 17.1 | 62 ± 12.6 |
| Height (cm) | 169 ± 4.6 | 163 ± 6.6 | 166 ± 7.8 | 167 ± 6.5 |
| VEF ₁ /CVF (%) | 88 ± 9.6 | 51.9 ± 12.1* | 56.5 ± 9.6* | 46.2 ± 11.2** |
| VEF ₁ (%) | 107.8 ± 16.9 | 69.7 ± 4.5* | 50.8 ± 6.8* [†] | 28.2 ± 6*** |

* Difference between G1 and G2; † Difference between G2 and G4; * Difference between G1 and G3; * Difference between G3 and G4; † Difference between G1 and G4; * Difference between G2 and G3.

ANOVA, $p \leq 0.05$.

Concerning the WT6, two tests in alternated days were performed. No significant difference ($p > 0.05$) between them concerning completed distance was identified.

Concerning the intragroup analysis, significant difference was seen when comparing the completed distance with the predicted one for G3 (387 ± 71 m vs 456 ± 56 m) ($p \leq 0.05$) and G4 (318 ± 97 m vs 477 ± 52 m) ($p \leq 0.01$), with the completed significantly shorter than the predicted values for both mentioned groups. G1 and G2 presented similar completed and predicted distance values, as shown in figure 1.

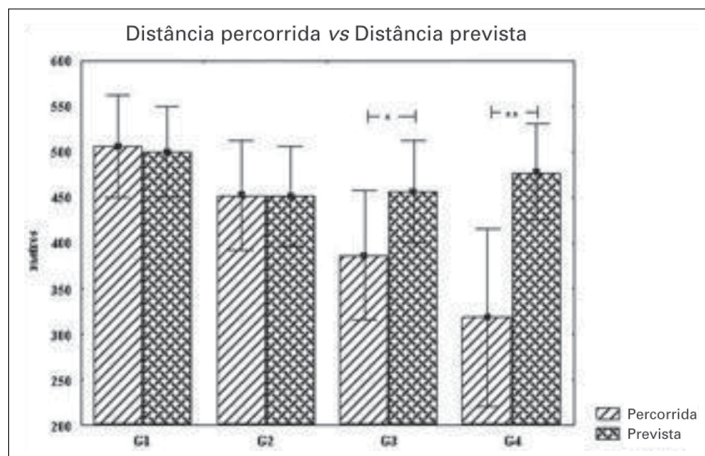


Figure 1 – Comparison between the completed and predicted distances for each of the evaluated groups. † Student test, * $p \leq 0.05$, ** $p \leq 0.01$.

When the intergroup analysis concerning completed distance was performed, significant difference was verified. G1 (506 ± 56 m) and G2 (452 ± 60 m) presented completed distance values significantly higher ($p \leq 0.01$) than G3 (387 ± 71 m) and G4 (318 ± 97 m), as well as G3 showed significantly higher values ($p \leq 0.05$) than G4 (figure 2).

DISCUSSION

The walk test is an important test of physical fitness in individuals with functional limitation, in which the evaluation will be useful

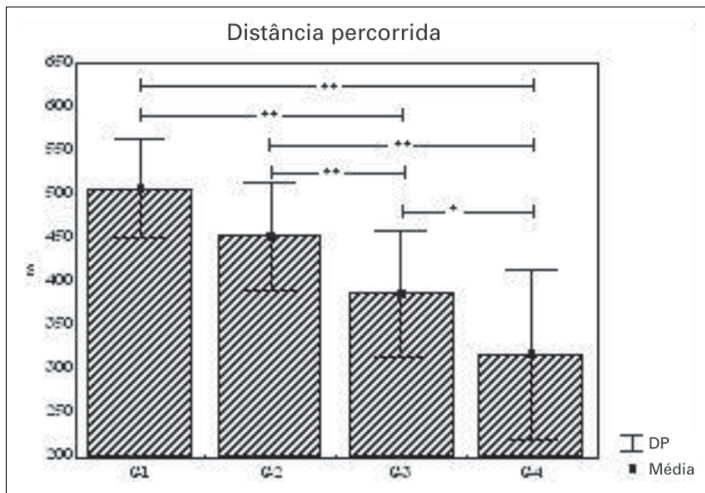


Figure 2 – Comparison of the completed distance among the different evaluated groups. ANOVA test (Newman-Keuls test), * $p \leq 0.05$, ** $p \leq 0.01$.

to quantify the severity of this limitation as well as treatment results.

Individuals with COPD present reduction of exercise tolerance⁽¹⁷⁾ associated with dyspnea and fatigue sensation. It is known that these individuals suffer a reduction of functional capacity to exercise as the disease progresses⁽¹⁸⁾. These symptoms initially appear in moderate efforts and as the disease progresses, intensity occurs, reaching to minimum efforts such as when performing a DLA⁽¹⁾. The WT6 has been used as of the functional tests in the evaluation and reevaluation of physical exertion tolerance in individuals with COPD.

In this study, the WT6 was applied in healthy and with COPD individuals with different degrees of obstruction with the purpose to identify the functional alterations caused by the obstruction, evaluated by the performance during the test.

The WT6 evaluates the functional capacity or ability to perform DLA. The measurement was important in the dynamic evaluation and in the clinical management of individuals with severe chronic cardiopulmonary diseases⁽¹⁹⁾.

The ATS⁽¹⁴⁾ has suggested the performance of a WT6 as training in order to obtain improvement in motor coordination and reduction of anxiety in subsequent tests. Therefore, this procedure may provide more reliability in the tests results, once the decrease of the influence of neuromuscular and psychological factors intrinsic to the individuals with COPD is observed. In the study by Rodrigues *et al.*⁽²⁰⁾ an important difference was observed between the first and the second WT6, differently from the result found in this study which did not find difference between tests.

It is believed that the performance of more than one WT6 should be considered during the functional evaluation process of the chronic pneumo patient, and that it can provide better quality and measurement safety of the physical capacity, as well as in the evaluation of the therapeutic results of individuals with COPD⁽²⁰⁾.

According to the ATS⁽¹⁴⁾, the therapist should not walk with the individual; however, in this study it was chosen to have the therapist discreetly behind each individual for more security in the test's performance. Some factors may influence the performance of each individual during the test. In a study conducted by Hamilton *et al.*⁽²¹⁾ it was verified that 70% of the individuals with COPD have reduction of the quadriceps muscles when compared with healthy ones in the same age group.

Moreover, therapy with corticosteroid may cause myopathy, affecting the respiratory and skeletal muscles⁽²²⁾. This fact may have been one of the factors which explain the results obtained in this study concerning G3 and G4. These groups presented reduced completed distance during the WT6 when compared with groups

1 and 2, showing how much the degree of obstruction interferes during a test's performance, even if it is considered submaximal. There is a tendency to better results in individuals considered healthy or who present less limitation to the air flow.

Concerning the completed distance during the WT6, in the study by Troosters *et al.*⁽²³⁾ it was observed a mean of completed distance for healthy older individuals of 631 ± 93 meters, while in this study the healthy individuals walked around 506 ± 56 meters. Nevertheless, in the study by Carter *et al.*⁽²⁴⁾ it was seen that the evaluated healthy individuals completed a distance of 416 ± 7 meters, being the mean of the distance similar to the result observed in this study for the group of individuals with COPD presenting mild obstruction (452 ± 60 m), demonstrating again that the lower the obstruction degree, the better the obtained results.

When analyzing individuals with COPD presenting moderate to severe obstruction, as in the study by Redelmeier *et al.*⁽²⁵⁾, in which 112 individuals with this degree of obstruction were evaluated, mean values of completed distance around 371 meters, with distances ranging from 119 and 705 meters, being the mean of these values similar to the ones obtained in this study, that is, the group with moderate obstruction completed around 387 ± 71 meters and the one with severe obstruction around 318 ± 97 meters.

The lowest performance verified in the groups with moderate to severe obstruction is shown by the ventilatory limitation, deconditioning and abnormalities in the muscles involved for the walk performance.

Concerning the completed and predicted distances, in the study by Moreira *et al.*⁽¹³⁾ it was verified that there was no difference when comparing the distance completed by the individuals with COPD with the distance predicted by the formula proposed by Enright and Sherrill⁽¹⁵⁾. However, in this study difference between the completed and predicted distances both for individuals with COPD presenting moderate or severe was observed. There was no difference only for individuals with mild COPD and the healthy ones.

When considering the predicted distance, in the study by Soares *et al.*⁽²⁶⁾, whose aim was to evaluate the applicability of this reference equation for the Brazilian healthy population, it was seen that such formula should be carefully used, once good correlation was only observed for males, and in this study only males were evaluated.

Therefore, the WT6 has been appearing as a complement in the evaluation of physical capacity, in the monitoring of the treatment's efficiency and as a way of establishing the prognostic of the individuals with COPD. These individuals can be included in a rehabilitation program⁽¹⁹⁾, besides enabling physical training programs.

This study's limitation was the difficulty in recruiting individuals for the evaluation, which made the sample heterogeneous concerning the number of individuals in each group.

According to the results obtained in this study, it was concluded that healthy and with COPD individuals presenting mild obstruction degree obtained similar performance during the test, besides showing completed distance values similar to the reference ones calculated through the formula described by Enright and Sherrill⁽¹⁵⁾. The higher the limitation to the air flow, the lower the performance to the effort of the individual during the performance of a physical exertion, according to what was observed when comparing the completed and predicted distances for each of the evaluated groups.

Therefore, the WT6 enables an evaluation of the functional capacity of healthy and with COPD individuals and the estimation of how much the degree of obstruction of air flow compromises one's physical performance, besides the simulation of DLA usually performed by individuals.

The individuals with COPD present alteration of pulmonary function, dyspnea and dysfunction of peripheral skeletal muscles. These factors lead to exercise intolerance and progressive decrease of physical fitness, even limiting DLA, and possibly causing social iso-

lation, anxiety, depression and dependence. Besides that, these individuals frequently present weight and body composition alterations, factors which can also contribute to their physical limitation. Physical incapability, loss of productivity and decrease of life quality substantially accentuate with COPD progression.

Thus, aerobic training becomes important since it increases the concentration of mitochondrial oxidative enzymes, capillarization of the trained muscles, anaerobic threshold, maximal oxygen consumption and reduces the recovery time of phosphate creatine. Therefore, the inclusion of individuals with COPD in physical training programs becomes important, regardless the stage of the disease, since it improves performance in questionnaires of life quality, improvement of exercise tolerance, as well as increase of completed distance in the WT6.

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