Correlation study on the results from measures of Function and Functionality tests of Portuguese COPD Patients

Pedro Santana\textsuperscript{1}, Rui Miguel Cintra [PT, MSc]\textsuperscript{2}, Fátima Rodrigues [MD, MSc]\textsuperscript{3}

\textsuperscript{1}Student - European School of Physiotherapy, Hogeschool van Amsterdam, Tafelbergweg 51, Amsterdam, The Netherlands
\textsuperscript{2}Client - Alto do Pacheco, Edificio Varandas Verdes 4ºB, Portimão, Portugal
\textsuperscript{3}External Advisor - Urbanização Carlos Santos, Rua Miguel Torga nº 146, Alcoitão, Alcobideche, Portugal

Received ; Accepted

Abstract

**Introduction:** The objective of the study is to find out the degree of relationship between the results of the measurements FEV\textsubscript{1} (%) and 6MWD (m) performed on actual patients and to find possible answers for the outcome, adding to the theoretical proposals existent in literature. **Methods:** Data on 54 participants (mean age ± SD: 66 ± 8.9 yrs) diagnosed with Chronic Obstructive Pulmonary Disease was collected from two hospital centers in Portugal and correlated. **Results:** The primary outcome shows no clear and linear relationship between FEV\textsubscript{1} (%) and 6MWD (m). The relationship had total correlation of \( r = 0.29 \) and a significance of \( s = 0.03 \). **Discussion:** The test results are proved to be independent from each other; hence the tests should be rather used complementarily. In conclusion, there was a weak relation found between the measurements for Function (FEV\textsubscript{1}) and Functionality (6MWD) tests for COPD patients which reinforces the current model for establishing COPD severity.

**Keywords:** COPD, rehabilitation, pulmonary function test, 6 minute walk test, six minute walk test, validity, reliability, exercise capacity.

Introduction

Chronic Obstructive Pulmonary Disease is one of the main causes of disability and mortality today (Eisner et al 2005; Jenkins 2007) and just this last year it was predicted to be the third leading cause of death worldwide in 2030 by the World Health Organization (2008). Alongside it seems to be the only major cause of death increasing in prevalence (Lopez et al 2006). COPD is a disease of the lungs in which the diameter of the airways becomes diminished. The diminishing of the airways is caused by inflammatory response processes triggered by inhaled noxious particles and gases (e.g.: Cigarette smoke, occupational hazardous)
guidelines). This diminished airway diameter limits the air flow between the environment and the lungs leading the COPD patient to experience dyspnea that, with the physiological deficits, can cause anxiety.

One of the cardinal signs of these patients is the lack of tolerance to effort due to (KNGF COPD guidelines):

a. the physio-pathological changes in the lungs (inflammatory processes and formation of fibrotic scar tissue) combined with the insidious onset of the disease cause these patients to progressively decrease their performance level in physical daily activities;

b. cardiocirculatory insufficiency in mild bronchial obstruction (i.e. FEV$_1$ > 60% predicted according to KNGF guidelines; FEV$_1$ > 80% predicted according to GOLD guidelines) denying the provision of enough oxygen to the muscles, causing them to switch to an anaerobic energy system that increases fatigue;

c. psychogenic limitations like anxiety and fear caused by dyspnea.

Keeping in mind that the International Classification of Function, Disability and Health (Steiner et al 2002) is still under implementation in Portugal and that it proposes a shift from the purely biomedical model to an integrated biopsychosocial model of human functioning and disability, this study sets itself to achieve a relatively simple relationship study between the measurements of Function and Functionality in Portuguese COPD patients in order to withdraw conclusions for severity determination at the intake of a COPD patient by the Physiotherapist.

The objective of the study is to find out the degree of relationship between the results of these two measurements performed on actual patients and to find possible answers for the outcome, adding to the theoretical proposals existent in literature. If the correlation proves strong and significant then either of the tests could be performed in order to estimate the patient’s performance in the other. For establishment of severity in Physiotherapy alone this would direct us to choose the most rapid and less costly test of the two.

It is expected that no significant correlation will be present (Celli et al 2008) which can probably be explained by the risk factors for this disease: gender, occupational hazards, smoking habit and lifestyle and others. When possible this information will be collected and correlated with both measurements.

Although Pulmonary Function measurement, in particular spirometry’s parameter for Forced Expiratory Volume in one second (FEV$_1$), has traditionally been used to assess severity of the disease in clinical practice (Eisner, M et al 2005) spirometry alone may underestimate the impact of the disease in some patients and overestimate in others (English COPD guidelines).

The 6-min Walk Test is a simple and low cost exercise capacity or effort tolerance test commonly performed on COPD patients (ATS, English, KNGF, GOLD Guidelines; Carter et al 2003; Jenkins 2007; Leung et al 2006;).

This test’s outcome is the 6-min Walk Distance (in meters) and studies about its validity and reliability show good results as a measure of functional capacity (Carter et al 2003).

The questions that were at the core foundation for the study are:

a. Are the Pulmonary Function tests enough to establish severity?

b. Is the 6-minute Walk Test enough to establish severity?

c. How do these tests correlate independently from other information (COPD patient’s risk information)?

d. Is the Pulmonary Function tests essential for the Physiotherapist?

e. Can the General Practitioner or the Pulmonary Doctor withdraw any useful information from the 6-min Walk Test?

This study tries to answer the questions mentioned above through the analysis of the following research question:

What is the relation between measurements of Function (FEV$_1$) and Functionality (6-min Walk Distance) for Portuguese COPD patients?
### Methods

#### Participants

In this project, data on 54 participants (mean age ± SD: 66 ± 8.9 yrs) was collected from two hospital centers in Portugal (Diagram 1).

All participants were diagnosed with Chronic Obstructive Pulmonary Disease, were assessed with the Pulmonary Function Test according to the ATS (American Thoracic Society) lung function guidelines (Miller et al 2005) and were as well assessed with the 6 Minute Walk Test according to the ATS six-minute walk test guideline (American Thoracic Society 2002).

#### Procedure

Three Hospital Centers from some of the most densely populated areas in Portugal were contacted and asked for permission to use their patient data. From the three hospitals contacted, only two granted their permission and these were C.H.B.A. (Centro Hospitalar do Barlavento Algarvio) in Portimao and C.H.L.N (Centro Hospitalar Lisboa Norte – Hospital Pulido Valente) in Lisbon. The patient data collected was: sex; age at the time of assessment; profession; weight (Kg); height (m); FEV$_1$ (%) post bronchodilator application; 6MWD (six minute walk distance) (m); cigarette Pack/Year value. Body Mass Index was calculated posteriorly. The study’s primary outcome was the degree of relationship between FEV$_1$ (%) and 6MWD (m) (Sciurba et al 2003). The study’s secondary outcomes were the degree of relationship measured between the following paired variables: 1. BMI and 6MWD (m); 2. BMI and FEV$_1$ (%); 3. Pack/Year and FEV$_1$ (%); 4. Pack/Year and 6MWD (m).

### Statistics

After the data collection, the degree of relationship between variables was measure with Pearson’s Product Moment Correlation using SPSS 15.0. The level of significance was set at 0.05.

### Results

The results of the experiment on the primary outcome show a not so clear and linear relationship was found between FEV$_1$ (%) and 6MWD (m). In Figure 1, a scatter plot shows the relationship present with a total correlation of $r = 0.29$ and a significance of $s = 0.03$.

**Figure 1: Relationship between FEV$_1$ (x-axis) and 6MWD (y-axis).**

The results of the experiment on secondary outcomes show no clear and linear relationship found between the paired variables. In table 1, the results for each correlation can be observed with values for total correlation ($r$) and significance (2-tailed).

**Table 1: Results on the secondary outcomes and its corresponding $r$ value and significance.**

<table>
<thead>
<tr>
<th>Sec. Out.</th>
<th>Variables</th>
<th>$r$ value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BMI x 6MWD</td>
<td>0.11</td>
<td>0.43</td>
</tr>
<tr>
<td>2</td>
<td>BMI x FEV$_1$</td>
<td>0.10</td>
<td>0.48</td>
</tr>
<tr>
<td>3</td>
<td>Pack/Year x FEV$_1$</td>
<td>-0.01</td>
<td>0.92</td>
</tr>
<tr>
<td>4</td>
<td>Pack/Year x 6MWD</td>
<td>-0.14</td>
<td>0.32</td>
</tr>
</tbody>
</table>
Discussion

As the results clearly show, the correlation between the FEV\textsubscript{1} (%) and the 6MWD proved to be present in spite of being weak, and it was the single significant correlational result found (p < 0.05). This means that the test results are independent from each other; hence the tests should be rather used complementarily, as suggested in literature. The most plausible explanation for this is that the tests are measuring different domains of the disease and therefore do not overlap, mainly due to the systemic repercussion which varies with each patient (Celli et al 2008). Thus, the evaluation of severity in COPD patients acquires a more complex conjugation of factors beyond the respiratory function or exercise capacity focus. It is profitable to complement it with information on topics such as: exacerbations in the preceding year; degree of dyspnea; nutritional evaluation. As proposed by Cote et al (2005) with the BODE index.

After establishing the relation that was the study’s focus, it became clear that other relations had to be looked at in order to establish further proofing. The fact that the secondary outcomes did not bring consequent changes to the findings proves that the first possible explanation was the closest to being true.

Going back to the questions that were raised prior to the study, it becomes apparent that questions a., b., d. and e. are already answered when it is said that both tests, although serving for severity identification, are measuring different domains of the disease:
- while the Lung Function Test has as outcomes respiratory related indexes only, the 6MWT’s outcome results from the interaction of all organ systems related and responsible for movement. This means that the reason for a lower result can have the meaningful outcome of a diminished exercise capacity or tolerance, but the reason behind the conclusion is still missing. Unfortunately, question c. remains unanswered since it was not possible relate severity and risk factors of COPD and grading it. Hence the impossibility of integrating the risk factors in the statistical analysis due to the lack of existing references offering a model that grades risk factors for this patient category. Further research is advised in this subject, having as result the unveiling certain unanswered topics as this one, within the present study topic.

An important fallback of the study was the impossibility of collecting patient data (another 30 participants) from the third institution contacted, although the short time-span in which a positive answer was needed can be regarded as the primary problem. This lowers the external validity level, in spite of the number of participants being satisfactory enough.

Also a time constraint issue was the impossibility of collecting data that would be gathered by the same technicians for all participants, but this was guarded by performing the tests accordingly to the same guidelines.

Another shortcoming was the impossibility of excluding patients with co-morbidities that were not already contemplated on the guidelines for both of the performed tests, which could have had a significant impact on the results.

In regard for Physiotherapy, a different outcome would be favorable. A strong relation between FEV\textsubscript{1} (%) and 6MWD (m) would mean that Physiotherapists could disregard the Lung Function Tests, gaining in time and cost efficiency for their practice with their COPD patients. This is not the case.

In conclusion, there was a weak statistically significant relation found between the measures for Function (FEV\textsubscript{1}) and Functionality (6MWD) tests for COPD patients which reinforces the current model for establishing COPD severity.

Acknowledgements

I would like to thank all those involved in the process of the making of this article, particularly:
- my Coach, for the constant honest and well intentioned worrying about the outcome of my performance;
- my Client, without whom this study would’ve not been possible as he bridged all the contacts made with the different institutions; his constant encouragement and good spirit;
- my External Advisors, who not only showed proof of great availability but also of competence in their reviews.
- my family, for accommodating the logistical demands of the study and encouraging me to always try harder.
- my colleagues, Bianca Refualu and Rebecca Duemmer, for taking the time to give me their valuable feedback.

References