

Relationship between the functional capacity and perception of limitation on activities of daily life of patients with COPD

Relação entre a capacidade funcional e a percepção de limitação em atividades de vida diária de pacientes com DPOC

Relación entre la capacidad funcional y la percepción de la limitación en las actividades diarias de los pacientes con EPOC

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ABSTRACT | The aim of this study was to investigate whether there is a correlation between functional capacity and the perception of limitation for activities of daily living (ADL) in patients with chronic obstructive pulmonary disease (COPD). Thirty patients underwent anthropometric assessment, spirometry, the London Chest Activity of Daily Living Scale (LCADL), the six minute walk test (6mWT) and the Glittre-ALD test (TGlittre). The normality of the data was tested using the Shapiro-Wilk test. To verify correlation between variables, the Spearman correlation coefficient was used. A simple linear regression and stepwise multiple linear regression were applied, using the percentage of LCADL (LCADL_{%total}) as dependent variable and the tests (TGlittre and 6mWT) as independents. The TGlittre correlated moderately with LCADL_{%total} ($r=0.58$, $p<0.05$) and with the LCADL domain “self care” ($r=0.45$, $p<0.05$) and “leisure” ($r=0.54$, $p<0.05$). The LCADL_{%total} and its domain “leisure” showed moderate and weak negative correlation with the 6mWT ($r=-0.45$ and $r=-0.53$, $p<0.05$, respectively), while the “self care” domain did not correlate with 6mWT. The variability of the TGlittre was able to explain 44% of the variability of the LCADL_{%total} ($p<0.01$), while 6mWT explained only 17% of the LCADL_{%total} ($p<0.05$). In the multiple linear

regression model, only the TGlittre was selected as LCADL_{%total} predictor ($R^2=0.44$; $p<0.01$). Therefore, both the 6mWT and TGlittre reflect ADL limitations perceived and reported by patients with COPD. However, TGlittre seems to be more sensitive to reflect the self-perception of functional impairment in those patients.

Keywords | Pulmonary Disease; Chronic Obstructive; Activities of Daily Living; Outcome Assessment (Health Care).

RESUMO | O objetivo deste estudo foi verificar se há correlação entre a capacidade funcional e a percepção da limitação em atividades de vida diária (AVDs) de pacientes com doença pulmonar obstrutiva crônica (DPOC). Trinta pacientes com DPOC foram submetidos a: avaliação antropométrica, espirometria, escala London Chest Activity of Daily Living (LCADL), teste de caminhada de seis minutos (TC6min) e teste de AVD-Glittre (TGlittre). A normalidade dos dados foi testada por meio do teste de Shapiro-Wilk. Para verificar a existência de correlação entre as variáveis, utilizou-se o coeficiente de correlação de Spearman. Uma regressão linear simples e uma regressão linear múltipla stepwise foram aplicadas utilizando-se o percentual da escala LCADL (LCADL_{%total}) como variável dependente e os testes

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(TGlittre e TC6min) como independentes. O TGlittre correlacionou-se moderadamente com o LCADL_{%total} ($r=0,58$; $p<0,05$), o domínio “cuidados pessoais” ($r=0,45$; $p<0,05$) e o domínio “lazer” ($r=0,54$; $p<0,05$) da escala LCADL. O LCADL_{%total} e o domínio “lazer” apresentaram moderada e fraca correlação negativa com o TC6min ($r=0,45$ e $r=-0,53$; $p<0,05$, respectivamente), enquanto o domínio “cuidados pessoais” não se correlacionou com o mesmo. A variabilidade do TGlittre foi capaz de explicar 44% ($p<0,01$) da variabilidade do LCADL_{%total}, enquanto do TC6min apenas 20% ($p<0,05$). No modelo de regressão linear múltipla, apenas o TGlittre foi selecionado como preditor do LCADL_{%total} ($R^2=0,44$; $p<0,01$). Portanto, o TGlittre e o TC6min refletem as limitações nas AVD percebidas e relatadas por pacientes com DPOC. Entretanto, o TGlittre parece ser mais sensível para refletir a percepção do comprometimento funcional dos pacientes.

Descritores | Doença Pulmonar Obstrutiva Crônica; Atividades Cotidianas; Avaliação de Resultados (Cuidados de Saúde).

RESUMEN | Este estudio tiene el propósito de comprobar si hay correlación entre la capacidad funcional y las limitaciones percibidas por pacientes con enfermedad pulmonar obstructiva crónica (EPOC) en las actividades de la vida diaria (AVDs). Se aplicaron a los treinta participantes la evaluación antropométrica, la espirometría, la escala London Chest Activity of Daily Living (LCADL), el test de marcha de 6 minutos (TM6m) y el test de

AVD-Glittre (TGlittre). La normalidad de los datos se puso a prueba mediante el test de Shapiro-Wilk, y para comprobar la correlación entre las variables se utilizó el coeficiente de correlación de Spearman. Una regresión lineal simple y una múltiple stepwise se aplicaron mediante el porcentaje de la escala LCADL (LCADL_{%total}) como variable dependiente y las pruebas (TGlittre y TM6m) como independientes. El TGlittre correlacionó moderadamente con la LCADL_{%total} ($r=0,58$; $p<0,05$), con el dominio “cuidados personales” ($r=0,45$; $p<0,05$) y con el dominio “tiempo de ocio” ($r=0,54$; $p<0,05$) de la escala LCADL. La LCADL_{%total} y el dominio “tiempo de ocio” mostraron correlación negativa moderada y débil con el TM6m ($r=-0,45$ y $r=-0,53$; $p<0,05$, respectivamente), mientras que este no correlacionó con el dominio “cuidados personales”. Un 44% ($p<0,01$) de la variación de la LCADL_{%total} se explicó por la variación del TGlittre, mientras que la del TM6m fue solamente un 20% ($p<0,05$). En el modelo de regresión lineal múltiple se seleccionó solamente el TGlittre como preditor de la LCADL_{%total} ($R^2=0,44$; $p<0,01$). Se concluyó que tanto el TGlittre como el TM6m mostraron las AVDs percibidas y relatadas por los pacientes con EPOC. Sin embargo, el TGlittre parece ser lo más sensible para percibir la alteración funcional de los pacientes.

Palabras clave | Enfermedad Pulmonar Obstrutiva Crónica; Actividades Cotidianas; Valoración de los Resultados (Atención de Salud).

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) has important systemic manifestations which determine the progressive decline of exercise capacity and, consequently the progressive decline of functional capacity, which is defined as the ability to perform activities of daily living (ADLs)¹. This process generates physical inactivity^{2,3} and high energy expenditure to perform simple everyday activities⁴. A compromised functional state is directly related to exacerbation frequency, hospital admittances and death rates in COPD patients⁶; assessing it is a routinely fundamental in pulmonary rehabilitation programs.

Limitations in ADLs can be assessed through questionnaires and field tests, but only a few tests are representative of most of the tasks performed in daily living⁸. The London Chest Activity of Daily Living (LCADL) scale assesses the limitations in ADL⁹ by prompting COPD patients to recall those they have noticed and the

activities comprised by the scale are global and common to everyday life^{9,10}. Although it involves various ADLs and is valid^{9,10} and responsive to pulmonary rehabilitation programs and is connected with the predictive index of death rates in such patients, the scale depends on the interpretation and subjectivity of the individual; besides, it is not able to objectively assess the physiological responses and dyspnea experienced at the very moment the ADLs are being performed. Since these aspects are essential, field tests, which are able to mimic the situations experienced by these patients in their daily lives, are important tools and should be included in your evaluation⁷.

In order to simulate the limitations noticed by these patients in an objective manner, the tests that will be performed should be complete and representative of the ADLs⁸. In that context, the 6-minute walk test (6MWT) is widely used in clinical practice due to its simple execution and low cost¹³, and its connection with the LCADL scale has already been shown in a previous study¹⁰. This test, however, comprises only the activity

of walking. The Glittre ADL-test (TGlittre), developed and validated for COPD patients, involves a set of tasks, such as: sitting down and getting up of a chair, climbing up and down the stairs, squatting and moving objects with the upper limbs without support, other than flat-ground walking. It is, however, still uncertain whether this tool is capable of reflecting the perception of everyday limitations by COPD patients like those assessed by the LCADL scale. Given that TGlittre is a multi-task test, perhaps it can reflect the limitations found by these patients in their everyday lives better than a test involving a sole activity.

In that context, the objective of this study was to verify if there is a correlation between these two field tests (6MWT and TGlittre) and the scores of the LCADL scale in COPD patients and to establish which reflects best the perception of functional limitations by the patients.

METHODOLOGY

The study was run on the COPD patients who were referred to the Núcleo de Assistência, Ensino e Pesquisa em Reabilitação Pulmonar (NuReab) by the pulmonary wards of public and private health care institutions in the Florianópolis metropolitan area. Eligibility criteria: clinical diagnosis of COPD; spirometric classification between stages 2-4 of the GOLD¹⁵ expert panel, 40 years of age or older; clinical stability during the month previous to the start of the protocol and smoking history of 20 years-pack or superior. Current smokers and patients having other respiratory, neurological, musculoskeletal or cardiomyopathies that might compromise the performance of any of the tests in the study were deemed ineligible. The study was cross-sectional, approved by the Comitê de Ética em Pesquisa em Seres Humanos da Universidade do Estado de Santa Catarina (UDESC) – Florianópolis (SC), Brazil.

The protocol comprised 2 days of testing. On the first day, the data collected were related to the characterization of the sample: anthropometry (ISP[®] stadiometer, São Paulo, Brazil; Filizola[®] scales, São Paulo, Brazil) and pulmonary function (6MWT and LCADL scale). On the second day, the TGlittre test was performed.

Pulmonary function

The pulmonary function was assessed through spirometry, on the *EasyOne* (NDD, Switzerland)

spirometer, whose calibration was checked daily. The methods and criteria used in the evaluation were those recommended by *ATS/ERS*¹⁶. The spirometric measurements were obtained before the inhalation of bronchodilator (BD) salbutamol (400µg). The forced expiratory volume (FEV₁) during the first second in liters and percent predicted (FEV_{1%prev}), forced vital capacity (FVC) in liters and percent predicted (FVC_{%prev}) and the relation FEV₁/FVC after BD were assessed. The predicted values were calculated according to the equations proposed by Pereira, et. al.¹⁷

Functional state

Glittre ADL-test

The TGlittre test consists of a standardized 10-meter circuit where the individual is instructed to go through the following sequence of activities in the shortest time: the individual stands up from a sitting position and walks on flat ground; halfway through the circuit, the individual climbs up then down a pair of stairs (17cm tall x 27cm wide) and walks on flat ground again. At the end of the circuit there is a bookshelf where the individual has to move three 1kg objects from the top shelf (at shoulder height) one at a time onto the bottom shelf (at waist height) and subsequently onto the floor; then the objects have to be moved again onto the bottom shelf and, finally, returned to the top shelf; next up the individual returns to their initial position. Immediately afterwards the individual starts another lap, going through the same ADLs circuit. In order for the test to be considered concluded, the individual has to complete 5 laps. During the test the individual has to carry a backpack containing 2,5kg (women) and 5,0kg (men)¹⁴.

Blood pressure (WelchAllyn[®] sphygmomanometer, New York, US; Littmann[®], stethoscope, Saint Paul, US) was taken at the beginning and at the end of the test. Peripheral capillary oxygen saturation (Oxi-Go[®] oximeter, New York, US), heart rate (Polar[®] heart rate monitor, Oulu, Finland) and dyspnea level through the modified¹⁸ Borg scale were assessed at every lap. The total time to complete the test was registered and used as outcome. The longer it takes a patient to perform the test, the worst their functional capacity is¹⁴.

6-Minute Walk Test

The 6MWT was run according to the American Thoracic Society's standards¹³. Two tests were performed

with a 30-minute break between them. The patient was instructed to walk the longest distance they could within a 6-minute interval to standardized prompts. The outcome of the test is the covered distance; the longer the distance covered by the patient, the better their functional capacity¹³ is. Peripheral capillary oxygen saturation (SpO₂), heart rate (HR) and dyspnea were measured at the beginning, every two minutes during the test and at the end. At the beginning and at the end of the test the blood pressure was taken. The analysis prioritized the longest distance covered and the predicted value was calculated according to the equation proposed by Iwama, et. al.¹⁹

The London Chest Activity of Daily Living scale

The LCADL scale was created and validated for COPD patients⁹. In Brazil it was translated and validated by Carpes, et. al.¹⁰ It aims at evaluating the limitations in ADLs and comprises four domains related to personal grooming, house chores, physical activities and leisure. It presents 15 quantitative questions, with scores ranging from 0 to 5, which combined reach a maximum total of 75 points. The higher the score, the bigger the limitation by dyspnea to perform the ADLs⁹. The total score (LCADL_{total}) and the percentage of the total (LCADL_{total%})¹⁰ were used in the analyses.

Sample size

The sample size was calculated according the correlation between the LCADL_{total%} and the distance covered in the 6MWT¹² found in a previous study. With a 0,05 bidirectional α and a 0,05 β the estimated value of the sample was of 30 patients.

Treatment of data

The data were collected and analysed on *Statistical Package for the Social Sciences* (SPSS, 20.0 version) for Windows and presented in average, standard deviation and 95% confidence interval (95%CI).

In order to verify the normality of the data, the Shapiro-Wilk test was run. The Spearman correlation coefficient was applied to verify correlations between the LCADL scores, and the TGlittre and 6MWT tests. Moreover, the simple linear regression and multiple linear regression, together with the *stepwise* method were applied using the LCADL_{total%} as a dependent variable and the variables time spent in the TGlittre and the distance covered in the 6MWT as independent.

In the treatment of data the functional influences of age and the compromising of the pulmonary function in the assessed functional capacity were not taken into account. In all the analyses, $p < 0,05$.

RESULTS

Thirty patients were evaluated of whom 21 men of 63,9±8,1 years of age on average. In 4 of them (13,3%) the pulmonary function was moderately compromised (GOLD 2), in 14 of them (46,7%) the pulmonary function was gravely compromised (GOLD 3) and in 12 of them (40%) the pulmonary function was extremely compromised (GOLD 4). Seventeen of the patients covered 80% less than the expected distance in the 6MWT and only three of them had important limitations in the ADLs, with LCADL_{total%} over 50%¹². The characteristics of the sample are listed in Table 1 and the data on the patients' functional state are listed in Table 2.

Table 1. Age, anthropometric measurements and pulmonary function of the sample

COPD	Average ± SD	CI95% (LI - LS)
Age (years)	63.9±8.1	45-78
Body mass (kg)	74.1±16.1	43-103
Stature (m)	1.66±0.09	1.48-1.88
BMI (kg/m ²)	26.7±5.0	18.8-36.3
FEV1 (L)	1.03±0.49	0.34-2.19
FEV1 (%pred)	34.1±14.4	15-69
FVC (L)	2.27±0.69	0.97-3.7
FVC (%pred)	60±13.4	34-84
FEV1/FVC (L)	0.43±0.12	0.25-0.68

SD: standard deviation; CI: confidence interval; LI: limit inferior; LS: limit superior; kg: kilograms; m: meters; BMI: body mass index; L: liters; FEV1: forced expiratory volume in the first second; %pred: percent predicted; FVC: forced vital capacity

Table 2. Functional state of the sample (LCADL and its domains, TGlittre and 6MWT)

Functional state	Average ± SD	95%CI (LI - LS)
LCADL (total score)	18.6±7.9	10-45
LCADL _{total%}	30.9±10.7	20-60
Personal grooming	5.77±2.4	4-14
House chores	4.9±5.4	0-22
Physical activities	3.83±1.2	2-7
Leisure	4.1±1.3	3-8
TGlittre (min)	4.5±1.2	2.65-7.97
6MWT (m)	424±93	160-602
6MWT _{%pred}	75.7±3.03	69.5-81.9

SD: standard deviation; CI: confidence interval; LI: limit inferior; LS: limit superior; LCADL: *London Chest Activity of Daily Living* scale; total%: percentage of the LCADL scale's total score; TGlittre: ADL-Glittre test; min: minutos; 6MWT: 6-minute walk test; m: metros; %pred: percent predicted for the distance covered in the 6MWT

There was a weak negative correlation between the $LCADL_{total\%}$ and the distance covered in the 6MWT ($r=-0,45$; $p<0,05$) and a moderate correlation between the $LCADL_{total\%}$ and the time spent in the TGlittre ($r=0,58$; $p<0,05$) (Figure 1). The variability of the time spent in TGlittre was able to explain 44% ($p<0,01$) of the variability of the $LCADL_{total\%}$, while that of the 6MWT was just 17% ($p<0,05$). In the analysis of the multiple linear regression, only the TGlittre was selected as the predictor of the $LCADL_{total\%}$ (Table 3).

Table 3. $LCADL_{total\%}$ predictor model

	Regression coefficient	SE	95%CI	R ²	p
Constant	4.28	5.82	-7.66 - 16.2	-	<0.001
TGlittre (min)	5.91	1.25	3.35 - 8.46	0.44	<0.001

LCADL: London Chest Activity of Daily Living scale; total%; percentage of the LCADL scale's total score; TGlittre: ADL-Glittre test; min: minutes; SE: standard error; 95%CI: 95% confidence interval

The domains of the “personal grooming” and “leisure” scales showed weak correlation with the time

spent in the TGlittre test ($r=0,45$ e $r=0,54$; $p<0,05$, respectively) (Figure 1) and the “leisure” domain had a moderate and negative correlation with the distance covered in the 6MWT ($r=-0,53$; $p<0,05$). The other domains of the scale showed no correlation with the performance in the 6MWT (Table 4). The total score in the LCADL scale showed no correlation with any of the tests.

Table 4. Correlation coefficient (r) between the LCADL scale and its domains, TGlittre and 6MWT

	TGlittre	6MWT
LCADL (total score)	0.28	-0.23
$LCADL_{total\%}$	0.58 [#]	-0.45 ^{**}
Personal grooming	0.45 [*]	-0.25
House chores	-0.08	0.1
Physical activities	0.23	-0.28
Leisure	0.55 ^{**}	-0.53 ^{**}

LCADL: London Chest Activity of Daily Living scale; total%; percentage of the LCADL scale's total score; TGlittre: ADL-Glittre test; 6MWT: 6-minute walk test. * $p\leq0,05$; ** $p\leq0,01$; # $p\leq0,001$

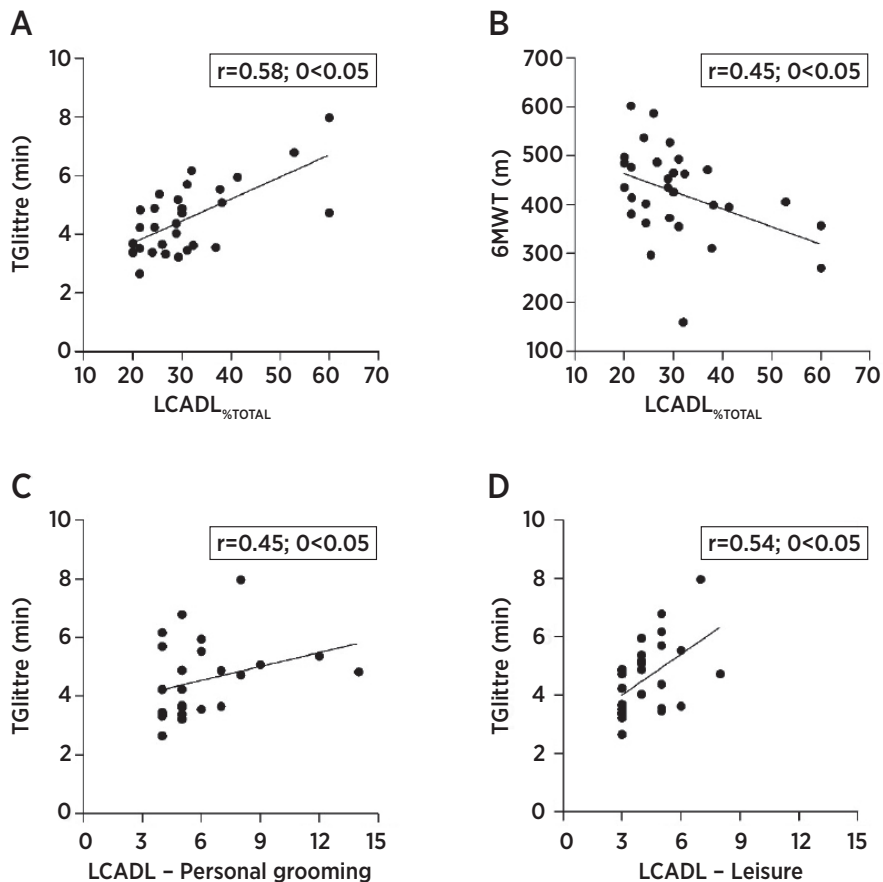


Figure 1. Correlation between: (A) percentage of the LCADL scale's total score and the TGlittre test; (B) percentage of the LCADL scale's total score and the 6MWT; (C) TGlittre the “personal grooming” domain of the LCADL scale; (D) TGlittre and the “leisure” domain of the LCADL scale

DISCUSSION

This study aimed at investigating the correlations between two field tests which assess the functional capacity and a scale of limitations in ADLs and to verify which of the field tests (TGlittre or 6MWT) is a better predictor of the perception of functional limitations in COPD patients. We observed that the LCADL_{total%} is predicted by the time spent in the TGlittre test and the distance covered in the 6MWT separately, showing moderate and weak correlations with those outcomes, respectively. However, when analyzed together, in a model of multiple linear regression, only the TGlittre test was selected as a predictor of the LCADL_{total%}. Previous studies had already shown that the LCADL_{total%} presents a moderate correlation with the 6MWT ($r=-0,67$; $p<0,05$)¹². Yet an investigation on the possible correlation between the scale and the TGlittre test and which is a better predictor of the perception of functional limitations in COPD patients had not been conducted at the time.

The GLittre test was created according to the main limitations reported by COPD patients in their everyday activities¹⁴, differently from other tests widely used for assessing functional capacity. Some were initially developed in order to assess athletes' performance, like the 6MWT²⁰ and the Shuttle test²¹. Thus, the GLittre test seems to have a nature more similar to that of the LCADL scale, which was also developed for COPD in order to measure the difficulties met in these patients' everyday tasks. For that reason the GLittre test can be more specific to assess limitations in ADLs than the other field tests. Moreover, most of the tests destined to the functional assessment of COPD patients involve only activities with the lower limbs^{13,21-24}; there are only three field tests which involve multiple tasks that are used on COPD patients: *Monitored Functional Task Evaluation e Neidstadt and Crepeau ADL Test*, other than the TGlittre test⁸.

We know that dynamic hyperinflation and thoracoabdominal dyssynchrony are connected with limitations in these patients' everyday activities, influencing the ability for ADLs that involve especially the upper limbs²⁵. Activities where the upper limbs are raised unsupported, even with intensities lower than those of the activities with the lower limbs, may cause thoracoabdominal dyssynchrony, dynamic hyperinflation and consequent dyspnea²⁶. The

activities performed with the upper limbs are assessed based on the LCADL scale and the TGlittre test.

This study verified that the GLittre test was a better predictor of the scoring in the LCADL scale than the 6MWT. Besides, the "personal grooming" domain in the scale, which assesses dyspnea in activities such as "towelling yourself after showering", "putting on your top", "putting some shoes/socks on" and "washing your hair" had a correlation with the GLittre test only. This shows that the test may be more sensitive in determining the limitations noticed by the patients in the ADLs that involve the upper limbs. Recently, Karloh et al.²⁷ compared the physiological response to the TGlittre test to that of the 6MWT and showed that the cardiovascular and ventilatory responses were similar between the two tests, however, the oxygen consumption (VO_2) during the TGlittre test was about 7% bigger than that of the 6MWT. This study suggests that a bigger VO_2 may be associated with the recruitment of the accessory muscles of respiration for a primary motor activity during the raising of the upper limbs in the task of moving objects on the bookshelf. This finding suggests yet that an increased effort of the muscles of respiration and their fatigue compromise blood flow to the postural and walking muscles, contributing to the increase in metabolic demand²⁶.

Despite this, another domain that relates to the use of the upper limbs, "house chores", showed no correlation with any of the field tests. Carpes et al.¹⁰, however, when they adjusted the tool for Brazil, they noticed many male individuals didn't perform most of the house chores mentioned in the tool, even before they developed COPD. In this study the same behavior was observed, therefore a possible determining factor for the non-correlation of this domain with the performance in the tests could be the strong presence of male individuals in the sample who answered score 0 ("I have never performed this activity because I never needed to or it's irrelevant") to some questions, possibly making the domain less sensitive to determine functional limitations in house chores. This behavior can also justify the absence of correlations between the total score of the LCADL scale and the field tests, since the "house chores" domain is the one that has more items to cover and corresponds to 40% of the scale's total score. For that reason, with hopes to improve its interpretation the percentage of the total score was created, not taking into account the activities attributed with score 0, which makes it a more reliable and more

sensitive measurement to determine the patients' functional limitations¹².

The domain that best moderately correlated with the TGLittre test was "leisure", which was also the only one that showed a moderate negative correlation with the 6MWT. The domain refers to the "walking at home" and "going out socially" activities, which involve the activity of walking, present in both tests. The "physical activities" domain on the other hand which has the "climbing up stairs" and "bending down" items, activities present in the TGLittre test, showed no correlation with this test, much less with the 6MWT. However, it is a two-item domain, which may have limited the sensitivity to correlations.

An element that might be cited as a limitation of the study is the higher ratio of male individuals, which might have been a hindrance to the investigation of correlation with the "house chores" domain. But this doesn't invalidate the results found, since this ratio is in accordance with the prevalence of the disease¹⁵. Another possible limitation is the poorer correlation found in this study between the LCADL_{total%} and the 6MWT compared to the previous study¹², which was used in the sample size calculation. However, we verified that with this study's sample there was a power-up of 80% for the correlations between the score of the LCADL scale and the performance in the 6MWT. Moreover, there was a power-up of 95% for the correlation between the TGLittre test and the LCADL score. The weakest correlation between the 6MWT and the LCADL scale may have been influenced by the low functional compromising among the patients subjected to this study, evidenced by scores below 50% in 90% of the patients in the sample¹².

Limitations found by COPD patients in their everyday lives is widely connected with their life quality²⁸. Thus, it is fundamental that the field tests not only objectively measure the performance, the physiological responses and the dyspnea at the very moment the ADLs are being performed but also that the activities reflect the impact the difficulty to perform them has on the patients themselves. Thus, the results of this study might contribute to the clinical practice, lending stronger support to the use of both tests (6MWT and TGLittre) for assessing COPD patients and showing that, maybe, the use of a more ADL-specific tool, like the TGLittre test, can better represent the perception of these patients' everyday limitations.

CONCLUSION

The GLittre and the 6MWT are able to reflect the limitations in ADLs observed by COPD patients; the variability of the GLittre test seems to explain the perception of the patients' functional compromising better than that of the 6MWT.

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