DOI: https://doi.org/10.17921/2447-8938.2022v24n3p201-205

Londrina ADL Protocol (LAP) Performance of Patients with Chronic Obstructive Pulmonary Disease in Different Gravity Classes

Desempenho no Londrina ADL Protocol (LAP) de Pacientes com Doença Pulmonar Obstrutiva Crônica em Diferentes Classes de Gravidade

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Abstract

Studies on the association between functionality and severity of chronic obstructive pulmonary disease (COPD) are conflicting. The GOLD ABCD system, as it includes variables by influence such as activities of daily living (ADLs), would be discriminative to verify the magnitude of the disease influence on functionality. The aims of this study are to compare the performance in the ADLs of patients with COPD classified at different levels of severity according to the GOLD ABCD system, as well as to verify the association among these variables. Participants performed the Londrina ADL Protocol (LAP) to assess ADLs, as well as: lung function, functional exercise capacity and clinical history. LAP time was compared among the GOLD-A (n = 13), GOLD-B (n = 18) and GOLD-C + D (n = 14) groups by the Kruskal-Wallis test. χ^2 test and V Cramer were used for analysis. The level of statistical significance adopted was P<0.05. For this study, 45 COPD patients completed the assessments (22 men; 65±8 years; FEV1: 51±15% predicted, 6MWT: 520±25m). Overall LAP runtime was 32[275-354] seconds (96[86-106]% predicted). When grouped together, the LAP time was 330[276-348]sec, 318[272-365]sec and 318[282-386]sec in the GOLD-A, B and C+D groups, respectively (P=0.78). There was no association between performance on the LAP and classification by the GOLD ABCD (P=0.24 and VCramer=0.27). It is possible to conclude that the performance in the ADLs of patients with COPD did not differ among the different levels of the GOLD ABCD. Other factors can interfere with performance in the LAP, due to the need for further studies.

Keywords: Pulmonary Disease. Chronic Obstructive. Activities of Daily Living. Exercise.

Resumo

Estudos sobre associação entre funcionalidade e gravidade da doença pulmonar obstrutiva crônica (DPOC), apresentam resultados conflitantes. O sistema GOLD ABCD, por incluir variáveis conhecidas por influenciar as atividades de vida diária (AVDs), seria discriminativo para verificar a magnitude da influência da doença sobre a funcionalidade. Os objetivos foram comparar o desempenho nas AVDs de pacientes com DPOC classificados em diferentes níveis de gravidade de acordo com o sistema GOLD ABCD, bem como verificar a associação entre estas variáveis. Os participantes realizaram o Londrina ADL Protocol (LAP) para avaliar as AVDs, assim como: função pulmonar, capacidade funcional de exercício e histórico clínico. O tempo do LAP foi comparado entre os grupos GOLD-A (n=13), GOLD-B (n=18) e GOLD-C+D (n=14) pelo teste de Kruskal-Wallis. Teste χ^2 e V Cramer foram utilizados para analisar associações. O nível de significância estatística adotado foi P<0,05. Para esse estudo, 45 pacientes com DPOC completaram as avaliações (22 homens; 65±8 anos; VEF_1: 51±15%predito, TC6min: 520±25m). O tempo de execução do LAP, no geral, foi de 321 [275-354]seg (96 [86-106]%predito). Quando agrupados, o tempo do LAP foi de 330 [276-348]seg, 318 [272-365]seg e 318 [282-386]seg nos grupos GOLD-A, B e C+D, respectivamente (P=0,78). Não houve associação entre o desempenho no LAP e a classificação pelo GOLD ABCD (P=0,24 e V Cramer=0,27). Portanto, concluiu-se que o desempenho nas AVDs de pacientes com DPOC não diferiu entre os diferentes níveis do GOLD ABCD. Outros fatores podem interferir no desempenho no LAP, apontando para a necessidade de novos estudos.

Palavras-chave: *Doença Pulmonar Obstrutiva Crônica. Atividades Cotidianas. Exercício Físico.*

1 Introduction

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable respiratory disease characterized by the presence of chronic airflow obstruction, which is not totally reversible. Airflow obstruction is usually progressive and is associated with an abnormal inflammatory response of the lungs to inhalation of toxic particles or gases, primarily caused by smoking. Although COPD compromises the lungs, it also produces significant systemic consequences[1].

COPD also leads to the occurrence of extrapulmonary manifestations such as systemic inflammation, increased oxidative stress, changes in body composition and muscle weakness[2].

The disease pulmonary and extrapulmonary changes lead to the sensation of fatigue and dyspnea, symptoms commonly reported by patients during daily life activity (ADLs). This symptomatology makes it uncomfortable or even limits the physical activities related to day-to-day[2].

The disease severity can be classified according to airflow obstruction through *the Global Initiative for Chronic Obstructive Lung Disease* (GOLD) 1,2,3,4 which takes into account forced expiratory volume in one second (FEV_1). spirometry results after bronchodilator use[1]. In 2011, a new

classification (Gold ABCD) was proposed by the GOLD initiative to specify the disease individual impact, taking into account the number of exacerbations and/or hospitalizations in addition to the questionnaire scores (COPD Assessment Test – CAT, Modified British Medical Research Council – mMRC).[1] in the classification. The patient may vary his or her score from A to D, being an A score the patient classified with a lighter commitment and D with a stronger disease impairment.

Studies in the literature have conflicting results regarding the association of disease severity, with performance in ADLs, evaluating these activities in the majority of cases subjectively with questionnaires[3,4]. Therefore, it is important to deepen the studies in this possible association for better prevention and follow-up of the disease, with the objective of reducing the clinical implications. Considering that, known exacerbations of the disease and hospitalizations negatively impact the patients' functional status, it is plausible to consider that the classification of GOLD ABCD severity, as they consider such conditions, is discriminatory to detect patients with greater or lesser functional limitation.

2 Material and Methods

2.1 Study Designer and sample recruitment

This cross-sectional study included COPD patients recruited through a convenience and "snowball" sampling at the Pneumology and Respiratory Physical Therapy Outpatient Clinics of Hospitais das Clínicas e Universitário of State University of Londrina (UEL), respectively. All individuals included in the study signed a free and informed consent term, this being the same as a longitudinal research project to which this subproject is related to. The longitudinal project was approved by the Research Ethics Committee of State University of Londrina under the legal opinion CAEE 57961716.2.0000.5231 of the State University of Londrina, 1.730.247.

Inclusion criteria were: clinical diagnosis of COPD, established according to the GOLD criteria; clinical stability, without infections and exacerbations in the last month; absence of severe and/or unstable heart disease; absence of osteoarticular and neuromuscular changes that could limit ADLs and physical activities of daily life; and have not followed any kind of physical exercise program in the last year. The exclusion criteria were: non-performance of the proposed tests for any reason; expression of the desire to leave the study at some point for any reason.

The patients carried out the following evaluations: pulmonary function (spirometry), performance in daily life activities (*Londrina ADL Protocol*), functional capacity (6-minute walking tests) limitation in ADLs by dyspnea (MRC scale) and a historical survey of exacerbations and hospitalizations (self-reporting).

2.2 Evaluations ratings

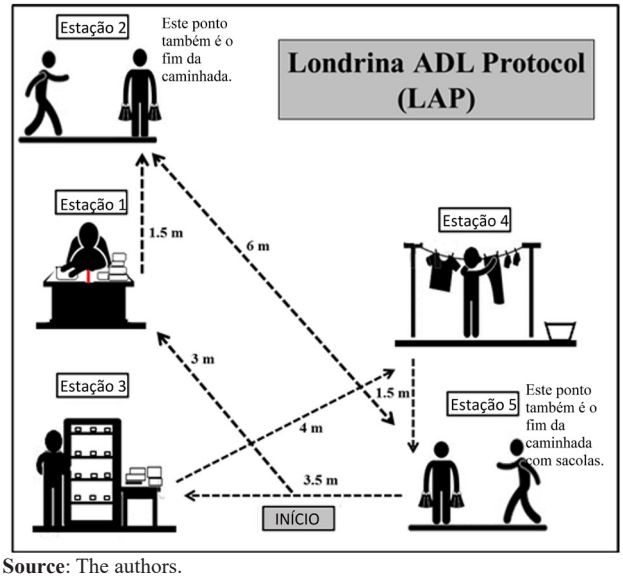
2.2.1 Pulmonary function

The pulmonary function evaluation was performed using a spirometer (Spirobank G®, MIR, Italy), following the guidelines of the *American Thoracic Society*[5]. Reference values of Pereira *et al* were used.[6]

2.2.2 Daily life activity

For the ADLs objective evaluation, the *Londrina ADL Protocol* (LAP) was applied (Figure 1). Lap consists of five activities that are performed in the form of a circuit. This protocol was created by the present research group and has already been validated for patients with COPD[7].

Figure 1 - Circuit with Londrina ADL Protocol activities



Source: The authors.

To perform the LAP, the patient starts the activity circuit standing up at the starting point, walks three meters to a table with objects, sits in a chair without support for MMSS and transfers 10 objects (weight varies from 250 g to 2 kg) from one side of the table to the other and then returns the same objects to the starting point. Then, he or she walks 1.5 meters to the point where two bags are located which together contain 10% of the individual's body weight divided equally between both bags; the individual then takes the bags and walks in a six-meter corridor three times, leaving the bags at the end of the walk. Then he or she walks 3.5 meters to a bookcase and transfer 12 objects (weight ranges from 250 g to 2 kg) that are on a bookshelf table and then return the same objects to the table. To perform the next activity, the individual walks four meters to a clothing stand and hands 10 pieces of clothing that are in a basket on the floor and then collects the same, returning them to the basket. Finally, he or she walks 1.5 meters to a six-meter corridor where he or she walk three times weightless, as shown in figure 1. While the patient performed the LAP, the execution time was recorded by the evaluator. All activities were previously explained and demonstrated by the evaluator

to each participant.

The time that the individual took to complete the circuit was used for analysis. In addition, heart rate, blood pressure and sensation of dyspnea and fatigue by the modified Borg scale for perceived exertion[9] were evaluated before and after the LAP was performed. The physiological responses to the protocol were compared among the groups.

2.2.3 Functional capacity

The functional capacity was evaluated by the 6-minute walk test (6MWT), according to the standardization of the *American Thoracic Society*[10]. The individuals were instructed to walk and travel as far as possible in 6 minutes in a 30-meter long flat corridor. Two tests were performed with a minimum interval of 30 minutes between them, and the reference values used were those of Britto *et al.*[11].

2.2.4 Functional limitation by dyspnea

For functional limitation by dyspnea, the mMRC scale was used: *Modified British Medical Research Council*. This scale consists of evaluating the functional limitation caused by dyspnea in daily activities. It has domains from 0 to 4, where 0 corresponds to the least severity, scoring to have dyspnea in great exertion. Therefore, scoring 4 corresponds to the highest severity, with dyspnea that prevents him or her from leaving his or her residence[12,13]. The questionnaire was explained and signaled according to the individual report.

2.3 Groups allocation

The patients were divided into four groups according the GOLD ABCD[1]. In which patients who did not exacerbate or had an exacerbation without need for hospitalization were classified as GOLD A if they scored 0 or 1 in the mMRC or GOLD B questionnaire if they had a score of two or more in this questionnaire[1].

The patients who had two or more exacerbations, either one or more exacerbations that required hospitalization together with a score of 0 or 1 in the mMRC questionnaire were classified as GOLD C and if the score in the questionnaire was greater than or equal to two of these patients were classified as GOLD D[1].

In the present study, the number of patients with GOLD D was small, possibly because they were more severe patients, with greater difficulty moving due to the number of symptoms. For that reason, it was necessary to joint these patients to the GOLD C group for the analyzes.

2.4 Statistical analysis

The Shapiro-Wilk test was used to analyze the normality of data distribution. The data that presented normal distribution were described as mean ± standard deviation and the data that presented non-normal distribution, in median [interquartile range 25%-75%].

The LAP execution time and the percentage of predicted was compared among the groups GOLD-A (n=13), GOLD-B (n=18) and GOLD-C D (n=14) by Kruskal-Wallis test and between the groups GOLD 1+2 and GOLD 3+4., the= comparison was performed by the Mann Whitney test. The $\chi 2$ and V Cramer tests were used to analyze associations between the LAP performance and the disease severity. Finally, in order to compare the physiological changes after carrying out the LAP protocol among the three groups, the Kruskal-Wallis test was also used. The level of statistical significance adopted was $P<0.05$.

3 Results and Discussion

In this study, 45 patients diagnosed with COPD whose characteristics are described in Table 1 were included. In Table 2, it is possible to verify the characteristics of the sample divided among groups GOLD-A, B and C D.

Table 1 - Characteristics of the individuals included in the study

	n=45
Gender (M/F)	22/23
Age (years)	65±8
BMI (kg/m^{-2})	27 ± 5
GOLD (A/B/C/D)	13/18/14
GOLD (1/2/3/4)	1/24/16/4
FEV_1 (%pred)	51 ± 15
FEV_1/FVC (%pred)	50 ± 10
6MWT (meters)	520 ± 25
6MWT (%pred)	75 ± 20
LAP (seconds)	321 [275-354]
LAP (%pred)	96 [86-106]

M: male; F: female; BMI: body mass index; FEV_1: forced expiratory volume in first second; FVC: forced vital capacity; GOLD: global initiative for chronic obstructive lung disease; 6MWT: 6-minute walk test; LAP: Londrina ADL protocol

Source: Resource data.

Table 2 - Characteristics of the individuals included in the study divided by disease severity, according to the GOLD ABCD classification

	GOLD A (n=13)	***GOLD B (n=18)***	***GOLD C+D (n=14)***
Gender (M/F)	10/3	7/11	5/9
Age (years)	69 ± 6	63 ± 8	63 ± 7
BMI (kg/m^{-2})	28 ± 5	27 ± 6	29 ± 5
GOLD (1/2/3/4)	1/7/5/0	0/11/6/1	0/6/5/3
FEV_1 (%pred)	52 ± 16	55 ± 15	47 ± 14
FEV_1/FVC (%pred)	50 ± 8	49 ± 11	52 ± 10
6MWT (meters)	517 ± 43	468 ± 63	391 ± 103
6MWT (%pred)	96 ± 7	88 ± 12	75 ± 20
LAP (seconds)	330 [276-348]	318 [272-365]	318 [282-386]
LAP (%pred)	95 ± 20	88 ± 23	84 ± 24

M: male; F: female; BMI: body mass index; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; GOLD: global initiative for chronic obstructive lung disease; 6MWT: 6-minute walk test; LAP: Londrina ADL protocol

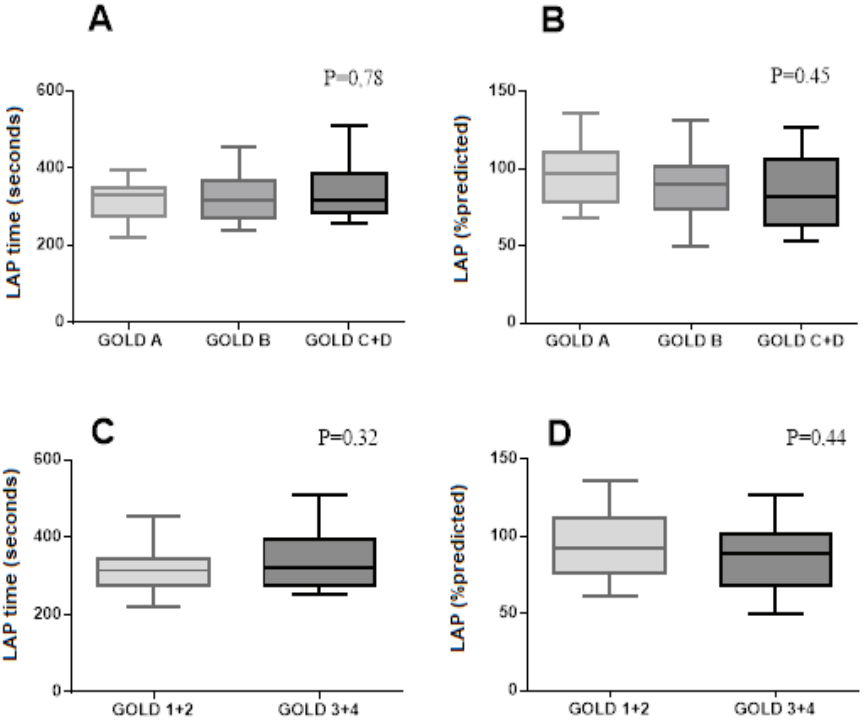
Source: Resource data.

The LAP overall execution time was 321 [275-354] sec and

96 [86-106] %predicted. When grouped, the LAP execution time did not show any difference between the GOLD-A, B and C+ D groups (330 [276-348]sec, 318 [272-365]sec, and 318 [282-386]sec respectively, *P*=0.78).

The protocol performance was also analyzed among the individuals according to the limitation through FEV_1 (GOLD 1, 2, 3 and 4), and it was necessary to allocate them in two groups (GOLD 1+2 and GOLD 3 +4), also without significant difference (*P*= 0.32). The charts showing the comparisons described above are shown in Figure 2.

Figure 2 - Comparison of the LAP performance according to disease classification



A: Comparison of the LAP time (seconds) between GOLD groups A, B and C+D; **B**: Comparison of the percentage of predicted of the LAP between GOLD A, B and C+D groups; **C:** Comparison of the LAP time (seconds) between the 1+2 and 3+4 GOLD groups; **D:** Comparison of the predicted percentage of the LAP between the GOLD 1+2 groups and 3+4
Source: The authors.

Taking into account both classifications (GOLD ABCD and 1, 2, 3 and 4), no significant difference was found with LAP in %predicted (*P*=0.45 and 0.44, respectively). Furthermore, there was no association between performance on the LAP and classification by the GOLD ABCD (P=0.24 and VCramer=0.27).

When analyzing the physiological changes in relation to the protocol, when comparing the variables evaluated before and immediately after the LAP, only the sensation of dyspnea evaluated by the Borg scale presented a statistically significant increase (*P*=0.0006), as shown in Table 3.

Table 3 - Comparison of the physiological responsibilities of individuals before and after the Protocol

	GOLD A	***GOLD B***	***GOLD C+D***	***P value***
Δ HR (bpm)	10 [2.5-13]	8 [2.5-12]	15 ± 13	0.08
Δ SBP (mmhg)	0 [0-20]	10 [0-20]	10 [7.5-8.5]	0.68
Δ SBP (mmhg)	0 [0-5]	0 [0-1.2]	5.7 ± 8.5	0.29
ΔSpO_2 (%)	-1 [-6 – 0]	-2.8 ± 4.3	-5 [-7 – -2.5]	0.08
Δ Borg Dyspnea (points)	**0 [0-0.7]***	1 [0.37-3]	**2.5 [2-3.2]**	**0.0006**
Δ Borg Fatigue UL (points)	0 [0-1.5]	0 [0-1.1]	0.5 [0-3]	0.51
Δ Borg Fatigue LL (points)	0 [0-1]	0 [0-0.8]	0 [0-2.5]	0.73

Δ: difference between post and pre-test (final-initial); HR: heart rate; bpm: beats per minute; SBP: systolic blood pressure; mmHg: millimeters of mercury; DBP: diastolic blood pressure; SpO_2: peripheral oxygen saturation; UL: upper limbs; LL: lower limbs. *: statistically significant difference with *P*=0.0003
Source: Resource data.

According to the results of this study, there was no association between the LAP protocol and the disease severity. It is suggested that other factors (external or internal) may interfere more significantly in this protocol, pointing to the need for further studies. A similar result was found in a study by Moreira *et al.*[10] who did not find any association among the

ADLs assessed by the *London Chest Activity of Daily Living* (LCADL) scale and with both disease severity classifications. The authors justify this result with the original development of LCADL that did not find an association between the scale and FEV_1. They also discussed that the global CAT questionnaire for quality of life could be considered more comprehensive and not specific for the AVD domain.

Souza et al.[14], who assessed daily life activities objectively using the *Glittre-ADL* test , also did not find any significant difference in the protocol when compared among the groups (GOLD 1, 2 and 3). They point out that ventilation is the main limitation for patients with COPD and should be assessed by gas analysis. In the present study, there was a statistically significant difference between the GOLD A and GOLD C+D groups in dyspnea evaluated by the Borg scale, which was already expected, since one of the main complaints of individuals with COPD is dyspnea in the performance of daily activities, changing even the lifestyle of these individuals[15].

As limitations of the study, one can mention the representativeness of the sample, since the patients presented preserved exercise capacity (close to 80% of the predicted, on average). Additionally, there were few patients with mild and very severe disease (GOLD I and IV) in the sample, in addition to few individuals who have exacerbated or been hospitalized, and the union of the GOLD C and D groups was necessary. Therefore, future studies that include less and more severe patients would add new information to the present study.

As clinical implications of the study, the importance of the patient's severity stratification and overall evaluation of several factors can be brought into practice, in order to recognize early which points affect overall performance in their daily activities.

4 Conclusion

The performance in ADLs of COPD patients evaluated by a recently validated protocol, LAP, did not differ among the different levels of the GOLD ABCD. The present result suggests that other factors, in addition to dyspnea and history of exacerbations and/or hospitalizations, interfere with the performance in the LAP.

Acknowledgements

To the LFIP researchers for contributing to my learning, helping me from the beginning in the work elaboration and for excelling for the quality.

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