

Limitation of Activities of Daily Living and Quality of Life Based on COPD Combined Classification

Marina S Barusso PT, Júlia Gianjoppe-Santos PT MSc, Renata P Basso-Vanelli PT PhD, Eloisa MG Regueiro PT PhD, Jéssica C Panin, and Valéria A Pires Di Lorenzo PT PhD

BACKGROUND: The Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2011 update recommends that the management and treatment of COPD be made to combine the impact of disease and future risk of exacerbation. These patients have worsening quality of life and limitation of activities of daily living (ADLs), which can be manifested as a decrease in S_{pO_2} and progressive dyspnea. The aim of this study was to determine whether the COPD combined classification proposed by GOLD 2011 is able to differentiate patients with ADL limitation, such as oxygen desaturation or dyspnea, and impaired quality of life. **METHODS:** This was an observational, cross-sectional study. Forty-four subjects were categorized in 4 GOLD groups (A–D). The mean age was 69 ± 8.8 y, with FEV_1 of 1.33 ± 0.53 L ($49 \pm 15.7\%$ of predicted). The Modified Medical Research Council dyspnea and London Chest Activity of Daily Living (LCADL) scales and the St George Respiratory Questionnaire (SGRQ) were applied. The 6-min walk test and ADL simulation in an appropriate laboratory were also conducted. **RESULTS:** There was no association between the COPD combined evaluation groups and the presence of oxygen desaturation and dyspnea (chi-square test), although a higher prevalence of oxygen desaturation was noticed in group D subjects. With regard to dyspnea, there were subjects with dyspnea in all groups when ADLs were performed. No correlation between dyspnea and oxygen desaturation variation was found. Group B and D subjects showed higher ADL dyspnea (total LCADL scores of 28% and 30%) compared with group A subjects. Group D subjects showed poorer quality of life (total SGRQ score of 49.3%) compared with less symptomatic groups. **CONCLUSIONS:** The COPD combined classification was not efficient in determining oxygen desaturation and dyspnea while subjects were performing ADLs. The subjects in the symptomatic groups with increased risk of exacerbation showed poorer quality of life and higher dyspnea levels. (ClinicalTrials.gov registration NCT01977469) *Key words:* COPD classification; oxygen desaturation; dyspnea; daily living activities; quality of life. [Respir Care 0;0(0):1–•. © 0 Daedalus Enterprises]

Introduction

COPD is a chronic, preventable, and treatable inflammatory disease characterized by progressive and persistent

air-flow obstruction. Its severity is influenced by comorbidities and history of exacerbations. Although diagnosis is based on post-bronchodilator spirometry, the severity classification is based on percent-of-predicted FEV_1 .¹

According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) classification, the degree of air-flow limitation assessed in an isolated way is a poor

Ms Barusso, Ms Gianjoppe-Santos, Dr Basso-Vanelli, Ms Panin, and Dr Di Lorenzo are affiliated with the Laboratory of Spirometry and Respiratory Physiotherapy, Physiotherapy Department, Universidade Federal de São Carlos, São Carlos, São Paulo, Brazil. Dr Regueiro is affiliated with the Centro Universitário UNIFAFIBE, Bebedouro, and the Centro Universitário Claretiano, Batatais, São Paulo, Brazil.

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Correspondence: Valéria A Pires Di Lorenzo PT PhD, Universidade Federal de São Carlos, Rodovia Washington Luís, km 235, Monjolinho, CEP 13565-905, São Carlos, São Paulo, Brazil. E-mail: vallorenzo@ufscar.br.

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predictor of other COPD features.² In the 2011 update, this limitation was recognized, and GOLD recommended that the management and treatment of COPD must match the impact of the disease, which is determined by assessment of symptoms and limitations of activities of daily living (ADLs), and the future risk of exacerbation, which is determined by air-flow limitation and history of exacerbations.³ Thus, subjects were categorized and treated according to 4 groups: A, low risk, few symptoms; B, low risk, many symptoms; C, high risk, few symptoms; and D, high risk, many symptoms.¹

With worsening of the disease, there is a progressive decrease in the ability to perform ADLs,⁴ with a decrease in peripheral S_{pO_2} , progressive dyspnea, and exercise intolerance. Oxygen desaturation may occur in patients with normal S_{pO_2} at rest and in those who are hypoxemic at rest. Oxygen desaturation may occur during activities such as walking, washing, and eating,⁵ thus limiting these activities, and happens simultaneously with the onset of dyspnea.⁶

Dyspnea is one of the most important and debilitating symptoms in subjects with COPD and certainly the trigger point to the vicious cycle of physical inactivity.⁷ Several instruments have been developed for the assessment of dyspnea in ADLs. The Modified Medical Research Council (MMRC) dyspnea scale⁸ and the London Chest Activity of Daily Living (LCADL) scale⁹ assess dyspnea based on patients' perceptions of past events, and the Borg scale assesses dyspnea reported during exercise or ADLs.

Dyspnea is the most frequent complaint while patients are performing ADLs,¹⁰ and it limits exercise performance as well as ability to perform basic ADLs, such as self-care and mobility. These are simple activities, essential to a patient's independence, as they allow patients to carry out activities at home.¹¹

Instrumental ADLs also undergo changes due to breathlessness, as these are more complex activities, such as preparing meals, house maintenance, and all other leisure activities. As a consequence of increased dyspnea, patients adapt themselves by reducing the amount of all ADLs performed, with a consequent reduction in quality of life, which is associated with actual limitations in performing ADLs.¹²

Nevertheless, there is no evidence in the literature confirming that patients belonging to high-risk groups (GOLD C and D) show increased ADL limitation and worse quality of life. In this context, the primary aim of this study was to investigate whether the COPD combined classification proposed by GOLD 2011 was able to discriminate subjects with ADL limitations, such as oxygen desaturation and dyspnea, and impaired quality of life. A secondary aim was to compare the quality of life, dyspnea, and oxygen desaturation during ADLs among groups stratified by GOLD 2011 classification. We hypothesized that there

QUICK LOOK

Current knowledge

COPD is a chronic inflammatory disease characterized by progressive and persistent air-flow obstruction. COPD severity is influenced by the presence of comorbidities and frequency of exacerbations. The severity classification of COPD is based on the percent-of-predicted FEV_1 .

What this paper contributes to our knowledge

A COPD combined classification system was not efficient in determining which subjects suffered oxygen desaturation and dyspnea while performing activities of daily living. The subjects in the symptomatic groups had an increased risk of exacerbation and demonstrated a diminished quality of life and higher dyspnea level.

would be an association among the subject's group classification according to the GOLD COPD combined evaluation and ADL limitations, as well as an association between the subject's GOLD classification and reduced quality of life.

Methods

Study Design and Subjects

This observational, cross-sectional study was conducted in the Laboratory of Spirometry and Respiratory Physiotherapy of the Universidade Federal de São Carlos, in São Paulo, Brazil, from December 2012 to September 2013.

Inclusion criteria were: subjects of both genders with COPD,¹ > 50 y of age, clinically stable, absence of infection, no exacerbation, and no change in medication for at least 2 months before inclusion in the study; dependent or not on home oxygen therapy; and absence of severe heart disease and of any other pathology that did not allow the performance of the proposed tests. Exclusion criteria were: systemic hypertension and uncompleted evaluation proposals. All included subjects signed a consent form approved by the human ethics committee of the university (decision 243/2012). After the assessment, all subjects were referred for pulmonary rehabilitation.

Study Subjects

Subjects were categorized into 4 groups (A–D) according to GOLD 2011 recommendations³ using the MMRC scale, FEV_1 , and history of exacerbations in the previous year before the study. GOLD indicated the need to use

only one scale to assess symptoms, so the MMRC scale was chosen. The standard choice was based on the higher score in FEV₁ and exacerbation history. Exacerbation was defined as any acute event characterized by worsening of respiratory symptoms that exceeded the normal daily variation and that caused the need for changes in medication¹ and/or use of health-care resources.¹³

Procedures

Subjects were assessed by a trained physiotherapist on non-consecutive days with a 48-d interval between assessments. In the first assessment, the subjects' history, anthropometric data, and the MMRC scale¹⁴ were collected. In the second assessment, two 6-min walk tests were performed,¹⁵ and the St George Respiratory Questionnaire (SGRQ)¹⁶ and LCADL scale¹⁷ were applied. In the third assessment, simulation of ADLs set in an appropriate laboratory was performed. All scales and questionnaires were applied by the same examiner in an interview in a quiet environment to minimize possible bias.

MMRC Dyspnea Scale

The MMRC scale consists of 5 items; the patient chooses the one that best represents his or her perception of dyspnea in ADLs. It was validated⁸ for the Brazilian population.¹⁴ The modified scale has the same interpretation, but score ranges from 0 to 4, with higher values indicating greater limitation by dyspnea in ADL performance.

SGRQ

The SGRQ was proposed and validated for patients with chronic respiratory diseases¹⁸ and translated and validated for the Brazilian population.¹⁹ The questionnaire approaches aspects related to 3 areas: symptoms, which relate to discomfort caused by respiratory symptoms; activity, which relates to changes in physical activity; and impact, which assesses the overall impact on ADLs and patient wellness. Each domain has a maximum possible score, with points added for each response and referred to as a percentage of this maximum. Values above 10% reflect a quality of life changed in that domain. In addition to the score of each domain, a total score is obtained, and a higher score is related to poorer quality of life.^{18,19}

LCADL Scale

The LCADL scale was proposed and validated for patients with COPD⁹ and was translated and validated for the Portuguese population.¹⁷ It consists of 4 domains: self-care, domestic, physical, and leisure. The LCADL scale can assess the degree of dyspnea in ADLs because it is

composed of 15 quantitative questions encompassing ADLs such as putting on a shirt, putting on shoes, making the bed, and drying after showering. Subjects indicate a score of 0–5, with the largest value representative of maximum inability to perform ADLs. Together, these scores account for a total of 75 points. A higher total score indicates greater limitation in performing ADLs due to dyspnea.⁹ One can also examine the scale as a percentage of the total score (LCADL%); for this, the percentage score for each area is calculated in relation to the maximum score allowed, that is, if the patient scores zero (cannot perform this activity because I have never needed to or it is irrelevant) for any item, it will be disregarded in the calculation of LCADL%. Thus, a new maximum value is obtained, subtracting 5 points for each item disregarded.

6-min Walk Distance

The 6-min walk test was performed according to the standards of the American Thoracic Society.¹⁵ Two tests were performed with an interval of 30 min. The greatest distance walked was considered for statistical analysis. The percent of predicted, described by Iwama et al,²⁰ was determined after testing.

ADL Assessment

Simulation of ADLs was carried out in an adapted laboratory within the School Health Unit belonging to the university. These included getting out of bed, putting on shoes, making the bed, showering, lifting and lowering containers on a shelf above the shoulder girdle, and raising and lowering pots on a shelf below the pelvic girdle (Fig. 1). The activities were carried out in the aforementioned order, as a circuit, with no breaks between activities, and the subjects were instructed to perform the activities as they do at home, with free time to their execution. The runtime was recorded to compare the total time to complete the circuit.

S_{pO₂} (model 2500, Nonin, Plymouth, Minnesota) and dyspnea (Borg category ratio 10) were monitored during rest and immediately after the execution of each of the ADLs. Breathing frequency and blood pressure were measured at rest and at the end of the ADL circuit, and heart rate was monitored during the execution of all ADLs.

Statistical Analysis

The statistical program SPSS 17.0.0 (SPSS, Chicago, Illinois) was used for statistical analysis. The Shapiro-Wilk test was used to assess the normality of the data. The variables that had a normal distribution were described as



Fig. 1. Subject with COPD performing activities of daily living. A: Getting out of bed and putting on shoes. B: Making the bed. C: Taking a shower. D: Raising and lowering containers on a shelf above the scapular girdle. E: Raising and lowering items on a shelf below the pelvic girdle.

mean \pm SD, whereas the variables without normal distribution were described as median (interquartile range). Analysis of variance with the Tukey post hoc test and its non-parametric equivalent, the Kruskal-Wallis test with the Mann-Whitney post hoc test with Bonferroni correction, were used to compare variables between the 4 GOLD groups.

To verify the degree of association between oxygen desaturation and dyspnea while performing ADLs in GOLD groups A–D, cutoff points were determined for these variables for further analysis and application of the chi-square test. For dyspnea, a 1-point increase on the Borg scale was considered as indicative of the presence of dyspnea in ADL performance according to Ries.²¹ Oxygen desaturation was taken as values below 88%, according to Andrianopoulos et al,²² and 4% decrease in S_{pO_2} , according to Dal Corso et al.²³

Furthermore, changes in S_{pO_2} and dyspnea before and after the end of each ADL were determined. The correlation between these variables was determined using the Spearman correlation coefficient, as these variables had abnormal distributions, and was subsequently plotted in a scatter plot.

A significance level of $P \leq .05$ was adopted. To detect the power of the test, G*Power 3.1.3 (Universität Düsseldorf, Düsseldorf, Germany) was used. We used LCADL%, total SGRQ score, and S_{pO_2} ADLs to determine a power of $> 95\%$ for these variables. For dyspnea in ADL performance, we determined a power of $< 80\%$.

Results

Of 50 subjects who fulfilled the inclusion criteria, 6 were excluded, so 44 subjects completed all assessments (Fig. 2). The subjects' mean age was 69 ± 8.8 y, with a mean FEV_1/FVC of 0.51 ± 0.12 and a mean FEV_1 of 1.3 ± 0.51 L ($49 \pm 15.7\%$ of predicted). Of the 44 subjects who completed the study, 26 (59%) had exacerbations during the year preceding the study.

Clinical Characteristics of Subjects Grouped According to COPD Combined Evaluation

Table 1 shows the demographic and clinical characteristics of subjects classified by GOLD 2011. There was no statistical difference in age, presence of comorbidities, smoking history, or body mass index between groups.

In addition, Table 1 shows that subjects in groups C and D had statistically lower FEV_1 and shorter 6-min walk distances. As expected, the MMRC scores were statistically higher in subjects in groups B and D. Subjects in groups B–D were found to have higher BODE indexes compared with subjects in group A.

There was no statistical difference between groups with regard to use of home oxygen therapy. Subjects in group D had a higher number of exacerbations compared with subjects in groups A and B.

ADL Limitations and COPD Combined Assessment

There was no significant difference between groups when measuring the runtime of ADLs. We verified that there was no significant difference between groups with regard to the presence of oxygen desaturation during ADLs performed on the circuit (Table 2) and no association between the risk groups and the presence of oxygen desaturation (Table 3). Although all subjects had an S_{pO_2} of $> 90\%$ at rest, there were subjects in all 4 groups who had a decrease in S_{pO_2} of $> 4\%$ or an S_{pO_2} of $< 88\%$. As expected, the largest percentage of low S_{pO_2} was found in group D, with 53% of subjects showing an S_{pO_2} of $< 88\%$ in ADLs, such as showering and lowering pots below the pelvic girdle. On the other hand, $\sim 41\%$ of subjects in this group demonstrated a decrease in S_{pO_2} of $\geq 4\%$ during showering.

There were no significant associations or differences in dyspnea in the 4 groups (see Table 2); however, in all groups, there were subjects who experienced dyspnea while performing ADLs (see Table 3), with this being more evident in subjects in group D. Furthermore, there was no correlation between the change in dyspnea and S_{pO_2} during the performance of ADLs, as shown in Figure 3.

On the LCADL scale (see Table 2), group D subjects presented higher values than group A subjects in the self-

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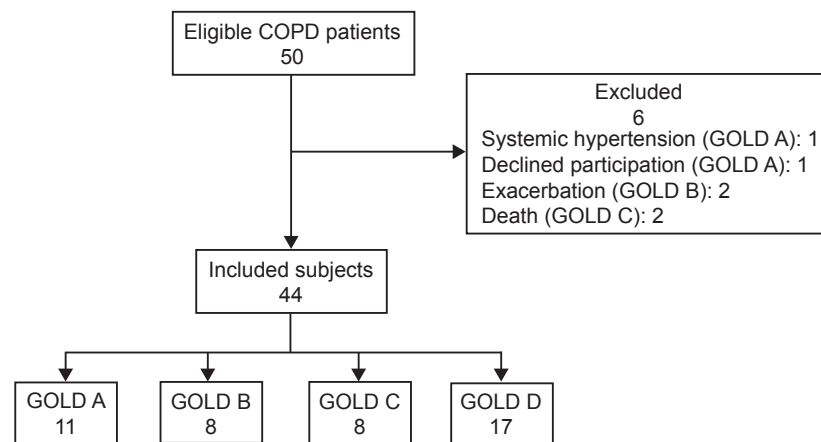


Fig. 2. Flow chart of inclusion and exclusion of subjects in the study and the COPD combined classification with association between symptoms, spirometric classification, and future risk of exacerbation. Global Initiative for Chronic Obstructive Lung Disease (GOLD) A = low risk, fewer symptoms; GOLD 1 or 2; ≤ 1 exacerbation/y; Modified Medical Research Council (MMRC) 0–1. GOLD B = low risk, more symptoms; GOLD 1 or 2; ≤ 1 exacerbation/y; MMRC ≥ 2 . GOLD C = high risk, fewer symptoms; GOLD 3 or 4; ≥ 2 exacerbations/y; MMRC 0–1. GOLD D = high risk, more symptoms; GOLD 3 or 4; ≥ 2 exacerbations/y; MMRC ≥ 2 .

Table 1. Anthropometric and Clinical Data of the Sample, Classification of Dyspnea, and 6MWD

	GOLD Group				P
	A (n = 11)	B (n = 8)	C (n = 8)	D (n = 17)	
Males, n	11	7	6	13	
Age (mean \pm SD), y	66 \pm 10.5	72.2 \pm 10.1	67 \pm 4.6	71.5 \pm 8.3	.34
Smoking history (mean \pm SD), pack-years	101 \pm 70	60.6 \pm 24.9	58.9 \pm 42.7	60.7 \pm 42.8	.15
Charlson comorbidity index, median (interquartile range)	1 (1–2)	1 (1–2.5)	1 (2.2–4.7)	1 (1–1)	.46
S _{pO₂} at rest (mean \pm SD), %	93 \pm 2	93 \pm 2	93 \pm 2	93 \pm 2	.83
BMI (mean \pm SD), kg/m ²	25.7 \pm 4.5	24.3 \pm 4.5	24.7 \pm 5.4	23.0 \pm 4.6	.53
FEV ₁ (mean \pm SD), L	1.72 \pm 0.2	1.8 \pm 0.3	1.0 \pm 0.3‡§	0.9 \pm 0.4‡§	< .001*
FEV ₁ (mean \pm SD), % predicted	62 \pm 9.2	62.9 \pm 10.1	40.6 \pm 6‡§	39.5 \pm 14.2‡§	< .001*
MMRC, median (interquartile range)	1 (1–1)	2 (2–2.75)‡	1 (0–1)§	2 (2–3.5)‡	< .001†
6MWD (mean \pm SD), m	487 \pm 50.7	371.6 \pm 140.1‡	354.7 \pm 53.8‡	352.7 \pm 84.2‡	.001*
6MWD (mean \pm SD), % predicted	86.8 \pm 8.1	67.1 \pm 24.4‡	65 \pm 8.8‡	65.5 \pm 14.8‡	.003*
BODE index, median (interquartile range)	0.5 (0–1)	3 (1.2–3)‡	3 (2.2–4.7)‡	5 (2–3)‡§	< .001†
BODE quartile, median (interquartile range)	1 (1–1)	2 (1–3)	2 (1.2–1)‡	3 (2–3)‡	< .001†
Exacerbation history, n (%)	4 (36)	2 (25)	5 (62.5)	15 (88.2)‡§	.002†
Oxygen use, n (%)	0	1 (12.5)	1 (12.5)	2 (11.8)	
Drugs, n (%)					
Bronchodilator	5 (45.5)	1 (12.5)	0	3 (17.6)	
Bronchodilator + inhaled corticosteroids	6 (54.5)	7 (87.5)	8 (100)	13 (76.5)	
Systemic corticosteroids	0	0	0	1 (5.9)	

* $P \leq .05$ (one-way analysis of variance with Tukey post hoc)

† $P \leq .05$ (Kruskal-Wallis test with Mann-Whitney post hoc and Bonferroni correction)

‡ Significant differences between groups A vs B, C, and D

§ Significant differences between groups B vs C and D

|| Significant differences between groups C vs D

GOLD = Global Initiative for Chronic Obstructive Lung Disease

BMI = body mass index

MMRC = Modified Medical Research Council

6MWD = 6-min walk distance

care domain. In the domestic domain, group C subjects had statistically lower values than group A subjects, and in the leisure domain, group D subjects had notably higher

values compared with group C subjects. Finally, subjects in groups B and D had statistically higher overall percentage scores compared with subjects in group A.

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Table 2. Comparison Between Groups With Regard to Quality of Life, Dyspnea in Daily Living, and Change in Oxygen Saturation and Dyspnea in the ADL Simulation

	GOLD Group				P
	A (n = 11)	B (n = 8)	C (n = 8)	D (n = 17)	
SGRQ, %					
Symptoms	29.6 ± 12	28.2 ± 22.7	26.6 ± 17	47.7 ± 21.1	.02*
Activities	37 ± 16.1	59.8 ± 12.8‡	36.9 ± 22.5	69.9 ± 12.3	< .001*
Impact	18.3 ± 14.1	33.2 ± 10.6	20.2 ± 19.1	38 ± 15.5	.005*
Total	25.8 ± 12.4	41.8 ± 9.4	26.9 ± 18	49.3 ± 12.5	< .001*
LCADL scale					
Self-care	4 (4–5)	5 (5–5)	5 (4.2–6.7)	6 (4.5–8)‡	.02†
Domestic	5 (4–6)	3 (0–4.7)	2 (0–2.7)‡	5 (0–8.5)	.05†
Physical	3 (3–4)	4 (4–5)	3 (2–5)	4 (3–5.5)	.051
Leisure	3 (3–4)	4 (3–4)	3 (3–3)§	4 (2–5)	.005†
Total	16 (14–18)	15 (14–18.2)	13 (9.7–17)	20 (13–22)	.02
Total %	23 (21–25)	28 (25–31)‡	24 (21–30)	30 (26–42)‡	.004†
ADL simulation					
Total time, min	13.6 ± 1.8	15.2 ± 4.5	13.2 ± 2.2	14.9 ± 2.3	.32
ΔS _{pO₂}					
Making the bed	−1 (−3 to 0)	−1 (−2.7 to −1)	−0.5 (−2–0)	−3 (−4.5 to 0)	.70
Showering	−1 (−2 to 0)	−1.5 (−2.7 to −1)	−2.5 (−4.5 to 1.2)	−3 (−5 to −1.5)	.61
Lifting containers above the scapular girdle	−1 (−3 to 0)	−2 (−5 to 0.2)	−1.5 (−13 to −0.2)	−3 (−4 to −0.5)	.37
Lowering pots below the pelvic girdle	0 (−1 to 1)	−1 (−4 to 0)	−0.5 (−13 to 0)	−1 (−6.5 to 0)	.56
ΔDyspnea					
Making the bed	0 (0–1)	0.5 (0–1)	0 (0–0.5)	0.5 (0–1.5)	.48
Showering	0.5 (−0.5–1)	1 (1–2)	1 (0.25–1.75)	1 (0–2.5)	.06
Lifting containers above the scapular girdle	0.5 (0–2)	1 (0–2.75)	1 (0.25–1.75)	1 (0.25–2.75)	.49
Lowering pots below the pelvic girdle	1 (−0.5–1.5)	1 (0–3.75)	1 (0.25–1)	1 (0–2.75)	.07

Values are expressed as mean ± SD or median (interquartile range).

* $P \leq .05$ (one-way analysis of variance with Tukey post hoc)

† $P \leq .05$ (Kruskal-Wallis test with Mann-Whitney post hoc and Bonferroni correction)

‡ Significant differences between groups A vs B, C, and D

§ Significant differences between groups B vs C and D

|| Significant differences between groups C vs D

ADL = activity of daily living

GOLD = Global Initiative for Chronic Obstructive Lung Disease

SGRQ = St George Respiratory Questionnaire

LCADL = London Chest Activity of Daily Living

Δ = value in activities – basal value.

Quality of Life and COPD Combined Assessment

The quality of life assessment comparison between groups (see Table 2) performed using the SGRQ revealed a significant difference in the activity domain among the groups except between groups A and C. As for the symptom domain, group D had higher values compared with group C.

When comparing the impact domain and the total score, group D subjects had statistically higher scores than group A and C subjects. In relation to the total score, the average score in less symptomatic groups (A and C) was 2 times lower than that in the more symptomatic groups (B and D).

Discussion

We showed that there was no association between groups when using the COPD combined assessment regarding the presence of oxygen desaturation and dyspnea in the execution of ADLs. However, we found that, in all groups proposed by GOLD 2011, there were subjects who demonstrated oxygen desaturation during ADLs, with the greatest percentage in group D. The main unsupported activities included flexion of the trunk and lifting of arms. All groups had subjects who reported dyspnea during ADL simulation. Group D subjects had greater ADL dyspnea as assessed by the LCADL scale. Compared with less symptomatic subjects, group D subjects had a poorer quality of life as assessed by the SGRQ.

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Table 3. Number of Subjects With a Decrease in S_{pO_2} of $\geq 4\%$, S_{pO_2} of $< 88\%$, and Difference From Rest to Exercise of ≥ 1 Point on the Borg Dyspnea Scale in ADL Simulation

	GOLD Group				<i>P</i> *
	A (<i>n</i> = 11)	B (<i>n</i> = 8)	C (<i>n</i> = 8)	D (<i>n</i> = 17)	
$\Delta S_{pO_2} \geq 4\%$, <i>n</i> (%)					
Making the bed	1 (9.1)	1 (12.5)	2 (25)	8 (47.1)	.11
Showering	1 (9.1)	2 (25)	2 (25)	7 (41.2)	.32
Lifting containers above the scapular girdle	2 (18.2)	3 (37.5)	4 (50)	8 (47.1)	.41
Lowering pots below the pelvic girdle	1 (9.1)	3 (37.5)	4 (50)	5 (29.4)	.26
$S_{pO_2} < 88\%$, <i>n</i> (%)					
Making the bed	1 (9.1)	1 (12.5)	1 (12.5)	5 (29.4)	.49
Showering	2 (18.2)	3 (37.5)	4 (50)	9 (52.9)	.30
Lifting containers above the scapular girdle	1 (9.1)	3 (37.5)	3 (37.5)	7 (41.2)	.32
Lowering pots below the pelvic girdle	1 (9.1)	1 (12.5)	3 (37.5)	6 (53.3)	.29
Δ Dyspnea > 1 point on the BORG scale, <i>n</i> (%)					
Making the bed	3 (27.3)	4 (50)	1 (12.5)	8 (47.1)	.28
Showering	4 (36.4)	4 (50)	6 (75)	9 (52.9)	.43
Lifting containers above the scapular girdle	5 (45.5)	5 (62.5)	6 (75)	11 (64.7)	.60
Lowering pots below the pelvic girdle	6 (54.5)	5 (62.5)	6 (75)	10 (58.8)	.83

* Chi-square test

ADL = activity of daily living

GOLD = Global Initiative for Chronic Obstructive Lung Disease

In addition, we also noticed that subjects with COPD developed a transient decrease in S_{pO_2} and dyspnea during ADLs, especially while performing activities such as walking, showering, and eating.²⁴ A decrease in S_{pO_2} and dyspnea could also accelerate the progress of the disease. Therefore, despite the fact that there are aspects yet to be confirmed, we suggest that there could be a relationship between the GOLD groups and oxygen desaturation and dyspnea.

Nevertheless, the largest percentage of subjects demonstrating oxygen desaturation belonged to group D. In this case, however, the desaturation, which was characterized by ΔS_{pO_2} of $> 4\%$, occurred mainly during activities such as making the bed (47.1%) and lifting containers above the girdle (47.1%). This was also true regarding the presence of an S_{pO_2} of $< 88\%$. In the other groups, there were also subjects who demonstrated oxygen desaturation, which makes it possible to infer that subjects with COPD can experience ADL limitation regardless of the risk group in which they are classified. In other words, it is necessary to be aware of this limitation in spite of the classification made by the COPD combined assessment. Although the COPD combined assessment was created in an attempt to minimize problems in a simplified classification of these patients, it may not have been the best option to identify patients presenting with oxygen desaturation because the factors involved in this mechanism are not encompassed in the assessment.

A recent study²² demonstrated that non-hypoxic subjects, who have an FEV_1 of $< 45\%$ of predicted, generally

have an S_{pO_2} of $\leq 88\%$ during walking activities, confirming the findings of our study showing that the highest prevalence of subjects with an S_{pO_2} of $< 88\%$ were in groups C and D, who also had an FEV_1 of $< 50\%$ of predicted. Oxygen desaturation was present in these subjects due to an imbalance between oxygen supply and demand during the exercise, what could be attributed to respiratory, hemodynamic, and peripheral muscle disorders or a combination of these.²⁵

It is important to note that the selected activities for ADL simulation included a great range of upper limb motions with different degrees of chest muscle involvement to assess not only one isolated ADL but most of the subjects' home activities. Considering this, free time to run the ADLs was determined in the assessments to simulate exactly how the subject would do it at home, and this was similar between groups, with means of 13 min for group A, 15 min for groups B and D, and 13 min for group C, with no statistically significant difference.

Elevating pots with different weights is a very dynamic activity, involving broad movements, especially the shoulders, besides maintenance of the upper limbs without support. This type of activity leads to increased minute ventilation by 60–70% of maximum voluntary ventilation, with a consequent drop in metabolic and ventilatory reserves associated with a decrease in S_{pO_2} and subsequent hypoxemia,²⁶ which could explain the findings of this study. In contrast, when considering activities involving trunk flexion, such as making the bed and putting on shoes,

LIMITATION OF ACTIVITIES OF DAILY LIVING AND COPD

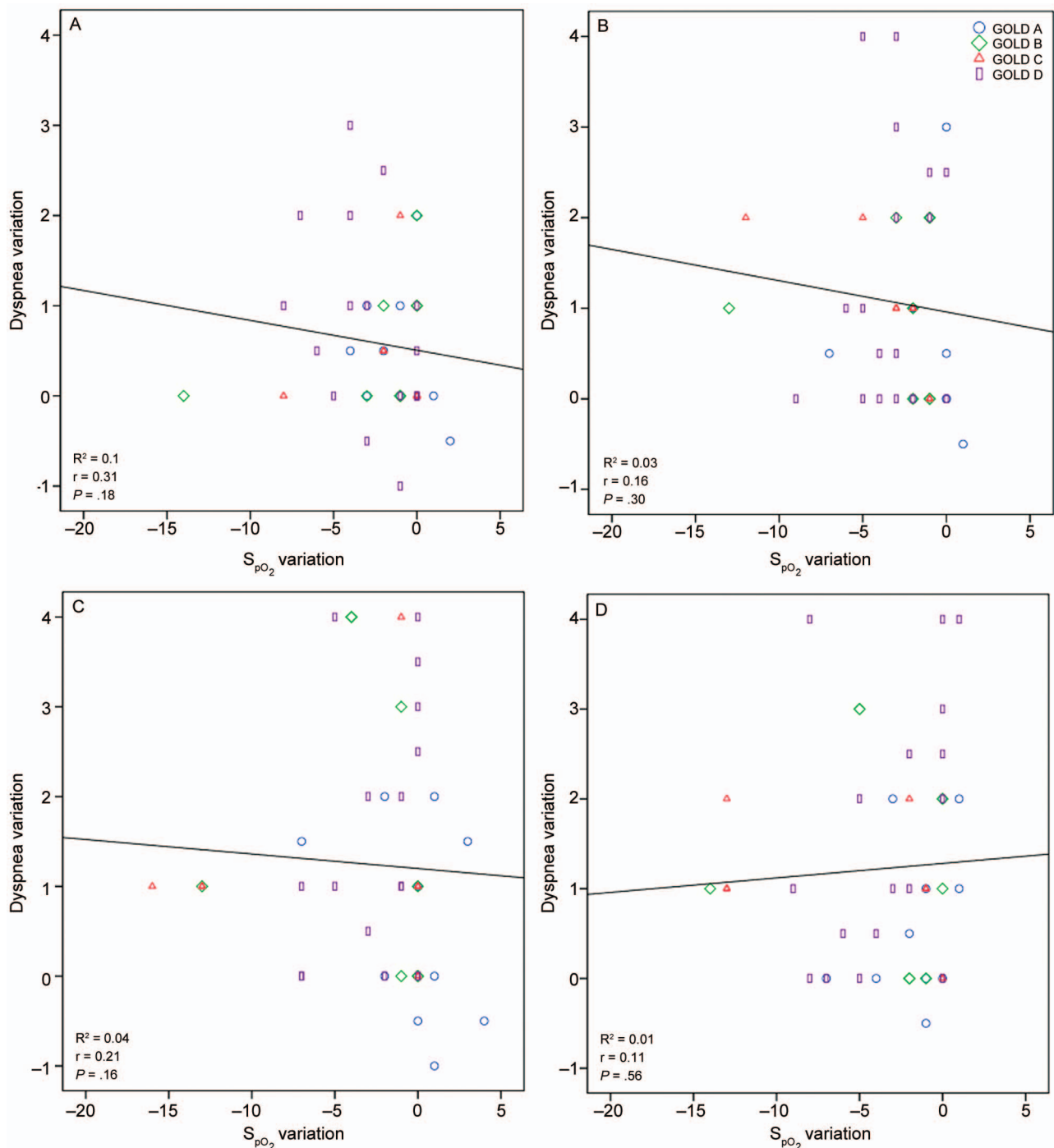


Fig. 3. Scatter plots of the variation of dyspnea and peripheral S_{pO_2} in activities of daily living according to Global Initiative for Chronic Obstructive Lung Disease (GOLD) group. A: Getting up, putting on shoes, and making the bed. B: Taking a shower. C: Raising and lowering items below the pelvic girdle; D: Raising and lowering items above the scapular girdle.

subjects had a rapid, shallow, and irregular breathing pattern,²⁷ which can explain the presence of oxygen desaturation while performing the activities.

In this study, we found that in all 4 GOLD groups, there were subjects who reported dyspnea in ADL performance,

which was assessed by the Borg scale. Impairment of rib cage mechanics and gas exchange inefficiency were prominent in subjects with COPD and contributed to an increase in respiratory effort, which occurred with the onset of dyspnea.²⁸

When assessed by the Borg scale, dyspnea not only involves the perception of breathlessness but also welfare, discomfort, and difficulty in ADL performance,²⁶ this being one of the most important factors in limiting ADL execution in patients with COPD.²⁹⁻³¹ Thus, it becomes important to focus on subjects with fewer symptoms because despite not reporting dyspnea when the ADL rating scales are applied, they do report dyspnea when simulating ADLs, with limitation in performing ordinary activities.

Reported dyspnea assessed by the MMRC scale is widely used to measure breathlessness in patients, as it is an easy, quick, and simple tool.⁸ In the 2011 update, GOLD proposed that this tool should be used to provide a complete evaluation of patients as long as it considers not only the air-flow limitation but also the symptoms and future risk of exacerbations.³

As a consequence, when assessed by the MMRC scale, subjects who presented with fewer symptoms (groups A and C) showed representative values of dyspnea while performing ADLs, and in these groups, the median for the MMRC scale was 1, which indicated the presence of dyspnea when the subject walked fast or climbed up a slope. While lifting containers above the shoulder girdle, 45% of group A subjects and 75% of group C subjects had a variation of > 1 point on the Borg scale. Considering this, it was possible to conclude that dyspnea reported by the MMRC scale does not exactly reflect the dyspnea reported while performing ADLs. This can be explained by the fact that the small number of ADLs that compose this scale³² do not reflect all ADLs performed on the circuit proposed by this study, and probably not the ones performed in a subject's home.

In the study by Vaes et al,³² oxygen consumption and dyspnea were evaluated while subjects performed ADLs. The subjects were stratified by sex, GOLD stage, MMRC score, and BODE index. The authors concluded that subjects classified as GOLD stage IV with an MMRC score of 5 and a score ≥ 6 in the BODE index have higher oxygen consumption and a greater perception of dyspnea while performing ADLs. They also found that subjects classified as GOLD stage II have a greater perception of dyspnea compared with healthy subjects. In that case, the subjects used a higher proportion of their peak aerobic and ventilatory capacity in contrast to the findings of our study, in which we found no association between subject stratification by the COPD combined classification and the presence of dyspnea during ADL performance. Nevertheless, it was verified that subjects belonging to the less symptomatic group also reported dyspnea while performing some ADLs. Because dyspnea is the trigger point for the beginning of the sedentary-dyspnea cycle,⁷ evaluation of this symptom in limiting ADLs is important, and as is inclusion of subjects in pulmonary rehabilitation programs to delay progression of this cycle. Oxygen desaturation not

linearly attached to dyspnea is important to consider and emphasizes the need to assess dyspnea even in patients without oxygen desaturation.

Another important finding was the lack of correlation between dyspnea and oxygen desaturation during ADL performance, which could be a consequence of independent and unrelated behaviors. For instance, desaturation could occur because of an imbalance between the oxygen available and the amount demanded while exercising. This could be attributed not only to respiratory disorders, but also to hemodynamic and peripheral muscle disorders or a combination of all.²⁴

The magnitude of dyspnea could depend on a diverse range of mechanisms, such as an increase in ventilatory needs due to physiological alterations of dead space, pulmonary overinflation, hypoxemia, hypercapnia, early lactic acidosis or peripheral and respiratory muscle weakness. It could also be associated with physical deconditioning or systemic and airway inflammation.^{33,34}

Coupled with the Borg and MMRC scales, the LCADL scale is widely used for a more specific evaluation of ADL dyspnea sensation. In this study, we found that subjects in groups B and D had higher percentages for the total LCADL score, averaging 28% and 30%, respectively, compared with group A (23%). Confirming the findings of this study, the EDIP-EPOC I and II studies³⁵ showed that subjects with severe or very severe COPD had higher scores for each of the 15 ADLs described for LCADL scale compared with those with moderate COPD, thus showing that the severity of the disease has a major impact on all functional aspects of a patient's life.¹¹

Studies show that patients with an FEV₁ of $< 50\%$ of predicted have a decreased quality of life; this value is a critical factor for quality of life and an indicator of general health.^{11,36,37} In addition, Hsu et al³⁸ demonstrated that the MMRC scale is able to detect early deterioration in quality of life, which could explain our study results showing that group B and D subjects had higher scores on the MMRC scale but a poorer quality of life, with means of 41.8% and 49.3%, respectively, in the SGRQ. This also shows a possible relationship between the score on the MMRC scale and quality of life.

The results of this study may have been limited by the small number of subjects, particularly in groups B and C, which may have contributed to the lack of association between the groups proposed by the COPD combined assessment and oxygen desaturation and dyspnea while performing ADLs.

Conclusions

The assessment of ADL limitations was based not only on the combined evaluation of COPD but also on the simulation of ADLs. This is because those subjects clas-

sified as mildly symptomatic may have had dyspnea and oxygen desaturation while performing ADLs. When it is not possible to simulate ADLs, it is necessary to apply more specific scales (such as LCADL) for evaluation of dyspnea in ADL performance. These additions would allow profiles to be made of those patients who have greater ADL limitations.

Based on the results of this study, in which we used the COPD combined assessment to support our findings, it was not possible to determine those subjects who had oxygen desaturation and dyspnea while performing ADLs. Therefore, further studies are needed to strengthen our findings. In contrast, the subjects in the more symptomatic group, who had the highest risk of exacerbation, presented the poorest quality of life and the highest intensity of dyspnea during ADL performance as assessed by the LCADL scale.

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