Effects of high intensity physical training in patients with Chronic Obstructive Pulmonary disease in a Pulmonary Rehabilitation Program
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Efeitos do treino físico de alta intensidade em doentes com doença pulmonar obstrutiva crónica num Programa de Reabilitação Pulmonar

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ABSTRACT
Objective: To evaluate the effect of high intensity physical training on a supervised Pulmonary Rehabilitation Program (PRP) in patients with Chronic Obstructive Pulmonary Disease (COPD). Methods: Interventional study with 30 patients with COPD, randomly divided into 2 groups: Control Group (CG) submitted to physical training of a traditional PRP and Experimental Group (EG) with bodybuilders with duration of 30 sessions in days alternates. All submitted to pre and post-intervention evaluation with the following variables: (I) pulse oximetry (SpO2); (II) 6 'walk test (6MWT); (III) Saint George's Quality of Life Questionnaire (SGRQ); (IV) DPOC assessment test (CAT); (V) cardiopulmonary exercise test; and (VI) 1 maximal repetition test (MRI). Results: Pre and post-intervention values were compared and the GE group presented a significant difference in the following parameters: increase 30.53 meters in the distance covered (p 0.021) improvement in all scores: CAT score for 12 points (p < 0.001), Score Saint George from 27 to 19 points (p 0.005), and in the improvement of the maximum physical capacity with increase 14 to 18 of (VO2 (%) (p 0.007) and 0,87 to 1,12 VO2 (L/min) (p 0.01) Conclusions: There was a significant improvement in exercise capacity and quality of life of the GE group, suggesting that high intensity physical training is the most efficient alternative in the treatment of patients with moderate COPD will be severe.

keywords: pulmonary rehabilitation program (prp), chronic obstructive pulmonary disease (copd), physical training, cardiopulmonary exercise test quality of life.

RESUMO
Objectivo: Avaliar o efeito do treino físico de alta intensidade num Programa de Reabilitação Pulmonar (PRP) supervisionado em doentes com Doença Pulmonar Obstrutiva Crónica (DPOC). Métodos: Estudo de intervenção com 30 pacientes com DPOC, divididos aleatoriamente em 2 grupos: Grupo de Controlo (GC) submetido ao treino físico de um PRP tradicional e Grupo Experimental (GE) com fisiculturistas com duração de 30 sessões em dias alternados. Todos submetidos a avaliação pré e pós-intervenção com as seguintes variáveis: (I) oximetria de pulso (SpO2); (II) 6 'teste de caminhada (6MWT); (III) Questionário de Qualidade de Vida de São Jorge (SGRQ); (IV) teste de avaliação DPOC (CAT); (V) teste de exercício cardiopulmonar; e (VI) 1 teste de repetição máxima (MRI). Resultados: Os valores pré e pós-intervenção foram comparados e o grupo GE apresentou uma diferença significativa nos seguintes parâmetros: aumento de 30,53 metros na distância percorrida (p 0,021) melhoria em todas as pontuações: pontuação CAT para 12 pontos (p < 0,001), pontuação Saint George de 27 para 19 pontos (p 0,005), e na melhoria da capacidade física máxima com aumento de 14 para 18 de (VO2 (%) (p 0,007) e 0,87 para 1,12 VO2 (L/min) (p 0,01) Conclusões: Houve uma melhoria significativa na capacidade de exercício e na qualidade de vida do grupo GE,

sugerindo que o treino físico de alta intensidade é a alternativa mais eficiente no tratamento de pacientes com DPOC moderada será grave.

Palavras-chave: programa de reabilitação pulmonar (prp), doença pulmonar obstrutiva crónica (copd), treino físico, teste de exercício cardiopulmonar de qualidade de vida.

1 INTRODUCTION

Patients with Chronic Obstructive Pulmonary Disease (COPD) have a progressive obstruction that is associated with an abnormal inflammatory response of the lungs through inhalation of noxious particles or gases, mainly caused by smoking. This respiratory disease is characterized by airflow obstruction, which is not totally reversible[1]. Indeed, it is still one of the main causes of morbidity and mortality wordwide[2].

This disease is also related with the decrease in the capacity to practice exercises, fatigue complaint and dyspnea, limiting factors in the performance [3], which can evolve into a scenario of weakness and immobility. Many patients with COPD have muscle weakness that usually affects the lower members, since most daily life activities (ADLs) require the use of the upper limbs. Exercise intolerance is a common reaction in patients with COPD, which contributes to a difficulty in ADLs and, consequently, to a reduction in quality of life[1]. Although ventilatory limitation contributes to this condition, such intolerance can also be attributed to skeletal muscle dysfunction[3], which may also be associated with a decrease in strength, fatigue, dyspnea and sedentary lifestyle[4].

As indicators of the functional capacity of patients with COPD, daily quality of life questionnaires and 6´ walk tests are used to evaluate exercise limitation mechanisms. However, cardiopulmonary exercise testing (CPET) is the procedure that can provide the most useful information regarding the multiple limiting factors[3]. Traditionally, the most valued variable has been the maximal oxygen consumption (VO_2 max) obtained at the peak of a TECP [5] [6] [7].

One of the treatments for patients suffering from this disease is the Pulmonary Rehabilitation Program (PRP), which is a treatment that aims to benefit the patient with COPD in several aspects, such as: (I) improving the symptoms of the disease; (II) improving quality of life; and (III) promoting the improvement of patients for ADLs[8] through physical training methods in general and muscular respiratory[9].

Combined physical exercise, that is, anaerobic and aerobic training, is considered to be more effective, in addition to working on muscular strength and cardiorespiratory capacity for patients[3].

Regardless of intensity, there are many benefits by strength training. However, when intensity and time are more frequent and longer with maximal and submaximal training load, there are significant improvements in the high intensity exercises responses, muscle strength and exercise capacity[10] [3].

There is still no consensus about adequate physical training strategies for these patients. A new high-intensity training approach may offer an alternative to increase outpatient rehabilitation for patients with COPD.

Considering this context, this study aimed to evaluate the increase in exercise tolerance, with measures of VO2peak and distance of the walking test, from a group of patients with moderate to severe COPD submitted to PRP with high-intensity exercises performed in bodybuilder equipment. Secondarily, this study aimed to evaluate the quality of life of the studied groups.

2 METHODS

2.1 PARTICIPANTS

An interventional study was performed with 30 consecutive patients who participated in the PRP of the Faculdade de Medicina do ABC. The study was approved by the Comitê de Ética em Pesquisa da Faculdade de Medicina do ABC (*Research Ethics Committee of the Faculty of Medicine of ABC*) (CAAE 08160012.0.0000.0082).

Inclusion criteria were: (i) COPD classified as moderate to severe FEV1> 30% and <80% predicted [4]; (ii) age ≥ 40 years; (iii) COPD of smoking origin ≥ 20 years/pack. As exclusion criteria: (i) long-term home domiciliary oxygen therapy; (ii) inability to perform physical tests; (iii) symptomatic coronary diseases, (iv) musculoskeletal limitation and neurological disease; (v) patients with exacerbation of COPD for less than 3 months.

Patients were randomized into two groups with 15 members each, being a group called Experimental Group (EG) and another Control Group (CG). Each group performed traditional physical training in a PRP[10], composed of aerobic and anaerobic exercises, with three sessions per week on alternate days, for 10 consecutive weeks, totaling 30 sessions. Each session lasted 50 minutes. For the accomplishment and the progression of the exercise intensity, it was applied as a safety criterion 70% an 80% of the maximal heart rate (HR max) reached in the cardiopulmonary test.

2.2 PULMONARY REHABILITATION PROGRAM

For GE, physical training was composed of aerobic exercise on the treadmill (T zero Johnson) ® for 15 minutes, with speed determined according to the tolerance of the patient.

The selected anaerobic exercises were: the bench press, performed with a 1.50m hollow bar with 1350g, in a bank (Body and Soul, Brazil) ® with weights plates varying from 1 to 10kg (according to the patient evolution) to work the strengthening of the pectoralis major muscle; pulley front for strengthening the latissimus dorsi muscle; leg extension chair for quadriceps muscle strengthening and flexor chair for strengthening ischiocrural muscles, all performed at the ST710 Multi-Station Gym. The patients performed three sets of 8 repetitions for each exercise, using 80% of the pre-determined load using the maximal repetition test (1RM).

The CG performed the traditional PRP with aerobic exercise on the exercise bicycle for 30 minutes, being the load determined according to the tolerance of the patient. For the anaerobic exercises, two sets of 15 repetitions were established, using dumbbells from 1 to 3 kg, elastic band of light resistance and medicine ball of 2 and 3 kg. Differentiated exercises were performed for the muscles: deltoid, biceps brachii, triceps brachii, quadriceps femoris and hamstrings, elastic muscles training: pectoralis major, large dorsal and triceps sural and medicine-ball from 2 to 3 kg for squatting, biceps brachii muscles, triceps brachii and deltoid.

2.3 PARAMETERS FOR THE PROTOCOLS EVALUATION

Initially, patients were submitted to evaluation and performed the following procedures: (i) pulse oximetry (SpO_2); (ii) 6' walk test (6MWT); (iii) Saint George's Respiratory Questionnaire (SGRQ); (iv) CPOD assessment test (CAT); (v) cardiopulmonary exercise test; and (vi) 1RM test.

1) 6' walk test: This test was performed at a distance of 38 meters and throughout the test, SpO_2 and heart rate (HR) were measured using a Moriya 1005 portable oximeter. The parameters observed before and after the test were: (i) blood pressure (BP), (ii) HR, (iii) SpO_2, and (iv) Modified Borg Dyspnea Scale[11, 12].

2) Saint George's Respiratory Questionnaire: The SGRQ was applied before and after the procedure to evaluate the quality of life in patients with COPD. This questionnaire was translated and validated in Brazil by Sousa et al in 2000 and addresses aspects that involve three realms: symptoms; activities and psychosocial impacts that COPD inflicts on the patient. The symptom realm contains items relating to symptomatology, including cough frequency, sputum production, wheezing, and dyspnea. The activity realm is related to activities that are affected or limited by the patient's degree of dyspnea.[13]

3) *COPD Assessment Test:* A test that allows the analysis of health status from a multidimensional perspective, such as cough, expectoration, sleep and mood [14].

4) *Cardiopulmonary Exercise Testing:* The cardiopulmonary exercise testing was performed with the patients, coupled with a facial mask, to the Vmax 229c™ 2005 system (Vyasis, Yorba Linda, CA, USA), exercising on ATL treadmill model (Inbrasport, RS, Brazil).

During the test patients were asked about the intensity of dyspnea (tiredness, lack of air or fatigue) and discomfort in the lower members using the Modified Borg Dyspnea Scale[16]. The main variable obtained was Oxygen Consumption (VO_2, ml/min). The patient was submitted to an exercise protocol with a standard speed of 1.2 km/h and a treadmill inclination of 2%. At the end of this initial period, the treadmill velocity was increased at the beginning of each minute by 0.5 km/h, without any change in the inclination, according to the basal functional capacity of the patient judged by responsible doctor for the exam. The patient was encouraged to continue the exercise for as long as possible until he reached his maximal tolerance. During recovery, the patient was asked to continue walking at a speed of 1.2 km/h for 2 minutes[15].

5) Maximal Repeat Test: This test - 1RM - is often used as a measure of muscle strength, in the context of physical fitness, sports training and physical rehabilitation [16]. In this sense, it is consensual that the basis for exercise prescription in the resistance training (RT) is established by the relation between the percentage of 1RM and the number of repetitions[17].

2.4 STATISTICAL ANALYSIS

Descriptive statistic was performed by absolute and relative frequencies for qualitative and average variables, as well as 95% confidence intervals for quantitative variables. To analyze the distribution of the sexes between the groups, it was used the Chi-square test.

The data distribution was evaluated by the Shapiro-Wilk test. Due to the fact of presenting normal distribution (Shapiro-Wilk, $p > 0.05$), student's *t* test was used to analyze the average differences of the quantitative variables at the initial and final moments of the study, as well as to analyze the differences of post-intervention variations. Changes were calculated by the difference between the final result and the initial result. The significance level was eastablished at 5%. The program used was Stata® (StataCorp, LC), version 11.0.

3 RESULTS

The results of 24 of the 30 selected patients were analyzed, since six patients were discontinued. Thus, the participation rate of the patients was 80%, because, during the present

study, some patients had crises (exacerbation) and, therefore, they could not conclude the training, so they could not be reevaluated.

The results regarding the demographic and clinical characteristics at the beginning of the study of GC and GE participants are shown in Table 1.

Tabel 1. Demographic and clinical characteristics at the beginning of the study of the participants of the Experimental and Control groups.

Characteristics	**Experimental (n=13; 54,2%)**	**Control (n=11; 45,8%)**	**p**
Sex, n (%)			
Female	6 (46,2)	5 (45,5)	0,973*
Male	7 (53,8)	6 (54,5)	
Age, average (CI 95%) years	73,0 (68,6; 77,3)	67,6 (65,3; 69,9)	0,034**
BMI, average (CI 95%)	25,6 (22,5; 28,7)	23,3 (21,1; 25,4)	0,204**
Clinical Characteristics			
6' Walk Test (average, CI 95%)			
Traveled distance, in meters	407,3 (380,88; 433,72)	410,6 (370,4; 450,9)	0,877**
Variation in SBP	2,3 (-5,6; 10,2)	0,0 (-9,5; 9,5)	0,681**
Variation in DBP	-0,77 (-5,9; 4,4)	0,90 (-6,1; 7,9)	0,670**
Variation in FC	-2,2 (-10,9; 6,6)	1,5 (-6,7; 9,6)	0,520**
Variation in $SatO_2$	0,08 (-0,92; 1,08)	0,36 (-1,32; 2,04)	0,740**
Score CAT, average (CI 95%)	18,8 (14,7; 23,0)	18,1 (12,9; 23,2)	0,801**
Score Saint George, average (IC 95%)	27,9 (22,4; 33,5)	27,3 (20,6; 33,9)	0,869**
Modified Borg Dyspnea Scale, average (CI 95%)	1,46 (1,46; 1,14; 1,78)	1,82 (1,31; 2,32)	0,184**
CPET, average (CI 95%)			
Time	6,53 (5,36; 7,71)	4,6 (3,47; 5,72)	0,102**
VO_2(%)	14,73 (12,12; 17,33)	16,81 (12,79; 20,82)	0,334**
VO_2(L/min)	0,87 (0,64; 1,10)	1,01 (0,71; 1,19)	0,441**
HR	121,92 (107,62; 136,22)	124,72 (112,89; 136,56)	0,749**
$SatO_2$	86,53 (5,36; 7,71)	88,81 (85,27; 92,35)	0,083**

CI 95%: Interval Confidence of 95%; BMI: Body Mass Index; CAT: *COPD Assessment Test*; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart Rate; SaO_2: Oxygen Saturation
*Chi-square; *T student test*

In the table it is possible to verify that both groups were homogeneous at the beginning of the studies, that is, both groups had the same characteristics (patients with moderate to severe COPD).

Although, in relation to the age group, there was a difference between the groups with *p* lower than 0.05 (0.034), the fact that the 95% confidence intervals cross between themselves, shows that, in this sample, the patients' ages were not different.

Table 2 shows the differences in clinical outcomes in pre and the post-intervention in EG, that is, how those characteristics presented themselves before and after exercise.

Tabel 2: Pre and post-intervention differences of the clinical outcomes in the Experimental group (EG)

Characteristics	EG		AD	p*
	Pre	Pos		
6MWT (average, CI 95%)				
Traveled distance, in meters	407,30 (380,88; 433,72)	437,84 (404,86; 470,82)	30,53 (5,46; 55,61)	**0,021**
Variation in SBP	131,53 (119,49; 143.58)	131,53 (123,41; 139,66)	0,0 (-9,86; 9,86)	0,998
Variation in DBP	79,23 (74,64; 83,82)	78,46 (76,19; 80,73)	-0,77 (-5,98; 4,44)	0,753
Variation in HR	83,23 (74,89; 91,56)	81,07 (72,96; 89,19)	-2,15 (-10,93; 6,62)	0,602
Variation in O2 Saturation	94,84 (92,47; 95,21)	93,92 (93,12; 94,72)	0,07 (-0,92; 1,08)	0,868
Score CAT, average (CI 95%)	18,84 (14,69; 22,99)	12,54 (7,64; 17,43)	-6,31 (-9,46; -3,15)	**<0,001**
Score Saint George, average (CI 95%)	27,92 (22,37; 33,47)	19,30 (13,94; 24,66)	-8,61 (-14,12; -3,10)	**0,005**
Modified Borg Dyspnea Scale, average (CI 95%)	1,46 (1,15; 1,78)	1,53 (1,07; 2,01)	0,77 (-0,44; 0,59)	0,753
CPET, average (CI 95%)				
Time	6,53 (5,36; 7,71)	6,30 (4,72; 7,89)	-0,23 (-2,11; 1,65)	0,793
VO_2(%)	14,73 (12,12; 17,33)	18,31 (15,23; 21,39)	3,58 (1,16; 6,00)	**0,007**
VO_2(L/min)	0,87 (0,64; 1,10)	1,12 (0,80; 1,44)	0,25 (0,08; 0,42)	**0,007**
HR	121,92 (107,62; 136,22)	120,60 (105,83; 135,55)	-1,23 (-5,17; 2,70)	0,509
SaO_2	83,76 (79,03; 88,50)	83,0 (78,61; 87,38)	-0,77 (-2,27; 0,73)	0,286

CI 95%: Interval Confidence of 95%; AD: Average Difference; CAT: *COPD Assessment Test*; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart Rate; SaO_2: Oxygen Saturation **T student test*

In this table, there is an average difference in the *p* in the pre and the post-intervention in the following clinical characteristics: (i) increase in the distance traveled; (ii) improvement in the CAT score; (iii) score Saint George; and (iv) increase in the maximal oxygen consumption (VO_2). This average difference in *p* indicates whether there was an increase or decrease in the indexes at the end of the study. In this sense, is that some characteristics of this group have has some kind of change.

Table 3 depicts the differences in clinical outcomes in the CG in the pre- and the post-intervention. In this sense, it was observed that none of the characteristics of this group underwent any kind of change between the beginning and the end of the study.

Tabel 3: Pre and post-intervention differences of the clinical outcomes in the Control group (CG)

Características	GC		AD	p*
	Pre	Pos		
6MWT (average, CI 95%)				
Traveled distance, in meters	410,63 (370,40; 450,87)	433,54 (388,69; 478,39)	22,91 (-2,02; 47,84)	0,068
Variation in SBP	125,45 (110,02; 140,88)	122,72 (111,86; 133,59)	2,72 (-16,76; 22,21)	0,761
Variation in DBP	76,36 (69,46; 83,26)	77,27 (71,19; 83,35)	0,91 (-6,11; 7,92)	0,778
Variation in HR	84,27 (76,39; 92,14)	85,72 (76,59; 94,86)	1,45 (-6,68; 9,59)	0,698
Variation in O2 Saturation	94,18 (92.26; 96,10)	94,54 (92,81; 96,28)	0,36 (-1,31; 2,04)	0,640
Score CAT, average (CI 95%)	18,09 (12,94; 23,23)	16,36 (9,85; 22,87)	-1,72 (-6,69; 3,23)	0,456
Score Saint George, average (CI 95%)	27,27 (20,64; 33,89)	25,72 (16,36; 35,08)	-1,54 (-7,94; 4,85)	0,602
MRC, average (CI 95%)	1,81 (1,31; 2,32)	1,81 (1,4; 2,22)	0,0 (-0,73; 0,73)	0,998
Ergospirometry, average (CI 95%)				
Time	4,6 (3,47; 5,72)	6,00 (4,57; 7,43)	1,40 (-0,45; 3,25)	0,121
VO_2(%)	16,81 (12,79; 20,82)	17,78 (14,67; 20,89)	0,97 (-2,6; 4,54)	0,557
VO_2(L/min)	1,01 (0,71; 1,19)	1,05 (0,85; 1,25)	0,05 (-0,18; 0,28)	0,634
HR	124,72 (112,89; 136,56)	122,0 (109,75; 134,24)	-2,72 (-12,46; 7,00)	0,546
SaO_2	88,81 (85,27; 92,35)	89,81 (86,21; 93,42)	1,0 (-1,42; 3,42)	0,379

CI 95%: Interval Confidence of 95%; AD: Average Difference; CAT: *COPD Assessment Test*; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart Rate; SaO_2: Oxygen Saturation **T student test*

It is important to emphasize that, considering the seriousness, as well as the continuous evolution of the disease, patients' health conditions did not get any worse.

Finally, table 4 shows the average difference found in the variation from the clinical outcomes between the EG and CG after one week of intervention. In other words, the goal of the study was a comparative analysis between both groups, in order to evaluate the relevance of the significant improvement of the GE when compared to the CG, both in the pre and the post-intervention.

Tabel 4: Average difference of the variation of the clinical outcomes between the Experimental group (EG) and the Control group (CG) after one-week intervention

Outcomes	EG	GC	AD	p*
	Average variation (CI 95%)			
Traveled distance in 6MWT	30,53 (5,46; 55,61)	22,90 (-2,01; 47,83)	7,62 (10,62; 43,46)	0,642
Score CAT	-6,30 (-9,46; -3,15)	-1,72 (-6,69; 3,23)	-4,58 (-9,93; 0,77)	0,089
Score Saint George	-8,61 (-14,12; -3,10)	-1,54 (-7,95; 4,85)	-7,07 (-14,98; 0,83)	0,077
Modified Borg Dyspnea Scale	0,07 (-0,44; 0,59)	0,0 (-0,73; 0,73)	0,07 (-0,75; 0,90)	0,849

AD: Average Difference; **T* student test; 6MWT: 6' walk test; CAT: COPD Assessment Test

4 DISCUSSION

The current study analyzed the effect of high-intensity training in resistance exercises, exercise tolerance and quality of life in patients submitted to a PRP. Our main findings were the improvement of VO2peak, the distance of the walk test and the symptoms of GE's quality

of life, pre and post-intervention intervention, suggesting that this kind of training is beneficial for these patients.

Initially, it is important to emphasize the impact on the improvement of the quality of life, effective aerobic gain and maximal physical capacity, with the increase of the oxygen consumption of the EG patients. It has already been described that activities performed at or above the anaerobic threshold (AT) tend to produce larger aerobic increments than less intense activities[18]. Therefore, exercises performed with high intensity methods are generally preferred, with initial targets of at least 60% of maximal exercise tolerance, although low intensity exercise is also beneficial[19].

Patients with COPD have exercise intolerance due to severe muscle dysfunction and intense dyspnea. Some strategies are used to minimize these symptoms. Paulo Almeida et al. demonstrated that high-intensity interval training when interleaved with periods of 30 seconds at 3 minutes of rest produces high-intensity peripheral muscle demand and, at the same time, lower ventilatory demand due to late lactic acidosis. Thus, exercise is well tolerated for patients with hyperinflation because it delays the onset of it. Besides, the is an improvement in the metabolism, in the size and number of capillaries of the muscle fibers and in the tolerance to the exercise[20]. Our study showed an increase in VO2peak after this kind of intervention, which reinforces the benefit of high-intensity training.

There are few studies comparing strength exercises with standard rehabilitation. Puhan et al.[21] compared the effects of strength or resistance exercises with the standard rehabilitation over the distance traveled in the 6' walk test, finding no differences between the three types of exercise. However, the review by Houchen et al.[22] showed that quadriceps muscle strength was higher in those patients who performed strength exercises compared to those submitted standard rehabilitation[8].

A study[23] comproved that with the increase of muscle strength there is a significant improvement of respiratory symptoms, thus increasing the quality of life of patients with COPD. Our study corroborates these findings, since the patients improved their quality of life with this kind of training, also suggesting that, possibly, they may have increased muscle strength, which can be reinforced with the increase in VO2peak and with the distance of the walk test. In addition, the current study suggests that high-intensity training indicates a better response when compared to the moderate and low intensity one. However, low load resistance exercises and high repetition with elastic bands can improve both the upper and lower extremities in functional capacity and muscular resistance in patients with COPD[23]. It is worth highlighting that high-intensity strength training (70-80% of maximal load) of upper members

allows the increase of muscular strength, besides being safe and well tolerated by the patient with moderate to severe COPD[24]. This data is demonstrated in our study which also used 70% of patients' HRpeak as safety criterion and no patient presented complications after exercise. Thus, high-intensity exercise can be a more effective option in older adults and in patients with COPD, however, it is important that progression be gradually introduced[25] [26].

An important component in the treatment of COPD is Pulmonary Rehabilitation (PR), which currently encompasses numerous resources and methods of physical training in general and muscular respiratory [27]. PRP promotes an increase in the abilities to perform ADLs and in the capacity to perform exercises and, consequently, improves the quality of life of patients with moderate to severe COPD[28]. However, the period that the training lasts can have interfered in the GC results, in the distance of the 6MWT and in the quality of life of the studied patients, since they did not present a significant difference in the pre and post-intervention, suggesting an adaptation of the individuals with the physical activity of a traditional PRP, since they were already participants in the program. Anyway, through physical training, the CG patients maintained their quality of life, which is an important finding because COPD is a progressive disease and, therefore, the fact that patients did not aggravate their condition health, has already demonstrated that the interventions had relevance in maintaining the clinical conditions and quality of life of the patients.

In this context, numerous treatments have been proposed in order to minimize the dysfunctions, as well to try to limit the progression of the disease. Besides, the content of PR programs, as well as their frequency, duration and intensity vary widely[29-31]. The fact is that strength training with intensities greater than 60% for patients with severe airflow obstruction may be a more adequate alternative, if compared to low intensity training, because of the possibility of working with higher loads with a lower dyspnea sensation, because it delays the hyperinflation of these patients[23]. In addition, higher intensity training results in higher increases in VO2peak than in lower intensity training and longer duration[10]. Once hyperinflated, the patient's breathing capacity becomes significantly jeopardized due to mechanical constraints resulting from reduced inspiratory capacity, increased respiratory work and negative effects on inspiratory muscles. Together, these changes can impact clinical symptoms, including functional capacity, dyspnea and physical activity.[2]

The choice of incorporating free weights or machines must be based on the level status of training and familiarity with specific exercise movements as well as the primary training goal. Weighing machines have been considered safer to use, easy to learn and allow the performance of some exercises that can be more difficult with free weights. The machines help

to stabilize the body and limit movement around specific joints involved in producing synergistic strength, and machine exercises demonstrated less neural activation when combined with intensity for most comparisons with free-weights exercises[27]. In this study, it was evidenced that the high-intensity training with bodybuilding apparatus improved the exercise tolerance observed by the increase in VO2peak and the distance traveled in the walk test. Our study carried out exercises on bodybuilding apparatus in GE, which can also have helped in the best response to training, as they are safer and provide increased load without damaging the patient.

A limitation of our study is the number of patients included. It is worth emphasizing that the selection of this group is more judicious and can hamper the inclusion of patients. However, a study with a higher number of patients may strengthen the results presented.

In conclusion, the EG showed a significant improvement in exercise capacity and quality of life of the patients, suggesting that a supervised high-intensity physical training with exercises performed in bodybuilding apparatuses, is more efficient in the treatment of patients with COPD.

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