


# Comparison between Pulmonary Rehabilitation and Dance in Patients with Chronic Obstructive Pulmonary Disease: A Randomized Controlled Clinical Trial

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**ABSTRACT:** Although dance is understudied in the context of chronic obstructive pulmonary disease (COPD), it is a physical activity that can improve individuals' psychological state and physical function. The aim of this research was to compare the impact of physical training using dance versus pulmonary rehabilitation (PR) on functional capacity, lung and muscle function, and quality of life (QoL) in COPD patients. This randomized controlled clinical trial involved 11 patients who underwent dance (DG) and 11 patients who underwent PR (PRG). The patients were evaluated using the following assessments: the mMRC scale, the COPD Assessment Test (CAT), the Short Form-36 (SF-36), the Hospital Anxiety and Depression Scale (HADS), spirometry, handgrip strength (HGS), the 1-repetition maximum (1-RM) test, and the 6-minute walk test (6MWT). In the intra-group comparison, the DG showed an increase in 6-minute walking distance (6MWD) ( $p=0.003$ ), a reduction in the mMRC scale, and an improvement in the SF-36 physical functioning and vitality domains. In the intra-group comparison, the PRG showed an increase in 6MWD ( $p=0.007$ ), a reduction in the mMRC scale, an increase in HGS, an increase in the 1-RM test, and an improvement in all SF-36 domains. In the comparison between groups, the PRG showed an improvement in QoL in the following domains: general perceptions of health and limitations of physical and emotional roles. In conclusion, for patients with COPD, a dance program has the potential to improve functional capacity, the degree of dyspnea, and QoL. However, when compared to a PR, dance is less effective in addressing muscle dysfunction.

**KEYWORDS:** Lung diseases, rehabilitation, dance, functional capacity, quality of life.

## Introduction

Chronic obstructive pulmonary disease (COPD) is one of the most prevalent respiratory diseases worldwide [1].

In addition to causing respiratory discomfort, COPD is a leading cause of functional disability.

Individuals with COPD are also more likely to experience an impaired quality of life (QoL), which tends to worsen over time and limit daily activities [2].

These patients exhibit progressive worsening of pulmonary function; however,

neurocognitive deficits and dysfunctions are often overlooked [1].

Many COPD patients also have comorbidities, such as anxiety and depression, due to impaired interoceptive awareness.

This leads to a discrepancy between the assessed lung function and the symptoms patients present [3].

The standard multidisciplinary strategy for treating patients with COPD is pulmonary rehabilitation (PR).

Studies show that PR reduces dyspnea, improves respiratory function and QoL, increases functional capacity, and reduces

morbidity and mortality rates in COPD patients [4,5].

In addition to its protective effect on the central nervous system (CNS), PR appears to improve cognition in this patient population [6].

However, poor adherence to PR programs poses a challenge to their implementation and effectiveness in patients with COPD [7].

Therefore, it is necessary to search for treatment options that involve exercise in order to increase patient engagement and adherence.

In this context, dance is an innovative approach that has been shown to be as effective as traditional physical training [8].

Dance is an exercise approach that incorporates pleasure and interactivity [8].

From a neuromotor and sensory perspective, dance training stimulates many regions of the CNS, resulting in rhythmic and expressive movements such as jumping, turning, shifting, contracting, and extending in order to create shapes in space [9].

In addition to strengthening body muscles, people who routinely engage in dance training demonstrate greater postural stability and balance control [10].

They also experience greater well-being, connectivity, and socialization compared to those not engaged in dance regularly [11].

Among patients with chronic diseases, dance improves well-being and mental health, resulting in a better QoL.

Dance is a safe and feasible physical activity that brings contentment and satisfaction to people with COPD.

Group dance training motivates participants more than individual exercise does [5].

Due to the low frequency and adherence rates of PR programs, there is an increasing search for alternatives to conventional PR to encourage physical activity among people with COPD.

Group dance training is a more enjoyable and comprehensive activity than conventional PR and can potentially benefit the physical conditioning of COPD patients [8].

Furthermore, people with COPD who perform dance steps report that the group dance environment is engaging and collaborative.

This environment can motivate those who have difficulty feeling comfortable practicing physical activities alone [5,13].

Since PR is a well-established program for COPD patients with a low adherence rate, we hypothesize that dance may increase adherence and improve ventilatory capacity, functionality, muscle strength, anxiety, depression, and QoL in COPD patients.

Thus, the aim of this research was to compare the impact of physical training using dance versus PR on functional capacity, lung and muscle function, mental health, and QoL in patients with COPD.

## Materials and Methods

### Study design and participants

From September to December of 2025, a randomized controlled clinical trial was conducted with COPD patients aged 40 years and older who were receiving treatment at the Policlínica Universitária Piquet Carneiro at the Universidade do Estado do Rio de Janeiro in Rio de Janeiro, Brazil.

Participants had no acute exacerbations in the previous eight weeks and were consistently taking their medications.

We used the following exclusion criteria: the presence of psychiatric conditions that would prevent understanding of objective and subjective measurements; the presence of cardiovascular or neuromuscular diseases that would hinder completion of functional tests, advanced cancer, previous lung surgery, and participation in another PR program within the last three months.

### Interventions

We randomly divided the participants into two groups using an online survey tool: (<http://www.edgarweb.org.uk/>).

One group (DG) performed dance exercises for approximately 50 minutes twice a week over eight weeks.

The other group (PRG) performed PR twice a week for approximately 50 minutes over eight weeks.

The same measurements were taken before and after the intervention.

For the PRG intervention, a low-load, high-repetition protocol was used.

Participants performed five exercises with the TheraBand® elastic band (Figure 1).



**Figure 1. The pulmonary rehabilitation group's intervention protocol consisted of low load and high repetition. Participants performed five exercises using the TheraBand® elastic band, as shown in the illustrations. The selected load should be sufficient so that patients could not perform more than 30 repetitions in one minute.**

Participants performed three 1-minute sets for each exercise, with at least one minute of rest between each set.

They were instructed to inhale at rest and exhale during movement.

If they could perform more than 30 repetitions, it meant that the exercise was too easy.

Therefore, they switched to a band with a higher resistance (Figure 2).

Each TheraBand® band has a specific resistance; therefore, the exercises always start with the lightest band.

|  |                |                   |                |                  |                 |                  |                   |                 |
|--|----------------|-------------------|----------------|------------------|-----------------|------------------|-------------------|-----------------|
| TheraBand® CLX/Band/Tubing color                 | TheraBand® Tan | TheraBand® Yellow | TheraBand® Red | TheraBand® Green | TheraBand® Blue | TheraBand® Black | TheraBand® Silver | TheraBand® Gold |
| Increase from preceding color at 100% elongation | -              | 25%               | 25%            | 25%              | 25%             | 25%              | 40%               | 40%             |
| 100% elongation                                  | 1.1            | 1.3               | 1.7            | 2.1              | 2.6             | 3.3              | 4.6               | 6.5             |

Beginner 
▶
 Advanced

**Figure 2. TheraBand® resistance band color progression each band has a specific resistance level, and exercises always start with the lightest band. Once the patient could perform more than 30 repetitions, they would progress to the next color band from right to left.**

For the DG intervention, a protocol was created in which songs that were more likely to be recognized by the participants were selected and used, along with songs by well-known artists.

The goal was to evoke nostalgia for past experiences with similar songs and melodies to increase engagement with the PR and, consequently, improve adherence rates.

The protocol used two playlists, each with an average duration of 40 to 50 minutes.

After the first four weeks of intervention, the first playlist was replaced by the second.

The dance steps were designed specifically for each song. Participants had their first contact with the steps on the first day of the intervention.

By the last day of the first playlist, they had recognized the steps and would sometimes initiate the planned sequences automatically.

This fostered the creation of bonds with the PR and with other participants since others copied those who remembered the steps and received their praise.

The steps began with simpler movements and gradually increased in difficulty as the songs and playlists progressed.

This formed choreographies that engaged muscles important for patients with COPD, such as the quadriceps and latissimus dorsi.

To better adapt the participants, the music created acceleration phases consisting of five minutes of slow steps, five minutes of medium steps, five minutes of brisk steps, and 20 minutes of slightly faster steps, reaching the point of maximum effort.

Immediately afterward, the deceleration phase began with approximately five minutes of brisk steps, five minutes of medium steps, and five minutes of slower steps.

The first and last songs of both playlists were choreographed to predominantly be performed with the participants seated.

This aimed to maintain the initial acceleration and final deceleration periods, respectively (Figure 3).



**Figure 3. Illustrations of dance-based training. For the first song in both playlists, the exercises began in a seated position using chairs without wheels. These exercises stimulated movements such as stretching (A). During the songs, participants were encouraged to interact by gathering in a group and alternating which foot was in front (B). Participants were encouraged to take two steps to the right with the support of others, lift one foot off the ground, and repeat the sequence to the left (C). Interaction was encouraged through performing sequences in pairs that stimulated balance, postural control, coordination, and trust in one's partner (D).**

The playlists featured a variety of musical styles to generate a greater emotional connection between participants and the songs and singers they love.

Songs from the following genres were selected: euro pop, rhythm and blues, pop, jazz, dance pop, soul, Charleston, rock 'n' roll, new wave, disco, samba rock, Brazilian pop rock, Brazilian soul, Brazilian funk melody, Brazilian

popular music, bossa nova, samba de raiz/classic samba, and samba de partido alto.

Including different genres of Brazilian music helped break down the initial barrier some participants may have had with this relatively unknown PR, while also catering to their nostalgia.

The first and second playlists had 13 and 12 songs, respectively.

Additionally, each playlist included three songs without specific choreography intended for improvisation.

The intervention was mostly carried out in a circle to encourage interaction among participants.

Participants were instructed to sit down and rest if they experienced any discomfort, such as shortness of breath, fatigue, or chest pain.

### Measurements

The degree of dyspnea was assessed using the mMRC scale.

This scale has only five items, and participants choose the item that best describes how much dyspnea limits their daily activities.

Participants report their subjective degree of dyspnea by selecting a value between 0 and 4; the higher the value, the more intense the dyspnea [14].

We use the COPD Assessment Test (CAT) to measure the effects of the clinical manifestations of COPD.

The CAT is an eight-item questionnaire about the physical and emotional state of COPD patients. Subjects choose one answer from six options for each item [15].

QoL was assessed using the Short Form-36 (SF-36).

The SF-36 is a questionnaire that evaluates QoL using eight domains.

Scores range from 0 to 100, with higher values indicating better QoL [16].

The Hospital Anxiety and Depression Scale (HADS) is a questionnaire that evaluates an individual's likelihood of experiencing anxiety, depression, or both.

Each item on the anxiety and depression subscales is scored from 0 to 3, and the cutoff points are 10 and 7, respectively.

A higher score indicates a greater likelihood of experiencing these disorders [17,18].

The spirometry test was performed using Vitatrace VT 130 SL equipment (Codax Ltda., Rio de Janeiro, Brazil) according to previous standardizations [19].

The reference values of Pereira et al. [20] were used to compare them with the absolute values of the participants.

We used a digital dynamometer (SH5001, Saehan Corporation, South Korea) to measure handgrip strength (HGS).

Briefly, participants performed a sustained handgrip contraction for three seconds.

Three measurements were taken at 60-second intervals, and the highest value was used in the study.

The cutoff points adopted were those previously proposed for males and females: 27 kgf and 16 kgf, respectively [21].

To analyze the intensity of the anaerobic exercise, a 1-repetition maximum (1-RM) quadriceps muscle extension test was performed using a load cell.

During the test, participants were verbally encouraged to perform better. Afterwards, the absolute value in kilogram-force was recorded for each individual [22].

The 6-minute walk test (6MWT) was performed in a 30-meter corridor according to previous recommendations [23].

The test was interrupted if peripheral oxygen saturation (SpO<sub>2</sub>) was <80%, if the participant experienced exhaustion, chest pain, or intolerable cramps.

The equation by Britto et al. [24] was used to obtain the predicted values, with values <80% of the predicted values considered abnormal.

A drop in SpO<sub>2</sub> of at least 4% was used as the criterion for establishing oxygen desaturation [25].

### Statistical analysis

The sample size was calculated using G\*Power 3.1 statistical software (University of Düsseldorf, Germany).

The calculation was based on a previous study investigating the effects of home-based PR associated with creative dance in COPD patients, using the 6MWD as the primary outcome [8].

The effect size was 0.497, calculated from the difference in mean 6MWD between pre- and post-PR (468.8±98.7m and 508.2±45.2m, respectively).

Using ANOVA repeated measures within-between interaction with error  $\beta=0.95$  and  $\alpha=0.05$ , the sample size was calculated to be 22 patients (11 in each group).

We assessed the normality of the data using the Shapiro-Wilk test, and we expressed the results as medians with interquartile ranges.

The Mann-Whitney test was used to analyze the comparison of pre-intervention variables between groups.

The Wilcoxon signed-rank test was used to analyze the variation in measurements between pre- and post-dance or PR time points.

Absolute deltas were calculated as the difference between the post-intervention and pre-intervention values of the variables.

The Mann-Whitney test was used to assess the comparison of absolute deltas between groups.

The statistical significance of the results was established using a p-value of 5%.

All statistical analyses were performed using SPSS software (version 26, IBM Corp., Armonk, NY, USA).

## Results

Eight of the 35 COPD patients eligible for the study were excluded for the following reasons: four were participating in another program, three had musculoskeletal alterations that hindered their ability to perform functional tests, and one had undergone previous pulmonary surgery.

Of the 27 patients included in the study, five missed the intervention sessions and did not respond to telephone contact attempts: four from the PRG and one from the DG.

Thus, the final sample consisted of 22 participants (19 women and 2 men), with 11 in each group.

The median ages for the DG and PRG were 59 (58-70) and 67 (65-71) years, respectively (p=0.11), and the median body mass indexes for the DG and PRG were 25 (21-28) and 26 (22-37) kg/m<sup>2</sup>, respectively (p=0.38).

The median pre-intervention CAT score was slightly higher in the DG group than in the PRG group [25 (20-31) vs. 19 (14-22), p=0.038].

At the pre-intervention time point, the median forced expiratory volume in one second (FEV<sub>1</sub>) for DG and PRG was not statistically different [52 (33-73) vs. 44 (43-53) percent predicted, p=0.62].

The median 6MWD at the pre-intervention time point was also not statistically different between the DG and PRG groups [52 (44-64) vs. 61 (53-73) % predicted, p=0.24].

Comparisons of clinical characteristics, pulmonary function, muscle function, functional capacity, QoL, and mental disorders between the two groups are shown in Table 1.

**Table 1. Clinical characteristics, pulmonary function, muscle function, functional capacity, and quality of life of the dance and pulmonary rehabilitation groups before the intervention.**

| Parameter                           | DG            | PRG           | p-value |
|-------------------------------------|---------------|---------------|---------|
| <b>Clinical characteristics</b>     |               |               |         |
| Male/female                         | 1/10          | 2/9           | 0.91    |
| Age (years)                         | 59 (58-70)    | 67 (65-71)    | 0.11    |
| BMI (kg/m <sup>2</sup> )            | 25 (21-28)    | 26 (22-37)    | 0.38    |
| Smoking load                        | 48 (40-92)    | 60 (44-86)    | 0.82    |
| mMRC scale                          | 3 (3-4)       | 4 (2-4)       | 0.80    |
| CAT                                 | 25 (20-31)    | 19 (14-22)    | 0.038   |
| <b>Spirometry</b>                   |               |               |         |
| FVC (% predicted)                   | 70 (63-73)    | 70 (63-98)    | 0.37    |
| FEV <sub>1</sub> (% predicted)      | 52 (33-73)    | 44 (43-53)    | 0.62    |
| FEV <sub>1</sub> /FVC (%)           | 64 (44-72)    | 66 (49-68)    | 0.51    |
| FEF <sub>25-75%</sub> (% predicted) | 24 (11-48)    | 31 (25-45)    | 0.15    |
| HGS (kgf)                           | 20 (16-22)    | 22 (14-25)    | 0.82    |
| 1-RM test (kg)                      | 15 (11-20)    | 18 (11-22)    | 0.84    |
| <b>6MWT</b>                         |               |               |         |
| 6MWD (meters)                       | 267 (240-349) | 306 (295-379) | 0.20    |
| 6MWD (% predicted)                  | 52 (44-64)    | 61 (56-73)    | 0.24    |
| <b>SF-36</b>                        |               |               |         |
| Physical functioning                | 25 (15-35)    | 42 (27-48)    | 0.029   |
| Physical role limitations           | 0 (0-0)       | 22 (16-32)    | 0.008   |
| Bodily pain                         | 45 (13-48)    | 48 (40-62)    | 0.26    |
| General health perceptions          | 30 (25-50)    | 50 (46-58)    | 0.26    |
| Vitality                            | 30 (15-60)    | 44 (36-47)    | 0.77    |
| Social functioning                  | 50 (13-75)    | 50 (36-65)    | 0.99    |
| Emotional role limitations          | 0 (0-75)      | 58 (45-67)    | 0.71    |
| Mental health                       | 56 (40-80)    | 60 (45-68)    | 0.82    |
| <b>HADS</b>                         |               |               |         |
| HADS-A                              | 9 (5-13)      | 9 (7-11)      | 0.53    |
| HADS-D                              | 8 (6-10)      | 7 (6-11)      | 0.82    |

The values shown are median (interquartile range). Bold type indicates significant differences. List of abbreviations: 1-RM-1-repetition maximum, 6MWT-6-minute walk test, 6MWD-6-minute walking distance, BMI-body mass index, CAT-COPD Assessment Test, DG-dance group, FEF<sub>25-75%</sub>-forced expiratory flow during the middle half of the FVC maneuver, FEV<sub>1</sub>-forced expiratory volume in one second, FVC-forced vital capacity, HADS-Hospital Anxiety and Depression Scale, HADS-A-HADS anxiety subscale, HADS-D-HADS depression subscale, HGS-handgrip strength, PRG-pulmonary rehabilitation group.

In the intragroup comparison between pre- and post-intervention time points, the DG improved the degree of dyspnea, with a reduction in the mMRC scale [3 (3-4) vs. 2 (1-3),  $p=0.027$ ].

The DG also showed an increase in the 6MWD [52 (44-64) vs. 67 (58-76) % predicted,  $p=0.003$ ].

Two participants presented desaturation during the 6MWT at the pre-intervention time point, which did not occur at the post-intervention time point.

In the DG, there was an improvement in QoL assessed by the SF-36 in the following domains: physical functioning [25 (15-35) vs. 40 (25-45),  $p=0.028$ ] and vitality [30 (15-60) vs. 55 (35-55),  $p=0.049$ ].

In the intragroup comparison, the PRG improved the degree of dyspnea, with a reduction in the mMRC scale [4 (2-4) vs. 2 (1-2),  $p=0.005$ ].

Unlike the GD, the PRG showed significant increases between the pre- and post-intervention time points in both HGS [22 (14-25) vs. 28 (16-28) kgf,  $p=0.039$ ] and the 1-RM test [18 (11-22) vs. 21 (16-25)kg,  $p=0.003$ ].

The PRG also showed an increase in the 6MWD [61 (56-73) vs. 70 (62-82) % predicted,  $p=0.007$ ], with no participant experiencing desaturation during the 6MWT at the pre- and post-intervention time points.

In the DG group, there was an improvement in QoL in all eight domains of the SF-36, with  $p=0.003$  for all of them.

Intragroup comparisons regarding clinical characteristics, pulmonary function, muscle function, functional capacity, and QoL before and after the intervention in DG and PRG are shown in Table 2.

**Table 2. Intragroup comparisons regarding clinical characteristics, pulmonary function, muscle function, functional capacity, and quality of life before and after the intervention.**

| Parameter                           | DG            |               |          | PRG           |               |          |
|-------------------------------------|---------------|---------------|----------|---------------|---------------|----------|
|                                     | Pre           | Post          | p-value* | Pre           | Post          | p-value* |
| mMRC scale                          | 3 (3-4)       | 2 (1-3)       | 0.027    | 4 (2-4)       | 2 (1-2)       | 0.005    |
| CAT                                 | 25 (20-31)    | 23 (16-24)    | 0.13     | 19 (14-22)    | 12 (12-15)    | 0.007    |
| <b>Spirometry</b>                   |               |               |          |               |               |          |
| FVC (% predicted)                   | 70 (63-73)    | 78 (65-85)    | 0.067    | 70 (63-98)    | 74 (65-102)   | 0.068    |
| FEV <sub>1</sub> (% predicted)      | 52 (33-73)    | 58 (38-73)    | 0.14     | 44 (43-53)    | 47 (43-61)    | 0.10     |
| FEV <sub>1</sub> /FVC (%)           | 64 (44-72)    | 68 (46-84)    | 0.27     | 66 (49-68)    | 67 (59-67)    | 0.99     |
| FEF <sub>25-75%</sub> (% predicted) | 24 (11-48)    | 29 (11-69)    | 0.10     | 31 (25-45)    | 40 (30-45)    | 0.067    |
| HGS (kgf)                           | 20 (16-22)    | 20 (16-26)    | 0.53     | 22 (14-25)    | 28 (16-28)    | 0.039    |
| 1-RM test (kg)                      | 15 (11-20)    | 18 (14-21)    | 0.33     | 18 (11-22)    | 21 (16-25)    | 0.003    |
| <b>6MWT</b>                         |               |               |          |               |               |          |
| 6MWD (meters)                       | 267 (240-349) | 330 (314-387) | 0.003    | 306 (295-379) | 352 (327-449) | 0.007    |
| 6MWD (% predicted)                  | 52 (44-64)    | 67 (58-76)    | 0.003    | 61 (56-73)    | 70 (62-82)    | 0.007    |
| <b>SF-36</b>                        |               |               |          |               |               |          |
| Physical functioning                | 25 (15-35)    | 40 (25-45)    | 0.028    | 42 (27-48)    | 60 (57-62)    | 0.003    |
| Physical role limitations           | 0 (0-0)       | 0 (0-25)      | 0.79     | 22 (16-32)    | 58 (49-60)    | 0.003    |
| Bodily pain                         | 45 (13-48)    | 50 (23-90)    | 0.14     | 48 (40-62)    | 62 (53-72)    | 0.003    |
| General health perceptions          | 30 (25-50)    | 38 (20-60)    | 0.41     | 50 (46-58)    | 61 (58-67)    | 0.003    |
| Vitality                            | 30 (15-60)    | 55 (35-55)    | 0.049    | 44 (36-47)    | 57 (52-71)    | 0.003    |
| Social functioning                  | 50 (13-75)    | 56 (38-100)   | 0.39     | 50 (36-65)    | 62 (50-79)    | 0.003    |
| Emotional role limitations          | 0 (0-75)      | 33 (0-100)    | 0.85     | 58 (45-67)    | 78 (64-87)    | 0.003    |
| Mental health                       | 56 (40-80)    | 60 (48-84)    | 0.65     | 60 (45-68)    | 74 (57-78)    | 0.003    |
| <b>HADS</b>                         |               |               |          |               |               |          |
| HADS-A                              | 9 (5-13)      | 7 (3-12)      | 0.80     | 9 (7-11)      | 8 (6-9)       | 0.70     |
| HADS-D                              | 8 (6-10)      | 7 (4-10)      | 0.34     | 7 (6-11)      | 6 (5-10)      | 0.21     |

The values shown are median (interquartile range). Bold type indicates significant differences. List of abbreviations:

1-RM-1-repetition maximum, 6MWT-6-minute walk test, 6MWD-6-minute walking distance, SF-36-Short Form-36, CAT-COPD Assessment Test, DG-dance group, FEF<sub>25-75%</sub>-forced expiratory flow during the middle half of the FVC maneuver, FEV<sub>1</sub>-forced expiratory volume in one second, FVC-forced vital capacity, HADS-Hospital Anxiety and Depression Scale, HADS-A-HADS anxiety subscale, HADS-D-HADS depression subscale, HGS-handgrip strength, PRG-pulmonary rehabilitation group.

Finally, we compared the two groups using the absolute delta of each variable at the pre- and post-intervention time points (Table 3).

This assessment revealed no significant differences in clinical characteristics, pulmonary function, muscle function, functional capacity, or mental disorders between the DG and the PRG.

However, the PRG showed improvement in QoL as assessed by the SF-36 in the following domains: physical role limitations (0 [0-0] vs. 28 [28-36],  $p=0.001$ ), general health perceptions (5 [0-15] vs. 8 [11-12],  $p=0.023$ ), and emotional role limitations (0 [0-0] vs. 27 [10-30],  $p=0.009$ ).

**Table 3. Comparisons between groups regarding clinical characteristics, pulmonary function, muscle function, functional capacity, and quality of life before and after the intervention.**

| Parameter                           | DG              | PRG        | p-value |
|-------------------------------------|-----------------|------------|---------|
|                                     | Absolute deltas |            |         |
| mMRC scale                          | -1 (-2-0)       | -2 (-2--1) | 0.39    |
| CAT                                 | -3 (-9-0)       | -3 (-8--2) | 0.53    |
| Spirometry                          |                 |            |         |
| FVC (% predicted)                   | 7 (3-17)        | 6 (4-7)    | 0.88    |
| FEV <sub>1</sub> (% predicted)      | 9 (0-19)        | 3 (3-3)    | 0.51    |
| FEV <sub>1</sub> /FVC (%)           | 12 (-6-23)      | 0 (0-0)    | 0.22    |
| FEF <sub>25-75%</sub> (% predicted) | 7 (1-15)        | 7 (5-9)    | 0.99    |
| HGS (kgf)                           | 1 (-1-3)        | 2 (2-5)    | 0.086   |
| 1-RM test (kg)                      | 1 (0-3)         | 5 (2-5)    | 0.069   |
| 6MWT                                |                 |            |         |
| 6MWD (meters)                       | 63 (28-120)     | 32 (28-43) | 0.093   |
| 6MWD (% predicted)                  | 11 (6-25)       | 6 (5-9)    | 0.072   |
| SF-36                               |                 |            |         |
| Physical functioning                | 15 (-5-25)      | 20 (13-24) | 0.32    |
| Physical role limitations           | 0 (0-0)         | 28 (28-36) | 0.001   |
| Bodily pain                         | 10 (0-45)       | 14 (9-16)  | 0.82    |
| General health perceptions          | 5 (0-15)        | 8 (11-12)  | 0.023   |
| Vitality                            | 25 (5-30)       | 17 (12-22) | 0.72    |
| Social functioning                  | 0 (0-25)        | 17 (12-20) | 0.28    |
| Emotional role limitations          | 0 (0-0)         | 27 (10-30) | 0.009   |
| Mental health                       | 4 (0-20)        | 14 (10-17) | 0.19    |
| HADS                                |                 |            |         |
| HADS-A                              | -2 (-3-0)       | -2 (-3-0)  | 0.59    |
| HADS-D                              | -1 (-2-0)       | -1 (-4-0)  | 0.50    |

The values shown are median (interquartile range). Bold type indicates significant differences. List of abbreviations: 1-RM-1-repetition maximum, 6MWT-6-minute walk test, 6MWD-6-minute walking distance, BMI-body mass index, CAT-COPD Assessment Test, DG-dance group, FEF<sub>25-75%</sub>-forced expiratory flow during the middle half of the FVC maneuver, FEV<sub>1</sub>-forced expiratory volume in one second, FVC-forced vital capacity, HADS-Hospital Anxiety and Depression Scale, HADS-A-HADS anxiety subscale, HADS-D-HADS depression subscale, HGS-handgrip strength, PRG-pulmonary rehabilitation group.

## Discussion

The main finding of this study is that the DG showed significant improvements in functional capacity, dyspnea level, and QoL compared to the PRG.

Although there was no statistically significant difference, the DG showed greater gains in functional capacity than the PRG.

However, PRG showed significant increases in symptoms impact and muscle function when compared to DG.

Furthermore, DG had a higher adherence rate than PRG. To our knowledge, this is the first randomized controlled trial to evaluate the effect of a well-designed dance program on patients with COPD.

In the present study, we observed a statistically significant increase in 6MWD in the DG after the intervention.

While the PRG also demonstrated a significant increase in 6MWD, the median 6MWD in the DG was nearly twice that observed in the PRG (63 meters vs. 32 meters).

Importantly, this value surpassed the previously established minimal clinically important difference (MCID) of 30 meters for the PR [26].

In assessing the feasibility of a dance intervention, Wshah et al. [5] studied 20 individuals with COPD who participated in an hour-long dance class twice a week for eight weeks.

The researchers observed significant improvements in the 6MWD ( $p=0.03$ ) and the Chronic Respiratory Disease Questionnaire ( $p=0.001$ ), though the gains did not reach the MCID.

Participants gained only  $18.7\pm 36.5$  meters in the 6MWD after the program. Kaya et al. [8] evaluated 24 COPD patients who were allocated to either a group that underwent home PR or a group that underwent home PR combined with creative dance.

They observed that the group that underwent home PR combined with creative dance achieved an increase in the 6MWD of 39.4 meters, which is greater than the MCID for COPD patients [26].

We believe that the progressive intensity of the music and playlists that focus on choreography recruiting important COPD-related muscles may explain our results, at least in part.

The effects of physical training on lung function in people with COPD remain uncertain.

In the present study, we did not observe significant improvements in spirometric parameters after the intervention, although all absolute values increased.

Interestingly, a study of menopausal women using Thai dance demonstrated significant increases in FEV<sub>1</sub>, forced vital capacity, and peak expiratory flow values [27].

The authors explained this result by stating that Thai dance resembles rhythmic, continuous physical activities of light-to-moderate intensity that use O<sub>2</sub> to produce muscle energy.

These activities increase thoracic expansion due to arm and chest movements.

Improvements in lung function observed in some studies appear to be associated with the speed at which biological catalysts convert substrates into products, indicating functional respiratory muscle efficiency [28].

We observed significant increases in HGS and 1-RM test in the PRG, but no increases in these tests were observed in the DG.

In contrast, Kaya et al. [8] found that a group that combined creative dance with home PR improved their quadriceps strength.

One possible explanation for the discrepancy between the two studies' results is that we evaluated two groups, one undergoing dance and the other PR, while Kaya et al. [8] combined two different protocols.

Additionally, we did not use a dynamometer to evaluate quadriceps strength, a tool that may be more effective at detecting subtle differences in muscle performance.

The increases in peripheral muscle strength observed in the PRG in our study may be due to high repetitions and progressive increases in resistance, which may have impacted muscle performance more significantly.

The increased peripheral muscle strength is thought to be due to two underlying physiological mechanisms: increased O<sub>2</sub> transport capacity and the rate at which biological catalysts convert substrates into products [8].

Supervised, enjoyable dancing is an interesting form of training that provides physical and mental improvements, as well as an increased QoL [3].

Our DG showed improvement in two important SF-36 domains (physical functioning and vitality) using dance exclusively, while the PRG showed improvement in all SF-36 domains after the intervention.

Similar to our study, Wshah et al. [5] assessed anxiety and depression in COPD

patients undergoing a dance protocol using the HADS.

Although HADS scores did not change significantly in our study or in Wshah et al.'s [5] study, it is important to note that baseline scores were within the normal range in both studies.

A scoping review showed that incorporating dance into physiotherapy amplifies psychomotor, affective, and cognitive outcomes in respiratory conditions [29].

Dance is an entertainment form that takes a mind-body approach and influences mental health through various factors, such as the stimulation of multiple senses to encourage learning, sensory regulation, and well-being [8].

However, achieving effective dance training can be difficult for many individuals.

Intrinsic motivation, pleasure in exercising, and enjoyment are key factors in the frequency of participation in exercise and physical activity programs [8].

The fact that only one patient dropped out of dance training demonstrates that they found it enjoyable.

Similarly, the study by Wahsh et al. [5] is notable.

The study found no issues with dance training for people with COPD and showed an adherence rate of almost 80%.

This study had some limitations.

First, although we reached the minimum number of participants in each group according to the sample size calculation, the sample size was small.

Second, we did not use a control group that did not perform PR.

However, since the benefits of thoracic physiotherapy for patients with COPD are well-known, we deemed it unethical to withhold this treatment.

Third, we did not use techniques capable of measuring pulmonary and muscle function with greater sensitivity and detail, which could have increased our ability to detect statistically significant differences within or between groups.

## Conclusions

Our findings show that a well-structured dance protocol can potentially improve functional capacity, dyspnea level, and QoL in patients with COPD.

However, when compared to a PR program, dance is less effective in addressing muscle dysfunction.

Therefore, when possible, dance should be offered to COPD patients, especially those unmotivated to perform a conventional PR program.

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None to declare.

### Author Contributions

Conceptualization, T.F.A.L., Y.R.S. and A.J.L.; Methodology, T.F.A.L., Y.R.S. and A.J.L.; Investigation, L.F.F.R., H.O.J., S.S.P., G.P.M.S.D., J.I.S. and C.H.C.; Data analysis, T.F.A.L.; Manuscript writing and initial draft preparation, T.F.A.L., Y.R.S. and A.J.L.; Manuscript review and editing, L.F.F.R., H.O.J., S.S.P., G.P.M.S.D., J.I.S. and C.H.C.; Supervision, Y.R.S. and A.J.L. All authors read and approved the final manuscript. If there are other persons whose contribution does not entitle them for being authors, please acknowledge them also here.

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### Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Institutional Review Board

The protocol was approved by the Research Ethics Committee of the Hospital Universitário Pedro Ernesto at the Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, under number CAAE-13529913.7.0000.5259. The trial has been registered on ClinicalTrials.gov under the number NCT07198763.

### Consent Statement

All human subjects involved in this study provided a written informed consent prior to participation, including the consent of publishing their anonymized data.

### Data availability

All data presented in the manuscript are available from the authors upon request.

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