

# Physiotherapeutic Approach in Elderly With COPD: A Systematic Review

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## Research

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# Abstract

**Background:** The number of elderly individuals with chronic obstructive pulmonary disease (COPD) is increasing, resulting in high costs, especially in the Brazilian public health system. Scientific studies show that the physical therapy approach has benefits and assists in pulmonary rehabilitation, however, it is necessary to know the interventions that optimize the clinical and functional improvement of the individual.

**Objective:** To analyze physical therapy interventions and their main outcomes in elderly with COPD.

**Methods:** Five researchers independently searched the PUBMED, LILACS, SCIELO and SCOPUS databases. Publications in English, Portuguese and Spanish were delimited. The quality of the studies was assessed by the Consolidated Standards of Reporting Trials (CONSORT) guidelines. Study conducted according to PRISMA standards.

**Results:** The sample consisted of 9 trials. Of these, 6 obtained a positive outcome from the proposed analysis and 3 of the studies did not obtain significant results. There was no homogeneity in study interventions.

**Conclusion:** The interventions or techniques used in elderly patients with COPD who had significant positive outcomes were: Use of vibration devices to enhance strength exercises, the use of Kinesio Taping associated with other therapeutic interventions, resistance training programs, strength and balance and upper limb exercises with coordinated breathing.

**Systematic Review Record:** CRD42020141337

## Background

According to the World Health Organization (WHO), in developing countries are considered elderly, adults over 60 years and according to the WHO estimate, by 2025 Brazil will be the sixth country with the largest number of elderly people in the world. The elderly Brazilian population is made up of 29,374 million people, representing a percentage of 14.3% of the total population of the country. With the increase of the elderly population, it indicates that the characteristics of social inequality in the development of aging causing an increase in respiratory diseases, leading to changes in public treatment policies, promoting new forms of care for this population.<sup>1</sup>

Chronic obstructive pulmonary disease (COPD) is the fifth leading cause of hospitalization in the Brazilian public health system. In the last 20 years, the number of deaths has increased in both sexes, with about 340% in mortality between 1980 and 1990. In recent years, it has been in the 4th to 7th position among the leading causes of death in Brazil.. The percentage of this condition attributed to work was estimated at 19.2% overall and 31.1% among non-smokers. About 15% of smokers have COPD<sup>2</sup>.

It is characterized by airflow obstruction in the lungs not fully reversible, progressive and linked to a regular inflammatory response of the lungs to inhalation of harmful particles or gases. The chronic inflammatory process produces bronchial changes (chronic bronchitis) and causes destruction of the pulmonary parenchyma (emphysema), such changes that lead to air trapping and progressive airflow limitation. The main risk factors are: smoking, cigarette smoke, occupational dust, chemical irritants, environmental pollution, low socioeconomic status, severe childhood respiratory infections, malnutrition, prematurity and bronchial hyperresponsiveness. In general, patients have a productive cough, dyspnea, and chronic secretion production.<sup>3,4</sup>

Since the last decade, there has been a growing body of scientific evidence supporting the practice of interdisciplinary pulmonary rehabilitation in the clinical and functional improvement of COPD patients. In this context, physiotherapy aims to optimize functionality, reduce symptoms and improve quality of life.<sup>5,6</sup>

Despite the certainty of the symptomatological pattern of the affected, the physical therapy intervention in pulmonary rehabilitation should be individualized, considering the specific needs of the patient. Even though it is constantly standardized according to the stage and symptoms of the disease, it is necessary and increasingly scientifically proven to use specific interventions to optimize the clinical and functional improvement of the individual.<sup>7</sup>

Although there is a worldwide consensus on the indication of pulmonary rehabilitation to improve these patients, there is still a lack of studies that guide physiotherapy professionals in prescribing specific interventions for the elderly population with COPD<sup>8</sup>.

Although there are general objectives, most physical therapy treatments aim to reduce dyspnea, bronchial hygiene, improve the ability to perform physical exercises, increase self-care<sup>9</sup>.

There are several modalities of respiratory physiotherapy in the rehabilitation of COPD patients, among them physical training such as endurance training for patients in all stages of the disease as long as they have restrictions or limitations on daily physical activities; Interval training is an alternative for patients who have difficulty in continuous exercise at an intensity. Other strategies used to reduce dyspnea and improve performance when performing physical exercise are breathing exercises (lip-braking, active exhalation, slow and deep breathing, diaphragmatic breathing); self-care patient guidelines and energy conservation techniques<sup>3,10</sup>.

Considering the relevance and growth of the elderly population with COPD and the amount of scientific studies on physiotherapeutic approaches in COPD patients, it was decided to conduct a systematic review of these studies to provide scientific knowledge of physiotherapeutic approaches to improve decision making. in clinical practice.

## Methods

This is a systematic literature review guided by the following question: What are the physiotherapeutic interventions applied to elderly with COPD and their outcomes?

The Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH) were consulted, according to the Boolean operators AND and OR, being combined as follows: "Doença pulmonar obstrutiva crônica" AND Idoso AND "modalidades de fisioterapia"; "Pulmonary disease" OR "chronic obstructive" AND Aged AND "physical therapy modalities"; "Enfermedad pulmonar obstructiva crónica" AND anciano AND "modalidades de fisioterapia".

The search was conducted at the bases of PUBMED, LILACS, SCIELO and SCOPUS. The entire process of searching and selecting articles was conducted by five independent researchers. When considered consensually eligible by the five researchers, the articles were included in the study, when there was no consensus, the researchers discussed the study until reaching a common opinion. Standardized forms were used, following inclusion, exclusion criteria and the risk of bias was performed by the Consort Statement qualitative analysis tool.

Inclusion criteria for the selection of articles were: (a) studies that addressed some physical therapy treatment; (b) research conducted in the elderly population; (c) randomized and nonrandomized controlled clinical trials; (d)

studies published from 2009 to 2019; (e) studies specifically addressing elderly with COPD. The definition of the last 10 years (from 2009 to 2019) was given as a broad and current time. The exclusion criteria determined were: (a) observational studies, editorials, letters, dissertations and theses; (b) studies that do not address physical therapy intervention; (c) duplicate articles; (d) studies addressing a pathology other than COPD; as shown in Table 1.

Table 1  
Inclusion and exclusion criteria

<b>Inclusion criteria for article selection</b>	<b>Yes</b>	<b>No</b>
(a) studies that addressed some physical therapy treatment		
(b) surveys conducted in the elderly population		
(c) randomized and nonrandomized controlled trials		
(d) studies published from 2009 to 2019		
(e) studies specifically addressing elderly with COPD		
<b>Article exclusion criteria</b>	<b>Yes</b>	<b>No</b>
(a) observational studies, editorials, letters, dissertations and theses		
(b) studies that do not address physical therapy intervention		
(c) duplicate articles		
(d) studies addressing a pathology other than COPD		

At the beginning of the search, 247 studies were identified, 105 from PubMed, 15 from Lilacs, 27 from Scielo and 100 from Scopus. The articles were submitted to a title investigation applying the inclusion criteria, which resulted in the selection of 45 articles and exclusion of 202 articles, 3 from Lilacs 23 from Scopus and 19 from PubMed. In SciELO database no studies were found. Of the 45 articles, seventeen were excluded by duplication, leaving 28 publications that were evaluated according to the reading of the abstracts, after reading the abstracts, 19 studies were submitted for full reading and of these, 10 studies were excluded for not addressing individually the proposed inclusion criteria.

Finally, 9 studies were assessed by the Consolidated Standards of Reporting Trials (CONSORT) criteria, which is based on a checklist directed to 22-item controlled clinical trials<sup>11</sup>. Each item received a score from zero to one and each article had a final score from zero to 22 from each researcher. For the final grade, an average of five was performed. Subsequently, the score was transformed into a percentage to better evaluate the quality of the articles. The cutoff point for considering the studies as adequate or not suitable was 60%.

A thorough analysis allowed us to extract from the articles and present important information about the studies in a table. At the same time, a critical analysis of the texts was performed.

## Results

The study sample consisted of 9 trials that analyzed the effectiveness of various physical therapy treatments in elderly with COPD. Table 2 shows the score and the percentage of quality of articles based on the CONSORT criteria, demonstrating that they all have an average above 60%, ie, good quality.

Table 2  
 Score and percentage of quality of articles  
 based on the CONSORT criteria.

<b>References</b>	<b>Points</b>	<b>%</b>
Beauchamp <i>et al</i> , 2013.	19,26	87,5%
Dolmage <i>et al</i> , 2013.	14,52	66%
Greulich <i>et al</i> , 2014.	18,22	82,8%
Blackstock <i>et al</i> , 2013.	17,64	80,1%
Gloeckl <i>et al</i> , 2012.	16,38	74,4%
Daitx <i>et al</i> , 2018.	17,86	81,1%
Kodric <i>et al</i> , 2009.	13,46	61,1%
Osadnik <i>et al</i> , 2013.	15,92	72,3%
Dourado <i>et al</i> , 2009.	13,52	61,4%

Table 3 presents the synthesis of the selected studies regarding the author, title, year, place, language and journal, type of study, sample profile, evaluated variables, intervention, time, frequency, duration and their main results.

Author, title, year, location, language and periodical	Type of study, sample profile	Evaluated Variables	Intervention performed	Time, frequency and duration of intervention.	Main results
DAITX et al. Limited utility of Kinesio Taping® in the physiotherapy treatment for patients with chronic obstructive pulmonary disease exacerbation, 2018. Hospital Nossa Senhora dos Navegantes. English. Scopus	ective, randomized, single-blind study; total n = 62. GI: n = 31, average age = 66.5. Gender [M / F]: Not specified. CG: n = 31, average age = 66.8. Gender [M / F]: Not specified.	Respiratory muscle strength, FEV1, PEF and SpO2.	GC: 1) Manual passive expiratory therapy during expiration. 2) Active mobilization of upper and lower limbs. 3) five minute walk. GI: received standard treatment beyond Kinesio Taping	CG and GI: 3x10 repetitions of manual therapy and mobilization and 5 minutes of walking. 6 weeks	Both groups showed improvements in respiratory muscle strength. Kinesio Taping improves SpO2 in non-hypoxic COPD exacerbated patients.
GREULICH et al. Benefits of whole body vibration training in patients hospitalized for COPD exacerbations - a randomized clinical trial, 2014. University of Marburg. English. Pubmed.	Randomized study; total n = 49. GI: n = 20, average age = 66.4. Sex [M / F]: 14/6; CG: n = 20, average age = 70.4. Gender [M / F]: 8/8.	Exercise capacity, quality of life and circulating levels of irisine.	CG: 5 min mobilization, 5 min passive and 10 min breathing exercises; GI: Standard program supplemented with supervised sessions on the WBV device.	GC: 20 min, 24 hours. GI: 20 min + 3 x 2 min / day on WBV platform, 24 hours.	GI significantly improved exercise capacity, quality of life, and serum levels of PGC1-α and irisine.
DALMAGE et al. Arm elevation and coordinated breathing strategies in patients with COPD, 2013. Toronto, Canada. English. Pubmed	Prospective, randomized and controlled study. n total = 51, GC: n = 12 mean age = 66, Gender [M / F] = 5/7. GI1: n = 12, mean age = 69, Sex [M / F] = 8/4. GI2: n = 12, mean age = 65, Gender [M / F] = 4/8	Arm lift task resistance time.	GC: 1: 2 inhalation and exhalation without instructions on breathing when lifting the bar. GI1: Inspiration when lifting the bar. GI2: Expiration o lifting the bar.	All groups performed 4 teaching sessions and practiced the exercise until they reached an Inspiration: Expiration ratio of 1: 2. 2 weeks.	GI1: Improved coordination index. GI2: Improved endurance time.
OSADIK et al. Positive expiratory pressure via mask does not improve ventilation inhomogeneity	Randomized crossover study. total n = 12. CG: n = 12, mean age = 66, Sex [M / F] = 8/4.	Pulmonary function tests (MBNW, spirometry and volumes lung)	GC: Cough-controlled huffing. GI: PEP Therapy (10-20 cm H2O)	GC: 5 total cycles (2 huffing and 2 coughs). GI: 5 total cycles using PEP. 4 days.	There was no significant difference between the control and intervention groups, ie, a single PEP

more than huffing and coughing in individuals with stable chronic obstructive pulmonary disease and chronic sputum expectoration, 2013. Melbourne. English. Scopus	GI: n = 12, mean age = 66, Gender [M / F] = 8/4.				mask treatment did not improve ventilation heterogeneity or increase CRF.
BEAUCHAMP, et al. A Randomized Controlled Trial of Balance Training During Pulmonary Rehabilitation for Individuals With COPD, 2013. West Park Healthcare Center. English. Pubmed	Prospective, controlled and randomized study. total n = 36. CG: n = 18, average age = 67.1. Gender [M / F] = 8/10. GI: n = 21, average age = 71.9, Gender [M / F] = 7/14	Balance tests (the Berg Balance Scale (BBS), Systems Test Balance Assessment (BESTest) and the Activity-specific Balance Confidence Scale (ABC)). self-reported physical function (Short-Health Survey Questionnaire (PF-10)) and lower limb muscle strength (30-s chair test)	GC: Received only standard lung rehabilitation (PR) program. GI: Standard PR and balance training.	GC: 5x week physical training, daily breathing exercises and self-management education. 6 weeks GI: PR time and 30 min of balance training, 3x week. 6 weeks	Both groups showed improvement, but GI had better results in balance, physical function and muscle strength of the lower limbs compared to CG.
BLACKSTOCK, et al. Comparable improvements achieved in chronic obstructive pulmonary disease through pulmonary rehabilitation with and without a structured educational intervention: A randomized controlled trial, 2013. Australian Clinical Trials. English. Pubmed	Randomized controlled trial. total n = 267. CG: n = 126, average age = 72.0. Gender [M / F]: 72/54. GI: n = 141, average age = 72.4. Gender [M / F]: 89/52.	Functional exercise capacity (6MWD), specific HRQoL (CRQ), dyspnea (Medical Research Council dyspnea scale), overall HRQoL (AQoL Questionnaire), and self-reported efficacy.	CG: Standard exercise training for COPD patients and exercise guide illustrated with daily home exercise. GI: Standard exercise training for COPD patients and educational program.	GC: 5x week. 6 weeks GI: 5x week exercise training and 16 45min sessions of educational program.	Both groups had similar significant improvements immediately after the intervention, and these were maintained comparatively for the subsequent 12 months. There was no significant difference between the two groups.
KODRIC, et al. The effectiveness of a bronchial drainage technique (ELTGOL) in COPD exacerbations, 2009. University	Randomized controlled trial. total n = 59, CG: n = 29, average age: 71.3, gender [M / F]: 21 \ 8, GI: n = 30,	Sputum volume, Length of stay, Dyspnea (Borg scale), Quality of life (St George Respiratory Questionnaire) and incidence	GC: Standard medical therapy. GI: Standard medical therapy and respiratory physiotherapy (ELTGOL) for 7 days.	GI: 30-40min, 2x daily, 7 consecutive days, plus standard medical therapy. 6 months beyond the	Both groups had similar significant improvements in hospital discharge. In the long run there were no significant differences

Hospital of Cattinara. English. Pubmed	average age: 69.1, gender [M / F]: 20 / 10.	of exacerbations.	Sessions 30 to 40 minutes the amount of days in the week.	individual hospital stay.	between the groups.
GLOECKI et al. Effects of whole body vibration in patients with chronic obstructive pulmonary disease - A randomized controlled trial, 2012. Bavaria. English. Pubmed	Prospective, randomized and controlled study. total n = 82. CG: n = 40 mean age = 65, Sex [M / F] = 21/19. GI: n = 42, average age = 65, Sex [M / F] = 23/17	Exercise capacity (6MWT, sit-to-stand), Pulmonary function, Quality of life and mortality risk (BODE)	GC: Standard rehabilitation program and supervised squat exercises. GI: Standard rehabilitation program and supervised squat exercises on a full body vibrating plate.	GC and GI: 3x 3 min squats, 3x week. 21 days.	GI significantly improved the functional capacity of individuals.
DOURADO et al. Effect of three exercise programs on patients with obstructive pulmonary disease chronic, 2009. Rehabilitation Center of Universidade Estadual Paulista (UNESP). English. Lilacs.	Prospective, randomized, single-blind study. total n = 13, CG: n = 3, average age = 62.1. Gender [M / F]: 7/4, GI1: n = 4, average age = 61.3. Gender [M / F]: 9/2. GI2: n = 6, average age = 65.4. Gender [M / F]: 10/3	Quality of Life, functional exercise tolerance and respiratory and peripheral muscle strength.	GC: TF and TGBI at half volume. GI1: 7 bodybuilding exercises with 50-80% workload. GI2: Walking with determined intensity and low intensity resistance training with free weights.	GC: 30 min TF and 30 min TGBI. 12 weeks GI1: 3x12 repetitions, 12 weeks. GI2: 30 min walk and 30 min resistance training. 12 weeks	Strength training associated with a COPD endurance training program increases the muscle strength of the upper limbs and lower limbs.
<p>LEGEND: GC: control group; GI: intervention group; M / F: male / female; WBV: whole body vibration; n: number; FEV1: forced expiratory volume in 1 second; PEF: peak expiratory flow; SpO2: oxygen saturation; TF: strength training; TGBI: low intensity general training; COPD: Chronic Obstructive Pulmonary Disease (chronic obstructive pulmonary disease); 6MWT: 6-minute walk test; BODE: Obstructive Dyspnea Airflow Body Mass Index and Exercise Capacity Index; MBNW: multiple breath nitrogen flush tests; PEP: positive expiratory pressure; BBS: Berg Balance Scale; BESTest: Equilibrium Assessment Systems Test; ABC: Specific Activity Balance Confidence Scale; PF-10: subscale of physical function of the Short-Health Survey questionnaire; PR: pulmonary rehabilitation; HRQoL: health-related quality of life; CRQ: Chronic Respiratory Questionnaire; AQoL Questionnaire: quality of life assessment questionnaire; ELTGOL: Full slow exhalation with open glottis.</p>					

Two studies were developed in Canada (22.22%), two were developed in Australia (22.22%), two were developed in Germany (22.22%), two were developed in Brazil (22.22%) and one in Italy. (11.11%). All 9 studies (100%) were published in English in various journals.

There was no homogeneity in study interventions. Two studies<sup>12,13</sup> used interventions using the vibrating platform. Two other studies<sup>14,15</sup> used respiratory modalities. A study<sup>16</sup> evaluated respiratory coordination associated with upper limb movements. Beauchamp's study<sup>17</sup> used a specific balance training. Blackstock, et al<sup>18</sup> evaluated the addition of educational classes to conventional exercises. Daitx<sup>19</sup> evaluated the influence of Kinesio Taping on conventional treatment. GOLDEN, et al<sup>20</sup> used exercise programs as an intervention. The average age of the study participants was 68 years old, and all involved female and male subjects.

## Discussion

In the design of the present study, 9 randomized and nonrandomized articles were analyzed, in which various types of physiotherapeutic interventions in the treatment of COPD in elderly patients were presented, from the analyzed trials, 6 studies obtained a positive outcome from the proposed analysis and 3 of the studies<sup>14,15,18</sup> did not obtain significant results.

One of the physiotherapeutic interventions used in the treatment of COPD is whole-body vibration that emerged in the early 1970s through training with Russian astronauts to prevent bone and muscle mass loss and subsequently to be employed in the training of athletes. Two of the included studies use the whole body vibration technique, one using the force exercise (squat) on the vibration platform and the other breathing exercise on the vibration platform. Due to the lack of data on the technique approach, the analyzed article demonstrates that the training modality is promising, allowing improvements for the exercise capacity, muscular strength and quality of life of these patients.<sup>12,13,21</sup>

The Kinesio Taping method, developed in 1996 by Kenzo Kase, consists in the direct application of the therapeutic bandage, with the view of stimulation of the musculature to be treated, where its effects depend on the form and force of application produced by the stretch, to correct the function. weak muscle function, increased blood and lymphatic circulation, increased proprioception, and other repercussions<sup>22,23</sup>. The Daitx study<sup>19</sup> demonstrated that this technique associated with conventional respiratory physiotherapy has seen an increase in SpO<sub>2</sub> in nonhypoxemic patients with COPD exacerbations.

Given the results of the study on resistance training, it was considered that through three procedures performed to evaluate the response in body composition, quality of life, dyspnea, muscle strength and exercise tolerance in patients with COPD, had significant improvements. on all parameters<sup>20</sup>. Relating the same with another study that reports that in the face of such procedures, exercises are indicated to be performed between 60–80% of the maximum load, promoting greater benefits, thus generating positive actions to the symptoms of dyspnea, exercise tolerance and exercise. quality of life, preferably in patients with moderate to severe COPD<sup>24</sup>.

The study by Dolmage, et al<sup>16</sup> addresses the influence of respiratory phase coordination on arm lift exercises. Such exercises are common in the treatment of COPD patients, due to the frequent difficulties and dyspnea in tasks requiring arm elevation.

Other studies on arm lift exercise have already been done with the instruction to breathe in during arm lift or without specific breathing instructions, but none compared these three practices. In this study comparing the three modalities, participants who were instructed to exhale during the survey showed significant improvements in activity performance and breathing sensation at the end of the exercise, suggesting that this strategy may help patients in rehabilitation, possibly due to, the mechanical advantage of shoulder flexors during exhalation that causes increased strength in the arm lift movement<sup>25,26</sup>.

Pulmonary rehabilitation programs support the implementation of an educational program in its context, aiming at better educating the patient about their pathology and the proper care to be taken, among their benefits are: the active participation of the patient in the care of their health, the assistance to the patient and family about how to deal with the disease, understanding of its functional changes, physical and psychological consequences. Aiming at this thinking, one study<sup>27</sup> used as an integral part of the pulmonary rehabilitation program the educational

program as in the study by Blackstock, et al<sup>18</sup> and in both studies, identified a significant improvement after the physical therapy intervention associated with the educational program.

Total slow expiration with open lateral decubitus glottis (ELTGOL) is a technique of bronchial clearance. The analyzed article performs this procedure in the lateral posture with the open glottis, from the residual functional capacity to the residual volume. This technique is indicated in cooperative patients with hypersecretion and in patients in whom forced maneuvers can cause constrictions or proximal collapses that compromise secretion elimination. As the study analyzed, this procedure does not show greater benefit in the technique of wide methodological variation prevented the production of higher level of evidence.<sup>28</sup>.

In order to minimize the detrimental effects of explosive cough, in addition to reducing the large energy expenditure, reducing dyspnea and subjective perception of fatigue, in the forced expiration technique (huffing), there should be an orientation to the patient regarding the knowledge of their effects. phases with reduced expiratory flow velocity<sup>29</sup>. Positive expiratory pressure (PEP) therapy involves expiratory respiration against a small resistance ranging from 10–20 cmH<sub>2</sub>O, and applying it with a PEP mask increases lung volumes and intrathoracic pressure. According to the study by OSADNIK, et al<sup>15</sup> there are no significant differences between the use of Huffing and PEP, because regardless of any benefit derived from therapy there appears to be no mediation for improvements in ventilation due to changes in lung volumes<sup>30</sup>.

Balance training has not resulted in major improvements in primary measurements, but there are no comments on the long-term persistence of these effects, where it reports that balance training in patients with this condition is a relevant factor in functional limitation, decrease risk of falls, also noting improvements in lower limb strength and self-reported physical function, being well tolerable in patients with moderate to severe COPD. However, there is little scientific evidence on the subject addressed.<sup>17</sup>.

During the elaboration of the study, recurrent limitations were observed on each included article, highlighting points such as: a short time of the applied protocols, heterogeneity of the conduct and lack of specification about the frequency of the interventions.

## Conclusion

COPD is the fifth leading cause of hospitalization in the public health system in Brazil. The implications of this condition have negative impacts on various conditions, especially quality of life, lung function, health service use and survival. However, a good elaboration of the therapeutic conduct establishes a better elaboration in the control of this disease<sup>31</sup>.

The different therapeutic modalities are used in patients with COPD, resulting in a wide range of resources to be used and / or added in standard pulmonary rehabilitation to optimize clinical outcomes, especially in the elderly requiring urgent discharge.

Of the articles included in this review, none used the same physical therapy modality. Thus, the interventions or techniques used in elderly patients with COPD were: the use of vibration devices to potentiate strength exercises, the use of Kinesio Taping associated with other therapeutic interventions, resistance training programs, strength and balance program. educational, coordinated breathing upper limb exercises, and breathing techniques such as

ELTGOL, PEP therapy, and Huffing. A wide methodological variety was analyzed, which hindered results with higher level of evidence.

This review highlights the need to conduct more clinical trials involving physiotherapeutic interventions in this population and with better methodological descriptions, with the purpose of assisting the therapeutic decision making by the physiotherapy professional and providing better outcomes to patients.

## **Abbreviation List**

COPD - Chronic Obstructive Pulmonary Disease

WHO - World Health Organization

CONSORT - Consolidated Standards of Reporting Trials

ELTGOL - Total slow exhalation with open glottis in lateral decubitus

PEP Therapy - Positive Expiratory Pressure Therapy

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All authors acknowledge that there are no conflicts of interest with any companies / organizations whose products or services may have influenced this study or manuscript.

### **Authors' Contribution**

ACBD: contributed to the conception, design of the study and shared scientific discussions.

AFO: contributed to the study organization, manuscript writing and data analysis and interpretation.

ANC: contributed to the study organization, manuscript writing and data analysis and interpretation.

PCC: contributed to the conception and design of the study.

JAM: contributed to the study organization, manuscript writing and data analysis and interpretation.

KMOA: contributed to the study organization, manuscript writing and data analysis and interpretation.

LFLL: contributed to the study organization, manuscript writing and data analysis and interpretation.

WMS: reviewed the work substantively.

All authors read and approved final manuscript

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## Figures

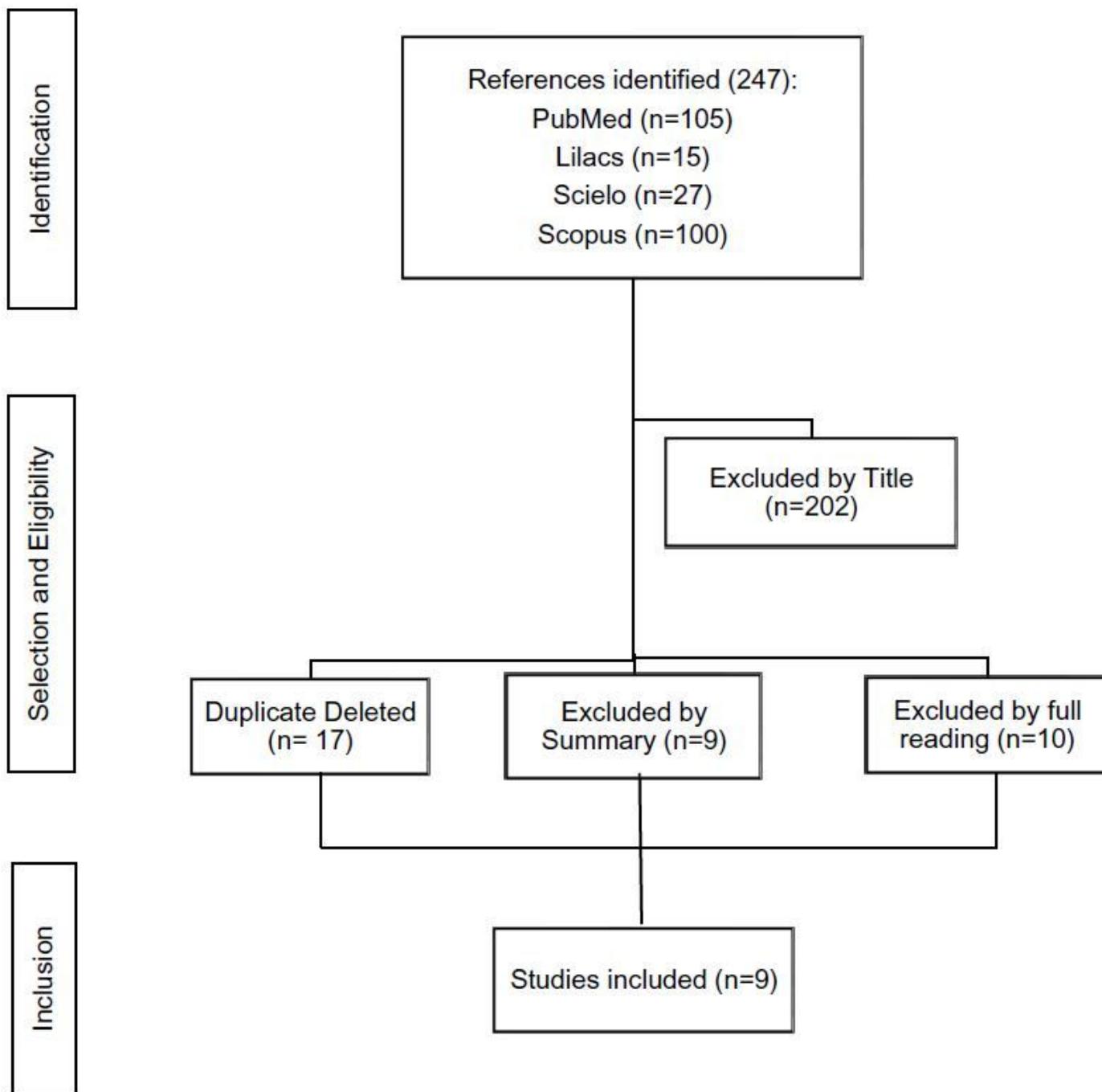


Figure 1

Flowchart of steps followed for article selection

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