

Effects of Physical Exercise in Patients with Pulmonary Blood Hypertension: A Systematic Review

Damille Santos De Freitas, Gustavo Dourado Macedo Marques, André Luiz Lisboa Cordeiro* and Amanda Marinho

Nobre College, Feira de Santana, Bahia, Brazil

*Corresponding author: André Luiz Lisboa Cordeiro, Nobre College, Feira de Santana, Bahia, Brazil, Tel: +557521029100; E-mail: andrelisboacordeiro@gmail.com

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Abstract

Introduction: Pulmonary Arterial Hypertension (PAH) is a complex clinical abnormality and its main characteristic is the increase in pulmonary arterial pressure followed by progressive advancement in vascular resistance, making it difficult for blood to pass through the arteries. Physical exercise is a non-drug treatment option for this population.

Objectives: To investigate the role of physical exercise in patients with pulmonary arterial hypertension.

Methodology: A search was made in the databases: Pubmed, Scielo and Lilacs in the last 10 years, and no language restriction were imposed. We searched for articles that reported the impact of physical exercise on functional variables in patients with PAH.

Results: Six articles were selected, which verified an improvement in the quality of life, an increase in the distance covered in the six-minute walk test and a reduction in the level of fatigue, without hemodynamic changes, in the group of patients who performed aerobic exercises.

Conclusion: It is suggested that physical exercise, such as aerobic training, promotes increased functional capacity and quality of life in patients with Pulmonary Arterial Hypertension.

Keywords: Hypertension; Pulmonary; Exercise; Quality of life

pulmonary arterial pressure followed by progressive advancement in pulmonary vascular resistance, making it difficult for blood to pass through the pulmonary artery.

The incidence of sporadic cases of PAH is approximately 1 or 2 per million people in the cases associated with connective tissue disease with pulmonary hypertension is approximately 10% to 30% of cases with scleroderma present severe pulmonary hypertension, a decisive factor of mortality in this group of patients or up to 50% in cases diagnosed by echocardiography [1].

During exercise, hypoxemia and gas exchange, with reduced carbon monoxide diffusion capacity and decreased oxygen saturation, contribute to decreased functionality in pulmonary hypertension. When hypoxemia occurs, it leads to dyspnea and increased ventilation by stimulation of skeletal muscle chemoreceptors. This musculature evolves with changes in the fibers, occurring dysfunction and weakness [2].

The pathophysiology of HP patients influences factors that limit physical exercise. To carry out the interventions, planning and structuring of these exercises, it is important to identify pathophysiological problems. Moderate intensity exercise is a conservative approach. Resistance training will be important in neutralizing skeletal muscle strength and endurance limitations that occur in PH patients, improving functional capacity and ability to perform activities of daily living [3,4].

The purpose of physiotherapy in relation to pulmonary hypertension is to guide patients by limiting excessive exertion during physical activities, avoiding sudden movements and air travel, as it may lead to worsening of hypoxemia, minimize respiratory problems, prevent and treat right ventricular insufficiency, control hypoxia, avoid acidemia and prevent the risk of thrombosis [5,6].

According to Damasceno physiotherapy is able to promote the rehabilitation and protection of the functionality of joints and muscles, through kinesiotherapy and its variables, helping and assisting its multi-professional team, physiotherapy enters with the role of controlling hypoxia and avoiding academia [7].

Introduction

Pulmonary arterial hypertension (PAH) is a complex clinical abnormality. Its main characteristic is the increase in

Pulmonary Rehabilitation is a treatment that includes physical training, patient education, oxygen therapy, social support and nutritional intervention and has been demonstrating efficacy to improve dyspnea, exercise capacity and quality of life. The physical training shows the patient that the exercise leads to improvement in dyspnoea and physical capacity, motivating him to maintain the exercises even after the end of his rehabilitation period in addition to training the inspiratory muscles using the Threshold equipment, which presents a system of locking for inspiration by a diaphragm by the spring adjustment inside it [8,9].

The objective of this study is to analyze the impact of exercise in patients with Pulmonary Arterial Hypertension.

Materials and Methods

Search strategy for study identification

The literature search was performed using the following databases: Pubmed, Lilacs and Scielo from October 2007 to July 2017, and no language restriction were imposed for the research, and only the studies developed in the last 10 years were used.

The keywords used to search for articles were: physical exercise and physical therapy and pulmonary hypertension and physical and pulmonary arterial hypertension and exercise and training.

Eligibility criteria

Participants in the studies should be 18 years of age or older and have Pulmonary Hypertension throughout the world. The review involved the use of studies that were based on the application of physical exercise in patients with individual pulmonary arterial hypertension or group and, outcome measures should include variables concerning musculoskeletal function, functionality or quality of life. We excluded the studies developed in children, those that did not present results based on the analysis of the desired variables, those developed in a clinical setting different from ambulatory units and studies that used physical exercise combined with drug therapy.

We included randomized clinical trials that investigated the effects of physical exercise in patients with Pulmonary Arterial Hypertension. Non-randomized studies, case reports, and clinical observations were excluded.

Methodological quality assessment

Eligible studies were systematically analyzed with a methodological quality assessment tool. For this analysis, the

PEDro scale was used, which uses a scoring system varying from 0-10 points, whose higher scores reflect higher methodological quality of the studies.

Two reviewers assessed the methodological quality of the studies independently, and the outcome was compared and discussed until an agreement was reached. If there was divergence between the evaluators, the studies would be sent to an assessed third party. Studies with a score of 5 or lower on the PED scale were considered of low to moderate quality.

It should be noted that the PEDro scale score was not used as a criterion for inclusion or exclusion of articles, but rather as an indicator of the scientific quality of the studies previously used.

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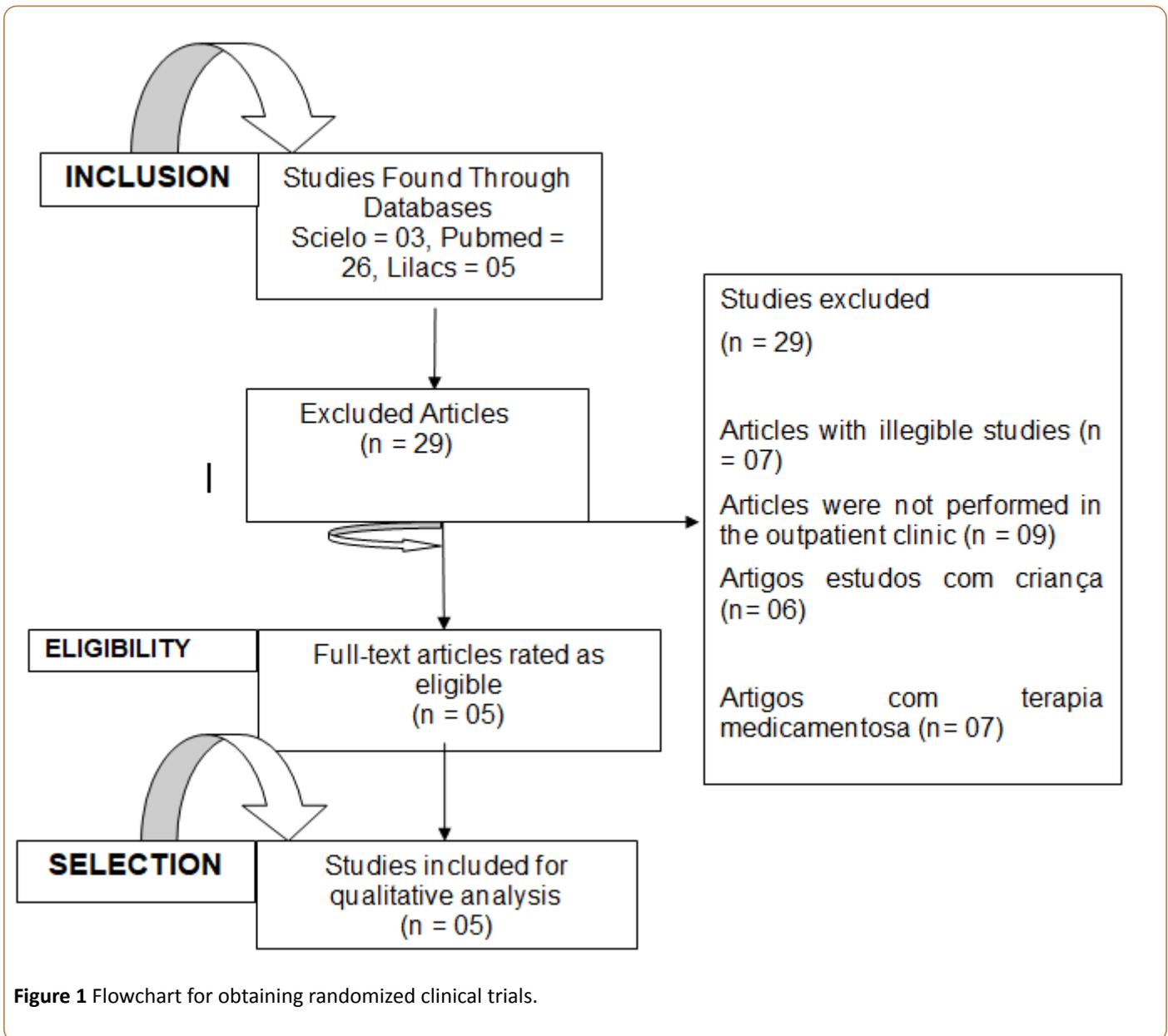
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Extraction of data

Initially, the selections from the studies for extracting the required data were based on the verification of the study titles as well as the analysis of the available abstracts. Subsequently, the full study reports were compared to the pre-established inclusion criteria in order to determine their relevance to the systematic review. Two reviewers extracted the data in order to examine the characteristics of the study.

Results

After analysis of 26 articles 21 were excluded according to eligibility criteria. Exclusion was given ineligible studies, studies with children and exercises with drug therapy and those that were not performed in outpatient clinics (**Figure 1**). Following a precise analysis for the development of this systematic review, five clinical trial studies 10-14 were potentially chosen, including the methodological criteria established for the proposed outcome.



The methodological quality assessed through the PEDro scale is shown in **Table 1**. The five studies included in this systemic review discuss the repercussion of physical exercise in patients with Pulmonary Arterial Hypertension.

Table 1 Methodological Quality Assessment of the Studies included in this review using the Pedro Database scale.

	Ganderton et al. [10]	Chan et al. [11]	Fowler et al. [12]	Gallaser et al. [14]	Weinstein et al. [13]
The eligibility criteria have been specified.	Yes	Yes	Yes	Yes	Yes
Subjects were randomly assigned to groups.	Yes	Yes	Yes	Yes	Yes
The subjects' allocation was secret.	No	No	No	No	No
Initially, the groups were similar for the most important prognostic indicators.	Yes	Yes	Yes	Yes	Yes
All subjects participated blindly in the studies.	No	No	No	No	No

All the therapists who administer the therapy did so blindly.	No	No	No	No	No
All the evaluators who measured at least one key result did so blindly.	Yes	No	No	No	No
Measurements of at least one key outcome were obtained in more than 85% of subjects initially allocated to groups.	No	No	Yes	No	Yes
All subjects from whom outcome measurements were submitted received the treatment or control condition according to the allocation, or when this was not the case, the data were analyzed for at least one of the key outcomes by "intention of treatment".	No	No	No	No	No
Os The results of the statistical comparisons between groups were described at least one key result.	Yes	Yes	Yes	Yes	Yes

We have related 05 articles in which convergent goals for a better understanding about the effects of physical exercise in patients with pulmonary hypertension (**Table 2**). The articles contain information about the benefits of physical exercise on

patients with Pulmonary Arterial Hypertension, the factors that improve the functional capacity of these patients and the relevant role of physical training and the authors' conclusion regarding the topics addressed in this research.

Table 2 General data on randomized controlled trials included. HAP- pulmonary arterial hypertension; HRQL-quality of life related to health; RM-Maximum Repeat; NYHA- New York Heart Association.

Author/Year	Sample	Average age (years)	Goal	Intervention	Results
Ganderton et al. [10]	34	Uninformed	Investigate benefits for 12 weeks based on ambulatory, individualized exercise, involving supervised exercise sessions in individuals with PAH.	Resistance training of lower limbs (walking and cycling). Functional lower limb strength, step-ups training (sit on pews) and upper limb training.	It showed significant improvements in exercise tolerance as measured by an increase in the minimum walking distance in 6 minutes or resistance in a cycle ergometer, improvement in muscle strength, endurance and HRQoL.
Chan et al. [11]	23	21±82	To examine the impact of exercise to decrease fatigue, severity, and increased physical activity in PAH patients.	The exercise program consisted of 24 to 30 treadmill sessions, 30 to 45 minutes per session in 70% to 80% heart rate reserve	Overall, exercise training resulted in a significant improvement in the 6-minute walk test distance in the combined exercise group, whereas there was no significant change in the 6-minute walk test over the 10-week period.
Fowler et al. [11]	14	Uninformed	Observe hemodynamic responses in patients with exercise-induced pulmonary hypertension.	Cyclergometer test, maximum resistance test (1RM) and one repetition resistance exercise in 40% and 60%.	There were no differences in hemodynamic or symptomatic response between the two modalities of submaximal exercise. At maximum exercise, all hemodynamic responses and symptoms were lower during endurance compared to aerobic exercise.
Gallaser et al. [14]	17 women 5 Men	Women 46.9 ± 12.7 and Men 57.47 ± 15.1	To compare an individualized NYHA adapted exercise protocol relationship with a fixed standard. Protocol in patients with severe pulmonary hypertension and right heart failure using a randomized protocol.	To compare an individualized NYHA adapted exercise protocol relationship with a fixed standard. Protocol in patients with severe pulmonary hypertension and right heart failure using a randomized protocol.	Dyspnoea in 16 patients (including all patients assessed as NYHA class III)

Weinstein et al. [13]	24	54.4 ± 10.4	Investigate the effectiveness of an exercise intervention to reduce fatigue severity and increased physical activity in individuals with pulmonary arterial hypertension.	The aerobic exercise training consisted of 24 to 30 treadmill sessions walking for 30 to 45 minutes per session, with an intensity of 70-80% of the heart rate reserve, three days a week over the 10 weeks.	After 10 weeks of intervention, patients who received aerobic exercise training reported higher levels of physical activity and a decrease in fatigue severity compared to the education group.
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Discussion

Based on the studies we have shown the main intervention for PAH patients are aerobic exercise, demonstrating an increase in quality of life and improved exercise capacity.

According to Fowler, there was no hemodynamic and symptomatic response to cycloergometer training and maximal 1-repetition resistance test (MRI) in patients with PAH, all of which were lower during the resistance test compared to exercise aerobic. The exercise-induced pulmonary arterial hypertension group (HPIE) presented lower oxygen consumption in the six-minute walk distance and 1RM exercise compared to the control group.

An individual exercise program (cycle ergometry, peripheral muscle training of the lower limbs and upper limb exercise) throughout the body for 12 weeks promoted improved exercise capacity and health-related quality of life [10]. As well as in the study by Fowler et al. no adverse events were recorded. This demonstrates that physical activity for this patient profile is feasible and safe [11].

Aerobic exercise is a useful tool for increasing functional capacity, assessed by the six-minute walk test. In the studies by Chan et al. and Weinstein et al., there was an increase in distance during the six-minute walk test, improvement in treadmill exercise test duration, increase in peak oxygen consumption power, and none dyspnea during aerobic exercise compared to the education group [12,13]. Patients in the aerobic exercise group had better performance in physical activities and reduced fatigue level.

One possible explanation for the increase in the aerobic capacity of these patients is the increase in muscular blood flow and, consequently, longer stay in an oxidative pathway, generating less lactate production and muscle fatigue.

It is worth mentioning that this result was associated with educational intervention, which consisted of weekly one-hour readings on anatomy, physiology, pulmonary diseases, medication use, oxygen therapy, sleep disturbance, infection prevention, airway clearance, lung function interpretation, panic control, relaxation techniques, social well-being, nutrition, and exercise benefit.

Despite the apparent positive role of aerobic exercise, Gallaser et al. did not demonstrate significant differences in relation to peak oxygen consumption, exercise performance, and ventilation on the first and second day of cardiopulmonary exercise testing [14]. This lack of significance may be associated with the limited sample size, only 22 patients, and the protocol used in the study. Due to the diversity of

protocols it is still not possible to state which would be the most accurate for the evaluation of these patients.

A common finding in the studies is the improvement of the quality of life [10,11,13]. It is worth mentioning that it is associated with activities of daily living and social participation, since there is an increase in functional capacity is notorious the change in quality of life since the patient returns to their interaction with the environment. One limitation of this study was the methodological divergence between the articles, all of them applied physical exercise as a predictor, but the outcome variables were diverse as demonstrated in the results and discussion.

Conclusion

The results demonstrate that physical exercise, such as aerobic training, promotes increased functional capacity and activities of daily living in patients with Pulmonary Arterial Hypertension.

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