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Literature review

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Respiratory Dysfunction in patients with Parkinson's disease: systematic review

Disfunções respiratórias em portadores de doença de Parkinson: revisão sistemática

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RESUMO | INTRODUÇÃO: A Doença de Parkinson (DP) é uma patologia neurodegenerativa, lentamente progressiva. As alterações posturais típicas da DP, associado à rigidez dos músculos intercostais, comprometem a mobilidade da caixa torácica, repercutindo na diminuição da expansibilidade pulmonar na inspiração e da depressão torácica na expiração. A dinâmica respiratória é afetada pela diminuição da força dos músculos respiratórios, a qual leva a atelectasia, hipoxemia e insuficiência ventilatória. **OBJETIVO:** Identificar através de revisão sistemática quais as disfunções respiratórias na doença de Parkinson. **MATERIAS e MÉTODOS:** trata-se de um estudo de Revisão Sistemática, sobre as disfunções respiratórias na doença de Parkinson. Foram realizadas buscas nas bases de dados, Medline, PubMED, Lilacs, SciELO, Scopus não foi imposta restrição de idiomas para pesquisa. Para critério de inclusão foram selecionados estudos que relataram as disfunções respiratórias na DP, desenvolvidos nos últimos 10 anos. A qualidade metodológica dos estudos foi analisada utilizando a escala de PEDro. **RESULTADOS:** Na buscar iniciada no período de 2009 a outubro de 2019, foram incluídos 10 artigos nesta revisão sistemática que demostraram as disfunções respiratórias na doença de Parkinson. **CONCLUSÃO:** Os estudos demostraram que a doença de Parkinson apresenta diminuição do volume expiratório forçado no primeiro segundo, diminuição da capacidade vital forçada, aumento do volume residual e resistências das vias aéreas.

PALAVRAS-CHAVE: Doença de Parkinson. Disfunções respiratórias. Complicações respiratórias. Alterações respiratórias.

ABSTRACT | INTRODUCTION: Parkinson's disease (PD) is a slowly progressive neurodegenerative disorder, being the characteristic neurological sign of the loss of dopaminergic neurons in the compact part of substantia nigra, causing and unknown and affecting elderly people over 65 years. The clinical features published in PD are used for signs and symptoms such as tremor at rest, bradykinesia, hypokinesia, postural alteration, loss of postural reflexes and freezing phenomenon. Because typical postural changes in PD, associated with intercostal muscle stiffness, compromise rib cage mobility, decrease the impact on pulmonary expansion on inspiration, and thoracic changes in respiration, respiratory respiration is affected by respiratory muscle strength, occasionally respiratory muscle strength intercostal muscles stiffness and bradykinesia leading to atelectasis, hypoxemia and ventilatory insufficiency. **OBJECTIVE:** Identify, through systematic review, what are the respiratory dysfunctions in Parkinson's disease. **MATERIALS AND METHODS:** This is a systematic review study on respiratory dysfunction in Parkinson's disease. Searches were performed in the databases Medline, Pubmed, Lilacs, Scielo, and no language restrictions were imposed for research. For inclusion criteria, studies related to respiratory dysfunction in PD lasting 10 years were selected. The methodological quality of the studies was analyzed using a PEDro scale. **RESULT:** In the research initiated between 2009 and October 2019, 10 articles were included in this systematic review that demonstrated respiratory dysfunction in Parkinson's disease. **CONCLUSION:** Studies of Parkinson's disease showed decreased forced expiratory volume in one second, decreased forced vital capacity, increased residual volume and airway resistance.

KEYWORDS: Parkinson's Disease. Respiratory disorders. Respiratory complications. Respiratory changes.

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Introduction

Parkinson's disease (PD) is a neurodegenerative pathology, slowly progressive, presenting a characteristic neurological signal to the loss of dopaminergic neurons in the compact part of the substantia nigra. The cause is unknown and affects the elderly over 65 years old[1,2].

According to the World Health Organization (WHO)[1], 1% of the world population over 65 years old has Parkinson's disease. . This typical disorder of old age is the second most prevalent neurodegenerative disease in the world, affecting about 6.3 million people. It still estimates that the total number of patients will grow by 2030.

The clinical features presented in DP are recognized through the signs and symptoms such as: tremor at rest, bradykinesia, hypokinesia, postural alteration, loss of postural reflexes, freezing phenomenon[3]. Some secondary changes are found, among them as respiratory, and comprise one of the main causes of death in Parkinson's disease[3,4].

Postural changes typical of PD (trunk flexion, protrusion of the head and kyphoscoliosis), associated with the intercostal muscles rigidity compromise the chest mobility, reflecting a decrease in lung expansion during inspiration and expiration depression in the chest[3,5,6]. At the low chest wall compliance and restrictive lung disease has therefore reduced capacity to inflate the lungs, thus reducing the potential for generating exhaled air flow necessary for effective coughing[7,8].

In PD respiratory dynamics are affected by decreased respiratory muscle strength, caused by the rigidity of the intercostal muscles and bradykinesia which leads to atelectasis, respiratory failure and hypoxemia, continuous progression of respiratory muscle weakness or decreased lung compliance and chest wall can lead to increased work of breathing, resulting in a decline of functional status, contributing to deterioration of quality of life[9,10].

The purpose of this article was to conduct a systematic review to identify what are the respiratory disorders in Parkinson's disease.

Methods

This systematic review was carried out according to the criteria of PRISMA MOHER, et al. (2010)[9], by two independent researchers, one of whom had great experience in systematic review. It is worth mentioning that this review was registered with Prospero - (International Bank for the Registration of Systematic Reviews) under the identification number 151291. A literature search was performed using the following databases: Medline, PubMed, Scopus, Lilacs, SciELO, not imposed language restriction for the search, selecting the studies developed in the last 10 years. The descriptors used for the search were: Parkison´s disease, respiratory dysfunctions, respiratory complications, respiratory changes.

The selection criteria were given to studies that reported respiratory dysfunction in PD. Excluded: monograph, completion of course work, systematic review, case report and literature review. The eligible studies were analyzed systematically with an instrument for assessing methodological quality. For such an analysis an analysis, a Pedro scale was used, a variable scoring system from 0 to 10 points, these higher scores reflected in higher methodological quality of the studies.

A Pedro scale is based on the Delphi list, developed by Vergen et al. A study developed by Maher et al.[9] and a recent review by Elkins et al. in 2010, consider a substantial range of substances to assess the methodological quality of a randomized clinical trial in physiotherapy. Two reviewers assessed the methodological quality of the studies independently the result was compared and discussed until an agreement was reached, studies with a higher score on the scale of Pedro were considered high quality. It should be noted that the score of Peter scale was not used as a criterion for inclusion or exclusion, but a scientific indicator.

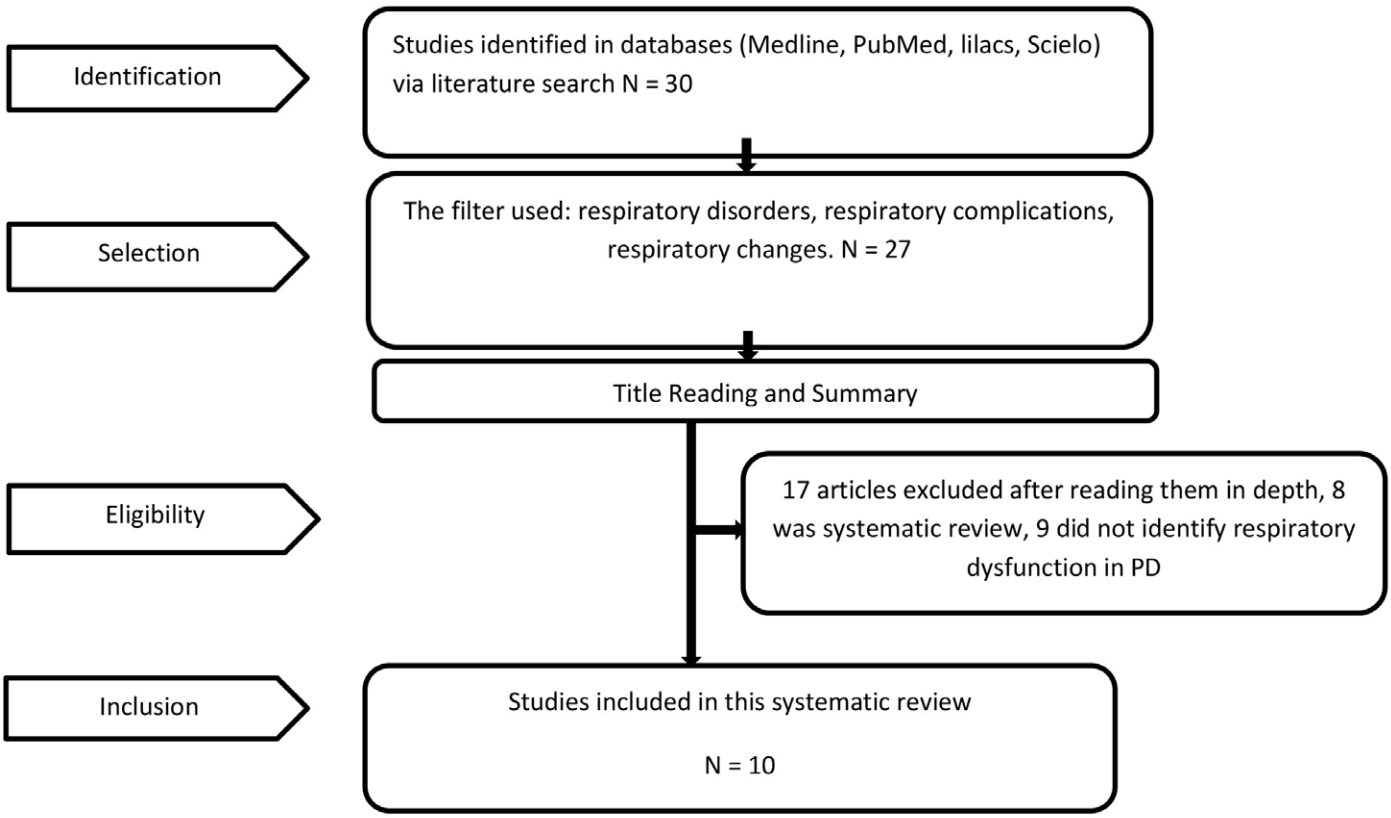
Initially the study selection was based on the verification of the titles of the studies and the analysis of available abstracts. Subsequently, the full reports of the studies were compared with the inclusion criteria, pre-established, in order to determine their relevance to systematic review reported that respiratory dysfunction in Parkinson's disease.

Results

In the search performed on Medline, PubMed, Lilacs, Scopus and started from January 2009 to October 2019 by two researchers identified a total of 30 articles, reduced to 27 when applied to the key words: respiratory disorders, respiratory complications, respiratory changes.

After reading the title and summary articles 17 were excluded, and 8 of them it was a systematic review and 9 did not identify the respiratory dysfunction in PD. At the end of 10 articles were included in this systematic review. Figure 1 shows the flowchart of the PRISMA platform in the article selection process.

Figure 1. Search and selection of studies from 2009 to 2019 for inclusion in the systematic review in accordance with the methodology PRISMA-2019



So, there is that all 10 articles that had relevance (score between 8,9,10 in the range of Pedro de methodological quality), displayed eligibility criteria as can is observed in Table 1.

Table 1. Methodological quality of studies using the PEDro scale of the articles included

Estudos	Critérios Presentes	Totais
Vieira et al (2014) [2]	**1,2,4,5,6,7,8,9,10,11**	**10|11**
Tasca et al (2014)[3]	**1,4,5,6,7,8,9,10**	**8 |11**
Ramos et al(2014)[4]	**1,4,5,6,7,9,10,11**	**8 |11**
Baille et al (2018)[5]	**1,2,4,5,6,7,8,9,10,11**	**10|11**
Lee et al (2018)[6]	**1,4,5,6,7,,8,9,10,11**	**9|11**
Frazão et al (2014)[7]	**1,4,5,6,7,8**	**6|11**
Hampton **et al (2016)**[8]	**1,4,5,6,7,8,9,10,11**	**9|11**
Wolabi et al (2016)[12]	**1,2,4,5,6,7,8,9,10,11**	**10|11**
Wong et el (2014)[10]	**1,4,5,6,7,8,9,10**	**8|11**
Darling et al (2017)[11]	**1,4,5,6,7,8,10**	**7|11**

Legend:**1**) Specification of the inclusion requirements**; 2**) Random allocation; **3**) Secrecy in the allocation; **4**) Similarity of the groups in the initial or baseline phase; **5**) Masking of the subjects; **6**) Masking the therapist; **7**) Masking the evaluator; **8**) Measurement of at least one primary outcome in 85% of the allocated individuals; **9**) Analysis of the intention to treat; **10**) Comparison between groups of minus one primary outcome; **11**) List of measures of variability estimated by the parameters less variable variables

The articles included in this systematic review had their year of publication between 2014 and 2018. Among the different types of studies, we have: prospective, observational study, randomized study, cohort study. Chart 1 presents a description of the objectives, results and conclusion of each study included.

Chart 1. Characterization of the sample, methodology, result and conclusion of the studies included in the systematic review according to the PRISMA-2019 methodology (to be continued)

AUTHOR	KIND OF STUDY	OBJECTIVE	*SAMPLE*	*RESULT*	CONCLUSION
Vieira et al,2014[2]	Observational	Evaluate the intensity of the cough and its association with the strength of the respiratory muscle.	107 patients with PD were included. Evaluation of PFT and PIMAX	showed a decrease in PFT (425.14 versus 481.74) PEMAX in cmH2O (80.60 versus 107.88)	Observe correlation of PFT with muscle respiratory strength .
Tasca et al,2014[3]	Observational	Check chest expansion and respiratory muscle strength .	were classified according to the stage of the disease using the Hoehn and yahr scale, using the certometry and manovacuometry assessment instrument	Maximum thoracic mobility with maximum inspiration 96.8 cm, maximum breathing 93.5 cm, muscle respiratory strength PIMAX 50.5 cmH2O, PEMAX 6217.02 cmH2	Muscle strength and chest mobility is reduced in PD.
Ramos et al 2014[4]	Cohort, observational	Check pneumatic changes in PD patients.	10 individuals diagnosed with PD classified by the Hoenh and Yahr scale, evaluated by PDQ39 and UPDRS and respiratory functions..	Most patients have respiratory changes, including signs of respiratory distress, decreased chest mobility and peak expiratory flow . Anormalidade dos músculos inspiratórios foi observada em 53,7% dos pacientes versus 25% nos controles. .	Parkinson's disease has pneumofunctional changes.

Chart 1. Characterization of the sample, methodology, result and conclusion of the studies included in the systematic review according to the PRISMA-2019 methodology (continuation)

AUTHOR	KIND OF STUDY	OBJECTIVE	*SAMPLE*	*RESULT*	CONCLUSION
Baillie et al 2018[5]	Prospective	Characterizes lung function in Parkinson's disease at an early stage and after two years .	41 Patients with early stage PD were compared with 36 healthy control subjects, assessed with reduced pulmonary function test .	PD patient has lower mean inspiratory pressurema.	Respiratory muscle weakness appears to be common in an early stage PD patient.
SiehYang Lee et al 2018[6]	Prospective	Consider the relationship between the volume of gray matter and the morphometry used in the voxel and in respiratory dysfunction in PD.	The analysis was performed on three-dimensional T1-weighted images in 25 patients with PD, with abnormal lung function compared to the control group.	O grupo de função pulmonar anormal apresentou GMU menor em varias região do cérebro e 50% da capacidade vital forçada.	The involvement of the central autonomous network and the loss of GM may underlie respiratory disorders in patients with PD.
Frazão et al 2014[7]	Control Case	Determina os efeitos agudos da pressão expiratória positiva na respiração, volume e velocidade de encurtamento dos músculos respiratórios em paciente com Parkinson.	Foram avaliados 15 pacientes por plestimografia utilizando PEP em três níveis diferente (10,15 e 20 cmH_2O)	There was an increase in tidal volume, chest wall volume and difference in the increase in abdominal muscles, diaphragm and inspiratory rib cage at all levels of PEP .	A DP promove alterações importantes nos diferentes componentes do padrão respiratórios.
Hampton et al 2016[8].	Prospective	Avaliar a função pulmonar no estado ON verso OFF e a qualidade espirométrica.	A espirometria foi realizada pelas diretrizes da América thoracic society na triagem durante 4 semana.	In all 86 patients, flow - volume curve before any study drug administration showed only a 3% incidence of morphology.	The morphology of the spirogram may be less indicative of various forms of respiratory dysfunction than was previously reported in PD.
Wallaby et al 2016[12].	Control Case	to assess lung function in a cohort of PD patients compared to age and sex-matched controls.	The pulmonary function test (PFT) was performed with spirometry KIT spirometry and the results of forced expiratory volume in 1 second and peak expiratory flow rate of 78 SD and 78 controls used.	Mean percentage of FEV1 in patients with PD and control were 75,812 and 80,303 with a statistically significant difference. The peak expiratory flow was 4.5.58, which is statically significant.	The values and parameters evaluated for the PFT were significantly lower in PD compared to the control matched for age and sex.
Wong et al 2014[10]	Control Case	Characteristic and performance of lung function and strength respiratory distress in PD and to investigate an association with the motor condition.	30 patients undergo pulmonary function test and muscle respiratory strength, submitted to UPDRS, according to diagnosis	Vital capacity, forced expiratory volume in 1 second reduced. Respiratory muscle strength was lower in both	These findings suggest that respiratory dysfunction is involved in PD.

Chart 1. Characterization of the sample, methodology, result and conclusion of the studies included in the systematic review according to the PRISMA-2019 methodology (conclusion)

AUTHOR	KIND OF STUDY	OBJECTIVE	*SAMPLE*	*RESULT*	CONCLUSION
Darling – White et, al 2017[11]	Observational	Examine the impact of muscle expiratory force treatment on speech and breathing.	12 individuals with PD were seen once a week, for 8 weeks, 4 previous training sessions, followed by a 4-week training period, were collected, maximum expiratory pressure, an indicator of muscle expiratory strength and lung volume at the beginning of speaks.	Maximum expiratory pressure, lung volume increased in most patients, not changing vocal volume.	Preliminary evidence suggests that the Direct physiological intervention of the respiratory system through expiration, muscle strength training improves breathing.

Discussion

Of the 10 selected articles, Parkinson's disease had respiratory ailments, caused by postural changes associated with stiffness of the intercostal muscles, bradykinesia and reduced muscle strength which can lead to increased work of breathing, resulting in a decline in functional status, contributing to the worse quality of life.

As described by Ramos et al. (2014)[4] changes the dynamic breathing of patients with PD, such as reduced chest expansion, reduction in lung volume and peak expiratory flow, are caused by the restriction of the rib cage and decreased inspiratory muscle strength, secondary muscle rigidity, stance flexion and bradykinesia

Sieh-yang et al.[10] agrees that Parkinson's (PD) patients present respiratory dysfunctions, caused by postural changes, which generate limitation of chest expansion due to stiff intercostal muscles and weakness of respiratory muscles, those postural and muscular ones that affect changes in lung compliance, which it will decrease the volume of current, the total lung capacity, residual capacity, vital capacity, which contributes to atelectasis, hypoxemia and respiratory failure.

For Guillaume et al.[5], PD patients have a decrease in tidal volume associated with an increase in respiratory rate. These dysfunctions are associated with weakness of the respiratory muscles, as the tidal volume decreases and the respiratory rate increases, the respiratory muscles become fatigued, compromising ventilation.

In the study by Viera et al. (2014)[2] found that 2 decreased intensity of coughing is related to reduction in the strength of the respiratory muscles and low chest wall compliance. The effectiveness of cough is dependent on the magnitude of the peak flow and speed generated during it, and complications of these changes, particularly aspiration pneumonia, are associated with high morbidity and mortality in this disease.

According to Tasca et al. (2014)[3], the respiratory dynamics is affected by the decrease in the strength of the respiratory muscles, especially of the expiratory musculature, it can cause reduction of the maximum expiratory pressure, smaller expiratory flows and increase of the residual volume. For this reason, the difficulty in mobilizing respiratory secretions can become a poor prognosis in patients with Parkinson's disease.

Hampson et al. (2016)[8], demonstrated their studies on Parkinson's disease, showing abnormal ventilation patterns, when present, the most common patterns were characterized as: restrictive lung dysfunction, obstructive air transport disease and airway obstruction upper airways.

Wolabi et al. (2016)[12] conclude that restrictive changes in respiratory function are caused mainly by chest stiffness, bring important changes in lung functions, with a reduction in forced vital capacity, forced expiratory volume in the first second, increase in residual volume and airway resistance, contributing to PD morbidity and mortality

Conclusion

This study concludes that postural changes, bradykinesia, rigid intercostal muscles and weakness of the respiratory muscles associated with respiratory disorders found in Parkinson's disease, these postural and muscle changes present respiratory complications: decreased forced expiratory volume in the first second, decreased vital capacity of the forced expiratory volume residual volume and increased airway resistance, contributing to respiratory failure in patients with PD.

Author contributions

VS Santos participated in the conception, design, search and analysis of research data, interpretation of results, writing of scientific articles. F Ferreira Neto participated in the conception, design and draft correction.

Competing interest

No financial, legal or political conflicts involved (government, companies and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to grants and funding, participation in advisory council, study design, practice) manuscript, statistical analysis, etc.).

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