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Functional respiratory re-education interventions in people with respiratory disease: a systematic literature review

Intervenções de reeducação funcional respiratória na pessoa com doença respiratória: revisão sistemática da literatura

Intervenciones de reeducación funcional respiratoria en la persona con enfermedad respiratoria: revisión sistemática de la literatura

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ABSTRACT

Objectives: to identify nursing interventions in rehabilitation, within the scope of functional respiratory reeducation, which allow a respiratory function improvement in people with respiratory disease. **Methods:** systematic literature review using the MEDLINE database search, adopting the PICO mnemonic and the Joanna Briggs Institute's assessment of the level of evidence and methodological quality. The search for randomized controlled trials was carried out in June 2021 considering the period from 2015 to 2020, in English or Portuguese. **Results:** a sample of nine randomized controlled trials with methodological quality was obtained which highlighted the use of positive expiratory pressure devices as an important component and intervention for respiratory functional reeducation. **Conclusions:** nursing interventions in rehabilitation with an emphasis on functional respiratory reeducation are essential, showing improvements in people's general health.

Descriptors: Rehabilitation Nursing; Remedial Teachings; Respiratory Tract Disease; Health Gains; Systematic Review.

RESUMO

Objetivos: identificar as intervenções de enfermagem em reabilitação, no âmbito da reeducação funcional respiratória, que permitem uma melhoria da função respiratória na pessoa com doença respiratória. **Métodos:** revisão sistemática da literatura com recurso à pesquisa na base de dados MEDLINE, adotando a mnemónica PICO e a avaliação do nível de evidência e qualidade metodológica salientado por *Joanna Briggs Institute*. No mês de junho de 2021, foi realizada a pesquisa de estudos randomizados controlados, no intervalo de 2015 a 2020, em inglês ou português. **Resultados:** obteve-se amostra de nove estudos randomizados controlados, com qualidade metodológica, dos quais se destaca o uso de dispositivos de pressão expiratória positiva como uma importante componente e intervenção de reeducação funcional respiratória. **Conclus**ões**:** as intervenções de enfermagem em reabilitação com ênfase na reeducação funcional respiratória são fundamentais, evidenciando-se melhorias na saúde geral das pessoas.

Descritores: Enfermagem em Reabilitação; Reeducação; Doença Respiratória; Ganhos em Saúde; Revisão Sistemática.

RESUMEN

Objetivos: identificar las intervenciones de enfermería en rehabilitación, en el ámbito de la reeducación funcional respiratoria, que permiten una mejoría de la función respiratoria en persona con enfermedad respiratoria. **Métodos:** revisión sistemática de la literatura con recurso a la investigación en la base de datos MEDLINE, adoptando la mnemónica PICO y evaluación del nivel de evidencia y calidad metodológica señalado por *Joanna Briggs Institute*. En el mes de junio de 2021, fue realizada la investigación de estudios randomizados controlados, en el intervalo de 2015 a 2020, en inglés o portugués. **Resultados:** se obtuvo muestra de nueve estudios randomizados controlados, con calidad metodológica, de los cuales se destaca el uso de dispositivos de presión espiratoria positiva como una importante componente e intervención de reeducación funcional respiratoria. **Conclusiones:** las intervenciones de enfermería en rehabilitación con énfasis en la reeducación funcional respiratoria son fundamentales, evidenciándose mejorías en la salud general de las personas.

Descriptores: Enfermería en Rehabilitación; Enseñanza Correctiva; Enfermedad Respiratoria; Logros en Salud; Revisión Sistemática.

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INTRODUCTION

According to the National Institute of Statistics[1], respiratory pathology was one of the main causes of mortality in Portugal in 2018, reaching 11.7% of the total number of deaths. Thus, since the respiratory system is one of the first to undergo changes, many of them due to gradual exposure to environmental pollutants, it is pertinent that nursing care corresponds to the real needs of people, and a readjustment of action plans may be necessary[2].

In this sense, to be able to act early, it is important to know the respiratory physiological changes that may be associated with aging, such as the loss of muscle strength in the respiratory muscles, less airway distension and lung expansion capacity, and the reduced number of pulmonary alveoli, which consequently affects lung volumes and capacities. These changes condition the worsening of lung function, increasing the mortality rate, being that respiratory pathologies and infections represent an important cause of death and hospitalization. In the case of aging-related pneumonia, there is a reduction or absence of coughing and sputum and the consequent inefficiency in eliminating particles and secretions as an important symptomatology. In this context, the role of specialist nurses in rehabilitation nursing (SNRN) can make a difference in maintaining airway patency and improving lung function, through the implementation of functional respiratory reeducation (FRR) interventions. This non-invasive therapy with no harmful side effects integrates a set of techniques, based on the control of breathing, positioning, and movement, which allow improving not only alveolar ventilation and gas exchange, but also the symptoms resulting from inherent disease and pathophysiological changes[2-3].

The SNRN possess the competence to guarantee and enhance the person's functional capacity, preventing respiratory function complications and disabilities[4]. Within the assessment of breathing, there may be signs and symptoms in people who have respiratory changes, such as dyspnea, coughing, secretions, chest pain, and hemoptysis. It is essential to also evaluate the respiratory rate, breathing pattern, amplitude, rhythm, and symmetry, as well as to observe the color of the skin and of the mucous membranes, perform pulmonary auscultation, and obtain data on pulse oximetry, arterial blood gases, chest radiography and functionality tests[5].

Cui et al.[6] verified in their study some benefits of FRR in combination with non-invasive ventilation in people with chronic obstructive pulmonary disease (COPD), noting in this population a relief of dyspnea and an increase in exercise tolerance and quality of life. Similarly, Liu et al.[7] concluded in their study that a six-week FRR program can improve respiratory function, quality of life, and anxiety in patients with COVID-19. After these examples, it appears that, in fact, FRR brings benefits for people with respiratory pathology. However, it raises the question of which nursing interventions in rehabilitation, within the scope of FRR, allow this improvement and in which context they are implemented.

This review was based on the Transitions Theory, proposed by Afaf Meleis, since the theory defends transition as a change in environments, states, or conditions, which requires the person to adapt to this new reality. In this sense, the SNRN appears as a professional endowed with skills that allow them to help people in this transition process, from the lowest functionality at the respiratory level to the state of maximum possible functionality[8].

The role of the SNRN towards the person with changes in the respiratory system is transversal to any of the phases of the life cycle. Thus, any implemented program must meet the person's individuality, adapting the selected techniques and interventions according to the pathologies and intended objectives[2]. As the SNRN specific interventions are not clearly identified and defined in other countries, there was a need to use trials that used rehabilitation interventions or programs of action of other health professionals, whose interventions were within the domain of/according to competences of the SNRN, as well as permitted by the Nurses' Order.

OBJECTIVES

To identify nursing interventions in rehabilitation, within the scope of functional respiratory reeducation, which allow a respiratory function improvement in people with respiratory disease.

METHODS

This is a systematic literature review (SLR), which consists of an explicit and systematic methodology, capable of being reproduced, and which makes it possible to identify, evaluate, and compile trials from the most diverse areas of knowledge. For its elaboration, a study question is initially defined; an investigation protocol is created, and its registration is carried out; the inclusion and exclusion criteria are identified; to answer the formulated question, a search for trials in scientific databases is carried out, in accordance with the outlined research strategy; subsequently, a selection and review of the obtained articles is performed by at least two people to avoid the risk of bias, and the quality of each one is critically evaluated; finally, it is possible to collect data, summarize, and assess the quality of the evidence found, presenting its results in a publication[9]. According to the Joanna Briggs Institute (JBI), the PICO mnemonic can be used to define a clear title of a systematic review, translating its evidence and effectiveness by specifying the Population, Intervention, Comparator (if any), and *Outcome*[10]. In view of the mnemonics addressed, an adaptation was elaborated, in which "C" is excluded, as it does not relate to the formulated question. Thus, Chart 1 was constructed.

Chart 1 – Adaptation of the PICO mnemonic for the elaboration of the question

Population	Intervention	Outcomes
People with respiratory disease	Rehabilitation nursing interventions under the FRR	To improve respiratory function

FRR – functional respiratory reeducation.

Therefore, the following question was elaborated: "What are the rehabilitation nursing interventions, within the scope of functional respiratory reeducation, that promote the improvement of respiratory function in people with respiratory disease?".

As a research strategy, in addition to the PICO question to formulate the research question, English or Portuguese literature published between 2015 and 2020 and the Boolean/phrase search mode with the Boolean operators *AND* and *OR* in the PubMed search engine were considered (MEDLINE database).

The selected inclusion criteria were: complete articles, randomized controlled trials (RCT), publications from 2015 to 2020, MEDLINE database, and age of participants equal to or greater than 18 years.

The present SLR exclusively contains trials whose population is constituted by people with respiratory pathology; the interventions of the trials must include specific nursing interventions in rehabilitation and/or rehabilitation programs in hospitals, care institutions and/or outpatient clinics, which may be associated and integrated in an interdisciplinary team; trials assess the results of the interventions mentioned above. We included in this SLR trials with people with respiratory disease and aged 18 years and over, trials that analyze the results of FRR interventions which are accepted as competence of the SNRN in Portugal (slow expiration with glottis opened in lateral posture [ELTGOL], postural drainage, accessory maneuvers [percussions], positive expiratory pressure [PEP]/Flutter®, intrapulmonary and extrapulmonary oscillation, controlled inspiratory flow exercise [CIFE], active cycle of breathing techniques [ACBT], teaching coughing and huffing, expiration with semi-closed lips, diaphragmatic breathing, costal re-education, rest and relaxation techniques, breath awareness and control, exercise training, respiratory muscle training, and selective costal opening), published from January 2015 to December 2020, in the English or Portuguese language.

The exclusion criteria were: language other than Portuguese or English; samples made up of people under 18 years of age; did not clearly state the type of study treated or the date of publication; ambiguous methodology; unrelated to the purpose of the study; did not present methodological quality as per JBI criteria (score < 9).

In order to select controlled quality descriptors, the MeSH criterion was used. However, as too many trials were obtained, the results of which were not very specific, there was a need to use uncontrolled descriptors, whose terms were associated with the area of health in research and defined in the scientific community. Therefore, the following descriptors were used: (*pulmonary rehabilitation* OR *respiratory rehabilitation* OR *breathing exercises*) AND (*airway clearance* OR *bronchorrhea* OR *bronchiectasis* OR *expectoration*). The searches were carried out in June 2021.

The choice of a single search engine, PubMed, which allows access to the MEDLINE database, made it possible to obtain a satisfactory number of results, with the required level of evidence and methodological quality, for the descriptors and specific criteria defined.

Next, there is Figure 1, which exemplifies the steps of the research methodology adopted in this work.

The articles obtained were analyzed and evaluated according to the Joanna Briggs Institute Manual in order to verify their level of strength and evidence. Likewise, the JBI Critical Appraisal Checklist questionnaires were filled out for randomized controlled trials, in order to verify their methodological quality[12,13]. This procedure was performed by six independent authors.

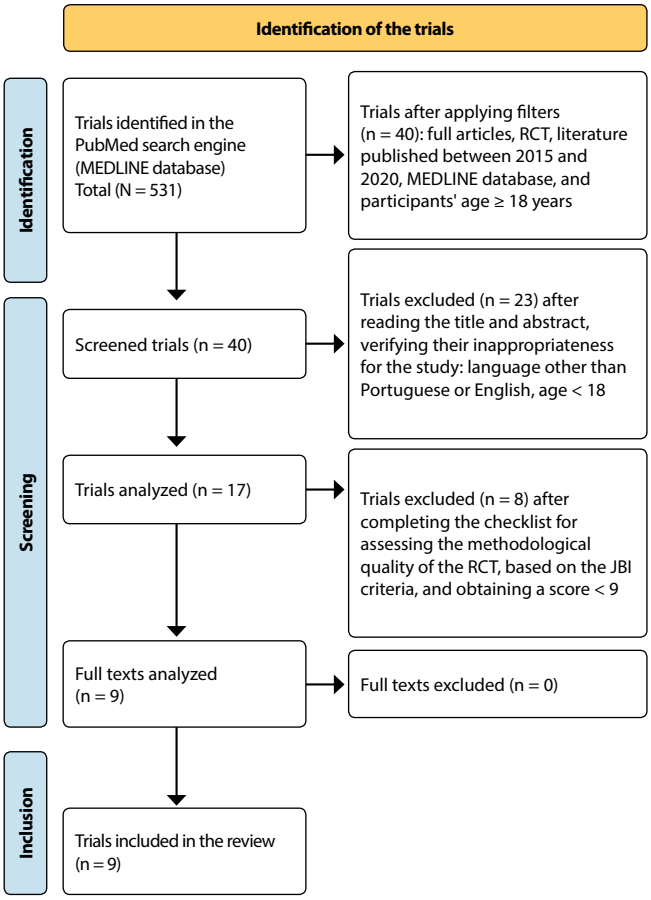

Figure 1 – Flowchart used for study selection – PRISMA 2020[11]

Chart 2 shows the titles of the nine articles obtained, as well as the respective level of evidence and methodological quality.

Chart 2 – Level of evidence and results of the JBI Critical Appraisal Checklist for randomized controlled trials

Title, authors and year	Evidence level	Methodological quality
T1: Long-term benefits of airway clearance in bronchiectasis: a randomized placebo-controlled trial. Muñoz et al., 2018[14].	1.c – RCT	12/13
T2: High-intensity inspiratory muscle training in bronchiectasis: a randomized controlled trial. Ozalp et al., 2018[15].	1.c – RCT	11/13
T3: Efficacy of a respiratory rehabilitation exercise training package in hospitalized elderly patients with acute exacerbation of COPD: a randomized control trial. Liao et al., 2015[16].	1.c – RCT	12/13

To be continued

Chart 2 (concluded)

Title, authors and year	Evidence level	Methodological quality
T4: Effects of treadmill exercise versus Flutter® on respiratory flow and sputum properties in adults with cystic fibrosis: a randomized, controlled, cross-over trial. Dwyer et al., 2017[17].	1.c – RCT	10/13
T5: Safety and effectiveness of the high-frequency chest wall oscillation vs intrapulmonary percussive ventilation in patients with severe COPD. Nicolini et al., 2018[18].	1.c – RCT	10/13
T6: A randomized controlled trial of respiratory physiotherapy in lower respiratory tract infections. Marques et al., 2020[19].	1.c – RCT	10/13
T7: Comparison of effectiveness of temporary positive expiratory pressure versus oscillatory positive expiratory pressure in severe COPD patients. Nicolini et al., 2017[20].	1.c – RCT	11/13
T8: Effects of exercise and airway clearance (PEP) on mucus clearance in cystic fibrosis: a randomized cross-over trial. Dwyer et al., 2019[21].	1.c – RCT	10/13
T9: Acute effects of oscillatory PEP and thoracic compression on secretion removal and impedance of the respiratory system in non-cystic fibrosis bronchiectasis. Simoni et al., 2019[22].	1.c – RCT	10/13

COPD – chronic obstructive pulmonary disease; T – trial; RCT – Randomized controlled trial; PEP – positive expiratory pressure.

RESULTS

After reading and analyzing the articles chosen for this SLR, a summary for each was performed, presented in Chart 3, which includes: each trials' identification and design, objective and participants, the interventions highlighted as relevant for the present SLR, and the results obtained.

The selected articles are from several countries, namely Spain (S1), Turkey (S2), China/Taiwan (S3), Australia (S4, S8), Italy (S5, S7), Portugal (S6), and Brazil (S9); and have population samples ranging from 15 to 120 participants. The average age of participants for trials S1, S3, S5, and S7 was close to 70 years. In trials S2, S4, S6, S8, and S9, the mean ages ranged between 27 and 59.6 years. The rehabilitation programs implemented were mostly in an outpatient setting, except for study S3, which included inpatients.

Chart 3 – Summary from article analysis

Trial identification	Trial objective and participants	Highlighted interventions	Results obtained
T1: Muñoz et al., 2018[14] Randomized controlled trial	Evaluate the effectiveness of the ELTGOL technique in respiratory function and elimination of secretions[14]. n = 44. Experimental group (EG): n = 22; age: 63.1±13.5 years. Control (CG)/ placebo group: n = 22; age: 66.8±8.4 years[14].	EG: ELTGOL technique with thoracoabdominal compressions[14]. CG / placebo: stretching exercises for the upper limbs[14].	- Greater clearance of secretions within 24 hours after the first assessment and fewer exacerbations in the EG; - Significant improvement in quality of life (QL) and impact of coughing on the EG[14].
T2: Ozalp et al., 2018[15] Randomized controlled trial	Evaluate the impact of high intensity inspiratory muscle training (H-IMT)[15]. n = 45. EG: n = 23; age: 42.22±14.3 years. CG: n=22; age: 45.95±11.26 years old[15].	Experimental group: H-IMT with gradual increase in intensity throughout training[15]. Control group: low intensity inspiratory muscle training, maintaining the same intensity[15].	- Lower values on the dyspnea scale; higher values in the social aspects of the QoL scale and higher number of hospitalizations in the EG; - Decrease in fatigue in both groups[15].
T3: Liao et al., 2015[16] Randomized controlled trial	Evaluate the effects of FRR regarding dyspnea, cough, exercise tolerance, and sputum production[16]. n = 61. EG: n = 30; age: 68 years (44%-89%). CG: n=31; age: 70 years (52%-91%)[16].	Experimental group (components of FRR): health education, postural drainage associated with percussion, breathing with semi-closed lips, mobilization of the upper limbs and walking training / mobilization of the lower limbs with breathing control[16]. Control group: usual health care and health education sessions[16].	- Dyspnea and coughing spells decreased, and exercise tolerance and the ability to expectorate increased in the EG[16].
T4: Dwyer et al., 2017[17] Randomized controlled crossover trial	Evaluate the effects of exercises performed on a treadmill and with the Flutter® for airway clearance[17]. n = 25. Age: 30±8 years (19%-48%)[17].	Treadmill intervention: 20 minutes of constant exercise[17]. Flutter® intervention: breathing 15 times through the device, followed by deep breathing, coughing and *huffing*. Cycle repeated 6 times[17]. Control intervention: sitting quietly for 20 minutes[17]. Participants were randomly assigned to the three interventions, performing them[17].	- The treadmill and Flutter® intervention revealed identical and significant improvements in the expiratory flow peak and in the reduction of the mechanism preventing expectoration; - The Flutter® created a expiratory air flow trend; - The treadmill intervention promoted sputum hydration[17].

To be continued

Chart 3 (concluded)

Trial identification	Trial objective and participants	Highlighted interventions	Results obtained
T5: Nicolini et al., 2018[18] Randomized controlled trial	Evaluate whether pharmacological therapy in combination with two percussion techniques produce additional benefits in terms of respiratory function and performance of activities of daily living (ADL)[18]. n = 63. IPV group: n = 20; age 72.8±6.1 years. HFCWO group: n=21; age: 73.8±5.9 years. GC: n=22; age: 74.9±2.7 years[18].	IPV group (intrapulmonary percussive ventilation): pharmacological treatment along with the IPV device[18]. HFCWO (high-frequency chest wall oscillation) group: pharmacological treatment along with the HFCWO device[18]. Control group: pharmacological treatment[18].	- Significant improvement in the IPV and HFCWO groups in relation to dyspnea and performance of ADL and pulmonary function (arterial blood gas values); - Significant improvement in maximal inspiratory and expiratory pressure in the IPV group, as well as greater efficiency in airway clearance and pulmonary muscle strengthening; - Similar results in cytological alterations of sputum with a decrease in inflammatory cells[18].
T6: Marques et al., 2020[19] Randomized controlled trial	To verify the effects of FRR, compared to traditional pharmacological care of the symptoms and functionality of people with lower respiratory tract infection (LRTI)[19]. n = 115. EG: n = 55; age: 56.02±18.5 years. CG: n=60; age: 54.1±17.3 years old[19].	Experimental group: conventional pharmacological treatment combined with FRR, which includes: breath control (breathing with semi-closed lips, rest and relaxation positions, and diaphragmatic breathing); CIFE and ELTGOL; ACBT technique, exercise training (mobilization of the trunk and upper and lower limbs, muscle strengthening, and stretching exercises) and health education sessions[19]. Control group: conventional pharmacological treatment[19].	- Both groups improved in all studied variables except for the values obtained in the modified Borg scale; - Improvement in terms of pulmonary crackle, oxygen saturation values, mMRC scale, and 6-minute walk test in the EG[19].
T7: Nicolini et al., 2017[20] Randomized controlled trial	To compare the effectiveness of two devices that use PEP in reducing exacerbations and improving respiratory function[20]. n = 120. T-PEP group: n = 40; age: 72.15±1.2 years. O-PEP group: n=40; age: 70.67±2.1 years. CG: n=40; age: 71.13±1.9[20].	O-PEP group: pharmacological therapy along with an oscillatory positive expiratory pressure (O-PEP) generator device[20]. T-PEP group: pharmacological therapy along with a device that generates temporary positive expiratory pressure (T-PEP)[20]. Control group: pharmacological therapy[20].	- Only the T-PEP group statistically reduced exacerbations; - The use of the two devices resulted in improvements in the dyspnea scale, in pulmonary function, and in the COPD assessment test; - Both interventions were well tolerated[20].
T8: Dwyer et al., 2019[21] Randomized controlled crossover trial	To compare the effect of exercise on a treadmill with the use of PEP in cleaning the airways at rest[21]. n = 15. Age: 27 years (18%-48%)[21].	Treadmill intervention: 20 minutes of constant exercise[21]. Intervention with PEP: breathing 15 times through the device, followed by deep breathing, coughing, and huffing. Cycle repeated 6 times for 20 minutes[21]. Control intervention: breath control sitting calmly for 20 minutes[21]. Participants were randomly assigned to the three interventions for participation[21].	- Exercise on a treadmill increased the clearance of secretions but was significantly less effective than intervention with PEP; - After the treadmill intervention, less sputum was eliminated from the central region of the lung compared to the PEP intervention; - PEP enabled more coughing spells than intervention on the treadmill[21].
T9: Simoni et al., 2019[22] Randomized controlled crossover trial	Evaluate the short-term effect of O-PEP and chest compressions on airway clearance[22]. n = 40. EG: n = 20; age: 57±14 years old. CG: n=20; age: 56±10 years old[22].	Two groups were created: people with bronchiectasis (bronchiectasis group / EG) and healthy people (control group). Each group performed three sessions randomly, that is, three types of intervention: O-PEP (Flutter®) intervention; lower back reeducation intervention; control intervention (sitting quietly)[22].	- The lower back reeducation intervention increased the amount of sputum eliminated, but O-PEP was more effective in the EG; - In the EG, there was a decrease in resistance to air passage through the airways; - There were no significant differences in acceptance, tolerance, dyspnea, and oxygen saturation[22].

ADL – activities of daily living; ACBT – active cycle of breathing techniques; COPD – chronic obstructive pulmonary disease; CIFE – controlled inspiratory flow exercise; ELTGOL – slow expiration with glottis opened in lateral posture; CF – cystic fibrosis; CG – control group; EG – experimental group; H-IMT – high intensity training of inspiratory muscles; IPV – intrapulmonary percussive ventilation; LRTI – lower respiratory tract infection; HFCWO – high-frequency chest wall oscillation; O- – oscillatory; PEP – positive expiratory pressure; QoL – quality of life; FRR – functional respiratory re-education; T- – temporary.

DISCUSSION

This SLR aims to identify the nursing interventions in rehabilitation, within the scope of the FRR, that enable an improvement in respiratory function in people with respiratory disease, within a population sample ranging from 15 to 120 participants and with an average age ranging from 27 to close to 75 years old.

While analyzing the articles, it was found that the ELTGOL technique was common to the studies by Muñoz et al.[14] and Marques et al.[19]. In the study by Muñoz et al.[14], it was shown that performing this technique twice a day helped to eliminate secretions, with a lower number of exacerbations in patients with bronchiectasis. At the same time, it is concluded that this technique, integrated in a FRR program with associated pharmacological treatment, provided greater recovery in terms of symptoms and functional parameters in bronchorrhea patients, particularly, with LRTI[19].

The results found in researches that address the ELTGOL technique are corroborated by Herrero-Cortina et al.[23], who analyzed

slow expiration techniques, including ELTGOL, and concluded that it induced a greater elimination of secretions, reducing the amount of sputum produced until the end of the day on which the FRR session was held; in turn, this has had a positive, short-term effect on the quality of life of people with bronchiectasis. Therefore, ELTGOL improves ventilation and oxygenation in a certain area of the lung, ensuring airway permeability and constituting objectives of the CIFE technique, also referred to in the study by Marques et al.[19] and related to the gains obtained with the implementation of the FRR[24]. The application of this allows for a recovery of functional capacity, a mobilization of secretions from the peripheral airway, and an improvement in pulmonary ventilation[25]. This last expected result is also common to the technique of global back opening with a mobilization of the upper limbs, highlighted in the study by Liao et al.[16] in patients with COPD, by promoting chest expansion, muscle strengthening, and joint mobility, complements which are essential to FRR programs[24]. This mobilization of the upper limbs, reported in the study by Liao et al.[16], is still associated with the training of walking/mobilization of the lower limbs with breathing control, which allows the improvement of dyspnea, as well as the QoL of people with COPD[26].

Such mobilization can be combined with the back re-education technique referred to in the trial by Simoni et al.[22]. In this one, the lower back re-education produced an increase in the elimination of secretions through an increase in the expiratory flow. This technique thus favors alveolar ventilation and chest expansion because of chest mobilization, which contributes to airway clearance and inspiratory muscle strengthening[25].

The work by Ozalp et al.[15] seeks to find the benefits of high intensity training of inspiratory muscles, and the results found may be related to the trial by Marques et al.[19], which highlights exercise training, and with the trials by Dwyer et al.[14,18], which investigate the benefits of exercising on a treadmill in eliminating secretions and clearing the airways.

In the research by Marques et al.[19], with the implementation of a FRR program in which exercise training was integrated, there were improvements in oxygen saturation values, in the dyspnea scale mMRC, in terms of pulmonary crackles and in the six-minute walk test. Therefore, exercise training is an effective strategy for the desensitization of dyspnea in people with COPD[26]. These results are identical to those of the study by Ozalp et al.[15], in which it was concluded that a high intensity training of the inspiratory muscles shows higher values in the social aspects of QoL, lower values of dyspnea in people with bronchiectasis, as well as less fatigue, just with the implementation of regular exercise training. This statement is corroborated by other authors, who report that the application of inspiratory muscle training reflects an increase in these muscles' strength, as well as an improvement in the level of pulmonary ventilation, also positively intervening in people's QoL, when relating with the decrease in the sensation of dyspnea[27].

Dwyer et al.[14,18] based themselves on the fact that physical exercise can replace airway clearance related interventions. They concluded that exercise alone on a treadmill was effective in eliminating secretions by facilitating the act of expectorating. Such statements can be related to the study by Marques et al.[19], in which there is an improvement in pulmonary crackle auscultation. In this sense, the auscultation of adventitious noises is a viable method to assess the effects of airway clearing techniques[28].

A cardiopulmonary rehabilitation program produces beneficial effects on the functioning of the respiratory system, stabilization of respiratory pressures, muscle strengthening and exercise tolerance, functional independence in carrying out activities of daily living, less fatigue, and changes in QoL[29]. It is noteworthy that QoL is considered an essential parameter, as it is a common result obtained in some studies, which reveal that the positive effects in this domain arise with the application of the ELTGOL[14] and H-IMT[15] techniques.

Regarding breathing with semi-closed lips, this allows for greater control of the breathing pattern, reducing the associated breathing work[25]. Breathing with semi-closed lips is highlighted in the study by Liao et al.[16] and in the study by Marques et al.[19], being that the latter study also emphasizes the resting and relaxation position and diaphragmatic breathing. Diaphragmatic breathing, with or without semi-closed lips, promotes an increase in lung volumes and oxygenation without increasing the sensation of dyspnea[30]. Similarly, breathing with semi-closed lips, together with diaphragmatic breathing, has proven to be effective in improving respiratory function and physical capacity in patients with COPD[31]. All these techniques promote breathing control, resulting in a lesser sensation of dyspnea, as reported in the studies by Liao et al.[16] and Marques et al.[19]. Therefore, the relevance of such techniques is highlighted, which should integrate all FRR sessions, namely at the beginning of any session, which should start with the resting and relaxation position in association with the control and dissociation of respiratory times[24].

In terms of aid devices that use O-PEP to promote the elimination of secretions and the consequent clearing of the airways, Flutter® stands out in the trials done by Dwyer et al.[17] and by Simoni et al.[22]. In the work by Dwyer et al.[17], it was found that the Flutter® increases the peak expiratory flow and helps to eliminate secretions, highlighting the tendency of this device for expiratory airflow in adults with cystic fibrosis, as well as increased subjective sensation of expectoration. In addition to the PEP-generating device, the teaching of coughing and *huffing* was mentioned in the Dwyer et al.[17,21] trials, which demonstrated an improvement in airway clearing. However, *huffing* has an advantage over coughing, as it has a greater potential in mobilizing secretions[25].

Also, with regard to the positive expiratory pressures provided by Flutter®, the research by Nicolini et al.[20] and Dwyer et al.[21] are highlighted. In these trials, the O-PEP and T-PEP airway clearing devices, in addition to being well tolerated, enabled the improvement of pulmonary function and dyspnea[20], favoring coughing spells and the consequent elimination of secretions[21]. T-PEP also demonstrated an efficacy like other techniques in reducing exacerbations[20]. Other authors corroborate this by stating that patients' access to the T-PEP device evidenced a lower number of exacerbations in patients with COPD, improving the parameters of respiratory function and the values of the dyspnea scale[32].

The use of Flutter® was associated with a lower number of complaints of coughing and fatigue, and with an increase in the production and elimination of secretions, with identification of similar results for the ACBT[33], this technique being highlighted in the study by Marques et al.[19], by integrating a FRR program

that obtained as results an improvement in the symptoms of respiratory infection, which includes the presence of sputum. Both postural drainage associated with ACBT and postural drainage with percussion are linked with an improvement in the elimination of secretions and a reduction in dyspnea, although the greatest results are seen in the association of ACBT with postural drainage[34]. Even so, these results are in line with the study by Liao et al.[16], in which the application of postural drainage is studied along with percussion (associated with breathing control and mobilization of the upper limbs) in elderly hospitalized with COPD and who obtained as results a sensation of less dyspnea, a greater tolerance to the exercise, and a greater capacity to expectorate.

Highlighted in the trial by Nicolini et al.[18], the IPV and HFCWO devices are also relevant to ensure airway permeability. In the present trial, when comparing the two devices, it was found that the IPV showed an improvement in terms of maximum inspiratory and expiratory pressure, as well as greater effectiveness in clearing the airways and strengthening the pulmonary muscles. Still, the two devices have been shown to improve lung function and the performance of ADL in people with COPD, through intrapulmonary and extrapulmonary oscillation. A device such as the IPV generates positive airway pressure oscillations upon exhalation and has the expected result of mobilizing bronchial secretions, as expected from HFCWO. This differs from the first device in terms of oscillations, which are applied externally to the chest wall, and adds other expected results, such as reduced air trapping, improved ventilation, and increased residual capacity[25].

Health education sessions are also highlighted in the investigations by Liao et al.[16] and Marques et al.[19] as an essential component of FRR. The implementation of FRR programs that include an educational aspect in addition to exercise makes it possible to verify, in the short term, improvements in physical capacity and QoL in people with bronchiectasis[35].

In general, within the selected studies, it was found that the implementation of a set of isolated interventions or those included in a rehabilitation program resulted in an improvement in lung function and, therefore, in an increase in the production and more effective elimination of secretions, airway clearance, lower values on the dyspnea scale, and a relief of dyspnea-related symptoms (reduced impact of coughing), fewer exacerbations, less fatigue, greater exercise tolerance, strengthening of the pulmonary muscles, better maximal inspiratory and expiratory pressures, alterations in pulmonary auscultation, and improvements verified in arterial blood gases and oxygen saturation, these techniques being well tolerated by people. Other gains were also verified, namely in terms of QoL, recovery of functional parameters, and performance of ADL.

Thus, for the transition process to be successful, specifically in the transition from the state of least functionality to that of maximum functionality, transitional care must be based on the steps of the nursing process and in accordance with a holistic view of the person[8].

Study limitations

As limitations to the SLR, it can be stated that most trials included FRR programs that encompassed several interventions and techniques of the SNRN, being difficult in some cases to identify which intervention produced the beneficial effect. Regarding the techniques and interventions, these acquire a different nomenclature depending on the country of origin of the study, which constituted another limitation to this SLR. In addition to studies addressing respiratory pathologies with pulmonary hypersecretion, they constitute different pathologies that present their particularities in terms of gains in rehabilitation. In the same way, they comprised, in the inclusion criteria, a very wide age group, making it difficult to study a specific population group. The use of only one database and the inclusion of works written only in Portuguese and English were also limitations to the realization of this SLR, as well as the exclusion of publications carried out in 2021 and some uncontrolled methodological aspects, such as the access to the database taking place in June and submission for publication happening only in August.

Contributions to the field of nursing, health, or public policy

Based on scientific evidence, it is possible to identify several rehabilitation nursing interventions, with an emphasis on FRR, which produce health gains in people with respiratory disease. Likewise, based on the identified and highlighted interventions, its importance in the level of respiratory function can be highlighted, namely in improving the effectiveness of the mechanism for clearing the airways and promoting sputum and coughing, reducing the sensation of dyspnea, as well as better results in arterial blood gases, oxygen saturation, pulmonary auscultation, and functionality tests.

Still, there is a need to invest not only in carrying out more trials, but also in the implementation of programs in the area of rehabilitation nursing that study, prove, and identify the particularities of the SNRN techniques or interventions in a unique way, noting which are the resulting health gains, in addition to those seen in this SLR and without other associated variables such as the existence of concomitant pharmacological treatment.

It is suggested that, in the future, more trials are carried out, specifically of long duration, and that particularize a certain age group, as in the case of the elderly population. This study also allows for the promotion of the application of good practices in the context of rehabilitation nursing care.

CONCLUSIONS

The realization of this SLR made it possible to take balance of the existing knowledge about interventions for functional respiratory reeducation and the benefits they produce in people with respiratory disease. In its production, it was essential to reflect rigor and quality for this work to be credible and to reduce the risk of biased results, which could jeopardize and undermine the provision of nursing care, as well as the knowledge produced. Thus, in order to highlight rehabilitation nursing and demonstrate its central role in health care, it is necessary to constantly increase the degree of recommendation and the strength and quality of the evidence produced, based on the performance of this type of work.

Therefore, in order to answer the initially formulated question, nursing interventions in rehabilitation, within the scope of functional respiratory reeducation, which allow a respiratory function improvement in people with respiratory disease are: ELTGOL, CIFE, back opening with mobilization of the upper limbs, lower limb walking/mobilization training with breathing control,

lower back re-education, high-intensity training of inspiratory muscles, exercise training, treadmill exercises, postural drainage and percussion, breathing with semi-closed lips, resting position and relaxation, diaphragmatic breathing, ACBT, Flutter®/O-PEP, T-PEP, intrapulmonary and extrapulmonary oscillation, cough teaching associated with huffing, and health education sessions.

Despite the aforementioned limitations, this SLR answered the initially formulated question, allowing evidence, within the scope of the FRR and the rehabilitation nursing programs, of health gains in people's respiratory function, such as the improvement of airway clearing mechanisms, through the promotion of coughing and elimination of secretions, reduction of dyspnea, and improvements obtained in arterial blood gases, oxygen saturation, pulmonary auscultation and functionality tests. Thus, this SLR led to the production of knowledge based on scientific evidence in the field of rehabilitation nursing.

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