Rehabilitation and Sports Medicine. 2025; 5:217
doi: 10.56294/ri2027217

REVIEW

Respiratory Rehabilitation Protocol for patients with Chronic Obstructive Pulmonary Disease

Protocolo de Rehabilitación Respiratoria para pacientes con Enfermedad Pulmonar Obstructiva Crónica

María Clara Roca[1], Patricia Romina Pereyra[1]

[1]Universidad Siglo 21, Licenciatura En Kinesiología y Fisioterapia. Córdoba, Argentina.

Cite as: Roca MC, Pereyra PR. Respiratory Rehabilitation Protocol for patients with Chronic Obstructive Pulmonary Disease. Rehabilitation and Sports Medicine. 2025; 5:217. https://doi.org/10.56294/ri2027217

Submitted: 10-02-2024 **Revised:** 12-07-2024 **Accepted:** 05-01-2025 **Published:** 06-01-2025

Editor: PhD. Nicola Luigi Bragazzi

ABSTRACT

The overall objective of this manuscript is to provide respiratory system-specialized kinesiologists with a guide for the effective implementation of a specific movement-based respiratory rehabilitation protocol for patients with COPD. In this study, a literature review was conducted on various research works, and those with a common objective were selected, which was to determine a specific respiratory rehabilitation protocol for COPD patients. The study was approached with a qualitative methodology since the goal was not to quantify the types of exercises and techniques corresponding to a specific treatment for COPD patients. Therefore, those techniques and exercises possible to perform in therapy were described. This study was confirmed that physical exercise is a fundamental tool for addressing COPD patients to improve their quality of life in all aspects, although it was not possible to determine at which stage of COPD each exercise can be carried out. Therefore, it is deemed appropriate to conduct further research to describe this with greater clarity.

Keywords: COPD; Specific Protocol; Respiratory Rehabilitation; Exercise; Techniques.

RESUMEN

El objetivo general del presente manuscrito es proporcionar a los kinesiólogos especializados en el sistema respiratorio, una guía para la implementación efectiva de un protocolo específico de rehabilitación respiratoria basado en el movimiento para pacientes con enfermedad pulmonar obstructiva crónica (EPOC). En el presente estudio se llevó a cabo una revisión bibliográfica acerca de diversas investigaciones, se seleccionaron aquellas que tenían el mismo objetivo en común, determinar un protocolo específico de rehabilitación respiratoria para pacientes con EPOC. El estudio se abordó desde una metodología cualitativa ya que el objetivo no fue conocer de forma numérica qué tipos de ejercicios y técnicas se correspondía a un tratamiento específico para pacientes con EPOC, por lo que se describieron únicamente aquellas técnicas y ejercicios posibles a realizar en una rehabilitación respiratoria. Dicho estudio, confirmó que el ejercicio físico es una herramienta fundamental en el abordaje de pacientes con EPOC para mejorar su calidad de vida, aunque no se logró determinar en qué estadio de la EPOC se puede llevar a cabo cada uno de los ejercicios. Debido a esto último, se cree conveniente ampliar con otras investigaciones que describan esta problemática, para brindar un mayor conocimiento a los profesionales kinesiólogos.

Palabras clave: EPOC; Protocolo Específico; Rehabilitación Respiratoria; Ejercicio Físico; Técnicas.

INTRODUCTION

The following manuscript is intended for individuals pursuing a degree in kinesiology and physiotherapy, with an interest in expanding knowledge about the kinesthetic approach in patients with chronic obstructive pulmonary disease in an advanced stage. This work will be based on a literature review of the findings and evidence of research on respiratory rehabilitation for patients with COPD. A thematic line will be chosen as the central axis, developed qualitatively, relating respiratory therapy to movement.

Before describing the general idea of this research project, some essential anatomical and physiological concepts within the respiratory system will be taken into account. This will be followed by an introduction to the etiology, concepts, and crucial data about COPD, which serves as a foundation for our chosen topic.

The respiratory system is comprised of structures that work together to oxygenate the body through the process of respiration; oxygen (O2) that enters through the nose and/or mouth is conducted through the airways to the alveoli, where gas exchange occurs.[1] O2 passes into the circulatory system through a capillary network that surrounds the alveoli and is transported to all cells. The O2 is dissolved in the plasma, and the gas is transported by the hemoglobin of the red blood cells to the entire organism at the same time that the carbon dioxide (CO2) produced in the cells is transported to the lungs for elimination.[1]

Breathing requires the involuntary activity of a set of muscles to be carried out. In inspiration, the same muscles that work in expiration do not work, therefore, when we talk about the phases of respiration and the muscles involved in the inspiratory phase of respiration, the muscles involved in the resting state are the diaphragm, scalenes and parasternal muscles; the accessory muscles involved are the sternocleidomastoid, trapezius and pectoral muscles and; the fixator muscles of the thoracic wall are the external intercostal muscles.[2] In the expiratory phase of breathing at rest, no muscle groups are involved. On the other hand, during forced breathing, two muscle groups are capable of accompanying expiration: the internal intercostal muscles and the abdominal muscles.[2]

The most important muscle in the respiratory action is the diaphragm, according to Alvarez-Arias A.M. et al.[3]: the diaphragm separates the thorax from the abdominal cavity and is considered the primary inspiratory muscle, this muscle is wide, flat and thin, has a cylinder shape in its upper part, ends in a tendinous dome and its periphery is formed by muscle fibers that run internally next to the lower rib cage, constituting the apposition zone. In front, its fibers are inserted in the dorsal side of the xiphoid appendix, and its posterior part in the vertebral column. When contracted it has two effects: appositional and insertional; the first is due to the juxtaposition of its fibers on the lower rib cage, this effect depends on the extension of the apposition zone and the magnitude of the abdominal pressure; the second effect is constituted by the direct action of the diaphragm when it inserts on the rib cage.

To refer to the intercostal muscles of respiration, Lopez Arias[4] does so as follows:

As for their anatomy, they occupy the intercostochondral space, limited behind by the costotransverse joint, in front by the sternum (for the first six spaces) and the common costal cartilage (for the next four spaces). Membranous formations border in front of the last two spaces below the 10th rib, related to the floating ribs. For each space, the external intercostal muscles and the internal intercostal muscles are described.

The external intercostal muscles extend from the rib tubercles dorsally to the costochondral junctions ventrally. The fibers of this layer are oriented obliquely, in a caudal-ventral direction, from the upper rib to the lower rib. The internal intercostals, on the other hand, extend from the sternocostal junctions to near the rib tubercles, and their fibers run in a caudal-dorsal direction from the upper rib to the lower rib [...]. In short, at low lung volumes, both intercostal muscles (external and internal) contract when inspiratory. At high lung volumes, both groups are expiratory, i.e., both external and internal intercostals act individually, but in turn act similarly on the ribs they insert into. This effect is related to changes in the rib cage and lung volume.

To describe the scalene muscles, we can take into account what López Arias.[4] mentions:

We have, on the one hand, the scalene muscles, which are located on the lateral sides of the neck, below the sternocleidomastoid muscle. They are arranged in the form of a staircase and are formed by three: anterior, middle, and posterior, which are the result of the same muscle that has separated into three fascicles.

Studies conducted on the scalenes, using needle electrodes, have shown that they exhibit electrical activity during inspiration, even during quiet breathing.

When talking about the sternocleidomastoid muscle, López Arias[4] mentions that: [...] This muscle is evident in the anterior part of the neck. Located under the skin, it forms, along with its symmetrical muscle, a V that extends from the region below the ears to the upper part of the sternum. It arises below the sternum and the clavicle and rises backwards, passing through the neck region without inserting into it. It ends above and behind, at the base of the skull, with a wide insertion that is installed on the mastoid process and, further back, on the occipital. This muscle raises the thoracic cage by pulling it from the upper part of the sternum. It thus contributes to very high inspiration.

The abdominal muscles, according to Hijano[5], are part of the abdomen, occupy the anterolateral side of the abdomen, and are made up of the following muscles: rectus abdominis, pyramidalis abdominis, external oblique abdominis, internal oblique abdominis, and transverse abdominis. Continuing with what Hijano[5] describes about the muscles of the abdominal wall, the anterior rectus abdominis muscle is located outside the midline, originates in the anterior part of the pubis and expands through the abdomen until it inserts in the fifth and sixth ribs, in the cartilage of the seventh rib and the anterior part of the xiphoid process. It is a muscle

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

that is interrupted by aponeurotic intersections and is characterized by being enclosed in a very resistant fibrous sheath composed of the aponeurosis of insertion of the other muscles that make up the abdominal wall; the pyramidal muscle of the abdomen is located parallel to the midline in the antero-inferior region of the abdomen, its shape is triangular, it originates in the pubis and inserts in the linea alba below the umbilicus; the external oblique muscle is the most superficial and extensive muscle of the abdominal wall, it runs from the thoracic region to the iliac crest and the pubis; the internal oblique muscle is located behind the external oblique, it has a flat and wide shape, it originates in the lumbar aponeurosis, the anterior portion of the iliac crest and the inguinal ligament and inserts proximal to the costal cartilages 9-10-11-12; the transversus abdominis muscle, arranged behind the internal oblique, is quadrilateral in shape, originates in the lumbar spine, ribs and iliac crest until inserting in the linea alba.[5]

Beginning to discuss the physiology of the respiratory system, Canet[6] emphasizes that it is essential to recognize ventilation as a vital process for human life. Continuing with what Canet[6] says about ventilation, this process is regulated by the respiratory center according to the metabolic needs, the gaseous state and acid-base balance of the blood, as well as the mechanical conditions of the thoracic cage and the lungs.

During pulmonary ventilation it is essential to take into account three types of pressures that occur in the respiratory apparatus mentioned by Díaz Villagrán[7]; firstly, pleural pressure, which is created in the narrow space between the two sheets of the pulmonary pleura (virtual space); secondly, alveolar pressure, which is present inside the pulmonary alveoli and; thirdly, intrapleural pressure identified as the force that determines the distension of the wall of an elastic structure such as the lung.

The characteristic elastic properties of the respiratory system's structures are elasticity and distensibility. As described by Arnedillo Muñoz et al.[8], these properties of the lungs are a result of the elastic behavior of the lungs, which is facilitated by the elastin and collagen fibers that form the lung parenchyma and are located in the alveolar walls. On the other hand, elasticity, also known as elastance, refers to the lung's capacity to return to its standard shape.

Continuing with the organization of the content, we will refer to the words of Burgos Rincón et al.[9], who indicate that in individuals with COPD, a notable distinction is observed in the pulmonary structure; the lung of a person with COPD tends to exhibit maximum expansion and rigidity since it lacks the elastic capacity necessary to expel air and return to its original shape. This alteration in lung elasticity is a distinctive feature that marks the pathophysiology of COPD.

Once these critical anatomical and physiological data on the respiratory system are understood, we will expand on the pathology that this manuscript will specifically address. According to Mieles Saltos[10]: chronic obstructive pulmonary disease (COPD) or chronic obstructive pulmonary disease (CODP) defined by the Global Initiateve for Chronic Obstructive Lung Disease (GOLD); is characterized by decreased flow velocity due to abnormalities and loss of elastic retraction in airways, where there is persistent airway obstruction that is not fully reversible, which is usually caused by or responds to emphysema, so they tend to lose their elastic contraction.

The World Health Organization[11] states that chronic obstructive pulmonary disease is a chronic degenerative pathology associated with chronic bronchitis and pulmonary emphysema. It is a disease characterized by being progressive, life-threatening, and predisposing to exacerbations and severe disease.[11] It is one of the leading causes of morbidity and mortality worldwide; therefore, this disease is expected to be the third leading cause of death by 2030. Also, WHO[11] states that 90 % of deaths from this pathology occur in low- and middle-income countries.

Shortness of breath, commonly referred to as dyspnea, occurs due to physiological processes, as described by Ángeles Castellanos et al.[12]:

Airflow obstruction arises from degrees of narrowing, smooth muscle hypertrophy, fibrosis in the respiratory bronchioles, and loss of elastic recoil pressure due to pulmonary emphysema. The inflammatory process of COPD is initiated by inhalation of noxious gases. It is characterized by an increase in the numbers of alveolar macrophages, neutrophils, T lymphocytes (predominantly Tc1, TH1, and TH2), and innate lymphoid cells that secrete a variety of proinflammatory mediators, cytokines, chemokines, growth factors, and lipid mediators.

Foreign materials that are inhaled become trapped in the mucus and are eliminated by mucociliary transport and coughing.

By the above and the words of Gáleas et al.[13]: chronic bronchitis is characterized by the inflammation of the bronchial mucosa resulting from chemical, mechanical, or infectious causes. The characteristic of this pathology is the inflammation of the respiratory tract, accompanied by an essential increase in secretion, which causes cough and abundant expectoration. Bronchitis is considered chronic when these symptoms occur for more than 90 days per year for two consecutive years, provided they are not due to a localized bronchopulmonary disease.

On the other hand, to refer to pulmonary emphysema, Pacheco Galván[14] describes this pathology as a disease characterized by the presence of respiratory distress that arises as a result of a progressive process of deterioration of the pulmonary alveoli, this phenomenon is attributed to a structural weakness that affects the gas exchange inside the alveoli, concomitant with a distension and hyperinflation of the lungs; this pathophysiological alteration is a distinctive element in the clinical presentation of pulmonary emphysema, contributing significantly to the decrease in respiratory capacity in affected individuals.

The prevalence of COPD is not conditioned by geographic area, as it varies worldwide. Still, it is said that it affects mainly developed countries due to high environmental pollution and increased smoking. It highly affects men more than women and older adults.

Pascansky et al.[15] in the field of public health indicate that COPD can have a significant impact on the quality of life of those affected. Therefore, it incurs a high economic cost due to medical expenses and lost productivity at work.

The WHO[11] determines that the causes of morbidity associated with people with this obstructive pathology may be cardiovascular diseases, diabetes, and mental health disorders.

Among the extrinsic risk factors for COPD, tobacco smoke is the most predominant, according to the World Health Organization.[11] Also, both tobacco consumption and passive inhalation can cause destruction of the lungs, obstruction of the airways due to secretions or inflammation of the epithelium of the respiratory tract. Another extrinsic factor, as identified by WHO,[11] is exposure to environmental pollution (including dust and indoor and outdoor smoke) and continuous exposure to products, wastes, and residues of biological origin from combustion processes (such as dust from mineral origin and coal mining).

Among the intrinsic risk factors mentioned by the WHO[11] for COPD are genetic factors due to deficiency of the enzyme alpha-1-antitrypsin because it participates in the control of inflammation; people who inherit this disease are susceptible to the development of emphysema with the presence of minimal irritations and at young ages compared to those who smoke; and respiratory infections caused by bacteria and viruses. It is necessary to clarify that respiratory infections do not cause COPD, but they can aggravate a pre-existing chronic bronchitis in a person.

A small number of COPD cases occur in people who have never smoked in their lives. Among this group of non-smokers, passive smoking is a risk factor. Also called environmental tobacco smoke, it is generated by the involuntary inhalation of the smoke of another person who smokes tobacco, considering that it is an involuntary act.[2]

The functional alteration characteristic of COPD, according to Chaia-Semerena et al.[16], is the chronic limitation of airflow that can be defined by irreversible factors such as, the presence of lower airways that present a reduced diameter, bronchial collapse, reduction of lung elasticity that generates changes in expiration possibly generated by a destruction of elastic fibers product of emphysema, which leads to a static increase in residual volume; There are also certain modifiable factors, those that limit the correct passage of air through the airways, these can be solved by correct rehabilitation or spontaneously, such as bronchospasm or inflammation of the mucosa in infectious exacerbations.

Chronic obstructive pulmonary disease is accompanied by determinant functional alterations as mentioned by Siebold Méndez et al.[17] the expiratory flow limitation that is evaluated by spirometry, is considered limited when the FEV1/FVC ratio (forced expiratory volume during the first second / forced vital capacity) is less than 70 %, after the use of a bronchodilator; also, pulmonary hyperinflation with increased residual capacity, evaluated through the inspiratory capacity that determines the ability to perform exercise and mortality of patients and; the alteration of gas exchange measured by arterial blood gasometry, when such study presents an increase in Pa02 (arterial oxygen pressure) by V/Q (ventilation/perfusion) disorders we are in the presence of progressive hypoxemia and CO2 retention in more advanced stages of the disease.

About the phenotypic characteristics of COPD, Silva[18] states that: no doubt using only one functional parameter (FEV1/FVC < 0.70) for the diagnosis of COPD opens the door to classifying a large number of diverse patients with different clinical patterns. We have oversimplified the diagnosis, with one aim: to reduce under-diagnosis and improve early detection, especially at the primary care level. This oversimplification has made us move from “blue puffy”, “pink blower”, tobacco bronchiolitis, asthmatic bronchitis, bronchiectasis in smokers, etc., to the unitary concept of COPD as FEV1/FVC < 0.70 post-bronchodilator, adopting an equal treatment pattern for all, based on the severity of obstruction. For this reason, some authors suggest transitioning from an indication of treatment based on severity, as we do today, to an indication of treatment based on phenotype, as it may be in the future.

However, there are not many clinical phenotypes of COPD that meet the characteristics included in the definition described and that, therefore, have proven clinical validation. These phenotypes are the following:

The first phenotype, and the oldest described, which meets the characteristic of having predictive value and prospectively validated for a specific clinical outcome, is constituted by patients with COPD and chronic respiratory failure, in whom the use of home oxygen, for at least 15 hours daily, has shown positive effect on mortality at 60 months while this same action has no beneficial effect on prognosis, if used in patients without the precise indication.

A second phenotype, more recently described, that meets these requirements is the positive response to

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

volume reduction surgery, which is effective in a specific subgroup of COPD patients, specifically those with localized upper lobe emphysema and poor exercise tolerance after a rehabilitation program.

A third phenotype with the characteristic mentioned above is a group of patients with moderate and severe COPD (FEV1 < 50 %) with chronic cough and permanent sputum production, that is, with characteristics of chronic bronchitis, who with the use of roflumilast, a phosphodiesterase-4 inhibitor, improve their pulmonary function and decrease the number of annual exacerbations.

Prevention and control of the disease focus on reducing exposure to risk factors, promoting healthy lifestyles, and early detection of the disease for its appropriate management.

For the diagnosis of COPD, it is essential to understand not only its etiology but also its primary symptoms and characteristic signs. Symptoms start mild, with subsequent progression. Patients with mild COPD may have few or no symptoms. Productive cough and progressive dyspnea are more frequent symptoms in COPD, in addition to recurrent respiratory infections with increasing symptoms. Chronic cough is common and is often accompanied by expectoration. It may begin intermittently but later appears daily, and can be present throughout the day. Increased volume or purulence of sputum may indicate the presence of a respiratory infection.

Dyspnea, considering what Cimas Hernando[19] mentions: dyspnea is the main symptom of COPD and is the reason why most patients seek medical attention. It is probably the most crucial cause of discomfort, anxiety, and reduced quality of life in these patients. It is a subjective symptom, and therefore difficult to standardize. It is typically described as an increased effort to breathe, a need for air, a lack of air in the lungs, or labored breathing ("wheezing").

The onset of dyspnea is indicative of moderate to severe impairment. It typically appears in individuals over 50-55 years of age and develops slowly over time. It is the primary clinical manifestation of airflow obstruction, and there is usually a relationship between the two; thus, dyspnea at rest usually appears when FEV1 is less than 30 % of the theoretical value. However, the subjectivity of this symptom means that it lacks a precise correlation with measures of pulmonary function.

Dyspnea in these patients is, as mentioned above, progressive. It initially appears with unusual exertion (e.g., climbing stairs in a hurry), but may not be perceived as pathological when avoidance behaviors are used (e.g., using the elevator). If the disease progresses, dyspnea becomes increasingly pronounced, and patients may find that they cannot walk at the same speed as others their age, or that they have difficulty performing tasks they used to do well, such as carrying shopping bags. If the disease progresses further, dyspnea may appear even with activities that require minimal effort, such as dressing or washing, and in extreme cases, become restful, eventually confining the patient to their home.

Given the progressive nature of dyspnea and its close relationship with the patient's perceived state of health, it is essential to be able to quantify or grade it in some way. For this reason, different scales have been proposed.

The simplest to use is the visual analog scale (VAS), which consists of a 100 mm vertical line, with the lower end corresponding to the absence of respiratory difficulty and the upper end corresponding to the maximum respiratory difficulty imaginable. The patient is asked to indicate where on the line they would stand according to their degree of respiratory difficulty, and then the distance in mm from the base is measured. It is straightforward to use, validated, and has the advantage of being usable with illiterate patients Illiterate patients.

A somewhat more complex adaptation is the Modified Borg Scale (MBS). This scale was initially developed by a Swedish psychologist, G. Borg, as a way of measuring the exercise load that athletes could withstand. Later, some modifications were introduced to measure the degree of dyspnea, giving rise to the scale we are familiar with. Its use is similar to the visual analog scale, but it helps the patient using key phrases at specific points on the scale. It is a categorical scale in which a number is associated with each sentence describing the patient's sensation of dyspnea. The patient is asked to score from 0 (no dyspnea) to 10 (maximum dyspnea) their respiratory difficulty, according to the phrase that best describes the current state of dyspnea.

Another scale widely used for its simplicity is the British Medical Research Council (MRC) scale. This scale, [...], classifies dyspnea into five grades, based on a simple quantification of the exercise required for respiratory distress to appear. Both this scale and the modification made by the American Thoracic Society (ATS) have the disadvantage that, although they indicate the magnitude of the trigger very well, they do not evaluate the functional and subjective repercussions on the patient.

The diagnosis of COPD, according to Peces-Barba et al.[20], should be considered in those who were active smokers for a long time and have characteristic symptoms, cough, expectoration, and/or dyspnea.

The diagnosis is confirmed by spirometry. The presence of a post-bronchodilator FEV1 less than 80 % of the predicted value, in combination with an FEV1/FVC index less than 70 %, confirms the presence of airflow limitation that is not fully reversible.

When spirometry is unavailable, the diagnosis should be made using alternative means. Clinical signs and symptoms, such as dyspnea and a prolonged expiratory phase, can aid in diagnosis. A low peak expiratory flow

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

(PEF) is consistent with the diagnosis of COPD. Still, it is not very specific, as it can be caused by other diseases and difficulties in performing the test.[21]

An example of an adult person who goes to a guard, for signs and symptoms associated with a respiratory pathology, the attending physician will determine the diagnosis by physical examination, so Baez Saldaña et al.[22] point out that:

The physical examination of the thorax is part of the clinical reasoning process in studying respiratory diseases, as it allows the generation of hypotheses. It requires a special sensitivity, which is acquired with practice, and although it has its limitations, it is not replaced by technology. Additionally, its psychological and therapeutic effects are undeniable, since physical examination improves the communication capacity between the physician and the patient.

Detecting the various signs will enable the student and physician to integrate syndromes, which will help them orient their diagnoses and inform the paraclinical studies that will support their hypotheses. As a way to help the physician perform an orderly exploration of the thorax, we first describe the lines and regions of the thorax, and we continue with the stages of the physical examination: inspection, palpation, percussion, and auscultation.

According to the Mayo Clinic[23] when diagnosing COPD, healthcare personnel will consult the patient about their signs and symptoms, personal and family history, and tobacco consumption during the anamnesis. Next, the physician, to corroborate the diagnosis, will indicate that tests such as chest X-ray, CT scan, laboratory tests, and pulmonary function tests, the latter tests are performed to measure the amount of air that a person can inhale and exhale, and whether the lungs supply enough oxygen to the blood. One of the most important tests is spirometry, which involves blowing into a tube connected to a device that measures the amount of air the lungs can hold and the rate at which it can be expelled during a maximal expiration. Other tests that the physician may order to determine the patient's diagnosis objectively may include the six-minute walk test, pulse oximetry, laboratory tests, and imaging studies.

Pulse oximetry is a non-invasive method that allows for the estimation of arterial hemoglobin oxygen saturation and also monitors heart rate and pulse amplitude.

The partial pressure of oxygen in arterial blood is referred to as PaO2. The percentage of oxygen saturation bound to hemoglobin in arterial blood is referred to as SaO2, and when measured by a pulse oximeter, this value is denoted as SpO2.[24]

Respiratory rehabilitation is a beneficial treatment option for individuals with diseases that impair the proper functioning of the respiratory system. It comprises a set of manual and instrumental techniques to improve and optimize respiratory function, increase the efficiency of the respiratory muscles, and enhance the mobility of the rib cage, both in chronic and acute patients.

In a respiratory rehabilitation, certain types of techniques, devices, and procedures can be performed, some of which can be:

Oxygen therapy or Therapeutic use of 02, according to Pírez et al.[25]: oxygen therapy is the therapeutic use of oxygen (O2) in concentrations greater than that of ambient air (21 %) to prevent and treat hypoxia and ensure the metabolic needs of the organism. The need for oxygen therapy is determined by the presence of inadequate partial pressure of oxygen in arterial blood (PaO2), which correlates with low hemoglobin oxygen saturation. O2 is administered when arterial blood PaO2 is less than 60 mmHg, or when peripheral blood hemoglobin saturation is less than 93 %-95 %.

To achieve adequate delivery of O2 to the tissues requires:

- Adequate gas exchange at the pulmonary level.
- Sufficient and uniform pulmonary blood flow.
- Sufficient hemoglobin concentration in blood.

Treatment objectives:

- Improve oxygenation.
- Decrease or prevent hypoxemia.
- Prevent or correct hypoxia.

Aerosol therapy, according to Álvarez et al.[26]: Aerosol therapy is a treatment that uses the airway for administering a drug in liquid or powder form as an aerosol or suspension of microscopic particles of solids or liquids in air or another gas. The drug is released through the gas, which acts as a vehicle to reach the respiratory tract. Through the oral cavity, the particles reach the upper airways, and depending on their size and other factors, they are deposited along the respiratory tract. Its main advantages over systemic therapies are the rapid access to the respiratory system and, therefore, a faster onset of action of the medication. Additionally, it enables us to administer a lower dose of the active ingredient, thereby achieving fewer side effects.

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

Aspiration of secretions, according to Olmedo[27]: to perform this technique, there are two types of systems: open-circuit or conventional aspiration, and closed-circuit aspiration.

Open circuit:

- By interrupting respiratory assistance, it facilitates the loss of lung volume, leading to alveolar collapse.
- Increases the risk of hypoxia due to longer ventilator disconnection time.
- The technique requires two operators.

Closed circuit:

- Respiratory support is not suspended. Decreases adverse effects.
- In patients with acute pathology requiring high pressures, high frequency, and nitric oxide, this prevents airway and alveolar collapse.
- Requires only one operator.

Closed-loop suctioning improves the efficiency of the technique, decreases nursing time, and lowers costs because it requires less circuit replacement.

Cough Assist, According to Gomez Grande et al.[28]: manual assisted cough, performed with a cooperative patient, begins with a maximal inspiration followed by air retention by closing the glottis, then opening to allow one or more insufflations with an Ambu bag or volumetric ventilator. When we reach the maximum insufflation capacity, the physiotherapist presses their hands on the thorax, the abdomen, or both, delivering a coordinated blow with the final opening of the glottis and maximum expiratory effort. Peak cough flow may increase by 14-100 %. When manual assisted cough does not achieve the expected result, the most effective alternative is the use of mechanical exhalation insufflation.

The mechanical insufflator-exufflator (IEM) (Cough Assist™, J.H. Emerson Co., Cambridge, MA) produces a deep insufflation (at a positive pressure of 30- 50cmH2O) followed, immediately, by a deep exufflation (at a negative pressure of -30-50cmH2O). Pressures and application times can be adjusted independently of each other. With an inspiratory time of 2 seconds and an expiratory time of 3 seconds, a good correlation exists between the pressure used and the flow obtained. The Cough Assist can operate in either automatic or manual cycling mode. The manual cycle facilitates coordination between the patient (collaborator or not) and the professional during inspiration and exhalation, as well as during insufflation and exhalation. However, more hands are needed to perform chest compressions, hold the mask, and regulate the machine. The technique should be repeated until secretions stop coming out and the desaturation caused by mucus plugs is reversed, so it should be used every few minutes and daily in the ICU.

Postural drainage, according to González Doniz et al.[29]: postural drainage is part of the group of procedures that aim to permeabilize or clear the airway and consists of adopting positions based on the anatomy of the bronchial tree that allow, by the action of gravity, to facilitate the flow of secretions from the segmental branches to the lobar branches, from these to the main bronchi and the trachea to be expelled, finally, to the outside1 and 2. It aims, therefore, to drain bronchial secretions in those situations in which their clearance is compromised, either by an alteration of the cough mechanisms that makes it ineffective, by changes in the rheological properties of bronchial secretions, by disorders in the mucociliary clearance mechanisms, or by structural defects of the airway3. Huff, according to Ezcurra[30]: forced expiratory technique: consists of one or two "HUFF" (gasps) or forced expirations, combined with another (low lung volume), which will help move secretions from the peripheral airways. A "HUFF" following a deep exhalation (high lung volume) will clear the mobilized secretions from the upper airways.

Positive Expiratory Pressure (PEP): About the PEP system, Ezcurra[30] mentions the following:

[...] The PEP system consists of a face mask and a one-way valve, to which an expiratory resistance can be added. A manometer, which will determine the correct PEP level, can be inserted between the valve and the resistor. The diameter of the resistor is determined for each patient individually to achieve a stable PEP of 10 to 20 cmH2O during mid-expiration.

Percussion, this technique is described by Ezcurra[30] as:

[...] the emission of a vibratory wave through the thorax towards the central airway, originated by a portion of air that is trapped under pressure between the patient's thorax and the hand, in the form of a cup, of the percussor.

Pressure and decompression, as explained by Simon[31]:

It consists of manual compressions performed on the thorax during the expiratory phase, followed by rapid decompression at the onset of inspiration, to facilitate active and deep breathing. This technique can be applied to patients of all types throughout the life cycle, and is particularly recommended for those with bronchial hypersecretion, decreased lung volumes, and ineffective coughing.

This technique, in the compression phase, is associated with the mobilization of secretions due to the

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

stimulation of biphasic flow. During its decompression phase, it favors the entry of higher inspiratory volumes, with an associated effect of recruiting alveolar units.

Vibration, According to Arriagada et al.[32]: maneuvers that are performed by alternating and successive contractions of flexor and extensor muscles of the upper extremities (tetanization), at frequencies between 2 and 16 Hz, and can even reach 25 Hz. This technique is frequently used in both mechanically ventilated and physiologically breathing patients, and its objective is to improve mucociliary clearance, primarily when associated with bronchial drainage, thereby enhancing its effect and allowing for equal outcomes with a shorter treatment time. Vibrations are performed, primarily during the expiratory phase, either manually or mechanically.

According to the respiratory exercises that we can find, we mention the following:

Diaphragmatic breathing exercises, according to Charreyre[33]: DR involves maximum contraction of the diaphragm, the primary muscle of respiration in the form of a dome that separates the thorax from the abdomen. This type of breathing also involves maximum expansion of the abdomen and deepening of inspiration and expiration.

Along with the above, we can observe that Diaphragmatic Breathing is one of the most commonly used relaxation methods, through which a person can achieve calmness and compliance quickly.[34]

Exercises with pursed lips, according to Damian et al.[35]:

Maneuver that consists of opposing the exhaled breath using a labial brake to slow it down. It produces effects such as the reduction of bronchial collapse, respiratory rate, and oxygen consumption, as well as dyspnea, and an increase in VT, oxygen saturation, and gas exchange. Additionally, it fights against ventilatory asynchronism.

Returning to what was mentioned about the signs and symptoms of COPD, according to Chacón-Chaves et al.[21], in the physical examination we can identify characteristic signs in the COPD patient such as: tachypnea, central or peripheral cyanosis, abnormalities of the thoracic cage due to pulmonary hyperinflation that causes horizontality of the ribs, barrel chest and prominent abdomen, flattening of the hemidiaphragms, activation of accessory muscles, presence of wheezing or rhonchi, reduction of the vesicular murmur (Vm).

Exercise intolerance in COPD patients is attributed to the dysfunction of muscles in the upper and lower extremities, resulting from low oxygen levels at the tissue level. Additionally, muscle weakness may be present due to loss of muscle mass.

According to our current research, we observe that respiratory rehabilitation (RR) improves quality of life across all pathologies, including those affecting patients with COPD.[36]

Salinas Toro[37] indicates that COPD is a chronic disease, therefore, once it appears there is no cure, even so, therapy includes medications, pulmonary rehabilitation and lifestyle changes; In general, the most effective and least expensive treatment for smokers is to stop smoking, since it delays the progression of the disease and reduces the risk of death from this cause, the treatment of the pathology will be focused on normalizing the respiratory pattern, reducing hyperinflation or air trapping, mobilizing airway secretions, improving thoracic mechanics and avoiding stiffness, improving the patient's tolerance to exertion, reducing morbidity and improving the patient's quality of life.

COPD is classified, according to Carrasco Figueroa et al.[38], according to spirometric criteria, the focus of this classification is on the amount of air that the patient can expel in the first second of a forced expiration (VEMS or FEV1), this is related to the forced vital capacity or maximum exhaled air volume (FVC; .If the FEV1/FVC ratio is less than 0,7 after administration of a bronchodilator, the disease is considered to be obstructive, such as COPD. After spirometry, it is necessary to compare the FEV1 value with a theoretical value based on the person's age, sex, and ethnicity. If the FEV1 value is greater than or equal to 80 % of the theoretical value, the disease is considered mild.

According to the value obtained, we will classify it using the GOLD Scale (Global Initiative for Chronic Obstructive Lung Disease), which determines the severity of COPD.

Related to the above, and continuing with the words of Carrasco Figueroa et al.[38], they mention the scale as follows: GOLD 1: Mild, when FEV1 is equal to or greater than 80 % of the theoretical value.GOLD 2: Moderate, when FEV1 is < 79 % up to 50 % of the theoretical value. GOLD 3: Severe, when FEV1 is present between 30 and 49 % of the theoretical value. GOLD 4: Very severe, < 30 % of the theoretical value.

According to Carrasco Figueroa R et al.[38], the GOLD scale classifies COPD based on the repercussions or consequences of the pathology on the patient, using the sensations of dyspnea, exacerbations, and the need for or absence of hospitalization in the previous year.

Another classification used to evaluate patients diagnosed with COPD is GesEPOC.

At this point, the words of Fernández et al.[39] are interesting, indicating that:

GesEPOC proposes a classification into two risk levels: low and high. This risk classification does not imply referral between levels of care. The factors considered for risk assessment are the degree of obstruction, measured by post-bronchodilator FEV1 (%), the level of dyspnea, measured by the modified Medical Research

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

Council (mMRC) scale, and the history of exacerbations during the previous year (see Figure 1). The importance of identifying the components of this risk classification lies in their demonstrated predictive power for the morbidity of these patients. The inclusion of FEV1 has been shown to add significant predictive value to the risk classification, and recent studies have demonstrated the adequacy of the risk classification regarding the reality of care and its contribution to the selection of pharmacological treatment. The higher the level of risk, the greater the need for therapeutic interventions.

According to Pérez Alonso[40]: the Spanish COPD Guide (GesEPOC) is a clinical practice guideline for the diagnosis and treatment of COPD. It was initially an initiative of the Spanish Society of Pneumonology and Thoracic Surgery (SEPAR) and is currently the reference guide for COPD in Spain, basing the approach to the disease on the creation of specific clinical phenotypes with common characteristics. According to GesEPOC, in 2017, studies on COPD phenotyping classified four distinct phenotypes:

- Non-exacerbating, with emphysema or chronic bronchitis.
- COPD-asthma: defined by a diagnosis of COPD and asthma or peripheral eosinophilia or a very positive bronchodilator test.
- Exacerbator with emphysema: defined by a diagnosis of pulmonary emphysema and two or more moderate exacerbations (requiring outpatient treatment) or one severe exacerbation (requiring hospitalization) separated by at least four weeks from the end of treatment of the previous exacerbation or six weeks from the onset of the last exacerbation if untreated.
- Acute exacerbator with chronic bronchitis: defined in the same way as above, but with concomitant diagnosis of chronic bronchitis instead of emphysema.

In the evolution of COPD, respiratory failure may appear, which, as indicated in the review article written by Gutiérrez Muñoz[41]:

[...] Respiratory failure is defined as the presence of arterial hypoxemia (PaO2 less than 60 mmHg), at rest, at sea level, and breathing ambient air, accompanied or not by hypercapnia (PaCO2 greater than 45 mmHg). We will refer to it as hypoxemia only when the PaO2 is between 60 and 80 mmHg1, 2-4.

Based on the information provided so far on the subject of COPD, concerns arise regarding the essential clinical data, including personal, pathological, and hereditary factors, necessary for a correct evaluation before initiating respiratory rehabilitation. What is the kinesic treatment for patients with chronic obstructive pulmonary disease? What kinesic maneuvers can be helpful when dealing with a patient with COPD? What respiratory and motor exercises are positive for the quality of life of the patient with COPD? How much time of respiratory rehabilitation will be necessary for a patient with COPD? Therefore, the following objectives are considered in the present research work.

The primary objective of this manuscript is to provide basic knowledge to professionals and kinesiology students interested in the respiratory system, specifically on the practical implementation of a movement-based respiratory rehabilitation protocol for COPD patients.

The specific objectives are:

1. To describe theoretical and practical fundamentals, including pathophysiology, and how the physiological mechanisms involved aid in the improvement of pulmonary function and exercise capacity in these patients.
2. To develop a kinesthetic rehabilitation protocol for COPD patients, including proper disease education, respiratory management techniques, and physical conditioning exercises.
3. To determine a kinesthetic rehabilitation protocol for patients with COPD.

METHOD

Research approach

The approach of this manuscript begins with a literature review and a comparative analysis of studies. A selection of four research works was made, aiming to develop a protocol for COPD patients that utilizes physical exercise as the primary tool for respiratory rehabilitation.

A description was provided of the factors considered in each of the selected studies and the protocol currently used at the Velez Sarsfield Norte Private Clinic, located at 2532 Emilio Caraffa Avenue, Córdoba, Argentina.

The present work, for those mentioned above, involved qualitative research, which entails collecting and analyzing non-numerical data to understand concepts, opinions, or experiences, as well as emotions or behaviors, with meanings elaborated by people. For the same reason, the results are expressed in words and not numerically. This type of research is based on the researchers' judgment, allowing them to reflect on their previous knowledge, choices, and assumptions.

The tools considered for the research project, typically used in this type of research, were observation and document analysis.

The main advantage of qualitative research is that it is a flexible research method since it can be adjusted to develop new knowledge and can be carried out with fewer samples.

Research design

A research design expresses the structure of the problem and the research plan used to obtain empirical evidence about the relationships of the problem.

The present COPD research project is of the non-experimental type. This type of design is applied when the research is conducted without manipulating variables and when only phenomena are observed as they occur naturally, in their natural environment, and then analyzed.

Type of research

Descriptive studies seek to characterize and specify the essential properties of persons, groups, communities, or any other phenomenon that is subjected to analysis. They record, measure, or evaluate various aspects, dimensions, or components of the phenomena to be investigated. For example, national population and housing censuses, such as that of Uruguay in 2011, allow for descriptive studies on the people residing in the country; one of their objectives is to measure a series of characteristics of the inhabitants, households and dwellings of a nation at a particular time.[42]

A research process can have different scopes: exploratory, descriptive, correlational, or explanatory. Each scope has its research design and procedures; however, any research may include elements of more than one of these scopes. This manuscript only falls within the descriptive scope.

The primary utility of descriptive studies is to provide detailed information, as in this research project, about COPD, including its definition. These factors contribute to its development, as well as associated signs and symptoms.

Population, sample, and participants

According to González et al.[43]: from the statistical point of view, a population or universe can be referred to as any set of elements of which it is intended to investigate and know their characteristics, or one of them, and for which the conclusions obtained in the research will be valid. It can also be defined as the set of data about units of analysis (individuals, objects) about the same characteristic, property, or attribute (variable).

In the present research project, the population consists of individuals suffering from COPD in middle to advanced stages.

The sample is a subgroup or subset of the population. These, in turn, can be probabilistic or non-probabilistic samples—the non-probabilistic samples, according to Gonzalez et al.[43], "Also called directed samples are chosen by the researcher". In this research work, the non-probabilistic sample was chosen as a reference. Within this type of sample, the researcher considered the sample of volunteers appropriate, which according to González et al.[43]:

They are fortuitous samples, also used in medicine and archaeology, where researchers conclude specimens that come into their hands by chance. This type of sample is used in laboratory studies where the subjects are homogeneous in variables such as age, sex, or intelligence, so that the results or effects are not due to individual differences, but to the conditions to which they were subjected.[43]

In this manuscript, the sample will consist of patients with COPD, as mentioned above.

Materials and data collection instruments

To carry out the research project, scientific studies dealing with COPD were selected for comparison with the previously examined protocols and the protocol chosen by the researcher, in collaboration with the kinesiologists at Clinica Privada Velez Sarsfield Norte, to follow a personalized treatment for each COPD patient. The studies selected were from different parts of the world, since in Argentina, the specialty of respiratory kinesiology began to develop recently, therefore, these were published in; Spain, "Protocol for the Management of COPD"; Peru, "Physical Therapy Treatment in COPD"; Cuba, "Respiratory Rehabilitation Protocol in the Patient with moderate and severe COPD"; Chile, "Pulmonary Rehabilitation Protocols and Physical Exercise and its Effectiveness in Patients with COPD. A Systematic Review".

In the present study, statistical data, observations, secondary data collected by the investigators, tests, kinesic maneuvers, clinical histories of some patients, and complementary studies, including arterial blood gases, spirometry, and imaging studies, were taken into account.

RESULTS

In this section, relevant data identified in each study selected from a previous bibliographic review are described to inform the development of a respiratory rehabilitation protocol for patients with chronic obstructive pulmonary disease.

The studies will be represented below as follows: firstly, the protocol formulated by kinesiologists from the Vélez Sarsfield Norte Private Clinic will be detailed; secondly, the study by Roca Benlloch[44] will be specified; thirdly, the study by Chigne Quiroz[2]; fourthly, the survey by Carrasco Figueroa et al.[38] and; fifthly, the study by Arana Castillo L et al.[45].

Before developing the studies, it is essential to emphasize the words of Sobradillo Peña[46], to demonstrate the importance of our objective of determining a specific respiratory rehabilitation protocol for patients with COPD.

Respiratory rehabilitation, particularly in patients with chronic obstructive pulmonary disease (COPD), has been demonstrated to be effective in enhancing dyspnea on exertion, improving exercise capacity, and enhancing quality of life in these patients. The more complex respiratory rehabilitation programs involving numerous professionals and very diverse techniques, ranging from smoking cessation to occupational therapy, are costly and can only be carried out at the hospital level. However, the most effective aspects of respiratory rehabilitation, such as training the muscles of the lower and upper extremities and the respiratory muscles, can be performed on an outpatient basis and be effective in patients with COPD.[46]

Thus, we will begin to describe the protocol formulated by kinesiologists at the Velez Sarsfield Norte Private Clinic, located in the province of Cordoba, Argentina. This protocol is applied once the patient enters the hospital. First of all, an anamnesis is performed to understand the patient's personal, pathological, and hereditary antecedents and habits; at the same time, the patient is inspected and observed. After observing the patient's condition, the structures of the neck, thorax, and abdomen are palpated to assess body structures. This is followed by percussion in both lung fields to delineate the lungs and listen for abnormalities, confirming any abnormalities within the lungs. Afterwards, anterior, posterior, and lateral lung auscultation is performed to listen for abnormal (or not) noises, such as those that can be heard in COPD.

Next, complementary studies will be observed and analyzed, including blood gases, spirometry, and imaging studies such as X-rays, MRI, and CT scans. Additionally, the patient's condition will be classified, allowing us to confirm the diagnosis of COPD and determine the specific treatment for each patient.

Continuing with the respiratory rehabilitation protocol for COPD patients in the clinic, after the physical examination performed on the patient, we will correct, if necessary, the patient's 02 supply, determined by the studies that were performed that day of blood gases and dyspnea that the patient may refer us, because if we observe a low level of oxygen saturation in arterial blood we will have to administer more oxygen and even place another oxygen therapy device to deliver more FIO2. It is also necessary to monitor CO2 levels in COPD patients, as they are usually present at high levels and can be normalized by placing a Venturi mask (if the patient is not already connected to a respirator).

Continuous monitoring of the COPD patient is essential to avoid exacerbations, as these can lead to a 50 % increase in mortality. Therefore, it is necessary that within the respiratory therapy of those patients, both lower and upper limb exercises are performed to increase respiratory capacity. To this end, it is essential to begin with mobility and muscle strengthening exercises of low intensity, progressing to exercises with lighter resistance.

Respiratory rehabilitation performed on patients with chronic bronchitis and pulmonary emphysema is common to both because the objectives of kinesthetic treatment will be, in case of secretions, to mobilize them through coughing and swallowing or through coughing and expectoration, among other techniques that can be carried out, we have postural drainage aided by manual kinesic maneuvers such as compression-decompression maneuvers, huff, and respiratory and motor exercises that include both lower and upper limbs, even the administration of bronchodilators (aerosol therapy) if indicated by the physician.

In the study extracted by Roca Benlloch[44] in Spain, it addresses a type of care protocol for patients with COPD across various health areas, including prevention, early diagnosis, treatment, referral to higher levels of care, education, and research. The work carried out by Roca Benlloch[44] is based on a protocol for COPD patients and is aimed at professionals involved in the care of these patients, including primary care, internal medicine, home hospitalization units, pulmonology, and the nurse in charge of the cases.

The general objectives of the protocol proposed by Roca Benlloch et al.[44] encompass the prevention and reduction of smoking, the reversal of underdiagnosis of COPD, coordinated care for patients with chronic COPD, comprehensive care for patients experiencing exacerbations of COPD, the promotion of information on COPD, and the enhancement of research in this pathology.

Therefore, the specific objectives emphasized by the referent of the study were: to implement smoking cessation programs in the health center, to promote COPD screening using spirometry and correct classification of phenotype and severity, to develop nursing care plans, to implement respiratory rehabilitation programs, to determine coordination between levels of care, to reach a consensus on the clinical pathway for the best care of patients with COPD exacerbation, to establish a palliative care strategy for COPD patients.

Roca Benlloch et al.[44] conducted a systematic search in the scientific literature aimed at locating clinical practice guidelines related to the diagnosis, treatment, and follow-up of COPD, including the GesEPOC guide and the GOLD classification.

The items considered punctual by Roca Benlloch[44] for the development of the plan for COPD patients are: prevention of COPD, early diagnosis, care of the chronic patient, care of the patient with exacerbations, and the training of health personnel at the research level. According to Roca Benlloch[44]: primary care functions in COPD care encompass:

1. Prevention
    a. Tobacco control.

2. Early Diagnosis
    a. Spirometry.
    b. Establish Phenotype.
    c. Severity assessment.

3. Management of STABLE COPD
    a. Nursing care plans and patient education.
    b. Treatment of the patient in early / mild stages of COPD.
    c. Respiratory rehabilitation program.
    d. Home Care Program.
    e. Referral to specialized care.

4. Management of COPD
    a. Referral to specialty care.

5. End-of-life care
    a. Palliative care.

According to Roca Benlloch[44]: to confirm the diagnosis of COPD, a forced spirometry with bronchodilator test of good quality will be performed, mainly in people older than 35 years with a cumulative smoking history of at least 10 years-pack and respiratory symptoms (moderate quality of evidence, strong recommendation in favor).

Confirmation of COPD is made by demonstrating the existence of a not completely reversible airflow obstruction using forced spirometry. Airflow obstruction is considered to be present when the ratio of forced expiratory volume in the first second/forced vital capacity (FEV1/FVC) post-bronchodilation is less than 0,7. The bronchodilator test (BTD) allows the reversibility or non-reversibility of airflow obstruction to be determined by repeating spirometry after administering a bronchodilator.

The author Roca Benlloch[44] selects the GesEPOC classification to recognize four clinical phenotypes: non-acute with emphysema or chronic bronchitis; Mixed EPOC-asthma, with or without frequent exacerbations; Acute with emphysema; and Acute with chronic bronchitis.

To guide treatment Roca Benlloch[44] indicates that COPD is classified into different levels according to severity; these, in turn, defined according to the severity index considered, the BODE index collects information from the body mass index (BMI), dyspnea (D), measured by the modified Medical Research Council (mMRC) scale that classifies dyspnea into 4 degrees and, the ability to perform physical activity assessed by the 6-minute walk test.

Also, Roca Benlloch[44] will use the BODEx index as an alternative for the exercise test by recording severe exacerbations, to avoid the need to perform the six-minute walk test which requires availability of time and adequate space for its realization, the BODEx is valid for patients levels one and two of severity.

In the comprehensive respiratory rehabilitation (RR) program proposed by Roca Benlloch[44]:

It will be offered to patients with dyspnea grade < 2 on the mMRC scale, RR will be performed in the primary care setting, not requiring hospital supervision (AG) 13. In patients with dyspnea grade 2 on the mMRC scale and who do not have complications or significant comorbidity, the RR program can be performed at the health center. It will consist of aerobic exercise (strong recommendation in favor): a. Aerobic physical activity of moderate intensity will be recommended through a walking program (strong recommendation in favor), involving walking for 20-30 minutes, 5 days a week. Another form of aerobic exercise is by a cycloergometer (15-30 minutes/day). This program can be completed in a group setting over a 4-week duration.

Motivate patients by recommending the “pneumosaludables routes”, a joint pneumonology and primary care project already implemented in Castellón. b. Physical training: upper and lower limb strengthening exercises (strong recommendation in favor) and respiratory muscle exercises (Evidence A). After completion of the RR program, patients will be advised to continue home rehabilitation exercises and regular physical activity indefinitely (Strong recommendation in favor).

It is essential that, at the end of the RR program, patients continue to perform the exercises at home and engage in regular physical activity on an ongoing basis.

According to the training program that Roca Benlloch[44] proposes in the home of COPD patients to promote self-care, it implies that the same is developed in the patient's home, through a weekly visit by a health professional for 2 months after RR; each visit has educational objectives for the patient, of structured skills and knowledge.

In the study conducted by Chigne Quiroz[2], "Respiratory rehabilitation has an essential value within the comprehensive treatment of COPD patients, where it has been shown to reduce dyspnea, increase exercise capacity and improve the quality of life of these patients". In this study, two groups of techniques within respiratory physiotherapy are divided. The first one emphasizes muscle mobilization and prevention, which are achieved through mobilization exercises for each joint and muscle group, necessary to avoid stiffness of the thoracic cage. This is accomplished by using hyperinflation techniques that transiently increase pulmonary distensibility. The second group deals with the reeducation of the diaphragm function and the elimination of secretions, these are specific techniques that are performed to stimulate cough and eliminate secretions that are associated with the evolutionary phase of the disease and characteristics of each patient, for this type of techniques in some cases it is necessary the use of complementary devices that facilitate the exercise, such as the CoughAssist and the ambu, which are used in a non-invasive way.

The study suggests that the type of resistance training should be excluded from this physiotherapeutic program, as it would cause muscle fatigue and a progressive loss of strength in the muscles involved.

Chigne Quiroz[2] proposes, as a general objective in his research, to maintain, modify, and reeducate the symptomatology and signs produced by COPD, as well as to prevent and mitigate alterations caused by the pathology. The specific objectives were to optimize respiratory function to avoid, stabilize, and manage chronic dysfunctions, and improve the quality of life; permeabilize the airways; reeducate the ventilatory pattern and thoracic cage mobility; reexpand pulmonary tissue; and prevent and modify postural alterations.

Chigne Quiroz[2] classifies the various techniques that can be performed in respiratory rehabilitation as follows:

- Techniques that employ the action of gravity: postural drainage and autogenous drainage, cough technique, thoracic expansion techniques, cough education, respiratory exercises.
- Techniques using shock waves: vibrations, thoracic percussions or "Clapping".
- The techniques of increased expiratory flow pressures, directed cough, forced expiratory techniques (TEF), active cycle breathing techniques (ACBT), expiratory flow technique (AFE) at low or high volume.
- Techniques using slow expiratory flow: slow total expiration with open glottis in lateralization (ELTGOL).
- Respiratory reeducation: relaxation techniques, controlled slow ventilation, slow ventilation with pursed lips, ventilations directed by the therapist or self-directed by the patient, thoracic mobilizations.
- Techniques with instrumental aids: VRPI Fluter, Acapella, Positive Expiratory Pressure Mask (PEP), Cornet.
- Global Postural Re-education (GPR) in patients with COPD.

The study conducted in Chile by Carrasco Figueroa et al.[38] on a pulmonary rehabilitation and physical exercise protocol and its effectiveness in patients with COPD indicates that, the Argentine consensus on respiratory rehabilitation states that three components are fundamental when making a pulmonary rehabilitation protocol: the first, education of the patient and his family; the second, systemic muscle training; the third, respiratory muscle training.

According to Carrasco Figueroa et al.[38], respiratory rehabilitation is considered an individualized program with a multidisciplinary approach that incorporates physical activity, nutritional intervention, psychological support, social support, and education for self-care management of the disease. Education for patients with COPD should focus on promoting healthy habits, increasing knowledge of the disease, and understanding its medical treatment.

The general objective of the study by Carrasco Figueroa et al.[38] is to determine the most effective type of training for pulmonary rehabilitation in patients with COPD. The specific objectives set out in the study were to evidence the benefits obtained in patients with COPD in different rehabilitation programs, to identify which protocol has the most significant impact on pulmonary rehabilitation in patients with COPD, and to demonstrate the effectiveness of current pulmonary rehabilitation programs and the need for new studies to endorse new programs.

Carrasco Figueroa et al.[38] state that, "(...) medium to high intensity aerobic PR, endurance and self-supervised endurance programs generate a significant increase in tolerance to exertion, without one being particularly more effective than another".

Carrasco Figueroa et al.[38]: aerobic exercise shows an improvement both in the tolerance to effort, as well as a decrease in the perception of dyspnea, which was observed when training at 60 % and 80 % of the maximum work capacity, without observing significant differences between these two groups.

No significant changes were observed in an aerobic exercise group where walking performance was assessed without workload parameters; therefore, it was noted that low-intensity training does not induce changes in tolerance to effort.

According to Carrasco Figueroa et al.(38), it has been observed that aerobic exercise in patients with COPD achieves significant improvements in both increased tolerance to exertion and a decrease in dyspnea.

Pulmonary function according to Carrasco Figueroa et al.(38) was objectified through spirometry and the various parameters that it delivers in most of the studies examined, from which they obtained improvements in the FEV1 parameter, for a group of patients who performed Tai-Chi when differentiated with the control group and for a calisthenics training group when comparing their final result with the baseline. FVC for a group of patients with cycloergometer training increased significantly when compared to baseline.

According to the protocol extracted from the study conducted by Arana Castillo et al.(45), RR is a non-pharmacological therapeutic measure; the objectives of the article were: to eliminate possible risk factors, mainly smoking, education of the patient and family members regarding the disease, reduce symptomatology, prevent disease progression, improve exercise tolerance, improve activities of daily living (ADL) and improve quality of life about health. The components used in the respiratory rehabilitation program developed in the article by Arana Castillo et al.(45) included education, a smoking cessation program, respiratory physiotherapy, which encompassed airway permeabilization techniques, respiratory reeducation techniques, and muscle training for the lower extremities, upper extremities, and respiratory muscles.

Complementing what was previously said about respiratory physiotherapy, according to Torres Delis(47), "airway patency techniques are indicated in all hypersecretory conditions with bronchial instability to mobilize distal secretions".

The most commonly used airway patency techniques in COPD, according to Arana Castillo et al.(45) are the techniques that use the effect of gravity, exercises with controlled inspiratory debit (EDIC): it consists of placing the segment to be drained in a position on a shelf and maintaining a determined lung volume, localized and sustained with an incentive spirometer, performing breaths with ventilatory control, techniques that use shock waves, Fluter VRP1 or Cornet: Positive expiratory pressure and high frequency vibration, techniques using gas compression, targeted cough (TD) which is a technique to expel secretions, which as its name indicates, is aimed at teaching the patient to cough, forced expiratory techniques (TEF) which consists of forced expiration at open glottis, with contraction of the thoracic and abdominal muscles, from medium to low lung volume, followed by respiratory control, active respiratory cycle (CAR) which is a technique consisting of 3 components (thoracic expansion exercise, respiratory control and forced expiration technique), increased expiratory flow (AFE) which consists of producing an active, active-assisted, passive increase in expiratory airflow, varying lung volume, expiratory flow rate or duration of expiration; Lateralized open-glottis slow total slow expiration (ELTGOL), a technique which consists of exhaling slowly with the mouth open in lateralization, the patient lying on the affected side and the technician assisting during the expiratory time by exerting abdominal pressure during expiration, in a cephalocaudal direction, and an opposing pressure on the supralateral costal grill.

The respiratory reeducation techniques of Arana Castillo et al.(45) include Giménez's targeted ventilation, which automates the coordination of thoracoabdominal movements during spontaneous ventilation at rest and exercise, decreasing the ventilatory frequency and giving a notable role to the diaphragm. This technique, according to Arana Castillo et al.(45) corrects paradoxical movements and ventilatory asynchronisms, achieves a natural abdominal diaphragmatic ventilation, achieves the acquisition of a new permanent ventilatory rhythm, increases the tidal volume and decreases the respiratory rate; in a first phase, the duration is from 1 to 2 weeks, harmonic and maximum use of the abdomino-diaphragmatic dome, correcting the ventilatory dyssynergies, working with respiratory frequencies of 5 to 10rpm which helps to increase the ventilatory work and; in a second phase, until the new ventilatory rhythm is achieved, the patient is suggested the new ventilatory rhythm, respiratory frequency of 10-15 rpm, the patient is the one who must choose the definitive tidal volume and the tidal volume/inspiratory time quotient.

According to Arana Castillo et al.(45), in an initial period where there is no displacement, specific exercises are indicated to the patient, the first exercise is performed in supine and lateral decubitus starting from breathing time: Slow nasal inhalation with the abdominal wall relaxed, so that the diaphragm in its descent can inflate the abdominal balloon; exhalation with lips ajar, it will be passive at the beginning and then completed actively with the contraction of the abdominal muscles, these will completely deflate the balloon. The respiratory frequency indicated by Arana Castillo et al.(45) decreases, without changing the inspiratory or expiratory time. The second and third exercises will be performed in supine and lateral decubitus positions with abdomino-diaphragmatic breathing. Alternately, raise both arms to perform costopulmonary expansions during the inspiratory phase and lower the arms during the expiratory phase. The fourth exercise is performed while maintaining abdomino-diaphragmatic breathing, executing inspiration at rest and during exhalation. A light elevation of the head,

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

arms, and shoulders is performed without support on the bed until the patient is seated. Once seated on the bed, breathe in and, during exhalation, return to the supine position, repeating this process several times. This exercise strengthens the rectus abdominis and oblique abdominals. The fifth exercise is performed in a bipedal position with hands forward at shoulder level. Nasal inhalation with abdominodiaphragmatic ventilation, with movement of the arms backwards. Mouth exhalation with forward movement of the arms. The movement of the arms backwards is faster than forwards, and inspiration is shorter than expiration. The movements should follow the respiratory cycle. This exercise helps to decrease the rigidity of the thorax. In this same position, with the arms in flexion and the hands embracing the lower ribs, thumbs backward, nasal inspiration causes the shoulders, elbows, and arms to move forward, simultaneously contracting the abdominal muscles. At the end of exhalation, the hands will compress the last ribs.

Muscle training, Arana Castillo et al.[45] mention that it is based on the capacity of the muscles to modify their structure and, as a consequence, their strength and resistance in response to a specific overload, these must be designed in such a way that they involve a stimulus of sufficient intensity, duration and frequency, applied over an adequate period to produce a physiological response. The training programs are strength and/or endurance.

For strength training, according to Arana Castillo et al.[45], a few repeated stimuli of high intensity are used, with the observed response being the hypertrophy of the fibers, increasing their ability to generate maximum strength. For resistance training, four very repeated stimuli of medium intensity are used, which produce an increase in the amount of myoglobin, oxidative enzymes, the number and size of mitochondria, and capillary density, increasing aerobic exercise capacity.

The general physical training program, as described by Arana Castillo et al.[45], is divided into three phases: a warm-up phase, a resistance and strength training phase, and stretching. The warm-up is performed in the first 10 minutes, consisting of low-intensity calisthenic exercises and stretching exercises to facilitate the adaptation of the cardiovascular and muscular systems to a higher level of exercise. It starts in a cephalo-caudal direction, followed by stretching exercises. Aerobic and upper limb strength physical training (MMSS). It increases the work capacity of the arms, decreases oxygen consumption, and ventilatory demand for a given level of work.

A resistance and strength training program for the upper and lower limbs requires a cool-down of 10 to 15 minutes after a physical workout, during which the level of effort will be gradually decreased. Stretching is performed after calisthenics and the training exercises themselves.

The training of the respiratory muscles, in the inspiratory phase, is performed only when the strength of the respiratory muscles is diminished. The benefits found include a reduction in dyspnea, improvement in inspiratory muscle function, and even physiological and structural adaptations at the muscular level.

The respiratory muscle training program lasts 6 weeks.

DISCUSSION

In a literature review, several studies were selected for analysis of protocols for COPD patients, based on those that met the objective proposed in this study. There was an error in not having obtained more information, as more could have been discussed about the subject.

Additionally, it would have been beneficial to obtain studies conducted in Argentina, as medical supplies are relatively scarce there.

The following table presents the distinctive characteristics of the four selected studies, including the protocol study conducted at the Vélez Sarsfield Norte Private Clinic.

In the table, we can observe a significant difference between the selected studies due to the focus on the population, as well as the differences between the two.

The protocols of the investigated studies on respiratory rehabilitation for COPD patients were similar, except for the methodology used, the countries in which they were conducted, the different stages of COPD on which they focused, and the exercises in which one study differed from another.

It is essential to emphasize that studies confirm that physical exercise can help patients with COPD reduce exacerbations, mortality, and improve quality of life, exercise tolerance, activities of daily living (ADLs), muscle strength, and fatigue. However, one aspect that cannot be confirmed in this study is the specific exercise guide for a COPD patient in each of its stages, as this influences treatment. For example, it is in vain to perform pressure decompression maneuvers on those patients who manage to mobilize their secretions and expectorate or swallow them with a spontaneous cough. Therefore, the protocol remains generalized and not specific, as this would require additional time for further research to be conducted and for the research to be tailored to a particular group of COPD patients.

It is imperative that the patient, as well as the doctors and the family, mainly, have a good will to accompany them. Smoking is a very determining factor, and we should not stop raising awareness so that people leave it aside and engage in healthy activities.

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

Table 1. Comparative Analysis of Pulmonary Rehabilitation Protocols in COPD: Techniques, Population, and Effectiveness (2011-2023)

Title of the work	Authors	Year	Center Rehabilitation Center (Population)	Aimed at COPD patients In Which stadium?	Featured exercise of the study
Respiratory Rehabilitation Respiratory Rehabilitation Protocol for patients with COPD.	Maria Clara Roca.	2023	Private Clinic Vélez Sarsfield North	COPD Flare-up	Huff
Physiotherapeutic treatment in COPD.	Chigne Quiroz, Rosario Nelly.	2021	Regional Hospital of Ambato.	COPD exacerbated	ELTGOL
Pulmonary rehabilitation and physical exercise protocol and its effectiveness in COPD patients. A systematic review.	René Carrasco Figueroa and Natalia Vitoria Urbina.	2018	Baskent University Hospital, Pulido Valente Hospital in Lisbon. Hospital Merem Asthma Center Heideheuvel, Hospital Clínico Universidad de Chile, Hospital Royal Hobart, Royal Hobart Hospital. Royal Hobart,	Mild COPD	Tai chi
Protocol protocol for on management of COPD.	Andrea Roca Benlloch.	2017	Hospital General Universitario of Castellón de la Plana. la Plana.	COPD mild acute	Activity aerobic physical activity, march from 6 minutes
Respiratory Rehabilitation Protocol in the at patient with moderate and severe COPD.	Arana Castillo, L, Ferrer Mclaughli n, Z., Martin Rijo, L., Rodriguez Gómez, Y., Smith Cortes, O. y Torres Delis, Y.	2011	National Rehabilitation Rehabilitation Center "Julio Díaz", Havana Havana, Cuba.	COPD moderate - severe	Strength and resistance exercises

To conclude, we can recognize that physical exercises should be performed either in a mild or acute stage, even in a severe stage, since the patient needs to be able to continue ventilating well, maintaining his joint mobility as a basis for an indication that it is the best for him, for his better quality of life.

BIBLIOGRAPHIC REFERENCES

1. Ramos GM. El aparato respiratorio. 2010. https://archivos.csif.es/archivos/andalucia/ensenanza/revistas/csicsif/revista/pdf/Numero_31/GLORIA%20MARIA_%20ESPINOSA%20RAMOS_1.pdf

2. Chigne Quiroz RN. Tratamiento fisioterapéutico en EPOC. Universidad Inca Garcilaso de la Vega; 2021. http://repositorio.uigv.edu.pe/bitstream/handle/20.500.11818/5932/TRSUFICIENCIA_CHIGNE%20QUIROZ.pdf?sequence=1&isAllowed=y

3. Álvarez-Arias AM, Muñoz-Manrique NA, Duque-Jurado J. Rehabilitación de músculos respiratorios con electroestimulación. Fundación Universitaria del Área Andina; 2022. https://digitk.areandina.edu.co/handle/areandina/5001

4. López Arias MB. La función de los músculos respiratorios durante la ventilación espontánea en el adulto sano: revisión sistemática. Universidad Abierta Interamericana; 2023. https://dspaceapi.uai.edu.ar/server/api/core/bitstreams/865d34a6-72a2-485c-9b39-3508554937e4/content

5. Hijano JC. Anatomía funcional de los músculos de la pared anterolateral del abdomen. Aspecto médico y quirúrgico. Universidad Nacional de La Plata; 2017. https://sedici.unlp.edu.ar/handle/10915/61083

6. Canet J. Fisiología respiratoria. Ventilación mecánica. 2006. https://www.scartd.org/arxius/fisioresp06.pdf

7. Díaz Villagrán DB. Eficacia de la fisiokinesioterapia respiratoria más la técnica de incentivometría en pacientes con tubo torácico por derrame pleural que son atendidos por el área de terapia respiratoria del

hospital de especialidades Eugenio Espejo en la ciudad de Quito en el periodo de marzo-agosto del 2013. Universidad Nacional de Chimborazo; 2013. http://dspace.unach.edu.ec/bitstream/51000/957/1/UNACH-EC-TER.FIS-2013-0005.pdf

8. Arnedillo Muñoz A, García Polo C, López-Campos Bodineau JL. Exploración funcional II. Volúmenes pulmonares, resistencias, difusión, presiones musculares, distensibilidad. En: Manual de diagnóstico y terapéutica en neumología. 2006. https://www.neumosur.net/files/ebooks/EB03-07_PFR_2.pdf

9. Burgos Rincón F, García de Pedro J, García Río F, Giner Donaire J, Molina París J, Rodríguez Nieto MJ. Programa formativo EPOC. EdikaMed. 2013. https://www.researchgate.net/profile/Felip-Burgos/publication/265847050_Espirometria_y_otras_pruebas_funcionales/links/541dbd2f0cf241a65a189953/Espirometria-y-otras-pruebas-funcionales.pdf#page=12

10. Mieles Saltos W. Determinar eficacia de los broncodilatadores en los pacientes con enfermedad pulmonar obstructiva crónica mediante espirometría. Universidad de Guayaquil; 2014. https://repositorio.ug.edu.ec/server/api/core/bitstreams/895d3ded-5cbd-4778-aa5d-19fdb837d521/content

11. Organización Mundial de la Salud. Enfermedad pulmonar obstructiva crónica (EPOC). 2023. https://www.who.int/es/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd)

12. Ángeles Castellanos M, Lázaro Pacheco RI, Martínez Luna M, Meza Alvarado JE, Rojas Granados A, Ubaldo Reyes L. Enfermedad pulmonar obstructiva crónica (EPOC). Bases para el médico general. Rev Fac Med (Méx). 2020;63(3):28–35. https://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0026-17422020000300028

13. Gáleas SSR, Gavilánez AS, Sanchez CP, Mancilla PIE. Fisioterapia respiratoria en pacientes críticos. J Sci Res Rev Cienc Investig. 2021;6(2):4. https://zenodo.org/records/5507530

14. Pacheco Galván A. ¿Qué es un enfisema pulmonar? TOP DOCTORS (España); 2012. https://www.topdoctors.es/diccionario-medico/enfisema-pulmonar#

15. Pascansky D, Sívori M, Capelli L. EPOC reagudizada hospitalizada: Estudio de costos directos en un hospital público de la Ciudad de Buenos Aires. Rev Am Med Respir. 2022;22(4). https://doi.org/10.56538/ramr.LYBB1788

16. Chaia-Semerena GM, Hernández-Pliego RR, Martínez-Aguilar NE, Pérez-Chavira MDR, Vargas-Camaño ME. Inmunopatología de la enfermedad pulmonar obstructiva crónica. Rev Alerg Mex. 2017;64(3):327–46. https://www.scielo.org.mx/pdf/ram/v64n3/2448-9190-ram-64-03-0327.pdf

17. Siebold Méndez JP, Quevedo AL. Evaluación espirométrica de médicos residentes de los departamentos de ginecología/obstetricia y pediatría. Universidad de San Carlos de Guatemala; 2014. https://biblioteca.medicina.usac.edu.gt/tesis/post/2014/212.pdf

18. Silva R. Fenotipos clínicos en enfermedad pulmonar obstructiva crónica: ¿volver al futuro? Rev Med Chil. 2012;140(7):926–33. https://www.scielo.cl/pdf/rmc/v140n7/art16.pdf

19. Cimas Hernando JE. Importancia de los síntomas en la EPOC. Medifam. 2003;13(3):46-55. https://scielo.isciii.es/pdf/medif/v13n3/hablemos2.pdf

20. Peces-Barba G, Barberà JA, Agustí A, Casanova C, Casas A, Izquierdo JL, et al. Guía clínica SEPAR-ALAT de diagnóstico y tratamiento de la EPOC. Arch Bronconeumol. 2008;44(5):271–81. https://alatoldsite.s3.amazonaws.com/images/stories/demo/pdf/epoc/Guias/SEPARALAT2008esp.pdf

21. Chacón-Chaves RA, Sibaja-Campos M, Dávila-Haas JA, Gutiérrez-Pimentel R, Gutiérrez-Sanabria A, Rocha-Contreras B, Sánchez-Romero G. Enfermedad pulmonar obstructiva crónica (EPOC). Acta Méd Costarric. 2003;45:23–8. https://www.scielo.sa.cr/scielo.php?script=sci_arttext&pid=S0001-60022003000500003

22. Báez Saldaña R, Monraz Pérez S, Castillo González P, Rumbo Nava U, García Torrentera R, Ortíz Siordia R, et al. La exploración del tórax: una guía para descifrar sus mensajes. Rev Fac Med UNAM. 2016;59(6):43–57. https://www.medigraphic.com/pdfs/facmed/un-2016/un166h.pdf

https://doi.org/10.56294/ri2027217 ISSN: 3072-838X

23. Mayo Clinic. EPOC. Mayo Foundation for Medical Education and Research; 2021. https://www.mayoclinic.org/es/diseases-conditions/copd/symptoms-causes/syc-20353679

24. Mejía Salas H, Mejía Suárez M. Oximetría de pulso. Rev Soc Boliv Pediatr. 2012;51(2):149–55. http://www.scielo.org.bo/pdf/rbp/v51n2/v51n2_a11.pdf

25. Pírez C, Peluffo G, Giachetto G, Menchaca A, Pérez W, Machado K, et al. Oxigenoterapia. Arch Pediatr Urug. 2020;91(Supl 1):26–8. http://www.scielo.edu.uy/pdf/adp/v91s1/1688-1249-adp-91-s1-26.pdf

26. Álvarez YF, Aznar EM, Ibuarben MTB, Longares MA, Obra RA, Portolés SIT. Revisión monográfica. Uso de la aerosolterapia. Rev Sanit Investig. 2023;4(1):40. https://revistasanitariadeinvestigacion.com/revision-monografica-uso-de-la-aerosolterapia/

27. Olmedo MI. Técnica de aspiración de secreciones por tubo endotraqueal. Rev Enferm Neonatal. 2009;6:29–32. https://www.fundasamin.org.ar/archivos/T%C3%A9cnica%20de%20aspiraci%C3%B3n%20de%20secreciones%20por%20tubo%20endotraqueal.pdf

28. Gómez Grande ML, González Bellido V, Olguin G, Rodríguez H. Manejo de las secreciones pulmonares en el paciente crítico. Enferm Intensiva. 2010;21(2):74-82. https://www.elsevier.es/es-revista-enfermeria-intensiva-142-pdf-S1130239910000350

29. González Doniz L, Souto-Camba S, López García A. Fisioterapia respiratoria: drenaje postural y evidencia científica. https://ruc.udc.es/dspace/bitstream/handle/2183/15888/GonzalezDoniz_FisioterapiaRespiratoria.pdf

30. Ezcurra PE. Terapias respiratorias aplicadas a pacientes con fibrosis quística. Universidad Abierta Interamericana; 2006. https://imgbiblio.vaneduc.edu.ar/fulltext/files/TC068568.pdf

31. Simón NB. Reeducación del patrón respiratorio y movilización de secreciones en un paciente con parálisis cerebral distónica de 29 años de edad. Presentación de un caso. Universidad del Gran Rosario; 2022. https://rid.ugr.edu.ar/bitstream/handle/20.500.14125/461/Inv.%20D-261%20MFN%207475%20TF.pdf?sequence=1&isAllowed=y

32. Arriagada R, Reyes G, Cavada C, Arellano D, Rouliez K. Guía de técnicas kinésicas manuales respiratorias de permeabilización bronquial. Material Docente Kinesiología Cardiorrespiratoria. 2018;52:1–41. https://www.researchgate.net/publication/351820510_Guia_de_Tecnicas_Kinesicas_Manuales_Respiratorias_de_Permeabilizacion_Bronquial_Serie_Creacion_Documento_de_trabajo_n52

33. Charreyre B. Efectos de la respiración diafragmática y de la educación terapéutica en la disminución del dolor en estudiantes universitarios con cefaleas tensionales. Universitat de Vic, Universitat Central de Catalunya; 2022. http://dspace.uvic.cat/handle/10854/7251

34. Dehghan M, Hazini A, Pahlavanzadeh S, Shahriari M. Effects of progressive muscle relaxation, guided imagery and deep diaphragmatic breathing on quality of life in elderly with breast or prostate cancer. J Educ Health Promot. 2017;6:1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5433629/pdf/JEHP-6-1.pdf

35. Damián AS, Soto CEP, Bolívar JRH, Reifetshamme LDVR. Fisioterapia respiratoria, una alternativa para la eliminación de secreciones en la distrofia muscular de Duchenne. Fisioglía. 2018;5(3):57-63. https://dialnet.unirioja.es/servlet/articulo?codigo=6543049

36. Santana Plúas RM. Efecto de la rehabilitación respiratoria por medio del uso de la acapella y el test de caminata en pacientes obstructivos. Universidad de Guayaquil; 2014. https://repositorio.ug.edu.ec/server/api/core/bitstreams/339030bd-cd3a-4c2f-b415-5f919c4fe34a/content

37. Salinas Toro BR. Plan de cuidados de enfermería para pacientes con enfermedad pulmonar obstructiva crónica (EPOC) que se encuentran hospitalizados en el área de clínica del hospital general docente Ambato. Universidad de Los Andes; 2019. https://dspace.uniandes.edu.ec/bitstream/123456789/10904/1/PIUAENF028-2019.pdf

38. Carrasco Figueroa R, Vitoria Urbina N. Protocolo de rehabilitación pulmonar y ejercicio físico y su

efectividad en pacientes con EPOC. Una revisión sistemática. Universidad de Valparaíso; 2018. https://repositoriobibliotecas.uv.cl/serveruv/api/core/bitstreams/96d79b49-2ea8-4ef2-94a6-a1d7594e9263/content

39. Fernández FAV, Torres AAG, Villegas JAC. Enfermedad pulmonar obstructiva crónica (EPOC). Rev Cient Mundo Investig Conoc RECIMUNDO. 2022;6(3):94-102. https://recimundo.com/index.php/es/article/view/1673/2110

40. Pérez Alonso J. Protocolo de tratamiento fisioterápico en enfermedad pulmonar obstructiva crónica (EPOC) de fenotipo no agudizador. Universidad de Salamanca; 2023. https://gredos.usal.es/bitstream/handle/10366/152910/TFG_P%c3%a9rezAlonsoJ_TratamientoFisioter%c3%a1picoEPOC.pdf?sequence=1&isAllowed=y

41. Gutiérrez Muñoz FR. Insuficiencia respiratoria aguda. Acta Méd Peruana. 2010;27(4):286-97. http://www.scielo.org.pe/pdf/amp/v27n4/a13v27n4

42. Alesina L, Batthyány K, Bertoni M, Cabrera M, Mascheroni P, Moreira N, et al. Metodología de la investigación para las ciencias sociales: apuntes para un curso inicial. 2011. https://www.colibri.udelar.edu.uy/jspui/bitstream/20.500.12008/26551/1/Metodologia%20de%20la%20investigaci%c3%b3n%20en%20CCSS_Batthyany_Cabrera.pdf

43. González RDC, Salazar FA. Aspectos básicos del estudio de muestra y población para la elaboración de los proyectos de investigación. Universidad de Oriente; 2009. https://recursos.salonesvirtuales.com/assets/bloques/Raisirys-Gonz%C3%A1lez.pdf

44. Roca Benlloch A. Protocolo asistencial para el manejo de la EPOC. Universitat Jaume I; 2017. https://repositori.uji.es/xmlui/bitstream/handle/10234/169839/TFG_2017_RocaBenlloch_Andrea.pdf?sequence=1

45. Arana Castillo L, Ferrer Mclaughlin Z, Martin Rijo L, Rodriguez Gómez Y, Smith Cortes O, Torres Delis Y. Protocolo de rehabilitación respiratoria en el paciente con EPOC moderada y severa. Rev Cub Med Fis Rehab. 2011;3(1). https://www.medigraphic.com/pdfs/revcubmedfisreah/cfr-2011/cfr111e.pdf

46. Sobradillo Peña V. La rehabilitación respiratoria en el paciente con enfermedad pulmonar obstructiva crónica. Med Integr. 2001;37(3). https://www.elsevier.es/es-revista-medicina-integral-63-pdf-10021635

47. Torres Delis Y. Programa de rehabilitación respiratoria en pacientes con enfermedad pulmonar obstructiva crónica (EPOC). Rev Electron Portales Med. 2009. https://www.portalesmedicos.com/publicaciones/articles/1496/1/Implementacion-del-Programa-de-Rehabilitacion-Respiratoria-en-pacientes-con-enfermedad-pulmonar-obstructiva-cronica---EPOC.html

FINANCING

None.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: María Clara Roca, Patricia Romina Pereyra.
Data curation: María Clara Roca, Patricia Romina Pereyra.
Formal analysis: María Clara Roca, Patricia Romina Pereyra.
Research: María Clara Roca, Patricia Romina Pereyra.
Methodology: María Clara Roca, Patricia Romina Pereyra.
Project Management: María Clara Roca, Patricia Romina Pereyra.
Resources: María Clara Roca, Patricia Romina Pereyra.
Software: María Clara Roca, Patricia Romina Pereyra.
Supervision: María Clara Roca, Patricia Romina Pereyra.
Validation: María Clara Roca, Patricia Romina Pereyra.
Visualization: María Clara Roca, Patricia Romina Pereyra.
Writing - original draft: María Clara Roca, Patricia Romina Pereyra.
Writing - proofreading and editing: María Clara Roca, Patricia Romina Pereyra.