# RESUME JURNAL TUGAS AKHIR MODUL KARDIOPULMONAL


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**FAKULTAS ILMU KESEHATAN**

**PRODI FISIOTERAPI**

**JURNAL 1**

**FISIOTERAPI PADA ASMA**

**JUDUL JURNAL :**

Effects of physiotherapy treatment in patients with bronchial asthma: A systematic review

Physiotherapy Theory and Practice An International Journal of Physical Therapy.

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**PENULIS :**

Daniel Garagorri-Gutiérrez & Raquel Leirós-Rodríguez

**RESUME :**

Asma bronkial (BA) adalah penyakit peradangan kronis pada saluran pernapasan, yang patogenesisnya melibatkan sel dan mediator peradangan yang dikondisikan, sebagian, oleh faktor genetik. Ini ditandai dengan gejala pernapasan seperti mengi, sesak napas, aliran udara ekspirasi terbatas, sesak dada dan batuk (García dan Pérez, 2012 ; Lundbäck, Backman, Lötvall, dan Rönmark, 2016 ). Ini adalah salah satu penyakit kronis yang paling sering terjadi di dunia dan mempengaruhi sekitar 300 juta orang. Dalam 30 tahun terakhir, prevalensi penyakit ini meningkat di negara-negara industri, yang tampaknya terkait dengan proporsi yang lebih besar dari populasi yang tinggal di perkotaan tetapi tampaknya telah stabil pada nilai 10 hingga 12% pada orang dewasa dan 15%. pada anak-anak (Lundbäck, Backman, Lötvall, dan Rönmark, 2016 ). Ada tiga proses yang mempengaruhi patofisiologi penyakit ini: peradangan bronkial, alergi dan hiperreaktivitas bronkial. Pada inflamasi bronkial, sel inflamasi terlibat (mampu menyebabkan edema dan bronkokonstriksi). Faktor alergi termasuk atopi dan alergen. Tautan patofisiologis terakhir BA adalah hiperreaktivitas bronkial, yang didefinisikan sebagai kecenderungan pohon bronkial untuk bereaksi terhadap respons bronkokonstriktor yang berlebihan terhadap rangsangan fisik dan kimia (Becker dan Abrams, 2017 ).

Perawatan fisioterapi bertujuan untuk mengurangi frekuensi serangan asma dan intensitas gejala. Metode yang digunakan bertindak terutama melalui pendidikan pasien dalam pengelolaan mantra asma yang benar dan peningkatan elastisitas paru (McCracken, Veeranki,Ameredes, dan Calhoun, 2017 ). Dalam studi oleh Löwhagen dan Bergqvist ( 2014 ) mereka menerapkan metode Lotorp selama enam minggu. Sebanyak 29 pasien berusia 20

hingga 52 tahun berpartisipasi dalam penelitian ini. Metode Lotorp diterapkan pada 17 dari mereka, sedangkan 12 sisanya diinstruksikan dalam program latihan yang direkomendasikan oleh Dewan Kesehatan dan Kesejahteraan Nasional Swedia. Metode Lotorp terdiri dari pemijatan dan perawatan trigger point sekelompok otot dorsal dan toraks, di antaranya adalah spinal dan lumbar square erectors atau pectorals dan diaphragm (Bardin, Rangaswamy, and Yo, 2018 ). Hasil penelitian menunjukkan bahwa terdapat penurunan gejala dominan yang signifikan baik saat istirahat maupun saat berolahraga dan peningkatan ekspansi toraks pada kelompok intervensi dengan metode Lotorp.

intervensi yang menerapkan terapi manual, perbaikan klinis yang paling menonjol diperoleh setelah penerapan terapi kraniosakral (Pandey dan Pandey, 2015 ) mengelola untuk menghilangkan mengi dan batuk pasien sehingga menyebabkan keputusan ahli paru untuk penarikan obat. Terlepas dari mendapatkan hasil yang sangat positif ini, ini adalah studi kasus, di mana penilaian awal pasien tidak jelas. Ini tidak menunjukkan bagaimana perubahan ini dievaluasi dan tidak mengambil tindakan obyektif apa pun, yang dapat mengurangi hasil ini. Intervensi lain yang menunjukkan hasil positif adalah penelitian yang menerapkan metode Lotorp (Löwhagen dan Bergqvist, 2014 ). Dalam hal ini, penelitian mencapai peningkatan yang signifikan dalam PEF tetapi, pada dasarnya, hanya berhasil memperbaiki gejala dominan (tekanan dada, terengah-engah, mengi, dan dispnea), yaitu untuk setiap pasien yang menunjukkan skor lebih tinggi pada visual analog. skala.

Kesimpulannya, kemungkinan terapeutik yang ditawarkan fisioterapi dalam pengobatan pasien dengan BA sangat banyak. Saat ini, penelitian yang dilakukan sejauh ini menunjukkan bahwa intervensi yang paling bermanfaat bagi pasien adalah teknik yang didasarkan pada kombinasi pendidikan ulang pernapasan dan latihan terapeutik. Terlepas dari jenis terapi yang dijelaskan dalam penelitian, semua pasien menunjukkan beberapa jenis perbaikan, yang menyoroti bahwa tindakan sederhana melakukan intervensi yang melibatkan pasien dalam patologi mereka dengan cara, paralel dengan pengobatan konvensional, merupakan peningkatan yang signifikan. selama perawatan medis biasa.

**JURNAL 2**

**FISIOTERAPI PADA COVID 19**

**JUDUL JURNAL**

Physiotherapy Interventions in COVID-19 Patient with Multiple Comorbidities: A Case Report

International Journal of Health Sciences and Research Vol.10; Issue: 10; October 2020

**PENULIS**

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**RESUME**

Coronavirus baru (COVID -19) yang disebabkan oleh SARS-CoV-2, pertama kali ditemukan di kota Wuhan di Cina pada bulan Desember. Wabah penyakit virus korona yang sangat cepat, yang muncul dari infeksi virus korona 2 (SARS-CoV-2) sindrom pernafasan akut parah, telah menjadi keadaan darurat kesehatan masyarakat. Banyak pasien yang terdiagnosis COVID-19 membutuhkan perawatan kritis untuk jangka waktu yang lama. Ada risiko hasil buruk yang parah pada pasien COVID-19 dengan beberapa penyakit penyerta. Kolaborasi antara intervensi medis dan rehabilitasi komprehensif awal dan berkelanjutan memainkan peran penting dalam pemulihan pasien dari perawatan akut hingga keluar dari rumah sakit. Fisioterapis yang berperan penting dalam pengobatan multidisiplin berkontribusi besar untuk meningkatkan paru-paru dan kapasitas fungsional pasien.Kami menyajikan kasus seorang pria berusia 52 tahun yang didiagnosis dengan COVID-19 dan dengan berbagai penyakit penyerta, dengan fokus pada peran rehabilitasi paru bekerja sama dengan manajemen Medis dan menguraikan jalur pemulihan dari ICU hingga keluar.

Seorang pria berusia 52 tahun yang datang dengan keluhan demam, batuk kering dan sesak saat beraktivitas, dirawat di ICU khusus COVID-19 pada 26/6/20 dengan diagnosis COVID-19, stadium 3 dan 70% keterlibatan paru pada HRCT. Dia telah berasosiasi komorbiditas dari Diabetes Mellitus (20 tahun) & HTN (4 tahun) dengan riwayat Pulmonary Koch's dan merupakan pecandu alkohol kronis. Dalam 2 sampai 3 hari pertama, itu penting untuk fokus di terapeutik posisi sebagai intervensi lain tidak dapat ditoleransi oleh pasien karena ketidakstabilan pernapasan. Pneumonia COVID-19 terutama dan terutama mempengaruhi zona posterobasal paru dan oleh karena itu posisi rawan terapeutik, yang membantu meningkatkan perluasan zona posterobasal paru berkontribusi secara signifikan untuk meningkatkan saturasi oksigen. Posisi tengkurap dengan kepala menoleh ke satu sisi diberikan selama 15 menit maksimal 30 menit dengan pemantauan tanda vital dan ditekankan dilakukan 3 sampai 4 kali / hari. Sulit bagi pasien untuk mencapai posisi tengkurap karena ketidaknyamanan yang disebabkan oleh NIV dan oleh karena itu bantuan fisioterapis untuk

mencapai posisi tengkurap dan menjelaskan pentingnya posisi tersebut, membantu pasien untuk mempertahankan posisi terapeutik.Pernapasan segmental posterobasal latihan dalam posisi tengkurap diberikan kepada pasien. Pasien tidak dapat sepenuhnya memperluas zona posterobasal paru-paru pada pernapasan segmental, dan oleh karena itu penambahan fasilitas neuromuskuler proprioseptif (PNF) membentang selama posterobasal pernafasan segmental pada rawan difasilitasi secara adekuat paru-paru ekspansi dan jadi peningkatan saturasi oksigen. 10 pengulangan PNF peregangan yang diberikan dengan jeda istirahat sesuai kebutuhan berdasarkan pemantauan vital. Teramati bahwa, posisi tengkurap dan PNF membentang ke dalam Pernapasan segmental posterobasal berperan penting dalam menghentikan NIV dan meningkatkan status oksigen pasien. Latihan mobilitas dada juga diberikan kepada pasien. Untuk mencegah komplikasi yang timbul karena imobilitas, gerakan kaki pergelangan kaki dan sisi Tumit diberikan kepada pasien dan akhirnya dilanjutkan ke latihan samping tempat tidur yang mencakup latihan mobilitas ekstremitas atas dan bawah serta jalan di tempat. Mengingat pasien tinggal di ICU dalam waktu yang lama, sangat penting untuk fokus pada peningkatan kondisi perifer pasien.Oleh karena itu, pasien membutuhkan dukungan oksigen yang diperpanjang pada masker non-rebreathing (NRBM) agresif pernafasan terapi terdiri dari intervensi untuk meningkatkan fungsi paru-paru pasien dan untuk membantu penyapihan dilanjutkan. Pernapasan diafragma dalam posisi tengkurap (pernapasan buaya) diberikan bersamaan dengan peregangan PNF di posterobasal segmental latihan pernapasan, latihan mobilitas dada dan terapeutik Rentan posisi. Pernapasan diafragma dalam posisi tengkurap menyebabkan peningkatan mobilitas bagian bawah tulang rusuk dan peningkatan ekspansi paru yang signifikan. Fisioterapi tunggal Sesi sehari-hari terdiri dari 10 repetisi setiap latihan dengan pemantauan vital dan saturasi oksigen dipertahankan di atas 90%. Program berjalan dimulai, setelah pasien mentolerir berjalan di sisi tempat tidur dengan oksigen tambahan. Titrasi oksigen diperlukan karena pasien mengalami desaturasi selama berjalan dan memberikan oksigen tambahan juga membantu pasien untuk menempuh jarak yang lebih jauh dan berkontribusi pada kapasitas fungsional pasien. Jarak ditingkatkan 10 meter setiap hari dengan titrasi oksigen sesuai kebutuhan untuk mencegah penurunan Spo2 di bawah 90%. Selama program berjalan, detak jantung dipertahankan dalam batas 20 detak / menit di atas detak jantung istirahat. Pada pasien ini, program berjalan dimulai dengan 20 meter pada 6 L oksigen, berkembang menjadi 40 meter pada 3 L oksigen dan kemudian 50 meter pada 3 L oksigen dan akhirnya pasien menutupi ajarak 200 meter pada oksigen 1 L. Jeda istirahat diberikan kepada pasien selama episode dispnea dan jika terjadi penurunan Spo2> 3% dari

baseline, kontrol pernapasan dan posisi menghilangkan dispnea membantu memulihkan saturasi awal, meredakan dispnea dan melanjutkan berjalan.

Setelah 9 minggu fisioterapi dan perawatan medis, pemulangan direncanakan berdasarkan pemulihan klinis pasien, tes RTPCR negatif, resolusi gejala dan kemampuan untuk mempertahankan saturasi oksigen selama 3 hari berturut-turut di udara kamar. Sebelum dipulangkan, pasien diberikan home program dan disarankan untuk follow up di bagian fisioterapi rawat jalan untuk rehabilitasi paru. Saat pulang pasien mempertahankan 99% saturasi oksigen saat istirahat dan selama semua aktivitas kehidupan sehari-hari (ADL).Rehabilitasi paru di rumah sakit dalam fase akut dan subakut yang melibatkan pendidikan pasien, perawatan pernapasan, pelatihan olahraga, berjalan program denganoksigen tambahan, konservasi energi dan dukungan psikologis memainkan peran penting pada pasien ini dalam perjalanannya dari ICU hingga keluar dengan membantu dalam penyapihan dari tambahan oksigen,meningkatkan paru-paru dan kapasitas fungsional dan dengan demikian memfasilitasi pemulihan.

**JURNAL 3**

**FISIOTERAPI PADA PPOK**

**JUDUL JURNAL**

Physiotherapy in Patients with Chronic Obstructive Pulmonary Disease

Journal of Medical Sciences. 2017 Oct 15; 5(6):720-723.

**PENULIS**

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**RESUME**

PPOK adalah penyakit umum yang mempengaruhi sistem bronkopulmonalis. Progresif PPOK terkait dengan perkembangan komplikasi paru ekstra seperti penyakit kardiovaskular, disfungsi otot rangka, osteoporosis, cachexy, kecemasan dan depresi. Dengan demikian memperburuk kualitas hidup terkait kesehatan dan meningkatkan intoleransi fisik pada pasien PPOK. Rehabilitasi paru adalah program multidisiplin untuk merawat pasien dengan penyakit paru kronis. Ini disesuaikan secara individual, dan tujuan utamanya adalah untuk mengoptimalkan

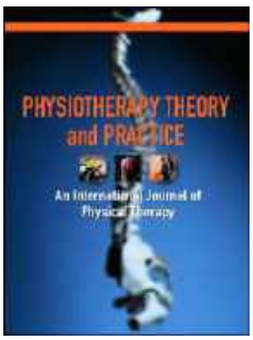
status fisik dan sosial pasien. Fisioterapi (PT) merupakan tonggak penting dalam struktur rehabilitasi paru. PT meningkatkan toleransi latihan, mobilitas dalam aktivitas sehari-hari, berkurang obstruktif paru sesak napas, meningkatkan kualitas hidup dengan menerapkan berbagai terapeutik latihan dan pernafasan teknik [1-3]. Penelitian ini bertujuan untuk menilai pengaruh protokol fisioterapi enam bulan yang sama terhadap status fungsional pasien PPOK pada berbagai tahap penyakit. Penelitian ini bertujuan untuk menilai pengaruh protokol fisioterapi enam bulan yang sama terhadap status fungsional pasien PPOK pada berbagai tahap penyakit.

Para penderita PPOK dibagi menjadi dua kelompok sesuai dengan stadium penyakitnya. Kelompok A terdiri dari 11 laki-laki dan 22 perempuan dengan penyakit paru obstruktif kronik fungsional dan klinis yang terbukti, usia rata-rata 68,6 ± 7,3. Pasien ada di stadium kedua hingga ketiga PPOK menurut GOLD (2014) dan durasi penyakit rata-rata 7,3 tahun (5 hingga 12 tahun). Seiring penyakit termasuk arteri hipertensi (70%), penyakit jantung iskemik (49%), diabetes tipe II (6%) dan penyakit sendi degeneratif termasuk osteoporosis (9%). Jumlah penyakit penyerta rata-rata 3,3 per orang. Grup B termasuk empat laki-laki dan 28 perempuan dengan PPOK pada usia rata-rata 71,7 ± 6,9. Pasien berada pada tahap pertama sampai kedua menurut GOLD (2014) dengan durasi penyakit rata-rata 2,5 tahun (1,5 sampai 4 tahun). Penyakit penyerta adalah penyakit hipertonik (53%), penyakit jantung iskemik (31%), diabetes melitus tipe II (9%), dan penyakit sendi degeneratif termasuk osteoporosis (6%). Jumlah penyakit penyerta rata-rata 3,0 per orang.

Dalam dua kelompok, fisioterapi dilakukan sesuai dengan metodologi kami yang dikembangkan untuk pasien PPOK dalam pengaturan rawat jalan. Protokol PT diterapkan selama enam bulan, dibagi menjadi tiga periode pelatihan - awal, utama dan akhir. Periode awal meliputi 4-6 minggu pertama dan ditujukan untuk adaptasi pasien terhadap aktivitas fisik reguler dan menciptakan kebiasaan bernafas yang benar. Periode utama berlangsung selama empat bulan, ditujukan untuk mencapai pengaruh terapi yang optimal (peningkatan kapasitas vital, daya tahan dan kekuatan otot pernafasan, mengurangi gejala, peningkatan tingkat kebugaran, pencegahan komplikasi, normalisasi fungsi kardiorespirasi).Periode terakhir mencakup 3-4 minggu terakhir, dan dalam pemandian udara sesi PT, mandi matahari, prosedur air dan pelatihan penguatan fisik dan ketahanan umum disertakan. Untuk alasan ini, kamp penyembuhan sedang dilakukan pada awal bulan musim gugur dengan program aktivitas penuh waktu dengan intensitas sedang dan klimatoterapi di laut atau di resor balneologi gunung, dengan ketinggian rata-rata sekitar 800 m. Pada kondisi rawat jalan, sesi fisioterapi kelompok

dilakukan tiga kali seminggu dengan durasi 30 menit pada awal penelitian, hingga satu jam pada akhir penelitian, meliputi senam aerobik dengan intensitas rendah (jalan kaki, lari lambat, bersepeda); permainan yang menghibur dan intensitas rendah; mendaki; latihan keseimbangan; latihan ketahanan; latihan kalistenik untuk semua orang yang fit pada orang dewasa dan manula dengan COPD.Teknik PT spesifik meliputi: pengajaran pernapasan fisiologis yang benar, pelatihan pernapasan diafragma, pernapasan di bagian bawah, tengah, dan atas paru-paru, pernapasan melalui hidung dan mulut saat istirahat dan selama latihan. Bertujuan untuk mengurangi bronkokonstriksi dan dispnea, kami memasukkan latihan dalam berbagai postur pernapasan spesifik sambil duduk di kursi; pernafasan; pernapasan lambat dengan penekanan pada pernafasan; memijat sendiri otot interkostal dan leher.Untuk meningkatkan kekuatan dan ketahanan otot pernapasan yang kami gunakan dalam sesi PT mendorong, latihan pernafasan paksa; latihan "batuk"; buang napas dengan mengucapkan suku kata ”, latihan untuk menghirup napas dalam waktu lama dan buang napas dalam waktu singkat, dikombinasikan dengan latihan senam untuk otot dada, perut, dan punggung.Indikator berikut, sebelum dan sesudah masa percobaan dipantau: tes jalan kaki enam menit, Skala Borg Dyspnoea dan skala mMRC.

Temuan kami menunjukkan bahwa hasil yang diperoleh pada kelompok B akan menguntungkan tentang sesak napas yang dirasakan karena dispnea disimpan pada tingkat yang relatif rendah selama periode pemantauan [15-19].Tingkat dasar sesak saat melakukan aktivitas kehidupan sehari-hari hampir tidak berubah, yang dulu Sebuah baik hasil,mempertimbangkan sifat dan prognosis PPOK yang diharapkan. Sesak napas dalam gaya hidup sehari-hari pada kelompok B kurang terasa (antara 0-1 poin), menurut Skala mMRC lima poin, yang menunjukkan bahwa gangguan pernapasan hanya terjadi setelah intens. aktivitas fisik, seperti kecepatan berjalan cepat di permukaan datar atau lereng ringan, atau menaiki lebih dari tiga lantai anak tangga. Dispnea tidak berpengaruh buruk terhadap toleransi fisik, yang diobjektifikasi dengan tes berjalan selama enam menit. Banyak peneliti merekomendasikan skala Borg untuk menilai efek melakukan terapi fisik [20-25].Sebagai kesimpulan, penelitian ini mengungkapkan efek positif dari protokol fisioterapi enam bulan yang sama terhadap toleransi fisik, tingkat dispnea setelah aktivitas fisik dan selama aktivitas hidup sehari-hari pada pasien PPOK pada berbagai tahap penyakit dan terutama untuk pasien dengan penyakit paru-paru. tingkat keparahan penyakit yang lebih jelas yang sangat penting untuk praktik PT.



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# Effects of physiotherapy treatment in patients with bronchial asthma: A systematic review

Daniel Garagorri-Gutiérrez & Raquel Leirós-Rodríguez

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# Effects of physiotherapy treatment in patients with bronchial asthma: A systematic review

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**ABSTRACT**

**Background**: Bronchial asthma is a chronic inflammatory disease of the respiratory tract. Its physiotherapy treatment aims to reduce the frequency of asthmatic spells and the intensity of symptoms. The methods employed act mainly through the education of the patient in the correct handling of the asthma attacks and the improvement of the pulmonary elasticity.
**Objective**: The objective of this review was to critically evaluate the available evidence on the effectiveness of different physiotherapy interventions in asthmatic patients.
**Methods**: To achieve this, the search was focused on scientific databases with the key words Physiotherapy and Asthma. The search was limited to studies that evaluated the effects of a physiotherapy intervention in patients diagnosed with bronchial asthma.
**Results**: 1794 articles were located and after the inclusion and exclusion criteria were applied, 12 studies were analyzed. Of these, 5 evaluated a respiratory reeducation intervention, 4 manual therapy techniques, 2 interventions based on therapeutic exercise and 1 relaxation techniques.
**Conclusions**: The results obtained revealed that physiotherapy provides a wide range of treatment options for bronchial asthma and all of them provide positive results against the exclusive application of pharmacological treatment.

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**KEYWORDS**
Physical therapy modalities; asthma; pulmonary medicine

## Introduction

Bronchial asthma (BA) is a chronic inflammatory disease of the respiratory tract, whose pathogenesis involves cells and mediators of inflammation conditioned, in part, by genetic factors. It has bronchial hyper response and airflow obstruction, which might be totally or partially reversible (Becker and Abrams, 2017; Moral et al., 2019). It is characterized by respiratory symptoms such as wheezing, shortness of breath, limited expiratory air flow, chest tightness and cough (García and Pérez, 2012; Lundbäck, Backman, Lötvall, and Rönmark, 2016). It is one of the most frequent chronic diseases in the world and it affects about 300 million people. In the last 30 years the prevalence of this disease has increased in industrialized countries, which is apparently related to the greater proportion of the population that lives in urban settings but it seems to have stabilized in values of 10 to 12% in adults and 15% in children (Lundbäck, Backman, Lötvall, and Rönmark, 2016). Although the causes of BA remain unknown, the existence of conditioning factors for their appearance, mainly of a genetic and environmental type (such as allergens, viral infections, smoking, pollution …) is demonstrated (Becker and Abrams, 2017).

There are three processes that influence the pathophysiology of this disease: bronchial inflammation, allergy and bronchial hyperreactivity. In bronchial inflammation, inflammatory cells are involved (capable of causing edema and bronchoconstriction). Allergic factors include atopy and allergens. The last pathophysiological link of BA is bronchial hyperreactivity, which is defined as the tendency of the bronchial tree to react to an excessive bronchoconstrictor response to physical and chemical stimuli (Becker and Abrams, 2017).

The physiotherapy treatment aims to reduce the frequency of asthmatic spells and the intensity of symptoms. The methods used act primarily through the education of the patient in the correct management of asthmatic spells and the improvement of lung elasticity (McCracken, Veeranki, Ameredes, and Calhoun, 2017). In addition, mechanical alterations related to respiratory muscle overload can lead to the development of musculoskeletal dysfunctions and posture alterations, so maintaining good ventilatory mechanics and preventing thoracic deformities is also an objective of physiotherapeutic interventions. During asthma attacks, the main thing is to control the symptoms, achieve good ventilation, control the respiratory rate and relax the breathing muscles (Porsbjerg and Menzies-Gow, 2017).

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Substantial advances have been made in scientific knowledge about the nature of asthma, a wide range of new medications and the understanding of important emotional, behavioral, social and administrative aspects of BA care. However, despite these efforts, international surveys provide continuous evidence of deficiencies in asthma control and lack of adherence to existing guidelines (Becker and Abrams, 2017). Therefore, it is still necessary to address the respiratory symptoms and secondary musculoskeletal compensations of the same, which are not sensitive to medical treatment and that affect the capacity of patients in the development of daily life activities and their full socio-labor development (Porsbjerg and Menzies-Gow, 2017). Taking into account all of the above, it was considered necessary to carry out a literature review of the scientific literature published so far with the objective of evaluating the effects of physiotherapy treatments in patients with BA; to validate the hypothesis that physiotherapy techniques are able to reduce the frequency of asthmatic spells and the intensity of their symptoms.

## Methods

For the systematic search of publications, the terms Medical Subject Headings (MeSH) Physical therapy modalities and Asthma were used. Given the small number of results, it was added as a Physiotherapy search descriptor. These terms were introduced in eight databases: Cinahl, Cochrane, Medline, PEDRO, Pubmed, Web of Science, SCOPUS and Directory of Open Access Journals. The search process took place throughout the month of January 2019. During the analysis of results, the following criteria were applied: inclusion of the studies from 2014 to the present, that evaluated a physiotherapy intervention and that the sample was formed by patients with BA. The PRISMA guidelines for systematic reviews of studies evaluating health care interventions was following (Moher, Liberati, Tetzlaff, and Altman, 2009). PICOS (population, interventions, comparators, outcomes, studies design) criteria were formulated a priori to guide the review's scope and the searching, selection and synthesis of the literature. Study quality was assessed using the Jadad scale (University of Oxford, Oxford, England) for randomized, controlled trials (Jadad et al., 1996); that scoring was not used to exclude the articles. The search and selection process is detailedly explained in Figure 1.

## Results

Twelve results were found: four evaluated a manual therapy intervention, five a treatment with ventilatory reeducation techniques, two explained interventions based on therapeutic exercise and one focused on a treatment with relaxation techniques. The methodological characteristics of the studies analyzed are detailedly explained in Table 1 and the characteristics of the interventions are detailed in Table 2.

### Manual therapy

In the study by Löwhagen and Bergqvist (2014) they applied the Lotorp method for six weeks. A total of 29 patients from 20 to 52 years old participated in this study. The Lotorp methodwas applied to 17 of them, while the remaining 12 were instructed in an exercise program recommended by the Swedish National Board of Health and Welfare. The Lotorp method consists of performing massage and treatment of trigger points of a group of dorsal and thoracic muscles, among which are the spinal and lumbar square erectors or the pectorals and the diaphragm (Bardin, Rangaswamy, and Yo, 2018). The results showed that there was a significant reduction of the dominant symptoms both during rest and during exercise and an increase in thoracic expansion in the intervention group with the Lotorp method. The peak expiratory flow (PEF) improved significantly but the maximum volume exhaled in the first second ($FEV_1$) and the forced vital capacity (FVC) did not improve. Finally, the symptoms of chest tightness and shortness of breath also decreased. Regarding the control group, significant improvements were observed in these same variables but to a lesser extent than in the intervention group.

Pandey and Pandey (2015) published a case study with the objective of evaluating the effects of a physiotherapy program consisting of a craniosacral therapy supplemented with intercostal release and proprioceptive neuromuscular facilitation for diaphragm relaxation in a 10-year-old child. The craniosacral fascial approach addressed three main areas: the lung tissue, the vagus nerve and the nasal sinus area. The authors considered that a healthy craniosacral cycle should be above 80 seconds, being reduced in the study patient to a time interval lower than 10 seconds. The patient received the treatment for seven 45-minute sessions over 5 weeks. The results showed that symptoms such as wheezing, dyspnea and coughing attacks decreased with the application of this therapy and the improvements were such that they allowed the withdrawal of drug treatment. On the other hand, the patient's craniosacral rhythm went from 2 seconds to 80 seconds, which are considered healthy.

In the study by Leonés-Macías et al. (2018) the effects of manual therapy on the diaphragm were evaluated by stretching the respiratory muscles in 32 asthmatic patients between 18 and 45 years of age. The intervention

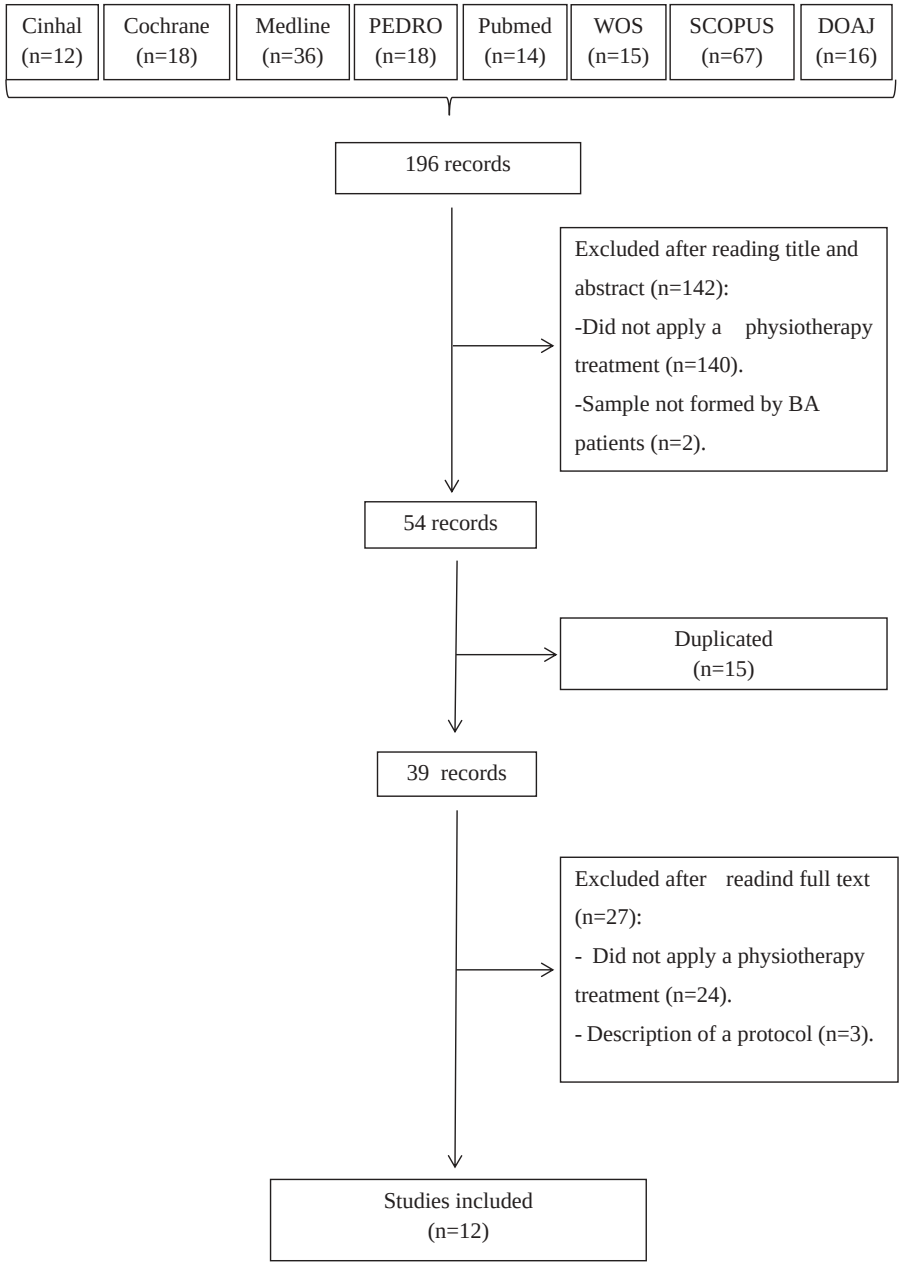


**Figure 1.** PRISMA flow diagram.

consisted of applying a diaphragm stretching technique for 5–7 minutes in the intervention group while the placebo group was administered a placebo using a disconnected ultrasonic head. Data were collected before and after the intervention (immediately before the treatment and 5 and 20 minutes after it). The results indicated that manual diaphragm stretching therapy led to an improvement in maximum inspiratory pressures, flexibility and mobility of the rib cage 5 minutes after the technique. These last two parameters also maintained improvements at 20 minutes post-intervention.

The Hupa case study (Hupa, 2015) reported on the evolution of a patient with BA for 22 years since he was diagnosed at 11 years of age. The long-term study based the evaluation of results on diagnostic methods using gasometry (through which they evaluated the pressure of oxygen, carbon dioxide, pH, bicarbonate concentration and base balance); spirometry (from which they extracted as study variables the FVC, $FEV_1$, $FEV_1$/FVC, PEF and forced expiratory flow); and, radiology through which they evaluated focal changes in the lung areas. The patient received pharmacological treatment and climatotherapy and a physiotherapy intervention that included postural drainage and thoracic mobility exercises. The analysis of the results led to the conclusion that the therapy applied significantly improved the patient's efficiency in controlling

**Table 1.** Methodological characteristics of the studies analyzed

| Authors | Design | Sample size | Inclussion criteria | JADAD Scale | | | |
|---|---|---|---|---|---|---|---|
| | | | | Randomization* | Blinding** | Withdrawals*** | Final score |
| Abdel-basset et al. (2018) | Randomized controlled clinical trial | 38 patients | School-aged children moderate asthmatic patients between 8 - 12 years (FEV1=60%–80%); were receiving long-acting β2-agonist and corticosteroid medications; and were suffering from dyspnea or wheezing, night cough, and airway obstruction in the last 6 months | 2 | 1 | 1 | 4 |
| Bruton et al. (2018) | Randomized controlled clinical trial | 655 patients | Diagnosis of asthma, age of 16–70 years, receipt of at least one anti-asthma medication in the previous year, and Asthma Quality of Life Questionnaire score of < 5.5 | 2 | 1 | 1 | 4 |
| Gramma-topoulou et al. (2017) | Experimental study | 24 patients | Adult mild-to-moderate asthma patients | 2 | 1 | 1 | 4 |
| Hupa (2015) | Case study | 1 patient | — | 0 | 0 | 0 | 0 |
| Leonés-Macías et al. (2018) | Randomized controlled pilot study | 32 patients | Diagnosis of allergic or non-allergic asthma and age from 18 to 45 years | 2 | 1 | 1 | 4 |
| Löwhagen & Bergqvist (2014) | Controlled clinical study | 29 patients | Adult asthma patients (ages 20-52), all had been prescribed bronchodilators | 0 | 0 | 1 | 1 |
| Majewski et al. (2015) | Experimental study | 10 patients | Adult women moderate and stable asthma patients | 0 | 0 | 1 | 1 |
| Mayank & Khaund (2014) | Experimental study | 46 patients | Adult mild asthmatic patients (ages 20-65 years) | 0 | 0 | 1 | 1 |
| Pandey & Pandey (2015) | Case study | 1 patient | — | 0 | 0 | 0 | 0 |
| Romieu et al (2018) | Randomized controlled clinical trial | 74 patients | Children aged 6-17 years, who were hospitalized for an asthma attack | 2 | 0 | 1 | 3 |
| Shine et al. (2016) | Experimental study | 30 patients | Moderate asthma adult patients (ages 20-40 years) with daily symptoms more than once a week, and nocturnal symptoms more than twice a month. | 0 | 0 | 1 | 1 |
| Tehrany et al. (2018) | Case study | 1 patient | — | 0 | 0 | 0 | 0 |

*Randomization: 1 point if randomization is mentioned; 2 points if the method of randomization is appropriate. **Blinding: 1 point if blinding is mentioned; 2 points if the method of blinding is appropriate. ***Whithdrawals: 1 point if the number and reasons in each group are stated. —: not applicable

**Table 2.** Characteristics of the interventions of the studies analyzed

| Authors | Intervention | | Time of intervention | Number of sessions (frequency) | Improvements |
|---|---|---|---|---|---|
| | Experimental group | Control group | | | |
| Abdelbasset et al. (2018) | Moderate-intensity aerobic exercise | Only pharmacological treatment | 10 weeks | 30 sessions (3 per week) | - Improved quality of life, pulmonary function and $VO_{2MAX}$, and fatigue index. |
| Bruton et al. (2018) | Respiratory reeducation (self-guided by DVD or face-to-face) | Only pharmacological treatment | 12 months | 26 sessions (1 each 2 weeks) | - Improved quality of life. |
| Grammatopoulou et al. (2017) | Respiratory reeducation (holistic self-control plan) | Short manual with asthma information | 12 months | 7 sessions (all in the first month) | - Improved control of symptoms, apnea time, and $FEV_1$.- Decreased hyperventilation, capnography, respiratory rate. |
| Hupa (2015) | Manual therapy (thoracic mobility exercises) and postural drainage | — | 22 years | *Not described* | - Improved patient's efficiency in controlling symptoms and attacks, and all spirometric values. |
| Leonés-Macías et al. (2018) | Manual therapy (diaphragm stretching technique) | Placebo (disconnected ultrasound) | 1 day | 1 session | - Improved $PI_{MAX}$, flexibility and mobility of the rib cage. |
| Löwhagen & Bergqvist (2014) | Manual therapy (Lotorp method) | Exercise program recommended by the Swedish National Board of Health and Welfare | 6 weeks | 2 sessions (one every third week) | - Improved thoracic expansion and PEF rate.<br>- Decreased chest tightness and shortness of breath. |
| Majewski et al. (2015) | Physical activity (home pulmonary rehabilitation program) | — | 8 weeks | 24 sessions (3 per week) | - Improved $PI_{MAX}$, exercise tolerance, lower body flexibility, fatigue and quality of life. |
| Mayank & Khaund (2014) | Respiratory reeducation (diaphragmatic breathing exercises or Buteyko technique) | — | 2 weeks | 14 sessions (one per day) | - Higher improvements in $FEV_1$, PEF, and FEV1/FVC with Buteyko technique. |
| Pandey & Pandey (2015) | Manual therapy (craniosacral therapy and propioceptive neuromuscular facilitation) | — | 5 weeks | 7 sessions (frequency not described) | - Decreased wheezing, dyspnea and coughing attacks. |
| Romieu et al (2018) | Relaxation technique (sophrology) and conventional treatment (pharmacological and physiotherapy treatment) | Conventional treatment (pharmacological and physiotherapy treatment) | 1 day | 1 session | - Higher improvements in PEF, oxygen saturation and dyspnea with sophrology technique. |
| Shine et al. (2016) | Respiratory reeducation (diaphragmatic breathing exercises) | Pursed-lip expiration exercise | 6 weeks | 60 sessions (2 sessions each day, 5 days/ week) | - Improved chest expansion and PEF rate. |
| Tehrany et al. (2018) | Respiratory reeducation | — | 16 weeks | 3 sessions (frequency not described) | - Need less Salbutamol.<br>- Improved asthma control and expiratory time.<br>- Decreased hyperventilation, anxiety and depression levels. |

$VO_{2MAX}$: maximal oxygen uptake; $FEV_1$: Forced expiratory volume in 1 second; $PI_{MAX}$: maximal inspiratory pressure; PEF: peak expiratory flow; FEV1/FVC: forced expiratory volume in 1 second/forced vital capacity.
— not applicable

symptoms and asthmatic spells. Significant improvements were observed in all spirometry values but in gasometry, despite having compensated for metabolic acidosis, it was noted that the patient continued to present a type II respiratory insufficiency.

### Respiratory reeducation

The study by Tehrany, DeVos, and Bruton (2018) aimed to prove the existence of changes in the respiratory pattern of a 57-year-old patient after a physiotherapy program. For this, they registered the respiratory patterns by means of respiratory inductive plethysmography, before and after the physiotherapy intervention. He received three face-to-face sessions: one of evaluation and awareness of the ventilatory pattern; and another two of evolution control over 16 weeks. The results showed that it reduced the use of salbutamol from 12 to 6 inhalations. In the Nijmegen questionnaire (NQ) for the assessment of hyperventilation, it went from 39/64 to 10/64, with a score of 23 or higher indicative of hyperventilation syndrome being considered on this scale. Regarding the hospital anxiety and depression scale (HADS), in which scores above 8 indicate involvement, it obtained a preintervention score of 10 in anxiety and 15 in depression. Both scores were reduced to 1 in the two subtests after the intervention. The results in the asthma control questionnaire (ACQ), indicated that it improved its score from 3.8 to 2.3. A change of 0.5 points on this scale is considered clinically important and it justifies a change in treatment. The study also found significant improvements in the PEF flow rate and a non-significant increase in $FEV_1$. The carbon dioxide parameters in the gas exhaled during the respiratory cycle or oxygen saturation did not change.

Bruton et al. (2018) evaluated for 12 months the effectiveness of a virtual self-guided respiratory reeducation intervention. A total of 655 patients were assigned to three interventions, two experimental groups and one control group, all of them maintaining their usual pharmacological treatment. A total of 261 patients (40%) performed self-guided breathing exercises following the instructions contained on a DVD; 132 patients (20%) performed a face-to-face respiratory reeducation program with a physiotherapist once every two weeks for 40 minutes; and the control group, with 262 patients (40%) received exclusively the pharmacological treatment. The exercises were aimed at training patients in the automation of diaphragmatic, nasal and slow breathing in combination with relaxation exercises. The results showed that virtual and face-to-face intervention with a physical therapist improved the quality of life in patients with BA as confirmed by the results of the asthmatic patient quality of life (AQLQ) questionnaire. However, no significant effect was found on pulmonary function values ($FEV_1$, PEF, FVC) or inflammation of the airways by measuring the exhaled fraction of nitric oxide. In the comparison of the results of the three groups, no significant differences were found, except for a vital improvement of the depression component of the HADS scale in the virtual intervention group versus the control group. In the two experimental groups, the one that received the virtual treatment and the one that did face-to-face sessions with a physiotherapist, there were significant improvements regarding the control group on the AQLQ scale, which assesses the quality of life. The results indicated that there were no differences between the three groups in the rest of the scales (ACQ and NQ) or in the spirometry parameters ($FEV_1$, PEF and the exhaled fraction of nitric oxide).

Grammatopoulou et al. (2017) published a study in which they evaluated the effect of a holistic BA self-control plan with 24 patients admitted to the Emergency Department due to an asthma attack for 12 months. The intervention, applied to 12 patients, was carried out in four educational sessions and three individualized sessions over a month. In two of these sessions, physiotherapist applied a ventilatory reeducation program to reduce the symptoms and exacerbations of BA in daily life and encouraged physical activity. The third session was conducted by a psychologist to teach them how to effectively manage the disease. In addition, a home-based asthma self-control plan was implemented, during which the patients had to carry out the following 11 months and that included recommendations to adopt the respiratory pattern in daily life activities, proper registration of the PEF and a promotion of physical activity for 30 minutes per day, five days a week. The 12 patients in the control group were only given a brief manual with information about the BA. The self-control plan included five components: diaphragmatic breathing with gentle filling of the abdomen and relaxation of the accessory muscles of respiration; nasal breathing; brief 2–3 seconds apnea; increased apnea time; and an adoption of an adequate respiratory pattern when speaking, coughing, yawning and sighing. The evaluation methods were the following ones: the asthma control test (ACT), which was performed in order to quantify the degree of disease control; the general self-efficacy (GSE) scale to measure changes in the perception of the ability to adequately manage various stress situations; the breathing hold time (BHT), to measure the maximum apnea time; the NQ, to assess hyperventilation; capnography, to measure the variations of exhaled carbon dioxide concentration and respiratory rate and spirometry for the measurement of $FEV_1$. The results obtained signposted to the fact that that, all the

measured variables having been taken into the account, the experimental group obtained significant improvements while the control group did not. Furthermore, a positive interaction between intervention and time of application was detected in the ACT, GSE, BHT, NQ, carbon dioxide concentration, respiratory rate and spirometry.

Shine et al. (2016) conducted a study with the objective of demonstrating that diaphragmatic breathing exercises play an important role in the management of BA to obtain functional benefits in lung function. Thirty patients from 20 to 40 years old participated in the study. Fifteen patients in the group that performed diaphragmatic breathing received six physiotherapy sessions lasting 20 minutes each. The frequency of treatment was twice a day, five days a week. Fifteen patients who participated in the second intervention performed exercises focused on nasal inspiration and slow mouth exhalation with pursed lips with the same frequency and duration of the sessions. The study showed a statistically significant improvement in the diaphragmatic breathing group, which increased thoracic expansion by 2% and PEF by 16.9% in comparison to the puffed-out exhalation group that improved 1 and 2,2%, respectively.

Mayank and Khaund (2014) published a study in which they compared the effectiveness of the Buteyko respiratory technique while performing diaphragmatic exercises. 46 patients participated, between 20 and 65 years of age. The study was carried out over 2 weeks, and both groups performed daily sessions lasting 60–90 minutes. Half of the patients were assigned to the group that performed the Buteyko technique and the other half to the group that performed diaphragmatic exercises. The Buteyko technique aims to reeducate the respiratory rate to correct hyperventilation, by reducing the amount of inhaled air. The intervention centered on diaphragmatic exercises consisted of being in a semi-Fowler position and performing slow and deep nasal inspirations keeping the shoulders relaxed, avoiding the pattern of costal breathing and performing oral exhalations. Spirometry was used to evaluate patients, assessing $FEV_1$, PEF and the relationship between $FEV_1$ and forced vital capacity ($FEV_1$/FVC). The results indicated that all participants improved in all parameters but significant improvements were noted only in the group that received the Buteyko technique.

### Physical activity

Abdelbasset et al. (2018) carried out a study with the objective of evaluating the effectiveness of training with aerobic exercise in school children compared to conventional treatment for 10 weeks. 38 children of school age (23 boys and 15 girls) aged between 8 and 12 years participated in the training program. The participants were randomly assigned to two groups, receiving both pharmacological treatment and respiratory exercises. The experimental group also carried out a moderate intensity exercise program simultaneously to the conventional treatment. For the evaluation of the participants, they measured lung function through spirometry by quantifying $FEV_1$ and FVC; aerobic capacity through maximum oxygen consumption ($VO_{2Max}$), 6-minute walk test (6MWT) and fatigue index; and the quality of life through PAQLQ. The results indicated that the physical exercise caused a significant improvement against the control group, as reflected by the post-intervention results, of all the parameters of pulmonary function assessment, aerobic capacity and quality of life.

Majewski, Dabrowska, Pawik, and Rozek (2015) analyzed the effectiveness of a home pulmonary rehabilitation program for the improvement of respiratory function, inspiratory muscle strength and physical condition in older women with BA. 10 women with a mean age of 70.8 years participated in the 8-week pulmonary rehabilitation program, which consisted of 2 home sessions and 1 supervised session per week. The main training included eight exercises, each with a 2-minute duration. The exercises were separated by 1-minute rest intervals. The patients counted the number of repetitions and wrote them down in a notebook. The home pulmonary rehabilitation program significantly improved the FVC, $FEV_1$, PEF and FEF as well as the values of maximum inspiratory pressure ($IP_{Max}$) of the patients. The results of the HADS and the Saint George's Respiratory Questionnaire (SGRQ) which assess the patients' quality of life, only showed significant improvements in aspects related to BA symptoms. The results obtained in the physical fitness tests (Fullerton Fitness Test) and the lower body flexibility had also improved.

### Relaxation techniques

Romieu et al. (2018) compared the PEF variations between the conventional treatment (administration of oxygen, corticosteroids, bronchodilators and physiotherapy) and this same treatment by adding a session of sophrology. 74 children hospitalized for an BA attack participated in this study, divided into two treatment groups of equal size. The intervention began with a previous fifteen-minute dialogue to create a climate of trust. In the main part of the session, which lasted for about thirty minutes, a slow and monotonous speech was used that took the patient to a level between awakening

and sleep (sophroliminal level). The session ended with a final discussion describing the sensations experienced. The data obtained showed that PEF, $SpO_2$ and dyspnea improved significantly in the group that received the sophrology session in comparison to the control group, but there was no improvement in respiratory or heart rate. No improvements were found regarding the conventional treatment group in the length of hospital stay, medication consumption or quality of life measured with the pediatric quality of life questionnaire (PedsQL).

## Discussion

The objective of this review was to evaluate the effects of physiotherapy treatments in patients with BA. In the light of the results obtained, to a greater or lesser extent, all physiotherapy interventions generate a positive impact on the clinical symptoms caused by BA.

### *Manual therapy*

Talking about the interventions that applied manual therapy, the most outstanding clinical improvements were obtained after the application of craniosacral therapy (Pandey and Pandey, 2015) managing to eliminate the wheezing and cough of the patient therefore leading to a decision of his pulmonologist for the medication withdrawal. Regardless of obtaining these very positive results, it is a case study, in which the initial assessment of the patient is not clear. It does not show how these changes were evaluated and it does not take any objective action, which may detract from these results. The other intervention that showed positive results was the study that applied the Lotorp method (Löwhagen and Bergqvist, 2014). In this case, the study achieved a significant improvement in PEF but, fundamentally, it merely managed to improve the dominant symptoms (chest pressure, gasping, wheezing and dyspnea), which are for each patient those who showed a higher score on the analog visual scale.

### *Respiratory reeducation*

Regarding ventilatory reeducation, the most effective therapy was the one that applied a reeducation of the ventilatory pattern (Tehrany, DeVos, and Bruton, 2018). With this intervention, significant improvements were achieved in the results obtained by the NQ, the ACQ, the PEF and the disappearance of anxiety and depression symptoms. Again, it is a case study, but in contrast to the Hupa study (Hupa, 2015), this time a correct recording of the variables was carried out. On the other hand, it is interesting to compare the effectiveness of different interventions as they were addressed by Mayank and Khaund (2014) in their study. In it, the two made a comparison of two respiratory techniques: Buteyko respiratory technique and diaphragmatic exercises. Although the effectiveness of respiratory techniques seems to be established, it is very important to assess which of them is the one that provides the best results. In this case, it was found that the Buteyko technique obtained significant improvements compared to the technique of diaphragmatic exercises as far as lung function values are concerned.

Hyperventilation did not obtain improvements in the study that applied a virtual ventilatory reeducation program (Bruton et al., 2018). Reeducation therapies of the ventilatory pattern (Tehrany, DeVos, and Bruton, 2018) and the holistic plan of asthma self-control (Grammatopoulou et al., 2017), both used face-to-face, did manage to reduce this symptom. These results support the need to apply face-to-face interventions since in them the physiotherapist can teach the techniques, resolve doubts, correct possible postural or execution errors, motivate the patient and, ultimately, facilitate adherence to the reeducation program. The virtual intervention sought to replace the physiotherapist's function for economic reasons but it did not pay attention to these fundamental factors in a ventilatory reeducation program and, probably, due to this phenomenon, its results were worse.

The degree of asthma control was evaluated in studies that applied ventilatory reeducation treatments. The study that applied a program of virtual ventilatory reeducation (Bruton et al., 2018), did not accomplish any improvements in the control of the disease but there were some improvements as far as the reeducation therapies of the ventilatory pattern (Tehrany, DeVos, and Bruton, 2018) and the holistic plan of self-control of asthma were concerned (Grammatopoulou et al., 2017). Since the control of the symptoms of BA is an essential factor in the treatment, only three out of all the enumerated studies evaluate the impact of their interventions on this variable.

Among the studies that evaluated depression and anxiety, only those who applied a treatment based on the reeducation of the ventilatory pattern (Tehrany, DeVos, and Bruton, 2018) obtained significant improvements. This intervention describes a process of reassessment and constant discussion with the patient that could have led her to be aware that reducing her anxiety can attenuate the severity of the asthma attacks.

With the exception of the research by Leonés-Macías et al. (2018) and Pandey and Pandey (2015), all studies assessed parameters indicative of lung function. The intervention that applied kinesitherapy and postural drainage (Hupa, 2015), seemed to show the best results,

significantly improving the FVC, $FEV_1$, PEF and $FEV_1$ /FVC. Being a prospective case study, developed over 22 years, the improvements cannot be attributed exclusively to the intervention with physiotherapy since in such a prolonged period from childhood to adulthood, lung capacities are modified and muscle strength, as a result of muscle growth, can influence many other factors that were not taken into account. In addition, in this study, postural drainage was used, which has been shown to have no positive results by demonstrating that the usual mechanism of secretion mobilization is antigravity (Ibarra-Cornejo et al., 2017). Another investigation that obtained great improvements was the one that developed a home pulmonary rehabilitation program (Majewski, Dabrowska, Pawik, and Rozek, 2015). In this case, the investigator discovered a viable combination of exercise with ventilatory awareness and relaxation. It seems that thanks to the multifactor approach of this study, most lung function parameters improved.

Among the studies that assessed quality of life, the intervention based on sophrology (Romieu et al., 2018), found no positive results. However, in investigations that applied a virtual and face-to-face ventilatory reeducation intervention (Tehrany, DeVos, and Bruton, 2018), a moderate intensity therapeutic exercise program (Abdelbasset et al., 2018) and a home pulmonary rehabilitation program with therapeutic exercise (Majewski, Dabrowska, Pawik, and Rozek, 2015) did show improvements in the different assessment scales. The results of these interventions, framed in respiratory reeducation and therapeutic exercise, seem to indicate that both therapies, by providing improvements in symptoms, were able to facilitate participation with fewer limitations in daily life activities, positively affecting the assessment of quality of life. This can be justified because these evaluations underline that the major part of the result lies in the limitations in daily life activities and the frequency and severity of respiratory symptoms and, to a lesser extent, in the degree of emotional involvement (in the one that focused on the intervention of sophrology).

### Physical activity

Among the physiotherapy interventions that applied therapeutic exercise (Abdelbasset et al., 2018; Majewski, Dabrowska, Pawik, and Rozek, 2015), it is worth highlighting the differences between them, one being applied in pediatric patients and the other in older women; one having moderate intensity, the other, having very low intensity. Despite of this fact, both interventions yielded positive results, showing significant improvements in respiratory functions and aerobic capacity. This means that therapeutic exercise is a valuable tool that adapts to the patients' capacity and baseline state, achieving positive results in all age groups. In addition, it allows for the improvements always to be achieved to a greater or lesser extent, regardless of the degree of involvement of the patient and the level of physical condition which might be his/her point of departure (Sparling, Howard, Dunstan, and Owen, 2015). In any case, the intervention that yielded the best results corresponds to the study that applied a program of therapeutic exercise of moderate intensity (Abdelbasset et al., 2018), in which there were also significant improvements in the life quality.

### Relaxation techniques

Finally, the study that evaluated a sophrology intervention in combination with a physiotherapy program (Romieu et al., 2018), showed significant improvements in PEF, $SpO_2$, and dyspnea. This implies the need to contemplate the inclusion of relaxation techniques in the treatment of BA since they do not seem to be widely used to address this pathology.

In the studies that included children, the parameters of respiratory function improved much more with the intervention that applied a program of therapeutic exercise of moderate intensity (Abdelbasset et al., 2018). On the other hand, in the studies with adult patients, these parameters improved to a greater extent in the study that was implemented alongside the home pulmonary rehabilitation program (Majewski, Dabrowska, Pawik, and Rozek, 2015). The two interventions belong to the group of therapies with therapeutic exercise which seems to indicate that it is the best approach for treatment in both children and adults to obtain improvements in lung function values ($FEV_1$, PEF, $FEV_1$/FVC).

Regarding the impact of the treatments on the patient's quality of life, the pediatric study that showed a better result is the one that applied a therapeutic exercise program of moderate intensity (Abdelbasset et al., 2018) and in the adult population, the home pulmonary rehabilitation program (Majewski, Dabrowska, Pawik, and Rozek, 2015). Both have achieved significant enhancements in the same vein as the best therapeutic option for the improvement of lung parameters; therefore, we draw the conclusion that the therapies that seem most effective are the ones that apply exercise.

On the other hand, studies seem to confirm that patient education plays a fundamental role in disease control. In the interventions, the learning of the techniques and their application in the home environment was decisive to maintain the improvements obtained. Sometimes, this educational function of the physiotherapist is intended to be

provided by offering intervention guidelines through virtual media. This trend responds to the search for a reduction in costs without taking into account the shortcomings of such treatment that strives to replace the role of the professional.

Considering the complexity of the management of the patient with BA, due to the diversity of physical, psychological, social and economic factors, it is very difficult to address the treatment of the disease from a single health discipline. Currently, in the health system, the most widespread treatment is the pharmacological one, which only focuses on symptoms. Therefore, the multidisciplinary approach is interesting, in which the physiotherapist plays a justified role due to the results obtained from the applied therapies, achieving improvements at a physical level, life quality, disease control and also cost reduction by reducing medical visits and hospital admissions. In addition, it would be necessary to evaluate the application of physiotherapeutic intervention protocols by health institutions, so health managers should focus on this type of interventions with few or no side effects, with very low economic cost of application, high impact on life quality and high saving capacity for the health system.

These studies have methodological limitations. In the case of a disease with such a high incidence worldwide, the size of the samples used is mostly small, making it difficult to find significant relationships and extract generalizations from the existent. On the other hand, some of the studies do not clearly explain the baseline and post-treatment data of the patients, making it difficult to assess the existence of improvements. In many cases, the information was collected through surveys and questionnaires preventing it from being verified and deducted from its results. Although there are several long-term studies, most of the interventions are short, probably due to economic and time limitations of the researchers. For these reasons and for not having included only randomized controlled trials the conclusions of this review on the efficacy of physiotherapy treatment in patients with BA should be taken with caution and cannot be generalized (van Tulder, Furlan, Bombardier, and Bouter, 2003).

The analysis performed shows the need to carry out a new research, the one with a higher methodological quality that will obtain rigorous results which clarify which therapy shows a greater effectiveness in the approach of the patient with BA. It would be interesting to design studies that would be focused on patients' follow-up to assess whether the effects achieved with physiotherapy treatment are maintained in the long term and whether the patient is able to retain the techniques he/she had learned.

In conclusion, the therapeutic possibilities that physiotherapy offers in the treatment of patients with BA are numerous. Currently, research carried out so far indicates that the interventions that can benefit patients the most are techniques based on the combination of respiratory reeducation and therapeutic exercise. Regardless of the type of therapy described in the studies, all patients showed some kind of improvement, which highlights that the simple act of performing an intervention that involves the patient in their pathology in a way, parallel to the conventional treatment, is a significant improvement over the usual medical treatment.

## Declaration of interest

The authors report no conflict of interest.

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# Physiotherapy Interventions in COVID-19 Patient with Multiple Comorbidities: A Case Report

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## ABSTRACT

The rapid outbreak of coronavirus disease, which arose from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections, has become a public health emergency. Large number of patients diagnosed with COVID-19 need critical care for prolong period of time. There is risk of severe adverse outcomes in COVID-19 patients with multiple comorbidities. Collaboration between medical interventions and early and sustained comprehensive rehabilitation play an important role in patient recovery from acute care to discharge. Physiotherapist, who play an important role in multidisciplinary treatment contribute majorly to improve patient's lung and functional capacity.
We present a case of a 52-year-Old male diagnosed with COVID-19 and with multiple comorbidities, focusing on role of pulmonary rehabilitation in collaboration with Medical management and outlining the pathway of recovery from ICU to discharge.

***Key words:*** COVID-19, Physiotherapy, Pulmonary rehabilitation, Comorbidities, Case report, Acute care.

## INTRODUCTION

The novel coronavirus (COVID -19) which is caused by SARS-CoV-2, was first found in Wuhan city of china in December 2019. [1] The spectrum of severity ranges from a complete asymptomatic/very mild presentation requiring no hospitalization, to a severe viral-pneumonia requiring intensive care, which in many cases, leads to respiratory failure and eventual death. [2] COVID-19 patients with comorbidities like diabetes, hypertension and other cardiovascular and cerebrovascular diseases yield poorer clinical outcomes. [3] Medication related myopathy, Critical illness myopathy and neuropathy (CIMN) are underdiagnosed conditions within the intensive care setting and contribute to ventilator wean failure and delay the recovery. [4] Physiotherapists are an integral part of the multidisciplinary team (MDT) of all hospital setups. Physiotherapy in COVID-19 patients, focusing on improving pulmonary functions and early mobility in intensive care unit(ICU) and in step down unit(SDU), have shown to be beneficial in augmenting early weaning of oxygen support, improving lung function, preventing ICU acquired weakness, and contributing to early recovery of patient. [5,6] Collaboration between the fields of medical care and pulmonary rehabilitation play an important role in optimizing patient recovery. [7]

## CASE PRESENTATION

A 52-year-old male presenting with complains of fever, dry cough and breathlessness on exertion, was admitted in COVID-19 dedicated ICU on 26/6/20 with

diagnosis of COVID-19, stage 3 and 70% lung involvement on HRCT. He had associated comorbidities of Diabetes Mellitus (20 years) & HTN (4 years) with a past history of Pulmonary Koch's and was a chronic alcoholic.

On admission in ICU, patient was on non-invasive ventilation (NIV) with fraction of inspired oxygen (FiO2) 90%. His investigations, medical treatment and physiotherapy care were as mentioned in table 1 and 2. He had prolonged hospital stay of 6 weeks (ICU) and 3 weeks in Step down care unit (SDU). He was discharged on 29/08/2020.

**Table 1: Investigations and medical management**

| RT -PCR test | | Result | |
|---|---|---|---|
| 26 /06/2020<br>6/07/2020<br>29/07/2020 | | COVID positive | |
| 24/08/2020 | | COVID negative | |
| Investigation | | Value | Inference |
| Haemoglobin | 17/07/2020 | 13.4 g/dl | Borderline normal |
| | 2/08/2020 | 12.1 g/dl | Borderline normal |
| Alkaline phosphatase | 7/7/2020 | 255.0 U/L | Above normal |
| BUN: Creatinine | 13/07/2020 | 20: 1.2 | Normal |
| INR | 18/07/2020 | 1.56 | Borderline high |
| HGT | 27/6/2020 | 467 mg/dl | Impaired |
| | 6/7/2020 | 289 mg/dl | Impaired |
| | 24/8/ 2020 | 168mg/dl | Normal |
| MEDICAL MANAGEMENT:<br>It included oxygen therapy and Medications (inj tocilizumab, low molecular weight heparin, inj piptaz, inj piperacilin, inj colistin, inj HI, tab Amlo, tab metoprolol, tab septran, inj DEXA.) | | | |

RT-PCR: Reverse Transcription Polymerase Chain Reaction, BUN: Blood Urea Nitrogen, INR: International normalized Ratio, HGT: Hemo Glucose Test, HI: Human Insulin, inj: injection

**Table 2: Physiotherapy management and Outcomes**

| Duration of hospital stay | Week 1-2 | Week 3-4 | Week 5 | Week 6-7 | Week 8 | Week 9 |
|---|---|---|---|---|---|---|
| Oxygen support | NIV with NRBM Trials | NRBM with FM trials | FM | NP | NP with off $O_2$ trial | Room air |
| Oxygen ($O_2$) l/min | 90%→ 80%→ 75% Fio2 → 15 | 15→8 →5 | 9→5→4 | 10→4→2 | 2 →1 | Off $O_2$ |
| Therapeutic position | √ | √ | √ | √ | √ | √ |
| Breathing exercise | √ | √ | √ | √ | √ | √ |
| Incentive spirometer | × | × | 400 cc/sec | 600 cc/sec | 800 cc/sec | 1000 cc/sec |
| ICU Mobility Score | 1-3 | 6 | 6 | 10 | 10 | 10 |
| 6 MWT | Date:8/8/20 Distance:135 metre, Oxygen titration:3 L<br>Date:23/8/20 Distance:144 metre, Oxygen titration: 2 L | | | | | |
| TUG | Date:8/8/20, oxygen support:2 L/min, time:33 sec<br>Date: 25/8/20, oxygen support: off $o_2$, time:8 sec | | | | | |
| SBC | Date:8/8/20, oxygen support:1 L/min, count:7<br>Date:25/8/20, oxygen support: off $o_2$, count:25 | | | | | |

NIV: Non-Invasive Ventilation, NRBM: Non-Rebreathing Mask, FM: Face Mask, NP: Nasal Prongs, $Fio_2$: Fraction of inspired oxygen, IMS: ICU Mobility Scale, L/min: Litre/minute,
6 MWT: six-minute walk test, TUG: Time up and go, SBC: single breath count

## DISCUSSION

The ongoing novel coronavirus disease (COVID-19) is threatening the global human population. Viral Pneumonia is the main feature of COVID-19 and adequate ventilatory support is crucial for survival of patient. Elderly patients with comorbidities are more vulnerable to coronavirus disease and studies have shown that prolonged ICU stay causes ICU acquired weakness and also has psychological impact on patient. Since patients with COVID-19 suffer from various degrees of respiratory, physical, and psychological dysfunction, pulmonary rehabilitation is equally important in acute as well as subacute phase for the treatment of the disease. This case represents the prolonged course of patient in hospital and effectiveness of multiple components of inpatient pulmonary rehabilitation along

with medical care which helped the patient to recover.

Patient was admitted in intensive care unit (ICU) with symptoms of fever, dry cough, breathlessness on exertion and was on noninvasive ventilatory (NIV) support. In initial period of ICU stay, physiotherapy goal was to improve lung functions and prevent complications arising due to immobility. The patient had fear of NIV mask and difficulty to adapt to NIV and this was a major barrier observed by the physiotherapist. Therefore, overcoming this barrier by educating about the need for NIV and counseling about his health condition played an important role to build rapport with patient. In initial 2 to 3 days, it was important to focus on therapeutic positioning as any other intervention was not tolerated by patient due to respiratory instability. COVID-19 pneumonia primarily and predominantly affects the posterobasal zone of lung and therefore therapeutic prone position, which helps to improve expansion of posterobasal zone of lung contributed significantly to improve oxygen saturation. [8] Awake prone position with head turned to one side was given for 15 minutes to maximum 30 minutes with monitoring of vitals and it was emphasized to do 3 to 4 times/day. [9] It was difficult for the patient to attain prone position due to discomfort caused by NIV and therefore assistance by physiotherapist to attain prone position and explaining the importance of it, helped the patient to maintain the therapeutic position.

Posterobasal segmental breathing exercises in prone position were given to the patient. Patient was unable to fully expand the posterobasal zone of lung in segmental breathing, and therefore addition of proprioceptive neuromuscular facilitation (PNF) stretches during posterobasal segmental breathing in prone facilitated adequate lung expansion and thus improvement in oxygen saturation. 10 repetitions of PNF stretches where given with rest pause as needed based on monitoring of vitals. It was observed that, prone position and PNF stretches in posterobasal segmental breathing plays an important role in weaning from NIV and to improve oxygen status of patient. Chest mobility exercises were also given to the patient. [10,11]

To prevent complications arising due to immobility, ankle toe movements and heel sides were given to patient and eventually progressed to bed side exercises which included upper limb and lower limb mobility exercises and spot marching. Considering prolonged ICU stay of patient, it was very crucial to focus on improving peripheral conditioning of patient.

Patient required extended oxygen support on non-rebreathing mask (NRBM), hence aggressive respiratory therapy consisting of interventions to improve patient's lung functions and to assist in weaning was continued. Diaphragmatic breathing in prone position (crocodile breathing) was given along with PNF stretches in posterobasal segmental breathing exercise, chest mobility exercises and therapeutic prone position. Diaphragmatic breathing in prone position led to increased mobility of lower part of ribcage and significant improvement in lung expansion. [12,13] Single physiotherapy session everyday consisted of 10 repetitions of each exercise with monitoring of vitals and oxygen saturation was maintained above 90%. [9]

Walking program was initiated, once the patient tolerated bed side walking with supplementary oxygen. Oxygen titration was required as patient desaturated during walking and providing supplementary oxygen also helped the patient to cover more distance and contributed to functional capacity of patient. Distance was increased by 10 metres daily with oxygen titration as required to prevent Spo2 drop below 90%. During walking program, heart rate was maintained within the limits of 20 beats/min above resting heart rate. [9] In this patient, walking program started with 20 metres on 6 L Of oxygen, progressing to 40 metres on 3 L of oxygen and later 50 metres on 3 L of oxygen and eventually patient covered a

distance of 200 metres on 1 L oxygen. Rest pause was given to the patient during episodes of dyspnoea and if Spo2 drop was > 3% from baseline, breathing control and dyspnoea relieving position helped to recover to baseline saturation, to relieve dyspnoea and to continue walking. [10,14]

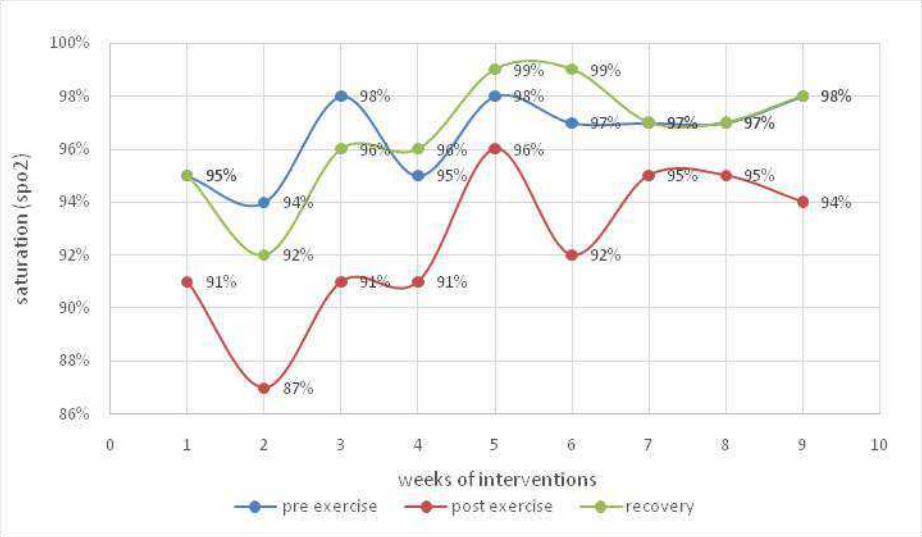
After a month of intensive physiotherapeutic and medical care, patient was weaned from higher to lower oxygen support as described in table 2 and transferred to step down unit (SDU). Incentive spirometry was initiated as patient was shifted to nasal prongs. Breathing exercise, mobility exercises and walking program were continued.10 repetitions of Incentive spirometer every one to two hours, provided visual feedback to the patient to take deep breaths, thus increasing his lung capacity from 400cc to 1000 cc and also led to self-motivation of the patient to perform better. [15,16]

Functional capacity was assessed by 6 min walk test (6MWT). Patient covered 6-minute walk distance(6MWD) of 135 metres with 2 pauses due to rate of perceived exertion-5 and oxygen was titrated upto 3 L to complete test with 95% Spo2 on recovery. After 2 weeks of pulmonary rehabilitation, a pre discharge 6MWT showed an increase in 6-minute walk distance (6MWD) of 144 metres with no pause, oxygen was titrated upto 2 L to complete the test and Spo2 on recovery was 98%. Improvement in functional independence was also indicated by decrease in Time up and go test (TUG) time from 33 seconds to 8 seconds at end of 2 weeks.

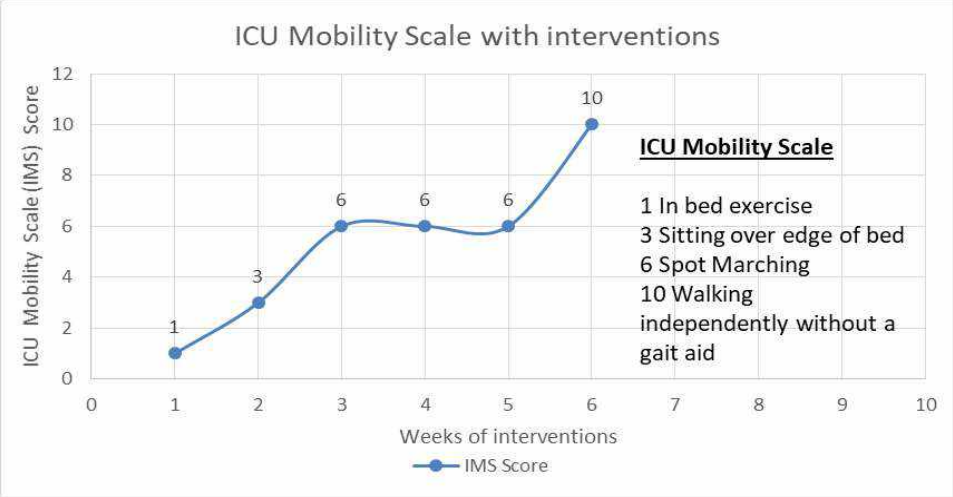
Pulmonary function of patient was assessed by Single breath count, a bedside pulmonary function test. A significant increase in single breath count (SBC) from 7 to 25 at the end of 2 weeks was observed which indicated effectiveness of breathing exercises and therapeutic positioning. On the day of admission, patient's x-ray revealed bilateral patchy consolidation as seen in figure 1 and x-ray done after a month showed significant reduction in bilateral patchy infiltrates as seen in figure 2 which also indicated improvement in lung function. As treatment continued patient was able to do exercises and daily activities without the need of supplementary oxygen. As treatment progressed over 9 weeks of duration of hospital stay, there was gradual increase seen in oxygen saturation and ICU mobility score as observed in graph 1 and 2.

On considering patients comorbidities, charts were screened daily for blood glucose and blood pressure during the exercise session. Rehabilitation along with ongoing medications in this patient had positive impact on glycemic and blood pressure control which accelerated patient's recovery. Due to extended hospital stay and severity of condition, patient had less hopes of recovery which was overcomed by motivation and psychological support provided by physiotherapist.

**Figure 1: AP view chest x-ray (26/6/20) Bilateral patchy consolidation Rt > Lt**
**Figure 2:PA view chest x-ray (29/7/20) Bilateral minimal patchy infiltrates indicative of resolving ARDS**




**Graph 1: oxygen saturation and weeks of intervention**




**Graph 2: ICU mobility and weeks of intervention**

After 9 weeks of physiotherapy and medical care, discharge was planned based on patient's clinical recovery, negative RT-PCR test, resolution of symptoms and ability to maintain oxygen saturation for 3 consecutive days at room air. Prior to discharge, home program was given to patient and he was advised to follow up at physiotherapy outpatient department for pulmonary rehabilitation. On discharge patient maintained 99% oxygen saturation at rest and in during all activities of daily living (ADL).

In-hospital Pulmonary rehabilitation in acute and subacute phase which involved patient education, respiratory care, exercise training, walking program with supplementary oxygen, energy conservation and psychological support played an important role in this patient in his course from ICU to discharge by assisting in weaning of supplementary oxygen, improving lung and functional capacity and thus facilitating recovery.

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**CONSENT**

Written Informed Consent was obtained from the patient for his anonymized information to be published in this article.

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# Physiotherapy in Patients with Chronic Obstructive Pulmonary Disease

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**Abstract**

**BACKGROUND:** Physiotherapy is an essential for the treatment of patients with chronic respiratory non-inflammatory diseases especially for chronic obstructive pulmonary disease (COPD).

**AIM:** To assess the effect of six months physiotherapy (PT) program on functional status in patients with COPD.

**MATERIAL AND METHODS:** The patients were divided into two groups according to the severity of the disease. Group A included 33 patients (mean age 68.6 ± 7.3; GOLD II – III stages). Group B included 32 patients (mean age 71.7 ± 6.9; GOLD I –II). They were referred to supervised PT program performed three times weekly for a half a year. All the patients were on standard medical care. At entry and after PT, six minutes walking test (6 MWT), Borg scale and modified Medical Research Council (mMRC) scale were assessed.

**RESULTS:** Significant changes in 6 MWT ($p < 0.001$) and mMRC scale ($p < 0.001$) were found after applied physical therapy program in patients of group A. Exertional dyspnoea decreased significantly in patients with group A ($p < 0.001$). Positive changes were found in physical tolerance in the patients of group B ($p < 0.001$).

**CONCLUSIONS:** The present study revealed the positive effect of six months physiotherapy in physical tolerance and dyspnoea in patients with COPD at different stages of the disease.

## Introduction

Chronic obstructive pulmonary disease (COPD) is a common disease that affects the bronchopulmonary system. The progressive course of COPD is connected with the development of extra pulmonary complications such as cardiovascular diseases, skeletal muscle dysfunction, osteoporosis, cachexy, anxiety and depression. Thus deteriorates the health related quality of life and increases physical intolerance in patients with COPD. Pulmonary rehabilitation is a multidisciplinary program for treating patients with chronic pulmonary diseases. It is individually tailored, and its principal goal is to optimize physical and social status of the patients. Physiotherapy (PT) is the milestone in the structure of pulmonary rehabilitation. PT increases exercise tolerance, mobility in daily activities, reduces breathlessness, improves quality of life by applying various therapeutic exercises and breathing techniques [1-3].

The study aims to assess the effect of the same six months physiotherapy protocol on functional status in patients with COPD at different stages of the disease.

## Material and Methods

The patients with COPD were divided into two groups according to the stage of the disease. Group A consists of 11 males and 22 females with proven clinical and functional chronic obstructive pulmonary disease, mean age 68.6 ± 7.3. Patients are in the

second to third stages of COPD according to GOLD (2014) and mean disease duration 7.3 years (5 to 12 years). Concomitant diseases include arterial hypertension (70%), ischemic heart disease (49%), diabetes type II (6%) and degenerative joint diseases including osteoporosis (9%). The number of concomitant diseases is on average 3.3 per person. Group B included four males and 28 women with COPD at an average age of 71.7 ± 6.9. Patients are in the first to second stages according to GOLD (2014) with mean disease duration 2.5 years (1.5 to 4 years). Concomitant diseases are a hypertonic disease (53%), ischemic heart disease (31%), type II diabetes mellitus (9%), and degenerative joint diseases including osteoporosis (6%). The number of concomitant diseases is an average of 3.0 per person.

The following including criteria for patients in the both groups were used: patients with clinical and paraclinical proven COPD, according to spirometric data; patients from both sexes, smokers and non-smokers; stable haemodynamic parameters; motivation and positive attitude while performing therapeutic exercises for a long time; informed written consent to participate in this research.

Exclusion criteria were: severe acute respiratory and cardiovascular failure; history of cerebrovascular accidents and/or myocardial infarction, within the past six months, and fractures of the lower extremities in the last three months; neurological and joint diseases, which can interfere implementation of the physiotherapeutic sessions and tests (such as rheumatoid arthritis, Parkinson's disease, polyneuropathy); decompensate diabetes mellitus; expressed cognitive impairments. The patients with COPD from the two groups were treated with adequate medication (bronchodilators, mucolytics, expectorants) and individual additional treatment for the patients with co-morbidities.

In the two groups, physiotherapy was performed according to our methodology developed for COPD patients in outpatient settings. The PT protocol was applied for six months, divided into three training periods - initial, main and final. The initial period includes the first 4-6 weeks and aimed patient’s adaptation to the regular physical activity and creating habits for proper breathing. The main period lasts four months, aimed at achieving optimal therapeutic influence (improvement of the vital capacity, endurance and strength of the respiratory muscles, reduce symptoms, an increase of fitness level, prevention of the complications, normalization of the cardiorespiratory function).

The final period covers the last 3-4 weeks, and in PT session’s air baths, sun baths, water procedures and general physical strengthening and endurance training were included. For these reasons, a healing camp is being carried out in the early autumn months with a full-time activity program with moderate intensity and climatotherapy at the sea or in the mountain's balneology resorts, around 800 m average altitude. In the outpatient conditions, physiotherapeutic group sessions were conducted three times weekly with duration of 30 min at the beginning of the study, to one hour at the end, including aerobic exercises with low intensity (walking, slow running, cycling); entertaining and low intensity games; hiking; equilibrium exercises; resistance exercises; callisthenic exercises for all over fit in adults and the elderly with COPD.

The specific PT techniques included: teaching in correct physiological breathing, training in diaphragmatic breathing, breathing in the lower, middle, and upper portions of the lungs, breathing through the nose and mouth at rest and during exercises. Aiming to reduce of bronchoconstriction and dyspnoea we included exercises in different specific respiratory postures sitting on a chair; inhalations; slow breathing with an emphasis on the exhalation; self-massage of the intercostal muscles and the neck.

To increase the strength and endurance of the respiratory muscles we used in the PT sessions pushed, forced exhalation exercises; "coughing" exercises; exhale by pronouncing the syllables”, exercise for prolonged inhalation and short-time exhale, combined with gymnastic exercises for the chest, abdominal and back muscles.

The following indicators, before and after the experimental period were monitored: six-minutes walking test, Borg Dyspnoea Scale and mMRC scale [4-6].

## Results

Regarding the demographic and anthropometric data, (sex, age, height, and weight) both groups of patients with COPD were almost identical. During the experimental period, the patients in the group A and the group B (with different severity of COPD and varying degrees of functional impairments) were treated by our physiotherapeutic methodology, and objective information about the changes in the monitored parameters were collected. The obtained study results were statistically analyzed using SPSS version19.0, and a paired sample t-test was applied. The significance level was set up at $p < 0.05$

The results of the group A, concerning physical tolerance and the dyspnoea levels during daily or physical activities, are presented in table one. At the beginning of the experiment the patients in the group A, had worse indicators of the functional status due to the severity of the disease.

**Table 1: Changes in the mean values of physical tolerance and levels of dyspnoea before and after physical therapy in group A**

| Measurement Test n =33 | $X_1 \pm SD$ | $X_2 \pm SD$ | $X_1 - X_2$ | t | p |
|---|---|---|---|---|---|
| Six minutes walking test (m) | 351.3 ± 74.3 | 389.3 ± 72.4 | 38. 0 | 6.12 | < 0.001 |
| Borg Scale (points) | 4.5 ± 2.4 | 3.6 ± 2.0 | - 0.9 | 5.72 | < 0.01 |
| mMRC Scale (points) | 1.8 ± 1.1 | 1.6 ± 1.0 | - 0.2 | 1.98 | 0.05 |

*$X_1 \pm SD$ - mean values and standard deviation at the start of the study; $X_2 \pm SD$ - mean values and standard deviation at the end of the study; t-criteria of Students t-test; ** p <0.01 - significant difference compared with baseline values;*** p <0.001 - significant difference compared with baseline values.*

Increasing walking distance with an average of 38 m was observed. The reported difference showed statistically significant improvement ($p < 0.001$). We believe that the improved tolerance to physical exercises was because specific exercises for the lower extremities were included in PT sessions. Similar results in patients at different stages of COPD have also been observed by some other authors [7-11].

Considering the importance and prevalence of the breathlessness as the main limiting factor for physical activity in patients with COPD, patients were examined using two additional special tests. One of the tests was used to evaluate the dyspnoea in performing daily activities (mMRC Dyspnoea Scale), and the other was used to assess the dyspnoea during physical exertion (Borg Dyspnoea Scale). According to the final research results for the patients in group A, a tendency for reducing the occurrence and severity of dyspnoea was reported. The changes were improved, based on the Borg Scale - 0.9 points ($p < 0.01$), as well as the mMRC Scale - an average of 0.2 points ($p < 0.05$). We believe that the reducing the feeling of breathlessness was associated with the following: improved bronchial patency and mechanics of breathing through learning, training and improving diaphragmatic breathing, exhaling through pursed lips, and exhaling while making whistling and buzzing sounds (producing a low-pitched sound resembling the bee humming). A diaphragmatic breathing technique is more economical for the body, but it is more difficult for women, who constitute the majority of the studied contingent. It became clear that decrease of this indicator has been achieved as a result of applying the physiotherapeutic methodology, where the special breathing exercises took place [12].

A baseline dyspnoea reduction of 0.3 points and improvement of the patient's subjective status after a six-month unsupervised home physiotherapeutic program which included physical exercises for strength and endurance was found [13]. Clini E et al (2008) established higher levels of improvement in the feeling of shortness of breath in daily living after at least 15 physiotherapeutic sessions, applied to patients with all stages of COPD [14]. The obtained results from mMRC Scale decreased on average by 1.1 points, compared to the baseline levels, which had been on average 2.7 points. At the beginning of their study, the baseline status of the monitored patients showed a significantly pronounced dyspnoea when compared to our patients (1.8 points) probably due to including patients from the fourth COPD stage in their study.

The changes occurring in the physical tolerance and the feeling of breathlessness in group B before and after physiotherapy are presented on Table two.

**Table 2: Changes in the mean values of physical tolerance and level of dyspnoea before and after physical therapy in group B**

| Measurement Test n = 32 | $X_1 \pm SD$ | $X_2 \pm SD$ | $X_1 - X_2$ | t | p |
|---|---|---|---|---|---|
| Six minutes walking test (m) | 426,6 ± 57,3 | 455,9 ±71,7 | 29,3 | 4,43 | < 0,001 |
| Borg Scale (points) | 0,53 ± 1,16 | 2,38 ± 1,80 | 1,85 | 5,72 | < 0,001 |
| mMRC Scale (points) | 0,59 ± 0,61 | 0,63 ± 0,61 | 0,04 | 0,57 | > 0,05 |

*$X_1 \pm SD$ - mean values and standard deviation at the start of the study; $X_2 \pm SD$ - mean values and standard deviation at the end of the study; t-criteria of Students t-test; *** p < 0.001 - significant difference compared with baseline values.*

The changes in 6MWT after the physiotherapeutic treatment were statistically significant ($p < 0.001$). The improvement in the walking distance for six minutes was on average 29 m, which was with 10 m less than the results of group A (38 m). According to the Enright P, (1998) formula, the referent value for healthy adults of the same age, height and weight, as the patients with COPD in the group B, was 452 m. After the initial examination the data obtained (427 m) represented 94% of the normative values, and at the end of the study, it corresponded to the normative value (456 m). Moreover, better physical tolerance was probably due to the lower degree of bronchial obstruction in the group B.

In the group B, increased dyspnoea levels were found with 1.85 points, according to the Borg Scale, tested after the 6MWT. However, after the final examination, dyspnoea levels (2.4 points) showed a lower degree (0-4 points), according to the ten-point Borg Scale.

## Discussion

Our findings suggested that the results obtained in the group B would be favourable about the perceived breathlessness because the dyspnoea was kept at a relatively low level throughout the monitored period [15-19].

The baseline level of dyspnoea while performing daily living activities was almost unchanged, which was a favourable result, considering the nature and expected prognosis of COPD. Breathlessness in daily lifestyle in the group B was less pronounced (between 0-1 points), according to the five-point mMRC Scale, which indicated that the breathing disturbances occurred only after intense

physical exertion, such as fast walking speed on a flat or a light slope surface, or climbing more than three floors of stairs. The dyspnoea did not adversely affect physical tolerance, objectified by a six minutes walk test. A lot of researchers recommend the Borg scale to assess the effect of performing physical therapy [20-25].

In conclusion, the present study revealed the positive effect of the same six months physiotherapy protocol on physical tolerance, the level of dyspnoea after physical exertion and during daily living activities in patients with COPD at the different stages of the disease and especially for the patients with more pronounced disease severity which is very important for PT practice.

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