Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-7, Issue-6 | November-December 2021
Page no- 282-293 | Section- Research Article (Physical Medicine and Rehabilitation)

Early Rehabilitation Can Prevent Long COVID Pulmonary Complications

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Received: 05 August 2021
Revised: 24 September 2021
Accepted: 04 October 2021
Published: 22 October 2021

Abstract

The long-term sequelae of coronavirus disease 2019 (COVID-19) are only now beginning to be defined, but it is already known that the disease can have direct and indirect impacts mainly on the cardiorespiratory system. The aim of the narrative review is to derive concepts for the treatment based on the experience gained from the early rehabilitation in the treatment of patients with COVID-19, and to prevent long COVID respiratory complications in connection with currently available sources and experiences. An online literature search was conducted June 2020 to January 2021 using Medline, PubMed ,Google scholar and manual search to retrieve meta-analyses, systematic reviews, randomized trials, guidelines, recommendations, state of the art, and other peer-reviewed studies investigating the relationship between COVID-19 and early Rehabilitation/mobilization or exercises. Thirty-four articles met the established criteria and the main findings were summarized and described, including indication, contraindication and recommendation for early rehabilitation and exercises prescription. after a detailed observation this review study can predict that long COVID pulmonary complications can be prevented in worth of early rehabilitation.

Keywords:- COVID, Pulmonary Complications.

INTRODUCTION

On 11 March 2020 the World Health Organization (WHO) declared the outbreak of novel corona virus disease (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) to be a pandemic.[1] Multisystem long-term sequelae are being described following severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, with a high impact at cardiorespiratory and neuromuscular system.[2] Although most people present mild forms of COVID-19, nearly 14% of individuals present severe forms, requiring hospitalization and oxygen therapy, and 5% need admission to intensive care units.[3] The number of people eventually requiring attention for COVID-19 sequelae could be high: on 30 January 2021, the present pandemic had already affected 102,107,858 people worldwide, being the main worldwide health problem with an uncertain future.[4]

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Early evaluation and rehabilitation interventions are necessary for patients with COVID-19 to effectively avoid further disease deterioration and reduce the risk of severe post-recovery disability.[5] Rehabilitation has been shown to improve patient awareness, reduce mechanical ventilation (MV) time, improve respiratory function, and reduce the risk of complications, length of hospital stays, mortality rates, and readmission risks.[6,7,8,9] Rehabilitation treatment is known to help functional recovery of various organs and improve patient quality of life (QoL) Long COVID was identified with the presence of at least one persistent symptom that includes either fatigue or dyspnea for at least three months after symptom onset, hospital admission, or diagnosis.[10,11] A spectrum of pulmonary manifestations, ranging from dyspnea (with or without chronic oxygen dependence) to difficult ventilator weaning and fibrotic lung damage, has been reported among COVID-19 survivors. Similar to survivors of acute respiratory distress syndrome (ARDS) from other etiologies, dyspnea is the most common persistent symptom beyond acute COVID-19, ranging from 42–66% prevalence at 60–100d follow-up.[12]

Furthermore, COVID-19 patients admitted to critical care often need long supportive care and mechanical ventilation, which put them at high risk to develop post-intensive care syndrome.[13] Furthermore, relatively young patients who survive acute respiratory distress syndrome can present persistent exercise limitations, reduced physical quality of life, and functional disability.[14] For all these reasons, early rehabilitation in the form of early mobilization and exercises should be performed to prevent these impairments. The early mobilization and exercises are common routine in several health conditions, as well as in critically ill patients, and its effects are well established.[15,16,17,18,19,20,21,22,23] However, as COVID-19 is a new disease, little is known about how and when mild, moderate or severe COVID-19 patients should be submitted to early mobilization and exercises.

So, the aim of the narrative review is to derive concepts for the treatment based on the experience gained from the early rehabilitation in the treatment of patients with COVID-19, and to prevent long COVID respiratory complications in connection with currently available sources and experiences.

MATERIAL AND METHODS

An online literature search was conducted June2020 to January 2021 using Medline, PubMed, Google scholar and manual search to retrieve meta-analyses, systematic reviews, randomized trials, guidelines, recommendations, state of the art, and other peer-reviewed studies investigating the relationship between COVID-19 and early Rehabilitation/mobilization or exercises. Key terms, including Medical Subject Headings (MeSH) terms, were identified for each construct and combined using the Boolean operators "OR" within the construct and "AND" between constructs. The MeSH terms used were "COVID-19", "SARS-CoV-2", Early Rehabilitation of COVID-19 patient"," Early rehabilitation of ICU patients with COVID 19" "Early Mobilization and Exercise in COVID 19 Patients" restricted to English language.

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Vol-7, Issue-6 | November-December 2021
Page no- 282-293 | Section- Research Article (Physical Medicine and Rehabilitation)

Inclusion Criteria:

The inclusion criteria were studies in which early rehabilitation/mobilization and exercises were discussed for patients diagnosed with COVID-19.

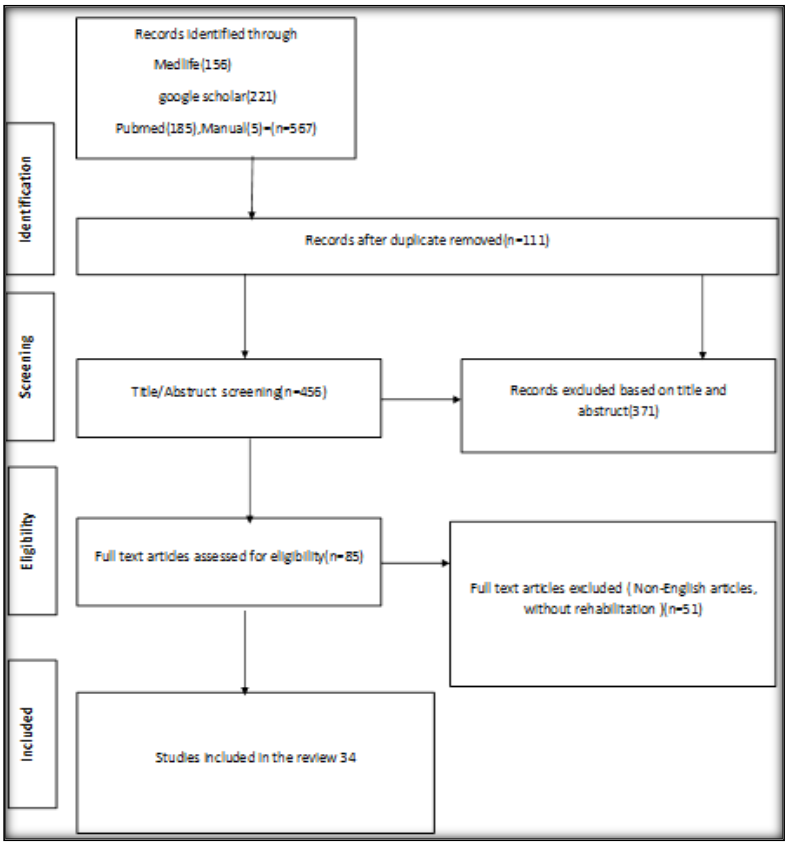
Exclusion Criteria:

The exclusion criteria were papers regarding exclusively the pediatric population, exclusively the respiratory exercise.

RESULTS

A total of 567 studies were identified in the searches. After the exclusion of 111 duplicate studies, 456 articles were screened by title and abstract, and the remained 85 articles were full text reviewed. So, 34 studies were included in this narrative review.

Among the 34 included papers, there are: thirteen opinion/ perspective/ communication/ special/ commentary/ correspondence/ experience/ document reports, four letters to the editor, four types of reviews, four guidelines, three position papers, three editorials, and three randomized controlled trial. It is necessary to highlight that there is no RCT investigating early mobilization and exercises in COVID-19 patients. Therefore, this narrative review is mainly based on observational studies in COVID-19, and on opinions of the scientific community about how to deal with early rehabilitation of COVID-19 patients, with these opinions arising from literature findings for other health conditions.



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Page no- 282-293 | Section- Research Article (Physical Medicine and Rehabilitation)

Recommendations about exercise for hospitalized patients with mild and moderate COVID-19.

Study	COVID-19 classification	Exercise type	Exercise intensity/frequency/duration criteria for interruption	Recommendation
Zhao et al. [24] 2020 China	Mild	Breathing exercises, Tai chi chuan, or square dancing.	Borg CR 10 scale dyspnea score ≤3 Twice a day, 15–45 min/session.	Start 1 h after meals; Fatigue should be absent on the next day (preferably).
Li [25] 2020 China	Mild Acute phase	Respiratory training, aerobic training, Chinese traditional exercises (Tai chi chuan, Ba-duan-jin), square dance.	Mild aerobic training.	
Kurtaiş et al.[26] 2020 Turkey	Mild pneumonia	Active-assisted or active ROM exercises, achieving mobilization, muscle strengthening exercises, incentive spirometry and other devices for patients having sputum and productive cough, breathing techniques.		Started when the virulence decreases and when patient's condition is stabilized: decreased fever, reduced dyspnea, RR < 30 breaths/min, SpO2 > 90%.
Righetti et al.[27] 2020 Brazil	Mild Acute phase	Neuromuscular stimulation, therapeutic exercises, and early verticalization.	Light intensity exercises; the exercises can be for maintenance of a Borg CR 10 scale < 3.	To maintain minimal functional capacity. Start as soon as possible, as long as the patient presents suitable clinical conditions.
Zhu et al.[28] 2020 China	Mild/Moderate Stable period	Respiratory training and RMT, mild exercise training, trying to walk, bedside bicycling, sitting and standing, resistance training, balance training; psychological support.	Exercises with intensity less than 3 Mets, maintaining a Borg score of 3–4 or visual analog scale (VAS) score 5–6. Progressive resistance training, three groups per day, 10 times per group, with a 1 repetition maximum of 50–70%. Criteria for exercise interruption: SpO2 decreased	Initiation Criteria: FiO2 ≤60%; SpO2 ≥93%; RR ≤ 30 breaths/min; PEEP ≤10 cmH2O; SBP 90–180 mmHg; MAP 65–110 mmHg; HR 40–120 BPM; temperature <38,5°. No new arrhythmias or myocardial

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Vol-7, Issue-6 | November-December 2021
Page no- 282-293 | Section- Research Article (Physical Medicine and Rehabilitation)

			by 4% points; or the patient had perspiration, nausea and vomiting, dizziness, blurred vision, etc.; severe sudden dyspnea; chest compression or pain; rapid heart rate or arrhythmia; unable to maintain balance.	ischemia; no new unstable deep vein thrombosis and pulmonary embolism; no aortic stenosis; no severe hepatorenal disease or new, progressive impairment of liver and kidney function. Contraindications: Temperature >38°; severe dyspnea; resting heart rate >120 BPM; X-ray manifestations: progression of thoracic infiltration >50% within 24–48 h; SpO2 < 95%; BP < 90/60 mmHg or >140/90 mmHg.
Vitacca et al.[29] 2020 Italy	Mild/Moderate Acute phase	Mobilization to get patient out of bed, posture changes/rotational therapy, therapeutic postures (early sitting/pronation), active limb exercises (also with devices), muscle reconditioning and strengthening, NES, RMT.	Criteria for exercise withdraw: high fever, worsening dyspnea, SpO2 < 93% or 4-point drop during exercise, chest tightness, belching, dizziness, headache, unclear vision, palpitations, sweating, inability to keep balance, increased need for O2 or NIV, radiological lesions' progression (>50%) within 24–48 h.	
Rayegani et al.[30] 2020 Iran		Rolls on the bed, gets out of bed, sits on a chair, stands up, walks a few steps, stroll up and down the stairs, tai chi, preventive exercises for venous thrombosis, and Zheng's recumbent exercises. Active and	The intensity of physical activity between 1 and 3 METs. Twice a day, at least 1 h after eating, and between 15 and 45 min, as beyond that may cause fatigue in patients.	

		passive joints range of motion exercises. The passive exercises are carried out if a patient has a reduced level of consciousness (assistive device for mobilization, ROM and stretching exercises, NES and compression stockings to prevent venous thrombosis). A full surface massage while using infrared light and TENS therapy to reduce myalgia.		
Zhao et al.[31] 2020 China	Moderate	Breathing exercises, stepping, Tai chi chuan and exercises to prevent thrombosis.	1 < METs to <3 METs (from rest to light) Twice a day, 15–45 min/session. Patients who are prone to fatigue or are physically weak should perform intermittent exercise. 3–5% of these patients develop severe disease after 7–14 d. So, intensity should not be high (exercise objective: maintain previous physical state) Criteria for exercise interruption: Borg > 3 (dyspnea), breathlessness, chest tightness, headache, blurred vision, palpitations, profuse sweating, dizziness, balance disorder, etc.	Start 1 h after meals Exclusion criteria: T > 38 °C, initial consultation time ≤7 d, from disease onset to dyspnea ≤3 d, chest radiological scans >50% progression within 24–48 h, SpO2 ≤ 95%, resting BP: <90/60 or >140/90 mmHg.
Thomas et al.[32] 2020 Australia		Range of motion (passive, active-assisted, active or resisted), muscle strength, bed mobility, sitting out of bed, sitting balance, sit to	Mobilization and exercise prescription depends on the patient clinical status.	Direct physiotherapy interventions should only be considered when there are significant functional

		stand, walking, tilt table, standing hoists, upper/lower ergometry and exercise programs.		limitations, such as (risk of) ICU-acquired weakness, frailty, multiple comorbidities and advanced age.

BP: blood pressure; COVID-19: coronavirus disease 2019; CR: category ratio; h: hour(s); d: days; FiO2: fraction of inspired oxygen; HR: heart rate; ICP: intracranial pressure; MRC: Medical Research Council; MAP: mean arterial pressure; MET: metabolic equivalent of task; NES: neuromuscular electrical stimulation; NIV: non-invasive ventilation; PEEP: positive end expiratory pressure; RASS: Richmond agitation sedation scale; RMT: respiratory muscle training; ROM: range of motion; RR: respiratory rate; SpO2: peripheral capillary oxygen saturation; SBP: systolic blood pressure; T: temper

Most of mild COVID-19 patients are not hospitalized, they should be advised to stay home and balance rest and physical activity, paying attention to their symptoms. A home exercise program may be instituted, and an individualized approach is recommended. For patients with mild and moderate signs and symptoms of COVID-19, the main interventions involve airway clearance, respiratory control, posture management, physical activity, and exercise.[33,34,35,36] Since some mild and moderate COVID-19 patients may rapidly progress to severe acute respiratory syndrome (SARS), it is recommended that interventions do not cause a further burden on breathing work, increasing the risk of respiratory distress.[33]

The rehabilitation of severe and critically ill patients should be undertaken once a patient's condition is assessed as stable. posture management, rollover, active/passive joint activity, respiratory muscle training, sputum training, simple exercises for patients confined to their beds, mobility training, stand on support, standing independently, and ADL training.[4,35] It should be noted that in the early stage of severe illness, aerobic exercise should be avoided as much as possible, as it may cause respiratory failure in patients,[36] a prone position combined with positive end-expiratory pressure ventilation (PEEP) for patients with ARDS can increase lung ventilation and reduce lung hyperinflation.[37,38,39] Placing patients in a prone position, first proposed in the 1870s, is used to improve gaseous exchange during the acute phase of ARDS.[38] Studies have shown that prone positioning can promote more uniform lung ventilation in patients with COVID-19, significantly improve the oxygenation index, reduce atelectasis, and prevent ventilator-induced lung injury.[36,38] One international team of experts undertook three rounds of online questionnaire surveys concerning respiratory tract management, and their findings indicated that >50% of international experts considered chest wall vibrations helped to clear surrounding respiratory secretions. Hyperinflation of the lungs can also increase the clearance of secretions and lung compliance.[40] Deep breathing techniques, cough training, and

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Page no- 282-293 | Section- Research Article (Physical Medicine and Rehabilitation)

airway clearance techniques can also effectively discharge airway secretions. For patients with ventilator dependence, progressive resistance training of inspiratory muscles has been found to be a feasible and effective treatment to improve inspiratory muscle strength and improve QoL after weaning.[38] As observed in clinical trials, high-intensity and low-frequency training appears to be relatively effective.[38] Early mobilization and exercises, including positioning with 45° head up in bed, regular bed decubitus changes, passive movement for all joints, frequent posture changes with gradual increase of antigravity position in order to achieve semi-sitting position, and/or neuromuscular electrical stimulation, are also recommended for unconscious or sedated critical COVID-19 patients.[39,42] These therapeutic approaches have to be choose based on patient's clinical condition, and are important to prevent skin lesions, immobilization sequelae and disability.[42,43] The rehabilitation team should discuss the possibility to start an active mobilization program as soon as patient sedation is reduced, to avoid critical illness myopathy and physical disability.[43] However, the active mobilization is not recommended for patients with clinical instability.[43] In these cases, the training of the skeletal muscle is contraindicated as it can impose an additional stress to the respiratory system, exposing the patients to an increased risk of respiratory distress.[39]

DISCUSSION

Early rehabilitation should be carried out within the patient's tolerance.[44] This series of treatment measures has been classified into four levels: Level 1, passive limb movements of unconscious patients; Level 2, conscious patients who can interact with a therapist and perform active limb movements; Level 3, patients able to perform activities using rehabilitation equipment; and Level 4, patients able to perform activities such as transfer.[45] According to the guidelines of the American Association for Cardiovascular and Pulmonary Rehabilitation, the most challenging aspect of exercise prescription for pulmonary patients is the estimate of the appropriate intensity for each person to ensure that exercise is not too intense to cause adverse physiological effects, but it is enough to promote beneficial effect Recently published guidance by the NHS lays out the likely aftercare needs of patients recovering from covid-19 and identifies potential respiratory problems including chronic cough, fibrotic lung disease, bronchiectasis, and pulmonary vascular disease.[46] Early physiotherapy in acute respiratory distress syndrome, beginning early in ICU, is a critical therapeutic tool to reduce complications of immobilization in critical illness. Benefits include improved residual respiratory, musculoskeletal, neurological, and psychological function; it prevents readmissions in the medium and long term, improves health status, and perceived quality of life after discharge.[47] No pharmacological intervention can prevent (or reverse) the functional deterioration that accompanies hospital confinement. By contrast, as confirmed in a recent meta-analysis, simple early mobilization programs have been found useful to attenuate the deleterious consequences of disuse observed upon discharge in older adults (> 60 years old) hospitalized for an acute medical condition.[48] For instance, an inpatient rehabilitation intervention (daily 50-min sessions for 8 days, including stretching, resistance and walking exercises) improved

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Vol-7, Issue-6 | November-December 2021
Page no- 282-293 | Section- Research Article (Physical Medicine and Rehabilitation)

functional ability, muscle strength, quality of life, and dyspnea as compared with standard respiratory physiotherapy (secretion removal, breathing exercises and walking) in adults (51–59 years old) hospitalized with community-acquired pneumonia American Thoracic Society/American College of Chest Physicians recommend that particularly those with mechanical ventilation for more than 24 hour, undergo early mobilization.[49] However, despite these recommendations, early mobilization is still uncommon in most ICUs (applied in ~16% of patients. In this regard, advanced age is not a barrier to the benefits of early mobilization. Simple interventions consisting of solely sit-to-stand and walking exercises have been found useful for preventing functional decline even in the oldest and weakest patients Once the infection curve has flattened and hospitals are no longer overwhelmed, these simple therapies could play an important role in promoting a functional return to home for patients and thus, in contributing to better management of the pandemic in general. Most of the reviewed rehabilitation programs had a positive effect on lung function, exercise endurance, and QoL of patients with mild, moderate, and severe COVID-19.Rehabilitationenables individuals to remain independed in home and community and minimisesthe need for financial support. Nevertheless, the usefulness of early rehabilitation programs in everyday clinical practice requires further investigation with robust study designs and additional followups.

CONCLUSIONS

There is no RCT regarding the effect of early rehabilitation in prevention of long COVID pulmonary complications. after a detailed observation this Review study can predict that Long COVID pulmonary complications can be prevented in worth of early rehabilitation.

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Source of Support: Nil, Conflict of Interest: None declared