Review Article
http://mjiri.iums.ac.ir
Medical Journal of the Islamic Republic of Iran (MJIRI)

Med J Islam Repub Iran. 2022 (10 Sep);36.104. https://doi.org/10.47176/mjiri.36.104

Effects of Exercise on COVID-19 Patients: A Narrative Review

Hesam Aldin Varpaei[1], Alireza Khafaee pour Khamseh[2], Arad Hashemi[2], Mostafa Mohammadi[3]*, Parsa Mohammadi[4]

Received: 18 Jan 2022 Published: 10 Sep 2022

Abstract

Background: Challenges concerning patient management exist worldwide, particularly in the critical care. In this review, we have summarized some studies regarding respiratory physiotherapy and exercise in COVID-19 patients.

Methods: For searching related articles, PubMed, Google Scholar, Embase, and the Web of Science databases were used. Keywords such as "respiratory physiotherapy" and "COVID-19," "exercise," "effect of exercise in COVID-19," and "respiratory physiotherapy for COVID-19 in ICU" were used to identify related papers until December 2021. The abstracts and entire texts were evaluated by 3 separate reviewers.

Results: During the symptomatic phase, individuals may benefit from brief durations of bed rest. Exercise appears to provide both emotional and physical benefits for individuals in the early stages of infection. As a result, it may lower viral load, minimize cytokine storm, shorten the acute phase, and expedite recovery. Mild exercise may also increase the autophagy pathway, which improves the immune system function in response to COVID-19 infection. Keeping this in mind, intense activity, especially without the guidance of an expert physical therapist, is not advantageous during the inflammatory period and may even be regarded a second hit phenomenon. Mild exercises during bed rest (e.g., acute phase) may reduce the risk of pulmonary capillary coagulation and deep vein thrombosis.

Conclusion: Although respiratory physiotherapy and prone positioning in hospitalized patients, particularly in critical care, can be challenging for medical staff, they are cost-effective and noninvasive approaches for COVID-19 patients. Early physiotherapy and muscle training exercise for patients in the intensive care unit (ICU) seems to be beneficial for patients and may reduce bed rest-induced weakness, improve oxygenation, and reduce length of stay. Finally, breathing exercises can improve some symptoms of COVID-19, like dyspnea and weakness.

Keywords: COVID-19, Critical Care, Physiotherapy (Techniques), Exercise, Physical Therapy

Conflicts of Interest: *None declared*
Funding: *None*

This work has been published under CC BY-NC-SA 1.0 license.
Copyright© Iran University of Medical Sciences

Cite this article as: Varpaei HA, Khafaee pour Khamseh A, Hashemi A, Mohammadi M, Mohammadi P. Effects of Exercise on COVID-19 Patients: A Narrative Review. *Med J Islam Repub Iran.* 2022 (10 Sep);36:104. https://doi.org/10.47176/mjiri.36.104

Introduction

Because of the worldwide coronavirus outbreak, concerns have increased about the management of critically ill patients. According to some reports, most patients were classified as mild to moderate, and less than 10% of pa-

Corresponding author: *Dr Mostafa Mohammadi, mohammady_mm@tums.ac.ir*

1. Department of Surgical Nursing, Faculty of Nursing, Near East University, Nicosia, Cyprus
2. Department of Medicine, Faculty of Medicine, Islamic Azad University of Tehran Medical Sciences, Tehran, Iran
3. Department of Critical Care, Tehran University of Medical Sciences, Imam Khomeini Hospital Complex, Tehran, Iran
4. Faculty of Medicine, Tehran University of Medical Sciences Tehran, Iran

↑What is "already known" in this topic:
Bed rest with immobility has always been recommended for patients suffering from flu-like symptoms, thus, this notion might be extended to coronavirus disease 2019 (COVID-19) infection. As a result, one may expect that bed rest might be advantageous for COVID-19 patients during the acute period. On the other hand, it is generally recommended that exercise is necessary to maintain and promote health.

→What this article adds:
Mild exercise could improve the autophagy mechanism that ameliorates the function of the immune system in response to COVID-19 infection. Respiratory physiotherapy and prone positioning in hospitalized patients, particularly in critical care, can be challenging for medical staff, however, they are cost-effective and noninvasive approaches for COVID-19 patients.

[Downloaded from mjiri.iums.ac.ir on 2026-11-06]

[DOI: 10.47176/mjiri.36.104]

tients required hospitalization (1). Bed rest immobility has always been recommended for patients suffering from flu-like symptoms, and so this notion might be extended to coronavirus disease 2019 (COVID-19) infection. As a result, one may expect that bed rest might be advantageous for COVID-19 patients, particularly during the acute period. Our observations at the bedside revealed some findings in this respect, since the patients' health deteriorated and oxygenation levels dropped shortly after moderate exertion. On the other hand, long rests can have devastating side effects like deep vein thrombosis, sarcopenia, loss of muscle mass, and a reduction in the immune system level.

One of the complications of critically ill patients who need to be admitted to the intensive care unit is pulmonary involvement or acute respiratory distress syndrome (ARDS) (1-3). According to the Berlin definition (4), severe ARDS is based on the degree of hypoxemia, which is a common complication of COVID-19 patients. Patients with mild to moderate pulmonary involvement who require no hospitalization are advised to complete their rest at home. However, the immobility of patients, hospitalization, or home quarantine can reduce the organ's resistance to viral infections. This, in turn, can lead to adverse effects on the immune system, respiratory, cardiovascular, musculoskeletal systems, and cognition (5). Consequently, this review aims to summarize findings on the effect of respiratory physiotherapy and exercise on COVID-19 patients.

Methods

This narrative review was done with ethical consideration. Two expert reviewers independently evaluated the eligibility of articles. All articles confirmed by both reviewers entered into this study. To search related articles, PubMed, Google Scholar, Embase, and the Web of Science databases were used. Main keywords such as "respiratory physiotherapy" and "COVID-19," "exercise," "effect of exercise in COVID-19," and "respiratory physiotherapy for COVID-19 in ICU" were used to identify related papers until December 2021. The database search was done in the first week of January 2022. The abstracts and entire texts were evaluated by 3 separate reviewers. The inclusion criteria were manuscripts that assessed the effect of respiratory physiotherapy and exercise on COVID-19 patients and disease phase. The study was limited to the papers written in the English language. Exclusion criteria were non-English papers and papers related on nonhuman subjects.

Of a total of 27,300 articles (Fig. 1 & Table 1), 1100 manuscripts were entered to the screening process. Finally, 63 papers were included in the study and reviewed narratively.

Results

The characteristics of the studies and resources used in this review are summarized in Table 1.

The Critical Role and the Benefits of Respiratory Physiotherapy in COVID-19 Patients

Negative changes in pulmonary function and decreased pulmonary compliance in patients with coronavirus are life-threatening and are among the reasons for physiotherapy interventions (6). In respiratory physiotherapy, an attempt is made to improve the patient's respiratory status

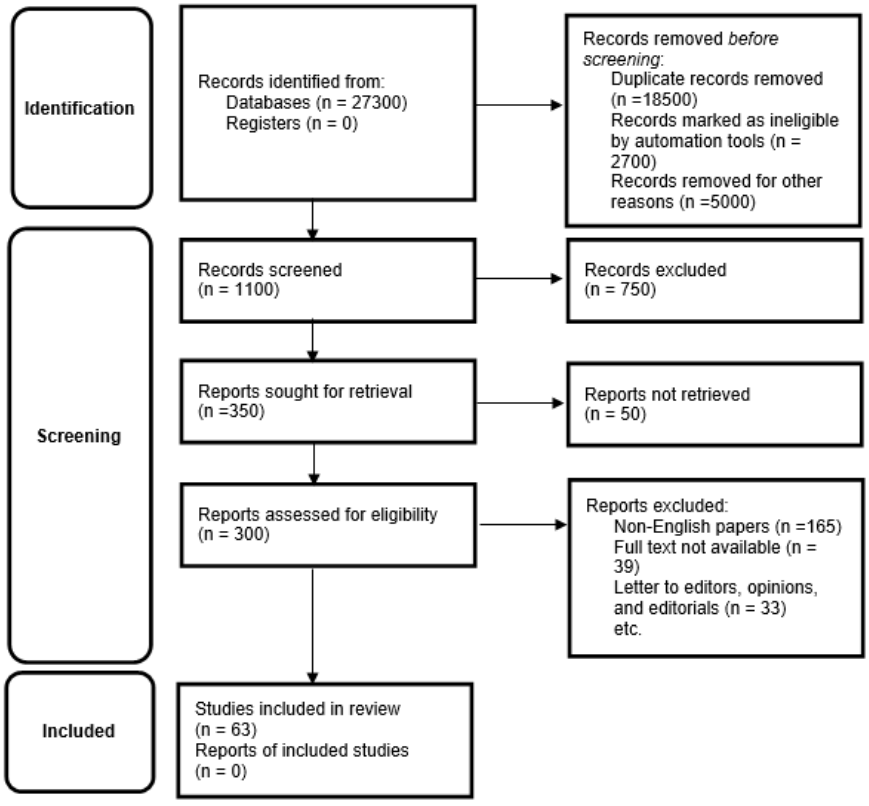

Fig. 1. The PRISMA 2020 flow diagram of the present review

[Downloaded from mjiri.iums.ac.ir on 2026-11-06]

[DOI: 10.47176/mjiri.36.104]

Table 1. Features of studies used in this review

First Author	Year	Study Design
Dean E (6)	2020	Perspective
Silva CM da S e (7)	2021	literature review
Vitacca M (8)	2020	review
Simonelli C (9)	2020	observational
Cerqueira Neto ML de (10)	2013	prospective nonrandomized clinical trial
Kayambu G (11)	2013	systematic review
Silver JK (12)	2020	n/a
Gonzalez-Gerez JJ (13)	2021	Randomized clinical trial
Thomas M (14)	2009	Randomized controlled trial.
Gaskell DV (15)	n/a	n/a
Al Chikhanie Y (16)	2021	prospective cohort study
Carolyn L Rochester (17)	2015	Practice Guideline
Battaglini D (18)	2021	observational
Bissett B (19)	2019	review
Matthews CE (20)	2002	Observational
Wong C-M (21)	2008	Retrospective
Nieman DC (22)	1990	n/a
Kostka T (23)	2000	prospective
Jones BH (24)	1994	review
Ahmadi S (25)	2020	review
Ekblom B (26)	2006	cohort
Lasanianos NG (27)	2010	review
Halabchi F (28)	2020	Editorial
Gattinoni L (29)	2020	Editorial
Kumagai Y (30)	2007	n/a
Jewell NA (31)	2007	In vivo
Sim Y-J (32)	2009	Lab test
Wareing MD (33)	2004	In vivo
Lin KL (34)	2008	In vivo
Legge KL (35)	2003	n/a
Kohut ML (36)	2006	In vivo
Lowder T (37)	2006	In vivo
Kobayashi S (38)	2015	Review
Choi Y (39)	2018	review
Viret C (40)	2018	review
He C (41)	2012	n/a
Vainshtein A (42)	2016	review
Escobar KA (43)	2019	review
Wang L (44)	2020	review
Wu NN (45)	2019	review
Baker FL (46)	2021	n/a
Abdelbary AA (47)	2021	Case report
Calles-Escandon J (48)	1984	n/a
Damiot A (49)	2020	review
Machado CLF (50)	2020	Short report
Narici M (51)	2021	review
Peçanha T (52)	2020	Perspectives
Guadalupe-Grau A (53)	2020	Commentary
Moro T (54)	2020	review
Sun S (55)	2020	n/a
Ammar A (56)	2020	n/a
Breen L (57)	2013	Clinical trial
Alomari MA (58)	2020	n/a
Barnes GD (59)	2020	Practice guideline
Carfora V (60)	2021	narrative review
Kollias A (61)	2020	Commentary
Wittmer VL (62)	2021	narrative literature review
Mohammadi M (63)	2021	letter
Rahmati-Ahmadabad S (64)	2020	mini review
Moonen HPFX (65)	2021	retrospective cohort
Jiandani MP (66)	2020	retrospective observational
Miller C (67)	2021	retrospective
Binda F (68)	2021	Prospective

by deep breathing and cough stimulation. Physical therapists deal with respiratory distress syndrome in the intensive care unit (ICU). Besides, many efforts are made to correct the body position and posture, the sensory system, particularly proprioception sense, passive and active mobilization, and gravity exercise. These clinical goals are based on comprehensive assessments and examinations to counteract the physical and psychological negative effects of total bed rest, improve and augment gas exchange, reduce airway shunt, deconditioning, and critical illness

[Downloaded from mjiri.iums.ac.ir on 2026-11-06]

[DOI: 10.47176/mjiri.36.104]

complications, and optimize long-term functional outcomes (7).

The multiple-benefits of respiratory physical therapy and rehabilitation were considered for 3 phases of COVID-19 patients: (1) acute phase, presenting with critical respiratory impairment (emergency department, first aid, ICU, stepdown unit); (2) acute phase, with severe respiratory impairment (internal medicine, respiratory, infectious disease, or other wards); and (3) post-acute phase (other units, intermediate care facilities, and subacute wards) (8). The results of a study in Northern Italy provided algorithms for guidance: (1) oxygen de-escalation by decreasing the inhaled fraction of oxygen (FiO2); (2) oxygenation enhancement through the use of a Venturi mask; and (3) reconditioning and physical activity (9). The previous study suggested that physical therapy interventions enhanced significant respiratory function and also improved cardiovascular and cerebral hemodynamic function (10). Complications of bed rest can be prevented with early physical therapy and rehabilitation; therefore, it would enhance the physical function, which might result in a reduction in the time of weaning (11). Besides, some results suggest that prerehabilitation for patients awaiting surgery might enhance the surgical outcomes in various populations (12). Gonzalez-Gerez et al (13) studied the effects of 10 breathing exercises, which have been proven in previous studies (14, 15), on mild to moderate COVID-19 patients in the acute phase of disease. They performed at the patient's house once a day for 7 days, depending on the Borg assessment score (BS). A physical therapist assisted with the exercise program. It is concluded that these programs can improve physical condition and dyspnea.

Chikhanie et al (16) studied pulmonary rehabilitation (PR) and 21 severe COVID-19 patients performed the Tinetti balance test, 6-minute walking distance, respiratory exercises, muscle strengthening, cycling, and gymnastics according to current American thoracic society/European respiratory society (ATS/ERS) recommendations (17). The following multidimensional testing batteries were done at admission and discharge: pulmonary function tests, psychological assessments, muscular strength, and balance measures, and the 6-minute walking test (6MWT). All patients attended all of the scheduled sessions without any side effects or limits. All COVID-19 patients improved significantly after PR in all physical and psychological assessments. There was a significant association between 6MWT improvement and the number of days after ICU in COVID-19 patients, and a trend for a significant correlation between 6MWT improvement and the number of days in PR.

The efficacy of respiratory physiotherapy (RPT) on intubated critically ill COVID-19 patients was evaluated by blood gas analysis (BGA) and lung ultrasound (LUS) (18). After weaning and extubation with conventional oxygen therapy (COT), one experienced physiotherapist specializing in RPT for critically ill patients performed respiratory physiotherapy maneuvers (2 strategies for individuals requiring invasive mechanical ventilation or who are spontaneously breathing). RPT was initiated just after consideration for the weaning process and bed head elevation (30°) and early passive mobilization (30 minutes per day) until the day of extubation. After weaning from the ventilator, each spontaneously breathing patient receiving COT did RPT with bed head elevation (30°), early sitting posture, and vigorous activity. The results suggested that the PaO2/FiO2 ratio improved immediately after RPT compared with baseline before RPT and at 6 hours after RPT compared with the baseline. The median LUS score decreased from 24 to 20. A correlation was observed between the variation of the LUS score and the percentage of lung gas volume. They concluded that while RPT improves oxygenation in critically ill COVID-19 patients, the improvement in oxygenation is not reflected by a reduction in LUS score, the improvement in LUS score after RPT is correlated with the lung gas volume at computed tomography, and finally, chest RPT has no effect on hemodynamics in COVID-19 patients.

According to Bernie Bissett et al (19), employing a high-intensity method, inspiratory muscle training (IMT) for ICU patients is likely to increase not only the inspiratory muscle strength but also the quality of life in patients who have recently been weaned from mechanical ventilation for 7 days or longer. To maximize practicality, effective IMT necessitates a multidisciplinary approach, with all health care providers collaborating to improve circumstances for successful IMT. They recommended using a removable threshold device to perform high-intensity training (5 sets of 6 breaths at a minimum of 50% of maximum inspiratory pressure) once per day, monitored by a physiotherapist, with the intensity increasing every day so that patients can just about complete the sixth breath in each set.

Exercise and Its Role in Viral Respiratory Infections

Some studies suggest that moderate exercise might play a role in the risk reduction of infection severity (20-22). Preinfection mild-intensity exercise results in significantly lower respiratory virus-associated mortality in laboratory studies on animals (23). However, exercise can be hazardous and associated with different injuries (24), which means that if exercise is not standardized or under the supervision of an experienced trainer, it can cause damage to the body rather than benefit. Furthermore, intense exercise before or during viral infection was associated with increased morbidity and mortality (25, 26). Extensive exercise could be regarded as a second-hit phenomenon (27). It might be considered that the cytokine storm, which is regulated by the immune system in response to viral infection, is the first hit. However, the definition of extensive exercise is not yet clear, and more research is needed to shed light in this regard. Also, the effect of exercise in COVID-19 infection is highly time-dependent (28). In the first phase of infection, "viral" exercise might be beneficial. However, in the subsequent phase, "inflammation" exercise seems to be hazardous. First, it would increase the risk of viral contamination due to the high level of viruses in the expired patients. Secondly, as mentioned previously, it can be a "second hit phenomenon" and deteriorate the physiological adaptation of the body.

[Downloaded from mjiri.iums.ac.ir on 2026-11-06]

[DOI: 10.47176/mjiri.36.104]

It is hypothesized that COVID-9 patients might represent 2 phenotypes as follows (29): Type L (Low elastance, high compliance), better ventilation-to-perfusion ratio, low lung weight and low recruitability, and Type H (High elastance, high right-to-left shunt), high lung weight and high recruitability. At the first stage, COVID-19 pneumonia demonstrates an L-type phenotype; these patients might stay without any changes for some time, and later on, they could improve or exacerbate. As shortness of breath worsens, a shift from the L to the H type occurs as a result of high-stress ventilation. In high elastance, low tidal volume is required for ventilation, and therefore, high tidal volume and respiratory effort seem to be deleterious and hazardous. In the inflammatory phase, specifically in H-type patients (COVID-19), intensive deep breathing could cause pulmonary epithelial injury. As a result, respiratory physiotherapy is indicated for hospitalized patients, particularly those in the critical care unit. In the case of pulmonary involvement (eg, ARDS), all efforts should be directed at lowering transpulmonary pressure, pulmonary edema, and the likelihood of lung damage. To avoid shear stress, mechanically ventilated patients with limited compliance are given a low tidal volume approach. High tidal volume and high transpulmonary pressure appear to be harmful during the inflammatory phase of the disease; hence, this might be the case with spontaneous breathing. Forcing the patient to take deep breaths (like in sports) or inducing a strong cough during the inflammatory phase may aggravate the harm. As a result, it is preferable for the patient to be more relaxed at this point, and to compensate for this immobility, an anticoagulant should be provided to the patient under the supervision of a d-dimmer (prophylactic, mild dose, or moderate dose).

Discussion

Exercise: Cellular, Molecular, and Autophagy Perspective

In terms of cellular and molecular biology, the construction of type I interferons, which are regulated by plasmacytoid dendritic cells, alveolar macrophages, and infected epithelial cells, is the primary reaction to respiratory viral infections (30, 31). Interferon type I has a high potential for antiviral responses (32). The accumulation of monocytes, macrophages, and neutrophils in the lungs, which results in the production of inflammatory cytokines, may be linked to immunopathologic responses (33, 34). Pulmonary natural killer cells that can be detected within 48 hours of infection consolidate their performance by producing interferon and virus-infected cells lyse (35). Yet, the effect of exercise on each of these components of the immune system is not well known (32). Mild exercise could play a critical role in limiting or clearing viral infections by increasing the activity of several components of the immune system. Moderate exercise raises interleukin-2 and antigen-specific IFN- levels (36). In the early stages of illness, moderate exercise can diminish pulmonary cellular infiltration and shift the T-helper 1 to T-helper 2 index (37). Persistent exercise has been linked to a reduction in symptoms, inflammatory factors, viral load, and inflammatory cytokine levels. Then, during the first period of illness, acute exercise may be helpful (32).

Besides, autophagy, as a natural and intracellular mechanism, by removing unnecessary or dysfunctional components, plays an important role (38). Thus, in viral infections, autophagy controls the infection by mechanisms, such as the destruction of viruses, regulating the inflammatory responses, and ameliorating antigen presentation (39, 40). Some studies have shown that exercise can induce autophagy by several intracellular mechanisms (41-43). On the contrary, it should not be underestimated that exercise in some chronic conditions, such as cardiovascular disease, can inhibit autophagy and reduce autophagic cell apoptosis (44, 45).

In a cross-sectional study on a healthy man, Baker et al (46) concluded that acute exercises like incremental continuous cycling affect multiple SARS-CoV-2 specific T-cell mobilization to the blood vessels and elevation of neutralizing antibodies temporarily, which can be caused by increased lymphatic flow due to exercise. Furthermore, exercise increased the IFN- response to SARS-CoV-2 peptide stimulation in the blood. Infection appears to be linked to an increased metabolic demand for specific exercise workloads, which was reversed following immunization to preinfection levels.

Mild to moderate exercise induces an increase in the excretion of urea and creatinine. It is an important consideration, particularly in medications that can induce nephrotoxicity, such as Favipiravir in COVID-19 patients (47, 48). Also, COVID-19 patients, particularly those in intensive care units, are at the risk of developing acute kidney injury; thus, exercise should be done with caution. It is highly vital for patients with a history of kidney disease.

Physical and Psychological Effects of Exercise in Patients With COVID-19

Although there is no direct evidence of the effect of physical therapy on the prevention or treatment of COVID-19, it is strongly recommended that by adopting an active lifestyle, the social isolation damage because of coronavirus infection could be prevented (49), especially in the elderly population (50). Evidence from COVID-19 home confinement suggested that low/medium intensity, high volume exercise, and a 15% to 25% reduction in calorie intake could prevent the harmful effects of sedentarism (51). Evidence also showed that even short-term inactivity could affect cardiac function negatively. On the other hand, home-based physical activity programs improved the health of cardiovascular and diabetic patients (52, 53). Furthermore, these programs have the potential to prevent skeletal muscle loss following exercise by applying a low load (54).

The Dangers of Bed Rest in COVID-19 Infection

Prolonged rest in patients with coronavirus can have dire or even life-threatening consequences. According to recommendations, people should be aware of social distancing, isolation, and quarantine, which in practice could result in an extended period of social isolation at home

[Downloaded from mjiri.iums.ac.ir on 2026-11-06]

[DOI: 10.47176/mjiri.36.104]

(55, 56). This in turn could lead to a decline in physical activity and increases in sedentary behavior, which are associated with the loss of muscle mass (51, 57, 58). Besides, inactivity and bed rest might induce insulin resistance (51), which could result in muscle loss due to social distancing measures and even a major susceptibility to COVID-19 (52). The results of a clinical study showed that prolonged rest and intensive care unit admission were significantly associated with deep vein thrombosis (53). Recent evidence-based recommendations suggest that patients with coronavirus who are at risk for thrombosis and blood clots (venous thromboembolism and deep vein thrombosis) should be considered for anticoagulant therapy (59-61).

Exercise in Accordance With the Severity of the Disease: Intensity and Timing

Recently, the results of a narrative review by Wittmer et al (62) confirmed that mild exercise in the early stage of the disease could be prescribed for COVID-19 patients, keeping in mind the comorbidities and contraindications of patients, if any. Furthermore, Mohammadi et al (63) claimed that during the inflammatory stage of COVID-19, exercise, particularly intense exercise, cannot be beneficial and may result in disease exacerbation. It is hypothesized (64) that high-intensity exercise (conservatively) may be dangerous and help to exacerbate the COVID-19 virus, owing to the production of oxidants and immune system suppression. It should also be emphasized that COVID-19 illness might be asymptomatic for several days, making strenuous high-intensity activity riskier. It suggests that moderate-intensity physical activity (instead of high-intensity physical activity) should be advocated as a nonpharmacological, low-cost, and practical strategy to deal with the COVID-19 virus.

Patients who were discharged from the ICU are highly exposed to intensive care unit acquired weakness. Meanwhile, they are more willing to undergo physical rehabilitation in comparison to non-COVID pneumo-sepsis ICU discharged patients (65). Therefore, SARS-CoV-2 patients who are going to be discharged may take advantage of primitive intensive physical therapy. It seems that physiotherapy intervention in the acute care of COVID-19 patients can facilitate recovery and discharge (66).

One of the most important considerations for COVID-19 patients in the ICU is that some of them may receive neuromuscular blocking agents (NMBA) (total dose, intermittent dose, and continuous). Applying respiratory physiotherapy can be harsh and impossible for nurses and physiotherapists. On this occasion, an intensivist or physiotherapist may recommend some passive and active muscle-strengthening exercises (67). Some occasions in clinical settings, the prone position may be applied to COVID-19 patients with dyspnea and decreased oxygen saturation as a nonpharmacological (also non-invasive) approach aimed at improving oxygenation. It is mostly used on awake patients (sometimes in mechanically ventilated patients), but it is said to be difficult for health care providers (68) (nurses and physiotherapists), especially in mechanically ventilated patients. When mechanically ventilated patients go into the prone position, there are several risks, such as unwanted extubation, discharging intravenous catheters, and clipping the oxygen pipe.

Before concluding, it should be noted that the COVID-19 epidemic still has many unknown aspects. In particular, the assessment of the quality of care (69) provided and the role of education for staff (also medical students) and patients are not yet clear (70). Also, with the onset of global vaccination against coronavirus infection, the role of exercise in vaccination efficacy should be reexamined (71, 72).

Conclusion

A strong body of evidence is in favor of supervised physical therapy and exercise for these patients. In the symptomatic phase (ie, the first week of disease), patients might take advantage of short periods of bed rest, but not complete bed rest. As previously stated, it appears that exercise would have both mental and physical benefits for patients in the early stages of infection. As a result, it may lower viral load, minimize cytokine storm, shorten the acute phase, and expedite recovery.

Later on, in the early phase of infection (before the second week), mild exercise could improve the autophagy mechanism that ameliorates the function of the immune system in response to COVID-19 infection, particularly in the sequence inflammation phase. Keeping this in mind, intense exercise, especially without the guidance of a qualified physical therapist, is not useful at all and may even be regarded a second-hit phenomena. Mild workouts during bed rest (ie, acute phase) may minimize the likelihood of pulmonary capillary coagulation and deep vein thrombosis. Although respiratory physiotherapy and prone positioning in hospitalized patients (particularly in critical care) can be challenging for medical staff, they are cheap and noninvasive approaches for COVID-19 patients. Also, by utilizing some novel technologies, such as telemedicine, muscle training exercises, and physiotherapy, can be delivered to patients either at their home or the hospital. Early physiotherapy for patients in the ICU seems to be beneficial for patients and may optimize ICU-induced weakness due to bed rest and reduce length of stay. Finally, breathing exercises can improve some symptoms of coronavirus disease, such as dyspnea and weakness.

Acknowledgment

The authors thank the faculty members of Tehran University of Medical Sciences who help us to write this review.

Ethical Approval

This study was a narrative review and the institutional review boards were exempt from ethical approval.

Conflict of Interests

The authors declare that they have no competing interests.

References

1. Klein S, Pekosz A, Park H-S, Ursin R, Shapiro J, Benner S, et al. Sex,

[Downloaded from mjiri.iums.ac.ir on 2026-11-06]

[DOI: 10.47176/mjiri.36.104]

age, and hospitalization drive antibody responses in a COVID-19 convalescent plasma donor population. medRxiv. 2020.
2. Mohammadi M, Khafaee Pour Khamseh A, Varpaei HA. Invasive airway "intubation" in COVID-19 patients; Statistics, causes, and recommendations: A review article. Anesth Pain Med. 2021;11(3):e115868.
3. Bikdeli B, Talasaz AH, Rashidi F, Sharif-Kashani B, Farrokhpour M, Bakhshandeh H, et al. Intermediate versus standard-dose prophylactic anticoagulation and statin therapy versus placebo in critically-ill patients with COVID-19: Rationale and design of the INSPIRATION/INSPIRATION-S studies. Thromb Res. 2020;196:382–94.
4. Force TR, Saul JD, Lewis M, Thompson T. Acute respiratory distress syndrome. Patient position and motion strategies. Respir Care Clin N Am. 1998;4(4):665–77, viii.
5. Woods JA, Hutchinson NT, Powers SK, Roberts WO, Gomez-Cabrera MC, Radak Z, et al. The COVID-19 pandemic and physical activity. Sports Med Health Sci. 2020;2(2):55–64.
6. Dean E, Jones A, Yu HP-M, Gosselink R, Skinner M. Translating COVID-19 evidence to maximize physical therapists' impact and public health response. Phys Ther. 2020;100(9):1458–64.
7. Silva CM da S e., Andrade A do N, Nepomuceno B, Xavier DS, Lima E, Gonzalez I, et al. Evidence-based Physiotherapy and functionality in adult and pediatric patients with COVID-19. J Hum Growth Dev. 2021;30(1):148–55.
8. Vitacca M, Carone M, Clini EM, Paneroni M, Lazzeri M, Lanza A, et al. Joint statement on the role of respiratory rehabilitation in the COVID-19 crisis: The Italian position paper. Respiration. 2020;99(6):493–9.
9. Simonelli C, Paneroni M, Fokom AG, Saleri M, Speltoni I, Favero I, et al. How the COVID-19 infection tsunami revolutionized the work of respiratory physiotherapists: an experience from Northern Italy. Monaldi Arch Chest Dis. 2020;90(2).
10. Cerqueira Neto ML de, Moura ÁV, Cerqueira TCF, Aquim EE, Reá-Neto A, Oliveira MC, et al. Acute effects of physiotherapeutic respiratory maneuvers in critically ill patients with craniocerebral trauma. Clinics (Sao Paulo). 2013;68(9):1210–4.
11. Kayambu G, Boots R, Paratz J. Physical therapy for the critically ill in the ICU: a systematic review and meta-analysis. Crit Care Med. 2013;41(6):1543–54.
12. Silver JK. Prehabilitation may help mitigate an increase in COVID-19 peripandemic surgical morbidity and mortality. Am J Phys Med Rehabil. 2020;99(6):459–63.
13. Gonzalez-Gerez JJ, Saavedra-Hernandez M, Anarte-Lazo E, Bernal-Utrera C, Perez-Ale M, Rodriguez-Blanco C. Short-term effects of a respiratory telerehabilitation program in confined COVID-19 patients in the acute phase: A pilot study. Int J Environ Res Public Health. 2021;18(14):7511.
14. Thomas M, McKinley RK, Mellor S, Watkin G, Holloway E, Scullion J, et al. Breathing exercises for asthma: a randomised controlled trial. Thorax. 2009;64(1):55–61.
15. Gaskell DV, Webber BA. The Brompton Hospital Guide to Chest Physiotherapy. Oxford, UK: Blackwell; 1980.
16. Al Chikhanie Y, Veale D, Schoeffler M, Pépin JL, Verges S, Hérengt F. Effectiveness of pulmonary rehabilitation in COVID-19 respiratory failure patients post-ICU. Respir Physiol Neurobiol. 2021;287(103639):103639.
17. An official american thoracic society/european respiratory society policy statement: enhancing implementation, use, and delivery of pulmonary rehabilitation. This official policy statement of the american thoracic society (ats) and the european respiratory society (ers) was approved by the ats board of directors. Am J Respir Crit Care Med. 2015;192(11):1373–86.
18. Battaglini D, Caiffa S, Gasti G, Ciaravolo E, Robba C, Herrmann J, et al. An experimental pre-post study on the efficacy of respiratory physiotherapy in severe critically III COVID-19 patients. J Clin Med. 2021;10(10):2139.
19. Bissett B, Leditschke IA, Green M, Marzano V, Collins S, Van Haren F. Inspiratory muscle training for intensive care patients: A multidisciplinary practical guide for clini-cians. Aust Crit Care. 2019;32(3):249–55.
20. Matthews CE, Ockene IS, Freedson PS, Rosal MC, Merriam PA, Hebert JR. Moderate to vigorous physical activity and risk of upper-respiratory tract infection. Med Sci Sports Exerc. 2002;34(8):1242–8.
21. Wong CM, Lai HK, Ou CQ, Ho SY, Chan KP, Thach TQ, et al. Is exercise protective against influenza-associated mortality? PLoS One. 2008;3(5):e2108.
22. Nieman DC, Johanssen LM, Lee JW, Arabatzis K. Infectious episodes in runners before and after the Los Angeles Marathon. J Sports Med Phys Fitness. 1990;30(3):316–28.
23. Kostka T, Berthouze SE, Lacour J, Bonnefoy M. The symptomatology of upper respiratory tract infections and exercise in elderly people. Med Sci Sports Exerc. 2000;32(1):46–51.
24. Jones BH, Cowan DN, Knapik JJ. Exercise, training and injuries. Sports Med. 1994;18(3):202–14.
25. Ahmadi S, Brietzke C, Silveira R, Prado RCR do, Brietzke R, Aguiar S da S, et al. Aspects of physical training related with upper respiratory tract infections: a review. Man Ther Posturology Rehabil J. 2020;16:1–8.
26. Ekblom B, Ekblom O, Malm C. Infectious episodes before and after a marathon race. Scand J Med Sci Sports. 2006;16(4):287–93.
27. Lasanianos NG, Kanakaris NK, Giannoudis PV. Intramedullary nailing as a 'second hit'phenomenon in experimental research: lessons learned and future directions. Clin Orthopaed Relat Res. 2010;1(9):2514–29.
28. Halabchi F, Ahmadinejad Z, Selk-Ghaffari M. COVID-19 Epidemic: Exercise or Not to Exercise; That is the Question! Asian J Sports Med. 2020;11(1).
29. Gattinoni L, Chiumello D, Caironi P, Busana M, Romitti F, Brazzi L, et al. COVID-19 pneumonia: different respiratory treatments for different phenotypes? Intensive Care Med. 2020;46(6):1099–102.
30. Kumagai Y, Takeuchi O, Kato H, Kumar H, Matsui K, Morii E, et al. Alveolar macrophages are the primary interferon-alpha producer in pulmonary infection with RNA viruses. Immunity. 2007;27(2):240–52.
31. Jewell NA, Vaghefi N, Mertz SE, Akter P, Peebles RS Jr, Bakaletz LO, et al. Differential type I interferon induction by respiratory syncytial virus and influenza a virus in vivo. J Virol. 2007;81(18):9790–800.
32. Sim YJ, Yu S, Yoon KJ, Loiacono CM, Kohut ML. Chronic exercise reduces illness severity, decreases viral load, and results in greater anti-inflammatory effects than acute exercise during influenza infection. J Infect Dis. 2009;200(9):1434–42.
33. Wareing MD, Lyon AB, Lu B, Gerard C, Sarawar SR. Chemokine expression during the development and resolution of a pulmonary leukocyte response to influenza A virus infection in mice. J Leukoc Biol. 2004;76(4):886–95.
34. Lin KL, Suzuki Y, Nakano H, Ramsburg E, Gunn MD. CCR2+ monocyte-derived dendritic cells and exudate macrophages produce influenza-induced pulmonary immune pathology and mortality. J Immunol. 2008;180(4):2562–72.
35. Legge KL, Braciale TJ. Accelerated migration of respiratory dendritic cells to the regional lymph nodes is limited to the early phase of pulmonary infection. Immunity. 2003;18(2):265–77.
36. Kohut ML, Boehm GW, Moynihan JA. Moderate exercise is associated with enhanced antigen-specific cytokine, but not IgM antibody production in aged mice. Mech Ageing Dev. 2001;122(11):1135–50.
37. Lowder T, Padgett DA, Woods JA. Moderate exercise early after influenza virus infection reduces the Th1 inflammatory response in lungs of mice. Exerc Immunol Rev. 2006;12:97–111.
38. Kobayashi S. Choose delicately and reuse adequately: The newly revealed process of autophagy. Biol Pharm Bull. 2015;38(8):1098–103.
39. Choi Y, Bowman JW, Jung JU. Autophagy during a viral infection-a double-edged sword. Nature Rev Microbiol. 2018;16(6):341–54.
40. Viret C, Rozières A, Faure M. Autophagy during Early Virus–Host Cell Interactions. J Mol Biol. 2018;430(12):1696–713.
41. He C, Sumpter R Jr, Levine B. Exercise induces autophagy in peripheral tissues and in the brain. Autophagy. 2012;8(10):1548–51.
42. Vainshtein A, Hood DA. The regulation of autophagy during exercise in skeletal muscle. J Appl Physiol. 2016;120(6):664–73.
43. Escobar KA, Cole NH, Mermier CM, VanDusseldorp TA. Autophagy and aging: Maintaining the proteome through exercise and caloric restriction. Aging Cell. 2019;18(1):e12876.
44. Wang L, Wang J, Cretoiu D, Li G, Xiao J. Exercise-mediated regulation of autophagy in the cardiovascular system. J Sport Health Sci. 2020;9(3):203–10.
45. Wu NN, Tian H, Chen P, Wang D, Ren J, Zhang Y. Physical exercise and selective autophagy: Benefit and risk on cardiovascular health. Cells. 2019;8(11):1436.
46. Baker FL, Smith KA, Zúñiga TM, Batatinha H, Niemiro GM, Pedlar

[Downloaded from mjiri.iums.ac.ir on 2026-11-06]

[DOI: 10.47176/mjiri.36.104]

CR, et al. Acute exercise increases immune responses to SARS CoV-2 in a previously infected man. Brain Behav Immun Health. 2021;18(100343):100343.
47. Abdelbary AA, Alharafsheh AE, Ahmed A, Nashwan AJ. Favipiravir-induced nephrotoxicity in a patient with COVID-19: A case report. Clin Case Rep. 2021;9(8):e04539.
48. Calles-Escandon J, Cunningham JJ, Snyder P, Jacob R, Huszar G, Loke J, et al. Influence of exercise on urea, creatinine, and 3-methylhistidine excretion in normal human subjects. Am J Physiol. 1984;246(4 Pt 1):E334-8.
49. Damiot A, Pinto AJ, Turner JE, Gualano B. Immunological implications of physical inactivity among older adults during the COVID-19 pandemic. Gerontology. 2020;66(5):431–8.
50. Machado CLF, Pinto RS, Brusco CM, Cadore EL, Radaelli R. COVID-19 pandemic is an urgent time for older people to practice resistance exercise at home. Exp Gerontol. 2020;141(111101):111101.
51. Narici M, Vito GD, Franchi M, Paoli A, Moro T, Marcolin G, et al. Impact of sedentarism due to the COVID-19 home confinement on neuromuscular, cardiovascular and metabolic health: Physiological and pathophysiological implications and recommendations for physical and nutritional countermeasures. EJSS (Champaign). 2021;21(4):614–35.
52. Peçanha T, Goessler KF, Roschel H, Gualano B. Social isolation during the COVID-19 pandemic can increase physical inactivity and the global burden of cardiovascular disease. Am J Physiol Heart Circ Physiol. 2020;318(6):H1441–6.
53. Guadalupe-Grau A, López-Torres O, Martos-Bermúdez Á, González-Gross M. Home-based training strategy to maintain muscle function in older adults with diabetes during COVID-19 confinement. J Diabetes. 2020;12(9):701–2.
54. Moro T, Paoli A. When COVID-19 affects muscle: effects of quarantine in older adults. Eur J Transl Myol. 2020;30(2):9069.
55. Sun S, Folarin A, Ranjan Y, Rashid Z, Conde P, Stewart C, et al. Using smartphones and wearable devices to monitor behavioural changes during COVID-19. arXiv [q-bio.QM]. 2020.
56. Ammar A, Brach M, Trabelsi K, Chtourou H, Boukhris O, Masmoudi L, et al. Effects of COVID-19 home confinement on eating behaviour and physical activity: Results of the ECLB-COVID19 international online survey. Nutrients. 2020;12(6):1583.
57. Breen L, Stokes KA, Churchward-Venne TA, Moore DR, Baker SK, Smith K, et al. Two weeks of reduced activity decreases leg lean mass and induces "anabolic resistance" of myofibrillar protein synthesis in healthy elderly. J Clin Endocrinol Metab. 2013;98(6):2604–12.
58. Alomari MA, Khabour OF, Alzoubi KH. Changes in physical activity and sedentary behavior amid confinement: The BKSQ-COVID-19 project. Risk Manag Healthc Policy. 2020;13:1757–64.
59. Barnes GD, Burnett A, Allen A, Blumenstein M, Clark NP, Cuker A, et al. Thromboembolism and anticoagulant therapy during the COVID-19 pandemic: interim clinical guidance from the anticoagulation forum. J Thromb Thrombolysis. 2020;50(1):72–81.
60. Carfora V, Spiniello G, Ricciolino R, Di Mauro M, Migliaccio MG, Mottola FF, et al. Anticoagulant treatment in COVID-19: a narrative review. J Thromb Thrombolysis. 2021;51(3):642–8.
61. Kollias A, Kyriakoulis KG, Dimakakos E, Poulakou G, Stergiou GS, Syrigos K. Thromboembolic risk and anticoagulant therapy in COVID-19 patients: emerging evidence and call for action. Br J Haematol. 2020;189(5):846–7.
62. Wittmer VL, Paro FM, Duarte H, Capellini VK, Barbalho-Moulim MC. Early mobilization and physical exercise in patients with COVID-19: A narrative literature review. Complement Ther Clin Pract. 2021;43(101364):101364.
63. Mohammadi M, Hadian MR, Varpaei HA. Exercise in COVID-19: Intensity and Timing. Asian J Sports Med. 2021;12(3).
64. Rahmati-Ahmadabad S, Hosseini F. Exercise against SARS-CoV-2 (COVID-19): Does workout intensity matter? (A mini review of some indirect evidence related to obesity). Obes Med. 2020;19(100245):100245.
65. Moonen HPFX, Strookappe B, van Zanten ARH. Physical recovery of COVID-19 pneumosepsis intensive care survivors compared with non-COVID pneumosepsis intensive care survivors during post-intensive care hospitalization: The RECOVID retrospective cohort study. JPEN J Parenter Enteral Nutr. 2021;(jpen.2242).
66. Jiandani MP, Salagre SB, Kazi S, Iyer S, Patil P, Khot WY, et al. Preliminary observations and experiences of physiotherapy practice in acute care setup of COVID 19: A retrospective observational study. J Assoc Physicians India. 2020;68(10):18–24.
67. Miller C, O'Sullivan J, Jeffrey J, Power D. Brachial plexus neuropathies during the COVID-19 pandemic: A retrospective case series of 15 patients in critical care. Phys Ther. 2021;101(1).
68. Binda F, Rossi V, Gambazza S, Privitera E, Galazzi A, Marelli F, et al. Muscle strength and functional outcome after prone positioning in COVID-19 ICU survivors. Intensive Crit Care Nurs. 2021;(103160):103160.
69. Moslehi S, Manesh PA, Asiabar AS. Quality measurement indicators for Iranian Health Centers. Med J Islam Repub Iran. 2015;29:177.
70. Moslehi S, Atefimanesh P, Asiabar AS, Ahmadzadeh N, Kafaeimehr M, Emamgholizadeh S. Does outsourcing paramedical departments of teaching hospitals affect educational status of the students? Med J Islam Repub Iran. 2016;30:404.
71. Mohammadi M, Khafaee Pour Khamseh A, Varpaei H A. The Need for Pre-vaccination Screening. Int J Infect.In Press(In Press):e119476.
72. Dadras O, SeyedAlinaghi S, Karimi A, Shamsabadi A, Mahdiabadi S, Mohammadi P, et al. Public acceptability of COVID-19 vaccines and its predictors in Middle Eastern/North African (MENA) countries: a systematic review. Hum Vaccin Immunother. 2022 Mar 21:1-6.

[Downloaded from mjiri.iums.ac.ir on 2026-11-06]

[DOI: 10.47176/mjiri.36.104]