



## Research Article

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# Changing the approach to rehabilitation exercise during the COVID-19 pandemic: A brief review

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## Abstract

**Background:** It is necessary to design a comprehensive rehabilitation program after high-grade systemic inflammation caused by the coronavirus, followed by a long rest and quarantine. In addition, pandemic quarantine has led to a lack of access to rehabilitation clinics and sports clubs. However, integrated information on how to implement a rehabilitation program in pandemic conditions is not yet available. **Objectives:** We aimed to investigate clinical trials regarding exercise rehabilitation related to Covid-19 in PubMed. **Methods:** The keywords (Covid-19 and exercise rehabilitation) were examined in PubMed electronic database until 11 August 2021, and 707 articles were found. **Results:** Twenty-nine clinical trial articles were found, and one unrelated article was deleted. Particular attention should be paid to maintaining the physiological and psychological health of health care workers. Most of the programs implemented include home-based rehabilitation (HBR) through web-based rehabilitation [WBR]. The multiplicity and variety of existing programs are not enough to cover all groups in society, including the healthy and sick ones. No problems have been reported for healthy people during strenuous exercise when wearing a surgical or cloth mask. **Conclusions:** In addition to conventional therapies and modern rehabilitation techniques, virtual rehabilitation learning through WBR is expanding [due to the quarantine conditions of patients and the closure of sports and clinical centers] with positive physiological and psychological effects.

**Keywords:** Home-based rehabilitation (HBR), Inflammation, Modern rehabilitation techniques, Web-based rehabilitation (WBR).

## INTRODUCTION

The emergence of the coronavirus has caused widespread health, physiological, psychological, social, cultural, and political changes throughout the world [1]. In addition, the front line of the conflict with the coronavirus is health. Health care can include prevention, control, and treatment. Coronavirus is characterized by complications such as coughs, shortness of breath, fatigue, sleep disturbances, and appetite disorders, which often lead to dysfunction of the cardiovascular system and general weakness [2]. All these issues indicate that it is necessary to create an effective method of sports rehabilitation to reduce the course of treatment and complications of the disease.

One of the most critical problems in treating patients with coronavirus is the length of hospitalization and rehabilitation. The duration of treatment and the severity of the disease can increase stress, which will lead to several other psychological complications [1-3]. Symptoms of stress, anxiety, depression, chronic pain, disability, and increased pain perception have been reported in patients with coronavirus [3]. The stress of coronavirus pandemics and government restrictions has disrupted the treatment of other diseases, and the use of telephone rehabilitation programs has helped control these factors [4]. Quarantine has also led to clubs and sports clinics closure, reduced physical activity, and increased smoking and alcohol consumption, especially in women [1]. Corona restrictions, in particular, endanger the health of the elderly. Regular physical activity can prevent the decline of cognitive function with age. However, due to COVID-19 quarantine measures, outdoor exercise opportunities have been limited [5].

Physiological stress, severe inflammation of the tissues involved, side effects of medications, inactivity due to hospitalization or rest at home can cause secondary complications, including poor cardiovascular function [2,6]. Six months of formal training followed by 18 months of intense resistance training in older men with osteosarcoma showed that quitting training or reducing training intensity had severe adverse effects on muscle mass [7]. In contrast, regular resistance training at home and protein supplements can maintain muscle mass and strength in the elderly [8]. Body composition, muscle strength, gait, and balance were measured in participants [9]. It has been reported that 6 months of performing home

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resistance training during a sudden outbreak of coronavirus strengthens muscles, prevents fat accumulation, and regulates eating habits in the elderly [9].

Previous studies [before the coronavirus pandemic] shows that changing lifestyles and engaging in regular physical activity can reduce the complications of many diseases [6]. However, there are specialized guidelines for each person and each disease [and degree of disease] provided by ACSM based on FITT. These principles are necessary for special rehabilitation exercises in cases of coronavirus infection to reduce the rehabilitation period and, at the same time, reduce the side effects. Another major problem in pandemic conditions is the unavailability of sports clubs or quarantine rest conditions at home. Because some diseases require the patient to be present for treatment, it is essential to pay attention to studies planned for each individual through virtual programs or distance learning [10,11]. The present study aimed to investigate clinical trials regarding exercise rehabilitation related to Covid-19 in PubMed.

## MATERIALS AND METHODS

The PubMed electronic site was used as the source of qualified articles in this study. The information of this database on the subject of study until 11 August 2021 was examined. The inclusive criteria were all articles with the following keywords. The exclusive criteria were all articles except clinical trials. Actually, only the clinical trial display was selected [Figure-1].

- *Sars covid 2019 and exercise rehabilitation*
- *Coronavirus 2019 and exercise rehabilitation*
- *Covid 2019 and exercise rehabilitation*
- *Sars covid 19 and exercise rehabilitation*
- *Coronavirus 19 and exercise rehabilitation*

## ○ Covid 19 and exercise rehabilitation

## RESULTS

A search result found 707 articles. Then, only the clinical trial display was selected [Figure-1]. As a result, 29 clinical trial articles were found. The full text of these 29 articles was read, and an unrelated article in it was deleted. Finally, 28 articles were used in the present study [Table-1]. In four articles, participants were patients with coronavirus [2, 12-14]. In other articles, patients with rheumatoid arthritis [RA][10], temporomandibular disorders [TMD][3], non-medicated BP [6], severe COPD [11,13], hip fracture patients [15], stroke survivors [16], progressive multiple sclerosis [PMS] [4], fibromyalgia [FM] [17], postmenopause with osteopenia or osteoporosis [18], obese men with low muscle and bone mass [7], sedentary men [8], oncology patients undergoing neoadjuvant therapy [19], hematologic cancer survivors [20], population diagnosed with ME/CFS [21], homeschooled grade 7 students [20], healthy individuals [22] and older patients [7,9,13] were participants [Table-1]. Exercise rehabilitation methods were used or were noticed in 21 articles [1,5-12,14-21,23-26]. Five articles used other techniques such as low-frequency magnetic therapy, recording psychological information using a questionnaire, nutrition intervention, and moving singing for lung health [2-4,13,22]. In 3 articles, physiological or endocrinological indicators such as blood pressure [6], CRP, IL-6, MDA [10], and ACE-2 [24] were considered. Other articles considered aspects of mental health or physical fitness and performance indicators. Three studies information was incomplete because they were only registered as a trial and they are ongoing [26-28]; however, some details such as rehabilitation methods have been reported. Some of the reviewed articles overlapped the above conditions, but all articles used the online or virtual control methods during the novel COVID-19 coronavirus pandemic [Table-1].

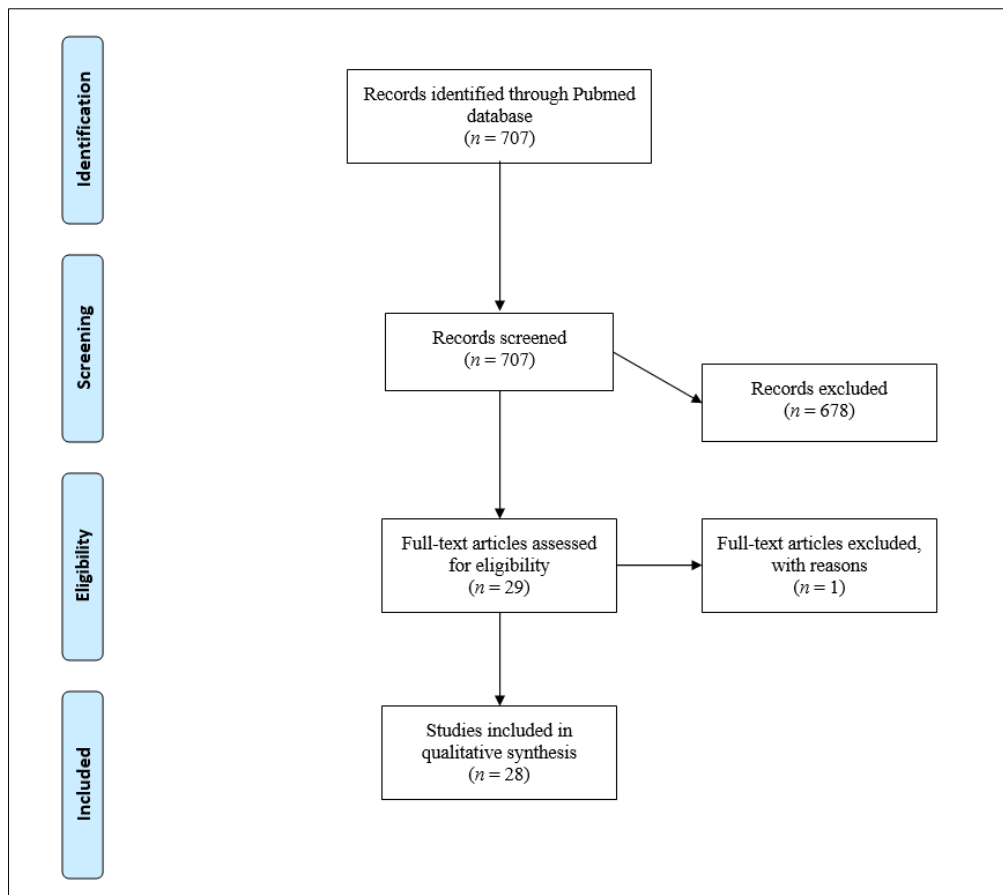


Figure 1: Results of database searching on the base of PRISMA Group [2009][29]

**Table 1:** Abstracts of articles reviewed in the present study

Author & date [Reference]	Participants/Treatment	Results
Adly et al. 2021 [10]#	Participants: 60 elderly patients who have Rheumatoid arthritis [RA] Group1: Tele-rehabilitation sessions of aerobic exercise and virtual reality training [n=8]. Group2: Laser acupuncture, followed by tele-rehabilitation sessions [aerobic exercises and virtual reality training] [n=8].	CRP, RAQoL, IL-6, and MDA and ATP were measured. In elderly patients suffering from RA, laser acupuncture teletherapy could provide an effective and safe treatment method. Health professionals and patients had more access to teletherapy, and the treatment was relatively affordable, providing a high satisfaction rate and a low cost.
Asquini et al. 2021 [3]	Participants: The study recruited 45 adults before the outbreak of COVID-19. Group1: Chronic temporomandibular disorders [TMD][n=19]. Group2: Acute/subacute temporomandibular disorders [TMD][n=26].	Acute/subacute TMDs had lower COVID-19 stress scales [CSS] compared to chronic TMDs. The CSS scores of chronic TMD patients were correlated with anxiety and depression scores. Scores on the CSS were correlated with variations on the central sensitization inventory and graded chronic pain scale.
Barone Gibbs et al. 2021 [6]#	Participants: The study included 300 adults with desk jobs, elevated blood pressure, and inactive lifestyles. Treatments: Taking up light-intensity activities instead of sitting. Each participant received twice-weekly automated text messages and counseling every two weeks [alternating between in-person and telephone].	An active lifestyle employed through distance education can lower blood pressure and be appropriate for the COVID-19 condition.
Benzo et al. 2021 [11]#	Participants: 154 patients with moderate to severe COPD. Treatments: The 8-week intervention consisted of video-guided exercises done 6 times a week and captured with a computer tablet.	There was no significant difference in breathlessness [CRQ dyspnea]. There was a significant improvement in self-management abilities.
Binder et al. 2021 [15]#	Participants: Patients with hip fractures who are 65 years of age or older Control: General treatments Treatment: Received education and exercise at home. Dietary counseling, calcium, and vitamin D were also provided.	Interventions, follow-up, and enrollment are ongoing
Bodrova et al. 2020 [2]*	Participants: There were 52 patients with pneumonia caused by COVID-19. Control [n=22]: Temporary clinical treatment was provided. Treatment: [n=30]: A low-frequency magnetotherapy treatment for 20 minutes per day was administered on day 16 after discharge from the hospital.	Because of treatment, the lungs' vitality increased, chest expansion increased, shortness of breath decreased, disabilities decreased, general mobility improved, pain decreased, anxiety decreased, and depression decreased.
Chae et al. 2020 [16]#	Participants: 23 stroke survivors Control: Control [n=6] Treatment: [n=17]: Home-based rehabilitation [HBR] system	Significant improvements in Wolf Motor Function Test [WMFT] scores and ranges of motion were seen in the HBR group. Only the internal rotation of the shoulder changed significantly in the control group.
Chiaravalloti et al. 2021 [4]	Participants: 131 individuals with progressive multiple sclerosis [PMS]	Psychological well-being was reported as the most significant impact of the virus, followed by financial well-being. There was a correlation between MS symptoms and changes in depression and responses to the pandemic and their impact on physical and psychological well-being.
Hernando-Garjito et al. 2021 [17]#	Participants: Thirty-four women with fibromyalgia [FM] Treatment: Tele-rehabilitation Program [TP] [2 sessions/week for 15 weeks]. A video-guided aerobic exercise program was used as the TP. Borg scales were used to monitor intensity in each session.	Psychological distress, pain intensity, and mechanical pain sensitivity improved among TP patients.
Hettchen et al. 2021 [18]#	Participants: 54 women 1-5 years postmenopause with osteopenia or osteoporosis. Group 1 [n=27]: Exercised once a week at a low intensity. Group 2 [n=27]: Participated in high-impact weight-bearing/high intensity/speed resistance training three times per week. Both groups were supplemented with cholecalciferol and calcium.	Bone mineral density [BMD] at the lumbar spine [LS], lean body mass [LBM], Total and abdominal body fat, menopausal symptoms, hip/leg extension strength, and power were improved in group 2 compared to group 1.
Jones et al. 2021 [23]#	Participants: Following the completion of an e-learning course, 15 Australian physiotherapists were interviewed.	The study provides evidence that a telehealth delivery platform that uses video conferencing delivers a physiotherapy training program perceived to be effective and acceptable [in the context of a clinical trial] for managing knee osteoarthritis [OA].
Kemmler et al. 2021 [7]#	Participants: 43 obese men between 72 and 91 years old with low muscle and bone mass. Control [n=22]: Non-training Treatment [n=21]: 18 months of high-intensity resistance exercise [HIT-RT].	Treatment had positive effects for LBM, total and abdominal body fat rate, and the Metabolic Syndrome Z-Score [MetSZ].
Kienle et al. 2021 [27]°		In COVID-19, the two main options for continuing the trial were switching from telemedicine to risk management or switching back to the previous design with

		telemedicine.
<i>Lai et al. 2020</i> [12]*#	Participants: Personnel from London, Ontario, Canada's hospital and long-term care home managing COVID-19 patients. Treatment: Online version of Surdhan Kriya Yoga [SKY] for a total duration of three hours.	After the study is complete, five feasibility outcomes will be evaluated: [1] rate of participation, [2] retention rate, [3] completeness of data entry, [4] cost of interventions, and [5] unexpected costs.
<i>Li et al. 2020</i> [24]#	Participants: 143 subjects [age > 18; BMI ≥ 27 kg/m <sup>2</sup> ] Treatment: Standardized 12-week dietary weight reduction program.	Insulin sensitivity is correlated with the expression of subcutaneous adipose ACE-2. Weight loss might reduce the expression of ACE-2 in subcutaneous adipose tissue, which might be relevant to the reduction of ACE-2 in SARS-CoV-2-infected myocellular insulin sensitivity.
<i>Lowe et al. 2021</i> [25]#	Recruiting during the COVID-19 pandemic of 2020-2021, one month after the first UK-wide lockdown. Treatment: A lifestyle, exercise, and activity package for people with progressive multiple sclerosis [LEAP-MS].	Interventions are helpful for people with multiple sclerosis who are far more isolated than ever before.
<i>Moon et al. 2020</i> [28]°		
<i>Nilsson et al. 2020</i> [8]#	Participants: 32 sedentary men Control: Non-training Treatment: Home-based, unsupervised RE [HBRE] and multi-ingredient supplementation [MIS].	Appendicular and total lean mass, lean mass to fat ratios, maximal strength, and function and fast-twitch muscle fiber cross-sectional areas of the quadriceps muscle were improved following HBRE/MIS therapy.
<i>Paltrinieri et al. 2021</i> [1]	Participants: 1826 adults participated in the survey.	Lockdown had a negative impact on physical activity, while some net beneficial effects were seen on a diet. In order to avoid long-term adverse effects of the lockdown, public health measures should be implemented, supporting individuals who may change for the worse.
<i>Philip et al. 2020</i> [13]*	Participants: 18 participants from a specialist COPD clinic at the Royal Brompton Hospital London Control [n=9] Treatment: Moving singing [n=9]	Based on preliminary study results, online group singing may improve balance confidence and reduce depression in people with COPD.
<i>Qi et al. 2021</i> [5]#	Participants: Healthy older people. Control: Applied physical stretching exercise Treatment: Applied Qigong exercise to the experimental group.	Significant improvement in processing speed sustained attention, and hippocampal volume was attributed to Qigong and a reduction in peripheral IL-6 levels. In addition, further significant reductions in peripheral IL-6 levels following Qigong training were associated with more significant improvements in processing speed.
<i>Sell et al. 2020</i> [26]°	Participants: Oncology patients were undergoing neoadjuvant therapy. Groups: 1] Non-training control group 2] Training control group 3] Exercise Intervention 4] Nutrition Intervention 5] Smoking Cessation 6] Mindfulness	
<i>Shaw et al. 2020</i> [22]	Participants: 7 men and 7 women. Wearing a surgical mask, a cloth mask, or no mask during a cycle ergometry test to exhaustion.	Using a facemask did not interfere with performance [time to exhaustion].
<i>Strayer et al. 2020</i> [21]#	Participants: 208 population diagnosed with ME/CFS.	Improvement in an exercise led to a clinically significant improvement in health status.
<i>Tang et al. 2021</i> [14]*#	Participants: 33 eligible patients with COVID-19. Treatment: The Liuzijue exercise was performed once a day over four weeks for 20 minutes.	After four weeks of intervention, the maximal inspiratory pressure [MIP], peak inspiratory flow [PIF], and diaphragm movement in deep breathing [DM-DB], dyspnea, exercise capacity, quality of life, and depression and anxiety status of patients improved.
<i>Vallerand et al. 2019</i> [19]#	Participants: 51 hematologic cancer survivors Group 1 [n = 25]: self-directed exercise for 12 weeks. Group 2 [n = 26]: weekly theory-based telephone counseling exercise [TCE] for 12 weeks.	An action control framework-based TCE intervention may improve motivation, regulation, and reflexivity in hematologic cancer survivors, resulting in greater fitness levels.
<i>Vitale et al. 2020</i> [9]#	Participants: 60-80 year old patients from the outpatient Clinic of the Endocrinology and Diabetology Treatment: 6 months exercise prescription	After a four-week suspension of resistance training during the COVID-19 outbreak, only within-group improvements in lower limb muscle strength but no changes in muscle mass and composition were observed in older subjects who completed the program at home. It may be because of a reduced daily PA regime and altered dietary regimen by which the total body fat increased while homebound.
<i>Zheng et al. 2021</i> [20]#	Participants: homeschooled grade 7 students at 12 middle schools in southern China. Control: Health education information Treatment: Health education information on exercise and eye relaxation, as well as a digital behavior change intervention with live streaming and peer sharing	During online schooling associated with COVID-19, children experienced less anxiety and eyestrain due to this digital behavior change intervention.

\* Studies involving patients with coronavirus. #Studies whose rehabilitation method has been exercise training. °Studies whose information was incomplete because they were only registered as a trial and are ongoing

#### Rehabilitation in pandemic conditions

Among patients discharged from Covid-19, physical and psychological disorders affect their quality of life and they experience poor health outcomes [14]. Possible side effects of the SARS-Cov-2 epidemic on general health are being identified [1]. The quarantine can aggravate

patients with ME / CFS [21]. Decreased physical activity, increased smoking, and alcohol use during quarantine has increased, and the female population has suffered more. These results indicate the need to increase comprehensive support for social groups in quarantine conditions [21]. These supports can include psychological counseling and rehabilitation training.

The coronavirus epidemic threatens clinical trials that require regular face-to-face meetings, especially in the elderly and high-risk groups. In a randomized clinical trial design, the use of sports rehabilitation in high-risk populations in coronavirus conditions as virtual distance education has been proposed as a solution [27].

The use of remote control methods in coronary conditions is essential, especially for the elderly. The effects of Qigong indoor exercise on neurocognitive function have been confirmed, and significant improvements in processing speed, sustained attention, increased hippocampal volume, and peripheral IL-6 levels have been observed [5]. Qigong practice involves a wide range of movements, including upper and lower body movements and relaxation, which follow the basic principles of traditional Chinese medicine [for example, Chi] [5]. In the rehabilitation of patients discharged from COVID-19, these traditional exercises [Liuzijue Qigong [LQG]] may prove to be a beneficial option [14] because in this view, physiological, psychological, personal, and environmental are reinforced simultaneously. Patients performed LQG exercise once a day for 20 minutes for 4 weeks. This exercise significantly increased respiratory function, exercise capacity, physical function, and quality of life in patients rescued from coronavirus. Shortness of breath, depression, and anxiety decreased [14].

In addition, clinical trial studies have explicitly focused on groups that even needed clinics for their current treatments without coronavirus, which is not the case in coronary conditions. Based on what was presented in the introduction as the hypothesis of the present study, it is mentioned as one of the methods of home practice that the use of acupuncture and laser teletherapy was combined with teaching virtual programs in patients with rheumatoid arthritis. However, the changes in biochemical biomarkers in the acupuncture and laser teletherapy groups were better than in the distance education group. However, the Health Assessment Questionnaire [HAQ] and Quality of Life Rheumatoid Arthritis [RAQoL] were significant in both groups compared to the pretest [10]. The use of rehabilitation programs in MS patients also improved psychological symptoms [4]. In this regard, remotely providing physiotherapy and physical activity can provide fairer access to services for patients [23].

Lifestyle, exercise, and activity packages [LEAP] for people with progressive multiple sclerosis [MS] were performed remotely using video conferencing or telephone software [25]. Using video conferencing, the researchers improved the rehabilitation of osteoarthritis patients with knee pain in a randomized controlled trial [23]. The authors concluded by noting that with the increasing adoption of distance service models for clinical care, it seems necessary to implement e-learning programs for physiotherapists in the field of distance health [23]. In general, the distance education method has been proposed to maintain the condition of COPD patients [11]. Note that patients with rheumatoid arthritis due to the use of some drugs that reduce immune function and lung patients due to the risk of coronavirus for lung tissue necessarily need to maintain more proper quarantine. The critical point here is the lack of the number and variety of home programs and distance learning methods due to new conditions. Naturally, solving this problem requires paying more serious attention as well as the passage of time.

In the studied studies, different groups of the society with different diseases have been studied. Resistance rehabilitation exercises are fundamental in the elderly with pelvic fractures, which are also

affected by the coronary pandemic and the unavailability of physiotherapy centers. Therefore, besides standard therapies including vitamin D, nutrition control, and testosterone therapy, resistance training in distance education at home was also very effective [15]. Immediate effects of distance-based rehabilitation programs based on aerobic exercise have also been reported in women with fibromyalgia [17]. Interventions including 15 weeks of aerobic exercise [2 sessions per week] were performed according to the Borg scale in women. The intervention group was significantly superior to the control group in all measured physiological and psychological criteria [17]. Menopause is a critical period in a woman's life. Regular physical activity may be the most promising non-pharmacological intervention to improve risk factors for severe estradiol depletion [18]. Although the 18-week program was discontinued after 13 weeks due to the corona epidemic, the intensive resistance-training program improved bone density, fat percentage, various risk factors, and menopausal complaints [18].

Meanwhile, cardiovascular patients who need supervised rehabilitation exercises are also suffering from coronavirus quarantine conditions. For this reason, rehabilitation programs using smartwatches and self-management techniques for remote rehabilitation through the web-based upper extremity rehabilitation system [WBR] have been proposed as home rehabilitation [HBR]. Because of this strategy, stroke survivors could potentially receive home health care at a lower cost in the future [16].

Paying attention to cancer patients is also very important. It has been reported that 20% of coronavirus patients in Italy also have cancer simultaneously [26]. Coronavirus epidemics can affect feeding patterns and self-management guidelines for patients due to reduced face-to-face visits. Therefore, this study also suggests using continuous remote support to prevent treatment outcomes [26]. In confirmation of these findings, it has been reported that telephone counseling exercise [TCE] interventions and self-directed exercise can increase aerobic exercise rehabilitation in cancer survivors [19].

Maintaining the condition and efficiency of health care personnel is also one of the health priorities in coronavirus pandemic conditions. In this regard, yoga and breathing exercises have been suggested as online training [12]. As noted, most studies have suggested considerations, including distance education and two-way video communication, to assess physical function/activity in clinical trials of the COVID-19 condition [28].

The coronavirus has been shown to enter the cell through the ACE-2 receptor. Decreased adipose tissue has been shown to reduce ACE-2 [24]. Therefore, maintaining a regular exercise program and a healthy lifestyle reduces the risk of developing coronavirus and reduces the duration of treatment by reducing adipose tissue and other effects of regular physical activity. In this way, the patient will reach his/her social status faster. The use of modern rehabilitation and treatment methods in coronavirus conditions has been suggested. The inclusion of low-frequency magnetic therapy in rehabilitation reduces respiratory disorders, reduces anxiety and depression, reduces pain and discomfort, and thus improves the patient's quality of life [2]. Psychological techniques have suggested singing practice for lung health [SLH] as a popular art activity [online delivery] in the field of health for people with long-term respiratory problems [13].

Distance education is not just about sports rehabilitation, as the Covid-19 epidemic has led to the closure of schools worldwide, and millions of children on the Internet have been restricted to online education at home. As a result, children may be more prone to digital eye anxiety and fatigue. Studies have also been conducted on home education to promote physical activity and reduce eyestrain and anxiety [20]. During COVID-19-related online education, digital behavior change training reduces children's eye anxiety and fatigue [20]. Finally, one of the questions asked by participants in rehabilitation programs is about

masking. In this regard, it has been reported that extra coverage or the use of a mask does not harm strenuous exercise performance in healthy individuals [22], although this issue should be considered for patient groups.

## CONCLUSION

In COVID-19 conditions, the implementation of clinical trial plans that require the presence of patients for interventions and tests is a challenge. Special attention should also be paid to maintaining the physiological and psychological health of health care workers. Studies have shown that the intervention period has been stopped due to the occurrence of pandemics. However, significant effects have been seen in these studies. Most programs run include education and learning by Home-Based Rehabilitation [HBR] and Web-Based Rehabilitation [WBR]. The multiplicity and variety of existing programs are not enough to cover all groups in society, including the healthy and sick. Due to the quarantine conditions of patients and the closure of some sports and clinical centers, the use of distance education and virtual rehabilitation is expanding. However, besides conventional therapies and modern rehabilitation techniques, exercise rehabilitation exercises are necessary due to their positive physiological and psychological effects. Even these methods can be beneficial as a supplement after the pandemic period.

The intensity and duration of exercises should be based on the patient's peak power [VO<sub>2</sub>peak] and according to the ACSM instructions in a unique way for each person. There have also been no reports of healthy people using masks during strenuous exercise, although no specific groups have been reported. Finally, in the COVID-19 pandemic, remote health can provide more access to services for patients equally. It is worth noting that the coronavirus pandemic has led to new technologies and technologies, and their use has been accelerated. The presented findings demonstrated the effectiveness [physiological and psychological] and necessity of sports rehabilitation intervention for patients rescued from COVID-19.

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## Authors' contributions

HF: reviewed background literature, conceived the review question, designed and executed the search strategy, extracted and tabulated data, synthesised results, and prepared the manuscript. SR: supported the identification of background literature, provided expert input to the synthesis of review data, and assisted in revisions of the paper. HF and SR have approved the final article.

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## Ethics approval

Not applicable.

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