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NOVEL CORONAVIRUS DISEASE AND EXERCISE THERAPY IN THE POST HOSPITALIZATION PERIOD



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**ABSTRACT**

Novel coronavirus disease 2019 (COVID-19) is spreading at a rapid pace all around the world. It is similar to severe acute respiratory syndrome (SARS) as the virus family is the same- coronavirus 2 (SARS-CoV-2) that causes problems in the respiratory system. An individual experiences several changes in their lifestyle due to COVID-19. The primary damage of the virus is on the respiratory system and immune system. Long duration of hospital stay and immobilization can impact the general well-being of a person. Post hospitalization period is described when a person is discharged. During this period, mild symptoms are still present. Therefore, low intensity exercise program should be prescribed in the initial 2 weeks and moderate intensity exercise in the next 8 weeks. Moderate intensity exercises (40 min at 65%-75% maximum heart rate on alternate days for at least 10 days) has been found to be effective in young people. In conclusion, we recommend that high intensity exercises should not be performed immediately in the post hospitalization period. Exercises should be progressed gradually from mild intensity to moderate and then high. Dosage should be adjusted after recommendations from health care professionals when switching from low intensity to moderate and from moderate intensity to high intensity exercises.

INTRODUCTION

Novel coronavirus disease 2019 (COVID-19) is spreading at a rapid pace all around the world. It is similar to severe acute respiratory syndrome (SARS) as the virus family is the same- coronavirus 2 (SARS-CoV-2) that causes problems in the respiratory system¹⁻³. An individual experiences several changes in their lifestyle due to COVID-19. The primary damage of the virus is on the respiratory system and immune system⁴. Long duration of hospital stay and immobilization can impact the general well-being of a person. There is evidence that exercise helps in prevention of disease along with its therapeutic benefits⁵. It is recommended to give a precise prescription of exercise to improve physical health and fitness components in an individual.

The pandemic and lockdown led to decrease in physical activity in all individuals, whether healthy or suffering from any chronic disease like diabetes and hypertension. Inactivity is the major reason for reduced immunity and hence it could make the person more susceptible to the coronavirus. The aim of this review is to outline the different types of exercises and the dosage of exercise (intensity and duration) that can be performed by healthy individuals and by patients in the post hospitalization period.

Search methodology

Literature review was carried out by using the key term, that is novel coronavirus disease in combination with 'disease', 'post hospitalization', 'exercise type', 'exercise intensity', 'exercise dose' from Google scholar, PubMed and non-academic sources were accessed manually.

Decreased immune function due to inactivity

Preventive measures of SARS-CoV-2 spread (i.e. lockdown) reduces physical activity. Exercise helps in preventing a viral attack by improving the immune system^{6,7}. It is seen that the immune system becomes stronger by exercising daily as daily exercise prevents co-morbidities like hypertension, increased fat percentage and diabetes. COVID-19 increases its severity when the above mentioned co-morbidities are present⁸. Animal experiments have shown that moderate exercise improves morbidity and the rate of survival to the infection⁹⁻¹¹. Viral infections cause severe impact on the respiratory system and if intense exercise is performed, it may lead to poor outcome^{12,13}.

Changes in the musculoskeletal system due to COVID-19

Muscles are considered as the main component of exercise training as they are the largest soft tissues in the body. Performing different intensities of exercises have shown different impact on the muscles because the muscles have the ability to adapt to higher or lower intensities of exercise. Effects of training can be seen in the entire muscle including the inner layers and fibers of the muscle, including the mitochondria¹⁴. "Power house" of muscle is mitochondria, which provides energy and helps in generation of new organelle¹⁵. Through training, dysfunctional mitochondria is eliminated through mitophagy and the morphological dynamics^{16,17}. Studies have shown that in long-term bed rest, protein destruction is more as compared to protein formation due to mitochondrial homeostasis and muscle immobilization^{18,19}. Research shows that deterioration of mitochondrial homeostasis causes inflammation in the body system and organs, which is one of the negative effects of COVID-19²⁰.

Problems in the post hospitalization period

1. Fatigue is the most common symptom that is frequently reported by patients in the hospital setting, followed by dyspnea and sleep disorders. These symptoms are persistent 110 days after being discharged²¹. Long term rehabilitation and follow-up program is suggested for these patients.
2. Respiratory muscle weakness is another problem encountered by patients post ICU stay. Usually patients in ICU are on ventilators and this leads to atrophy of diaphragm and respiratory distress²⁰.
3. Peripheral muscles are infected by virus, which directly or indirectly harms the tissue. COVID-19 causes inflammation, which helps in release of cytokines. These cytokines cause muscle aches

and muscle soreness²²⁻²⁴.

4. Loss of physical health and fitness, muscle atrophy and loss of memory and confusion (approximately 7% reduction in peak oxygen uptake in healthy people)²⁵.

5. Inadequate breakdown of adipose tissue and inappropriate changes in the mitochondrial pathways cause insulin resistance and inflammation²⁵.

6. When insulin sensitivity is decreased, central fat accumulation increase²⁶. Regular muscular activity is necessary to regulate metabolism of fat and improve mitochondrial function²⁷.

Exercise training program

Post hospitalization period is described when a person is discharged. During this period, mild symptoms are still present. Therefore, low intensity exercise program should be prescribed in the initial 2 weeks and moderate intensity exercise in the next 8 weeks²⁸.

Moderate intensity exercises (40 min at 65%-75% maximum heart rate on alternate days for at least 10 days) has been found to be effective in young people²⁹. These exercises (walking, brisk walking, cycling) should be performed for 30 minutes with a frequency of 2 or 3 times in a week. This is the lowest dose at which beneficial effects can be seen²⁹. It is not advisable to perform highly intense (75%-85% maximum heart rate) sustained exercise if someone is not familiar to such activities. It is advisable to start exercise intensity at 55%-65% maximum heart rate that is, low intensity and increase the duration gradually.

Strengthening the diaphragm in ICU- Exercising at low intensities and high frequency (endurance) stimulates certain biochemical changes in the diaphragm³⁰. It is proved that 10 successive days of low intensity and high frequency training results in substantial defense against diaphragm muscle weakness³¹⁻³³. It is proven that exercising the diaphragm regularly through breathing exercises will help in strengthening the diaphragm and the post-ventilatory muscle weakness can be minimised²⁰.

When the virus enters the body, it causes inflammation in the muscle cells. That is why exercise during this phase is not recommended as it can put a person at risk of fatigue and breathlessness^{22, 24}. Therefore, being physically active and performing regular exercise promotes cardiorespiratory fitness. So, it is recommended for healthy individuals to remain physically active and exercise while healthy, take rest when there are any symptoms of COVID-19, and resume exercise gradually following recovery. Recovery from the viral infection takes at least 2 weeks and 3-6 weeks for patients with severe manifestations. Rest is encouraged during the active phase of COVID-19. Available data suggests that exercise at 65%-75% maximum heart rate up to 45 min is enough to boost the immune function²⁰. The recommended dosage of exercises is given in table I.

In healthy individuals WHO recommends 2.5 hours of moderate-intensity or 1 hour 15 minutes of high-intensity activity weekly, or a mixture of both. Exercise to increase muscle strength should involve large muscle groups and are recommended twice or thrice weekly³⁴. In young people it is advised to exercise at least 1 hour per day at high or moderate intensity³⁵.

Table 1- Recommended dosage for exercise training in the post hospitalization period following COVID-19

Phase	Intensity	Duration	Type of exercise
Healthy individuals (for prevention of viral infection)	-Moderate (65%-75% MHR)	150min/week	Walking, jogging, squatting, cycling
	-Vigorous (75%-85% MHR)	75min/week	Weight training, push-ups, pilates

First 2 weeks after discharge	Mild (55%-65% MHR)	30min 2-3 days/week	Walking
3-8 weeks after discharge	Moderate (65%-75% MHR)	40min every alternate day	Brisk walking, mini-squats, Chair squats, planks, yoga, Tai-chi
More than 8 weeks after discharge	Vigorous (75%-85% MHR)	2 days/week 20min	Weight training, push-ups, pilates

MHR- maximum heart rate; min/week- minutes per week;

Types of exercises

Walking is the most common form of activity. Steps give us an idea about the intensity. 10,000 steps per day is commonly considered as a vigorous intensity physical activity and approximately 1500 steps per day is categorized as a low intensity physical activity³³. Exercises that can be easily performed include walking, climbing stairs, pilates, lifting weights, mini-squats, chair squats, wall- squats, planks, pushups, military push-ups, skipping and yoga.

Recommendations of respiratory training for patients with COVID-19

It is recommended that respiratory rehabilitation should not begin too early so as to avoid aggravating respiratory distress³⁶⁻⁴⁸. In the acute phase, exercises such as diaphragmatic breathing, pursed lip breathing, respiratory muscle training, and aerobic exercises are not recommended when given at high intensities⁴⁹. Exercises according to the patient category are given in table II.

Table II- Respiratory training for different categories of patient³⁷⁻³⁹

Patient category	Exercise intensity	Exercise frequency	Type of exercise	Exercise termination
Moderately ill (In patient)	Rest between 1.0 MET and light exercise- 3.0 MET	Twice a day, 15-45 min/session , 1 hour after meal	Upright sitting position, Positions to reduce dyspnea, relaxation of shoulder and neck muscles	Chest tightness, Shortness of breath, Dizziness, Headache, Palpitation, Profuse sweating
Post acute phase (In patient)	Borg dyspnea score ≤ 3 points (total score- 10 points)	Twice a day, 15-45 min/session , 1 hour after meal	Breathing exercise, Tai Chi	Fatigue, Dyspnea, decreases SaO ₂ (< 4% from baseline), Headache
Post acute phase (outpatient)	Borg dyspnea score ≤ 7 points (total score- 10 points)	Two sessions 10 min/week for 6 weeks	Deep slow breathing, diaphragmatic breathing, mobilization of respiratory muscles, pursed lip breathing	Fatigue, dyspnea, decreased SaO ₂ (< 95%), blood pressure (< 90/60 or >140/90), heart rate >100bpm

SaO₂- oxygen saturation; MET- metabolic equivalent; bpm- beats per minute.

Box-1 Recommendations for exercising during the post hospitalization period

Perform exercises according to your capacity

Exercise intensity and duration depends upon the patient's current status.
Monitor vital parameters like oxygen uptake, pulse, blood pressure and respiratory rate.
Start with mild intensity exercises and progress gradually.
Do not engage in high intensity exercises soon after discharge
Do not continue exercises if symptoms like dyspnea, breathlessness, excessive sweating, headache and fatigue develop.
Always ask the health care practitioner for the type of exercise, duration and intensity.

CONCLUSION

Physical inactivity is a major reason for reduced immunity and general well-being of a person. Healthy individuals should exercise daily at the recommended dosage to prevent any viral infection, since exercise works as a preventive measure. In conclusion, we recommend that high intensity exercises should not be performed immediately in the post hospitalization period. Exercises should be progressed gradually from mild intensity to moderate and then high. Dosage should be adjusted after recommendations from health care professionals when switching from low intensity to moderate and from moderate intensity to high intensity exercises.

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Conflicts of interest- None

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