Can exercise be used as a protective agent against disease severity in COVID-19 and as treatment during subsequent rehabilitation?

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ABSTRACT

In a matter of months, COVID-19 has spread worldwide, and it has affected not only human lives but also the socioeconomic structure. Disease severity increases with the presence of other factors such as age, diabetes, and hypertension. Exercise has been shown to control blood pressure and blood sugar level; it enhances the immune system and age-related physiological changes. Given its ability to control all of these factors, exercise can be used as a protective agent against disease severity in COVID-19 and as treatment during subsequent rehabilitation.

Key words: COVID-19; severity; exercise; hypertension; diabetes; age; rehabilitation; physical therapy.

RESUMEN

En cuestión de meses la COVID-19 se ha expandido a todo el mundo y su impacto no solo ha sido en vidas humanas, sino también en la estructura socioeconómica. La severidad de la enfermedad aumenta en presencia de factores tales como edad, diabetes e hipertensión. Se ha demostrado que el ejercicio puede controlar la presión sanguínea y los niveles de azúcar en sangre, además de aumentar la función inmune y cambios fisiológicos relacionados con la edad. Dada a la habilidad de controlar todos estos factores, el ejercicio tiene el potencial de ser usado como factor protector para reducir la severidad de la COVID-19 y como tratamiento durante la rehabilitación subsecuente.

Palabras clave: COVID-19; severidad; ejercicio; hipertensión; diabetes; edad; rehabilitación; terapia física.

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1. INTRODUCTION

Since its first appearance in December 2019, COVID-19 has spread from its place of origin in China to the whole world in months. It has an incubation period of 5 days and has symptoms like fever, dry cough, and fatigue.1 The main form of transmission is via droplets, and it can affect several tissues besides the lungs, such as the central nervous system, heart, liver, gastrointestinal tract, and kidneys.2 The most common risk factors for disease severity for COVID-19 are diabetes, age, and hypertension.3-6 Until now, there is no known cure, and the best strategy for controlling its spread has been the implementation of preventive measures, such as social distancing, use of face masks, quarantine, the proper cleaning of surfaces, and hand washing.7 COVID-19 has had an impact on every aspect of the world socioeconomic landscape and is estimated to have long-term repercussions.8

Benefits of physical activity have been well documented, from a better quality of sleep, anxiety and weight management, and lower cardiovascular disease risk to reduction of all-cause mortality, among others.9-12 The terms physical activity and exercise are sometimes used interchangeably, but one should not be confused with the other. Exercise must be a planned, structured, repetitive, and purposeful physical activity with measurement methods.13 Zbinden-Foncea, Deldicque, and Howley reviewed the possible role of exercise as a preventive strategy to decrease the severity of COVID-19, focusing on its role in regulating the inflammatory status.14 This review will focus on the role of exercise during the COVID-19 pandemic, from reducing risk factors for disease severity to its role during rehabilitation in disease recovery.

2. SUBTOPICS

Blood pressure control

Although hypertension is considered a risk factor for COVID-19 severity15,16, the changes in the pro-inflammatory status and immune suppression that accompany hypertension are the reason why it is considered a risk factor.17 Nevertheless, data suggests that patients with poor blood pressure control have higher rates of adverse outcomes like mortality, ICU admission, heart failure, respiratory failure, and mechanical ventilation.18-19 One possible treatment line for preventing adverse outcomes in these patients is to keep blood pressure under control. After an acute bout of exercise, there is a decrease in blood pressure known as post-exercise hypotension (PEH). There are several mechanisms for this change in pressure, and it is likely a combination of neural and hormonal mechanisms.20-22 One strong candidate for PEH is post-exercise baroreflex. After exercise cessation, there is an increased sympathetic nervous activity that causes a reset in the baroreflex, thus decreasing blood pressure.23,24 As little as 30–60 min aerobic exercise per week is enough to lower blood pressure.25 Even in resistant hypertension, interval walking exercise decreases blood pressure.26 Thirty minutes of moderate treadmill walking lowers systolic and diastolic blood pressure over 8 hours of prolonged sitting.27 Aerobic exercise in the evening results in a better hypotensive effect when compared to exercise done in the morning in hypertensive individuals, although both options are effective in lowering blood pressure.27 High-Intensity Interval Training (HIIT) can provide a longer28 or the same29 hypotensive effect as continuous aerobic exercise. Isometric handgrip has been proposed as a cost-effective, low-equity alternative to decrease blood pressure.30-32 However, aerobic exercise yields a better blood pressure control response when compared with isometric exercise.33,34

Glycemic control

It has been hypothesized that people with diabetes appear to have worse outcomes because of high levels of blood glucose and changes in their physiology that accompany diabetes. Among these changes are increased ACE-2 expression and furin levels, impaired T cell function, increased interleukin-6 (IL-6) levels, and impaired neutrophil chemotaxis and phagocytosis.15,35,36 In a cohort of 7,337 patients with confirmed COVID-19 and type-2 diabetes, individuals who had well-controlled glucose levels (6.4 mmol/L) had a higher lymphocyte count and lower neutrophil and serum IL-6 levels. Furthermore, they had reduced organ injury and lower death rates compared to patients with poorly controlled glucose levels.37 It could be argued that a possible prevention strategy for the diabetic patient is to keep their blood glucose under control. Glycemic control (GC) refers to the regulation of glucose that a human has in their system. The mechanisms of GC as a response to exercise are a combination of increased blood flow, permeability, and glucose requirements during exercise.38 Exercise is a recommended lifestyle change for GC in individuals with type-1 and type-2 diabetes.39,40 Resistance and aerobic exercise decrease glucose in type-1 diabetes; resistance exercise decrease mean glucose for 24 hours post-exercise.41 Both continuous and interval aerobic exercises result in decreased glucose in type 2 diabetes.42 Even walking exercise programs can be useful in decreasing glucose levels. An interval-style walking program resulted in decreased mean and maximum glucose concentration compared to continuous walking.43 Exercise can also be used as a prevention strategy for the development of type-2 diabetes. HIIT has been shown to prevent the progression of type-2 diabetes in prediabetic individuals.44
Exercise as a countermeasure for age-related physiological changes

Aging is related to a series of changes that affect all systems within the human body. These changes comprise an increase in arterial wall stiffness, a decrease in muscle strength, size, bone mineral density (BMD), and lung structure, which affects gas exchange, and a decrease in immune cell count and function, among others. All these changes lead the individual to a state known as frailty and appear to be the reason why the elderly are amongst the at-risk population. One possible alternative to prevent these changes from happening altogether is aerobic exercise. The direct connection between aerobic exercise and longevity has been shown in animal studies. The survival chances increased by 25% when the animal had higher VO2max while doing aerobic exercise, lowering cholesterol levels and arterial pressure and increasing glucose tolerance, alveolar ventilation, and pulmonary diffusion. Exercise can improve cardiorespiratory function through various mechanisms such as an increase in muscle mass and heart function. High and low-intensity resistance exercise leads to improved oxygen consumption and cardiorespiratory endurance. Aerobic and endurance exercise, coupled with interval training, produced an increase in VO2max and skeletal muscle area and strength. A combination of aerobic and resistance exercise leads to increased muscle strength and body composition changes in sarcopenic obese individuals. A cross-sectional study showed that men who performed moderate-to-vigorous exercise showed a lower risk of osteoporosis. A 5-month resistance and aerobic exercise intervention effectively reduced BMD loss during caloric restriction in older adults, although resistance exercise showed better results. Resistance exercise can improve muscle size, quality, and power production as well as physical function in older adults. Both supervised and home-based exercise improved lower limb strength and walking speed in frail and pre-frail individuals. Changes in immune parameters can still be obtained despite age. Master athletes exhibited lower senescent lymphocytes compared to healthy age-matched controls. The aerobic exercise yielded a better immune response than resistance exercise in the elderly. Both acute and chronic exercise has a positive effect on immune parameters in the elderly. Overall, exercise improvements the notion that the stimulus by exercise leads to changes in the physiology, specifically when it comes to blood pressure control, glycemic control, and the delay and even reversal of age-related changes. This may confer some protection against COVID-19 severity.

Role of exercise in cardiopulmonary rehabilitation

The role of exercise in pulmonary rehabilitation has been well established, and rehabilitation can start as early as in the intensive care unit (ICU). Elastic bands have been used effectively and safely in the ICU to prevent a decline in upper body strength and trunk control. Cycling combined with functional electric stimulation increased cardiac output in patients during bed stay at the ICU. British Thoracic Society Guidelines places exercise as an integral part of pulmonary rehabilitation given that it enhances muscle size and function, pulmonary capacity, and residual capacity. Exercise can also help regulate symptom control and quality of life. Moderate aerobic exercise resulted in better symptom control and quality of life in patients with chronic obstructive pulmonary disease (COPD). Considering the COVID-19 lockdown, rehabilitation must be done in a home-based setting. Home-based telerehabilitation in individuals with COPD leads to

Figure 1. Relationship between exercise and COVID-19 risk factors.

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increased exercise capacity and quality of life. Six months of telerehabilitation with COPD and heart failure effectively reduced hospitalization rate, exercise tolerance measured by 6-minute walk test, increased quality of life, and reduced dyspnea. Individuals undergoing home-based cardiac rehabilitation showed improvement in VO2max and quality of life. Exercise can also provide a treatment option for non-disease side effects of the COVID-19 pandemic, such as mental exhaustion, depression, sedentarism, mood changes, self-esteem, and even social isolation. Exercise can provide a viable treatment option for the rehabilitation of COVID-19 patients in every step of the way, from ICU stay to outpatient rehabilitation and even at-home exercise programs (Figure 1).

3. CONCLUSION

Exercise could be used as a low-cost treatment for reducing risk factors and mortality from COVID-19. HIIT appears to be a time-effective option to reduce COVID-19 disease severity factors. Several challenges need to be considered, such as a correct exercise prescription by a certified physical therapist. Therapy must be based on specific needs, abilities, and monitoring of the individual and equipment needed to ensure a correct and safe exercise execution, all while maintaining preventive measures against COVID-19.

4. CONFLICT OF INTERESTS

The authors declare no conflict of interest.

5. REFERENCES


