

## Doing Exercise during the COVID-19 Pandemic: Wearing or Not Wearing a Face Mask?

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The coronavirus disease 2019 (COVID-19) pandemic - caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) - is an extraordinary global health emergency. The pandemic has also influenced every aspect of human life and caused panic in the community. On the 11<sup>th</sup> of March 2020, the World Health Organization (WHO) designated the COVID-19 outbreak a global pandemic (World Health Organization, 2020d) [1]. Since then, many governments have enforced strict policies to prevent and slow the ongoing spread of the COVID-19 disease. Government policies have included lockdowns of cities, prohibited certain social activities and gatherings, and travel bans. People were encouraged to physically distance themselves, practice good hand hygiene, wear a face mask in public areas, and remain at home where possible.

Encouraging people to stay at home could remarkably reduce the possibility of getting infected by COVID-19. Nevertheless, otherwise, it may also diminish physical activity and increase sedentary behavior. In contrast, exercise has been known to increase immunity, which would be helpful if infected with COVID-19 [2,3]. For those with training facilities at home, reaching the WHO recommendations of 150 min of moderate-intensity or 75 min of vigorous-intensity physical activity per week (World Health Organization, 2010) is still attainable [4]. Performing physical exercise at home is secure and can maintain fitness levels. However, most people in developing countries are used to exercising in a public area, such as a city park or square. However, exercising outdoors increases the risk of being exposed to COVID-19. Therefore, maintaining social distance and the use of masks are mandatory for those who exercise in public places.

Most health authorities have urged the use of face masks as one of the measures to control COVID-19 transmission. Face masks can protect COVID-19 patients and healthy people. A simulation showed that cotton masks, surgical masks, and N95 masks could protect against COVID-19 transmission by filtering fine airborne particles and blocking the droplets or aerosol inhalation [5,6]. Hence, the use of face masks is important during the COVID-19 pandemic.

While exercise is essential to improve immunity against COVID-19 infection, exercising during a pandemic is challenging. There have been many questions regarding the use of face masks when exercising. During the ongoing pandemic, professions working in sports health or medicine have been frequently asked about wearing a face mask when exercising. An applicable answer should be based on the effect of face masks on exercise performance. Face masks might affect the entire organ system, and face masks mainly affect exercise performance through their effect on cardiorespiratory function.

### **Wearing a Face Mask May Reduce Physiological Capacity and Exercise Performance**

Some hypotheses and studies indicate that wearing a face mask during exercise can disturb the normal breathing process leading to reduce performance. The effect of wearing a face mask during exercise on the respiratory system can be described as resembling exercise by patients with chronic obstructive pulmonary disease (COPD) [7]. While using a face mask may not induce significant hypoxia, hypercapnia, and acidosis under regular use at rest, it will do so during exercise.

The first effect on the respiratory system is inadequate gas exchange due to trapped air causing hypercapnia [8]. Oxygen uptake will diminish, and exhaled air containing carbon dioxide (CO<sub>2</sub>) will be trapped within the mask air space. This will increase rebreathing of CO<sub>2</sub>, causes hypercapnic hypoxia, in which CO<sub>2</sub> expels oxygen from its binding to hemoglobin. The face mask also enhances resistance to inspiration and expiration, which aggravates breathing work [9].

The second effect on the respiratory system may come from increased dead space. Rebreathing of exhaled air can be likened to added dead space. It is estimated that rebreathing will increase dead space by 50-100ml. However, during exercise, using a face mask can achieve a total dead space of 600ml. This will cause people to have higher end-tidal PCO<sub>2</sub>, higher minute ventilation, and greater dyspnea than those who do not face mask during exercise [10].

Using a face mask during exercise also influences kidney function. Rebreathing CO<sub>2</sub> will raise arterial CO<sub>2</sub> concentrations leading to create an acidic environment [11]. Hypercapnic hypoxia and acidosis decrease renal blood flow and glomerular filtration rate, increasing the risk of renal tubular damage. Also, aciduria can damage renal tubular cells, potentially decreasing renal function, especially in individuals with existing chronic diseases [12]. This acidic environment at the alveolar and blood vessels level will also stimulate physiological changes and responses, including metabolic drift, cardiorespiratory disorder, immune system, and others [13].

Using a face mask has an alteration on the cardiovascular system. Low availability of oxygen and CO<sub>2</sub> stimulate the heart to work harder to keep oxygen delivery sufficient to meet the tissue's demands. This could

increase the heart rate and blood pressure even at low exercise intensity [14]. Furthermore, these physiological adjustments increase aortic pressure and ventricular pressure, raising the cardiac load and coronary demands [14]. This puts those exercising at a high risk of having a heart attack. Increased adrenergic stimulation and oxidative stress, hypoxia, and hypercapnia promote arrhythmias and impaired electric conduction in the heart, leading to sudden cardiac death [15].

Individuals using face masks when exercising experience several subjective symptoms with different sensations and intensities [16]. The most frequently reported complaints related to the use of face masks are dyspnea, discomfort, fatigue, dizziness, headache, shortness of breath, muscular weakness, drowsiness [17,18], and increased breathing effort [13,19]. Some studies reported that exercise performance decreases when using a face mask. A higher rating of perceived exertion (RPE) and somewhat increased heart rate was found in participants wearing face masks than those not wearing a face mask when walking on a treadmill at 4km/h for 6 min [20]. Using cloth masks can reduce exercise duration by 14% and  $VO_{2max}$  by 29% [21]. Maximum power was also reported to decrease during a progressive cycle ergometer test while wearing a face mask [22].

## **Wearing a Face Mask Has No Effect on Physiological Capacity and Exercise Performance**

There have also been some studies reporting that physiological capacity and exercise performance was not impaired while wearing a face mask during exercise. Those studies were carried out recently. A study by Epstein *et al.* in healthy subjects reported that wearing a face mask during short-term moderate-vigorous aerobic exercise was feasible and safe. They found only a slight increase in end-tidal carbon dioxide ( $EtCO_2$ ) [23].

Shaw *et al.* investigated the effect of wearing a face mask during vigorous exercise in young, healthy participants. No parameters were significantly different with those who did not wear a face mask. Arterial oxygen saturation, tissue oxygenation index, RPE, and heart rate were comparable at any time during the exercise test [24]. Shein *et al.* also conducted a study involving 50 adults (18-65 years old, male and female, some with comorbidity). Participants were assigned to sit and to walk briskly while using and not using a face mask. Three variables were measured, heart rate, oxygen saturation, and  $PCO_2$ . None of the participants experienced hypoxemia and hypercarbia at sitting and when walking briskly. These results indicated that gas exchange impairment did not occur when exercising using a face mask [25].

## **Conclusion**

1. The effects of using a face mask on exercise remain inconclusive due to differences in scientific literature sources, study design, subject characteristics, and exercise protocols.
2. The effect of wearing a face mask while exercising might be more noticeable in less trained individuals or those with low-level physical fitness and when performing high-intensity, strenuous exercise.
3. Subjective complaints from individuals about wearing a face mask when exercising include that it is extremely uncomfortable.

## Recommendation

1. For trained individuals, using a face mask when exercising is feasible and recommended. Nevertheless, when feeling uncomfortable, they should lower the exercise intensity.
2. For untrained and less trained individuals, those with low physical fitness, and those who cannot afford to wear a mask when exercising, they are recommended to do exercise without a face mask at home or in a quiet place where social distancing can be maintained.

## Conflict of Interest

None to declare

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