

Exercise with a Facial Mask. Questions and Answers from Sports and Exercise Medicine Perspective

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Abstract

The use of a face mask to reduce the risk of transmission of infectious diseases has been widely recommended. This simple practice contains diseases that become global threats like the current COVID-19 pandemic. In addition, exercising regularly is one of the most important preventive measures to combat physical inactivity and improve the immune system and although there are alternatives at home, many people can only practice it outdoors and may require a mask.

For this reason, it is important to know the physiological effects of face masks on the human body during physical exercise.

In this mini review we want in an academic way and supported by the best available evidence, to answer some concerns generated around this topic.

Keywords: Facial mask; Exercise; Hypoxia; Carbon Dioxide; COVID-19

At this time of a pandemic, should we use a face mask during physical activity to avoid transmitting the virus?

Yes, at this time when the COVID-19 disease spreads to more of our country's population and the risk of infection is higher, the proper use of a face mask when we are at risk of contact with other people is a of the most important measures to avoid the infection and transmission of this disease caused by the SARS-CoV-2 virus. Face masks are an effective physical barrier to reduce the risk of acquiring infectious diseases of viral origin. The form of transmission of COVID-19 is by droplets of secretions such as saliva or mucus which are expelled when breathing, speaking, coughing or sneezing. During the practice of physical activity, the risk of transmission can be increased since the respiratory rate and the volume of air that enters and leaves the respiratory tract increase, the above is important especially when sharing the space with other people as in the gym or outdoors, therefore our recommendation is that a facial mask be used in these spaces.

As long as the proper use of the facial mask is guaranteed by covering the mouth and nose and following all the recommendations according to the type of facial mask used, the efficacy of the facial mask is in two ways: one for the person who is not infected and do not want to be it, it prevents the virus from reaching your respiratory tract and the second way is for the person who is infected (Positive test in symptomatic or asymptomatic people) avoid expelling the virus through these droplets and infect other people, this has been shown by studies that show how the degree of contagion or infected people decreases in the populations studied when using the facial mask correctly, in closed environments such as hospitals and open environments such as the street or a park [1].

Remember that Medical or surgical face masks are disposable and must have a proper final disposal after each use, they should ideally be discarded in a separate bag for biological waste (This recommendation is important especially in case of being treated with COVID-19), otherwise, its final disposal will be in the toilet paper can and alcohol should be spread on their surfaces before placing it in the bag or

bin. Cloth tissue masks should ideally be washed with hot, soapy water and then put to dry in a cool, airy place until completely dry before next use. If for any particular reason type N95 respirator is used, store it in a paper bag placing it in a ventilated and dry place, if it is used properly it can be effective for up to a week (However, it is important to clarify that this type of device is indicated for health personnel who are exposed daily in their work) [2].

Are there different types of mask and are they just as effective?

There are several types of face masks as mentioned above and these can be classified according to the material, shape, size and accessories that make them up, their effectiveness in preventing the passage of particles into the respiratory tract depends on this. According to this, it is the objective of its use and therefore also the indication of the population in which its use is recommended.

The masks with which we are most familiar are surgical or medical masks, which are disposable, that is, for single use. These have a proven efficacy of 95 to 96% to prevent the transmission of viral infections, they can be used for 4 - 6 hours continuously while at rest and for a maximum of 60 minutes during physical activity.

The other type of face mask frequently used are cloth tissue masks, which are manufactured with various types of fabrics and in many cases with low quality requirements and even homemade. Its effectiveness varies depending on the material from which it is made.

Some studies have compared cotton, linen, silk, sheet, towel masks, even made with vacuum cleaner filters, showing a better efficiency with towel and vacuum cleaner filter 83 - 94% respectively, however in this study regular use is not recommended of homemade masks [3].

On the other hand, it has been found in studies that the combination in layers of some fabrics, materials or density of the fabric would improve their effectiveness in a certain proportion, reaching 96 - 97% in non-woven fabrics of dense cotton, combination cotton chiffon, cotton silk, polyester or polypropylene. If this type of facial mask with these aforementioned characteristics were to become generalized in the entire population, then it would imply a decrease in the rate of transmission from one person to another [4].

This combination of layers, having multiple layers or certain materials like lycra, neoprene or antifluid materials in a mask leads to one drawback: comfort, breathability, side effects and safety. This is why adherence to proper use of a facial mask during physical activity will depend on the type of mask we choose to perform the exercise and especially when it lasts for more than one hour.

Others to which the N95 belongs to, called high-efficiency respirators, with filters for drops and aerosols, used by health personnel. These types of face masks are close to 99% effective in preventing COVID-19 infection [4].

And finally, there are respiratory protection devices known as elastomeric respirators that are used for professionals or workers in mining, metalworking factories, firefighters, workers exposed to chemicals and pesticides. This device is also used by health personnel since they are exposed during long working hours to microparticles that endanger their health. Elastomeric respirators can cover the entire face or just the nose and mouth, they have valves with filters that allow comfortable and safe breathing. It should be clarified that these devices are not recommended by the CDC for use in the general population to prevent the spread of COVID-19 [5].

Whichever facial mask is used, it must be used properly, covering the mouth and nose, ensuring that it is well adjusted to the face, because even being with the most effective material, if it is not used correctly it loses up to 50% effectiveness [4].

Does the facemask produce hypoxia?

There are studies carried out with exercise at low and moderate intensity effort, in which some physiological changes with respect to oxygen and carbon dioxide are evidenced, however these do not threaten life or affect performance significantly [6].

Regarding the impact on the oxygen level in the body when using a face mask during physical activity; it can be concluded that in fact, there is a decrease in oxygen levels in the body, finding a decrease in oxygen saturation between 1 - 2% when performing low to moderate intensity activities. It should be clarified that the above is not clinically significant and does not threaten health.

This was demonstrated by Beder, *et al.* in 2008; When they studied oxygen saturation in surgeons before and after performing surgery using a surgical mask, they also took into account the duration of the surgical procedure. They found that oxygen saturation fell about 1% in interventions of 60 to 180 minutes in duration, and under 2% in those interventions that were between 180 and 240 minutes. There was no report of major adverse effects, nor was there a report of dyspnea at any time, but there was an increase in heart rate that was directly proportional to the duration of the surgical intervention, which is part of the physical activity of these professionals [7].

It has been shown that in exercise oxygen saturation does not drop more than 1 - 2% (Kim, Benson and Roberge). There are studies evaluating band walking exercise at a speed of 2.7 and 4 km/h without evidence of changes in oxygen saturation using N95 face masks with or without a valve, but the inspired fraction of oxygen can drop from 21% to 16.6%. The aforementioned changes are not clinically significant [6,8].

Another study published by Yi Li, *et al.* in which a band walk was performed at 6.4 km/h for a period of 10 min using a surgical mask and type N95 respirator; is to date the study carried out with the highest intensity of exercise This corresponds to an energy expenditure of approximately 3.7 METs (which corresponds to a low to moderate intensity exercise) and a significant decrease in available oxygen was not shown either [9].

Am I breathing my own waste?

Well if we think of CO₂ (Carbon Dioxide) as that waste, the answer is yes, with any mask we use. However, there is less accumulation with surgical masks, those made of cloth, those that have valves and those that do not generate an airtight seal with the skin.

The progressive accumulation of CO₂ in the body is called hypercapnia, and it has been shown that CO₂ levels in inspired air can rise up to 3% with moderate intensities of exercise using a face mask without reporting adverse effects or signs of toxicity [6,10]. So far we have no evidence of high performance and/or high intensity exercise. There is already a pilot study from our group evaluating triathletes using different types of face mask and so far no life-threatening changes have been found.

Now to breathe CO₂ we don't need to wear a face mask, you have to live in big cities and there you will not only breathe carbon dioxide but also carbon monoxide (CO) which is even more toxic. In almost all the cities of the world there is pollution with CO₂ and CO and we do not see people falling suddenly intoxicated by this waste. Now on the other hand also to think, CO₂ plays an important role in having a positive stimulating effect on the respiratory centers and maintaining the ventilatory status quo. That is why when people are in a state of anxiety that they begin to increase their respiratory rate, this causes them to eliminate more CO₂, losing that stimulus at the brain level and they go from being hyperventilated to having respiratory failure, that is why we see that these people in This state of hyperventilation puts them to breathe in a paper bag so that in this way the stimulus of CO₂ returns to the respiratory center.

Chandrasekaran and S Fernandes, *et al.* comment in their publication with very poor scientific support, that they could find hypercapnia and deleterious effects of exercise of more than 2 METs using a type N95 mask [11], this in a certain way goes hand in hand from what was published by Yumiao Chen, *et al.* who evaluated the use of N95 with and without expiratory valve in subjects at rest seated and others walking for 5 minutes with a gait speed of 1.6 m/s in a young population, activating much less accessory muscles (Evaluated by surface electromyography) in the subjects who used N95 with an expiratory valve that allowed the elimination of accumulated CO₂ [12].

Does using a face mask during exercise affect my physical performance?

We refer to physical performance as the ability to maintain an effort or intensity of exercise for a specified time. To date, published research shows that it is possible to exercise and maintain physical performance using masks at low to moderate intensity of effort for periods of less than 60 minutes, without significant changes in oxygen saturation, heart rate and/or negative risks for health [13]. Some cases report of athletes show that it is possible to maintain this physical effort for much longer, however these reports have not been analyzed under scientific rigor and therefore we cannot recommend a longer duration in a generalized way.

We did not find studies where tolerance to high intensity physical effort is evaluated using masks. Low tolerance to high intensity exercises has been reported due to several factors that may be associated with the characteristics of the mask, such as sticking to the mouth, sweating and/or heat in the area of the mask.

In the long term, there is no justification for physical performance to be affected in athletes where the physical effort they must maintain during their competitions is of low to moderate intensity, such as those that last more than 60 minutes.

If the athlete requires training at a high intensity of effort in order to maintain their physical effort, it is recommended that they initially seek advice from a sports medicine physician in addition to planning their training in safety conditions if they must do so without a mask.

My heart rate increases more than normal wearing a mask, is that bad?

During physical exercise, wearing a mask increases both the sensation of physical effort and the physiological variables associated with this effort, in this case, heart rate and respiratory variables [13]. However, the increase that has been evidenced is within what is expected and should not cause any cardiovascular problems for a healthy, trained person and/or who has been authorized to exercise by a sports medicine physician.

There is a direct and normal, almost linear relationship between physical exertion and increased cardiac output (heart rate and stroke volume) with the aim of increasing the amount of oxygen delivered to the muscles during exercise.

Each increase in perceived exertion on a traditional Borg scale, from 6 to 20, correlates with an increase of approximately 10 beats per minute. Therefore, it is to be expected that if the physical effort we experience when exercising increases, so will the heart rate as a compensatory response.

Is it safe to use a facial mask for exercise?

The use of different respiratory protection devices during the practice of physical activity of moderate intensity (less than 3.7 METs) and short duration (less than 90 min) is safe and is not associated with fatal outcomes. This is supported by the available literature on the behavior of different physiological variables during the practice of physical activity (Band walk at 6.4 km/h) while using a face mask [9]. Nor has it been found to date that exercise at these intensities generates significant increases in carbon dioxide levels and that this has a significant and deleterious impact on human health [14].

It should be clarified that to date there are no studies available on the use of different types of face masks (cloth, surgical, N95 respirators, etc.) during high intensity and long duration exercise. It is a gap in knowledge which must be resolved with future research on the subject. However, we dare to state that the more intense and longer the exercise is, the greater the probability of deleterious effects, given the progressive accumulation of carbon dioxide, which would be re-inhaled associated with a decrease in the inspired fraction of available oxygen and the increase in metabolic demands in high intensity and long duration exercise. The foregoing would be aggravated by variables such as age, cardiopulmonary capacity, underlying pathologies, type of mask, material of the facial mask, among others.

It is for this reason that we always recommend using a facial mask to practice physical activity, since as we previously stated, we consider it to be a necessary and safe intervention. However, in a susceptible population or in people who perform high-intensity and

long-duration exercise, we recommend taking breaks every 20 - 30 minutes to remove the face mask, breathe room air and continue your activity. The above favors a sweep of the accumulated CO₂ and thus avoid the deleterious effects of its progressive accumulation.

Is there a special population to consider prior to using a face mask during exercise?

Yes, a special population or those susceptible to developing complications associated with the use of a facial mask during physical activity, given their particularities and physiological behavior during physical activity, are the following:

- Children.
- Pregnant women.
- People with chronic respiratory diseases such as asthma, COPD, bronchiectasis, bullae, among others, even the population that has had a moderate to severe respiratory infection due to COVID-19.
- People with pre-existing coronary heart disease or angina pectoris.
- People with anemia.

These population groups should have close professional support, adequate monitoring of symptoms and different clinical variables, and have a consultation with a doctor who specializes in physical activity and sport before starting an exercise program using a face mask.

So far we only have a few studies available in the scientific literature on the effect of the use of a facial mask during physical activity in this population [15-18].

What precautions and/or recommendations should I take into account to use the facial mask during physical activity?

In order to guarantee the safety and health of the entire population, at this time we recommend using a facial mask in an appropriate way (covering nose and mouth permanently) whenever physical activity is going to be carried out, whether in a closed space such as a gym or be it outdoors and can be in close contact with other people, in this way we reduce the probability of transmitting viral diseases such as COVID-19. It is a measure that, together with hand washing and social distancing, has proven to be effective in reducing its transmission. In addition, it is necessary to make proper use of the face mask to guarantee its effectiveness, always be aware of all the technical specifications that the manufacturer of each respiratory protection device provides us when we buy each mask from its use, storage and final disposal.

When going to perform physical activity outdoors using a facial mask, it is always recommended to carry out an acclimatization period for approximately 5 - 10 minutes at home, evaluate sensations, guarantee an adequate form to put the facial mask and adapt to its use before go out for physical activity.

If you are going to carry out long-term physical activity (> 60 - 90 minutes) it is always advisable to carry a replacement face mask since when they get wet they lose their effectiveness, so half the time it is recommended to change it to improve its effectiveness during physical activity. As a final recommendation, the fact of removing the face mask every 15 - 20 minutes to breathe room air for approximately 1 minute, a barrier with carbon dioxide that can accumulate in the microenvironment generated in the face mask and thus have better tolerability to its use. and avoid the possible deleterious effects that can be observed especially during high intensity exercise (> 3.5 METs) and long duration.

The above is also recommended in the susceptible population, which was mentioned above (pregnant women, children, people with chronic diseases).

In addition, it must be taken into account that whenever this pause is going to take place and the facial mask is removed, we must guarantee a physical distance of 2 meters with respect to other people who can share the same space during physical activity.

Dispnea	Difficulty breathing
Syncope or presyncope	Fainting or feeling faint
Dizziness	Sensation of movement
Visual symptoms	Blurred vision, spots, or scotomata
Cephalea	Headache
Profuse diaphoresis	Excessive sweating while resting
Irritability	React excessively or aggressively to a certain situation
Confusion	Disoriented, inattentive, or memory impairment
Anxiety	Nervousness, anxiety, or excessive worry

Table 1: Alarma signs.

Clinical signs or symptoms that may indicate some degree of health compromise with its description for better understanding.

All the above conditions represent alarm signs, for this reason in the presence of any of them it is recommended to suspend physical activity and consult with a doctor who specializes in physical activity and sports [17].

Conclusion

During a pandemic of viral origin, social distancing, hand washing and the generalized use of a facial mask are strategies that have been shown to decrease the transmissibility of the virus, which is why it is a common situation during these episodes that affect the world population to use facial mask during physical activity. This is why it is important to clarify that it is a safe intervention that is not related to fatal outcomes or major adverse events during the practice of moderate intensity physical activity. There is also support in the literature that when using this respiratory protection device there is a slight affectation of ventilatory mechanics and gas exchange, which are not clinically significant and do not affect human health when moderate intensity exercise is performed for a maximum of 120 minutes. It is also important to know that the alteration in thermoregulation and the slight increase in core temperature must be taken into account, which under extreme conditions of heat and humidity can lead to heat stroke during long-term and high-intensity exercise. Finally, it is important to emphasize that health must always be a priority above sports performance and be attentive to the warning signs that may arise.

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