

Prolonged Use of Face Mask and Future Concerns

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ABSTRACT

There are certain professions, which demand every day long time and continuous use of face mask. Such professions mainly include doctors, nurses, paramedical staff, police personnel, etc. With the starting of the second wave of the coronavirus disease-2019 (COVID-19) pandemic and the anticipated third wave, the duration of wearing face mask will also extend for a significant period of time. Hence, a strong possibility of prolonged and chronic hypoxia is expected to occur in the aforementioned group of population. Hence, there is a need to envisage the chronic effects of long-term usage of face mask on the normal physiology of humans. In the present paper, we enlisted futuristic consequences that could be associated with this pragmatic proposition. As face mask usage will continue for years together, efforts were made to provide a rational remedial measure to avoid such consequences.

Keywords: Coronavirus disease-2019, Erythropoiesis, Face mask, Hypoxia.

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INTRODUCTION

The impact of the coronavirus disease-2019 (COVID-19) pandemic has hugely affected mankind in various ways. Various nations have witnessed the first and second waves, and are in anticipation of the third wave.¹ Due to the airborne nature of the SARS-CoV-2, face mask use has become a common practice in day-to-day life. It is a well-known fact that a face mask significantly reduces the chances of infection and thus the associated morbidity and mortality.² The anxiety generated among common people has prolonged the duration as well as frequency for which an individual wears a mask.³ After lifting the lockdown, the use of face mask has become compulsory at public and workplaces. The second wave of the pandemic has already been reported and thus the use of face mask will continue to be in use by people for an undefined time.

There are certain professions, which demand every day long time and continuous use of face mask. Such professions mainly include doctors, nurses, paramedical staff, police personnel, etc. With the starting of the second wave of the COVID-19 pandemic and the anticipated third wave, the duration of wearing face mask will also extend for a significant period. Hence, a strong possibility of prolonged and chronic hypoxia is expected to occur in the aforementioned group of population. Development of acute hypoxia and hypercapnia causing ventricular tachycardia/fibrillation leading to sudden cardiac arrest has recently been hypothesized.⁴ However, there is a need to envisage the chronic effects of long-term usage of face mask on the normal physiology of humans and the present paper proposes a possible impact on erythropoiesis.

PROLONGED FACE MASK USE AND HYPOXIA

It is a well-known fact that the prolonged use of a face mask generally causes breathlessness and can even lead to hypoxic conditions.³ Studies propose that a part of the exhaled carbon dioxide gets entrapped beneath the face masks.⁵ A fraction of carbon dioxide exhaled is also inhaled back in the next respiratory cycle, thus initiating a gradual decrease in blood oxygen saturation.⁵ Face masks allow hot, humid exhaled air to accumulate beneath them and have an impaired cooling effect on the face.⁶ Studies have

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supported the theory that a state of mild or moderate hypoxemia and hypercapnia develops due to prolonged wearing of face masks.^{4,7} Thus, prolonged use of face masks eventually leads to a state of chronic low-grade hypoxia.

This proposition would not apply to the majority of the population (working from home, small working hours, working in an isolated environment) who do not wear the mask continuously for a significant period. It will only affect the people associated with an aforementioned profession for whom there is no choice but to wear the mask for a significantly longer duration of time without removing it.

CHRONIC HYPOXIA AND ERYTHROPOIESIS

It is well known that chronic hypoxia affects red blood cell numbers and hemoglobin concentration.⁸ The hypoxia state triggers many physiological responses, which include increased heart rate, hyperventilation, and stimulation erythropoiesis.⁸ Erythropoiesis is controlled by a glycoprotein hormone called erythropoietin. Reduced oxygen supply to the tissues creates a condition of

hypoxia in the kidneys, which are the main sites for erythropoiesis. Chronic hypoxia leads to the formation of prostaglandin, which in turn triggers erythropoietin formation. Thus, it ensures increased erythropoiesis. An increase in the number of red blood cells also leads to increased hemoglobin concentration. Studies also suggest that under hypoxia-like conditions, the hypoxia inducible factor-2 α gets stabilized and there is an activation of *erythropoietin* gene (*EPO* gene).⁹ *EPO* binds to its receptors (EPOR) on the progenitors of red blood cells in bone marrow leading to an increase in their number.

IMPLICATIONS AND CAUTIONS

From the aforementioned discussion, it is quite conceivable that the use of a face mask might lead to chronic low-grade hypoxia, which in turn can change the hematocrit levels and hemoglobin concentrations, and there are chances that these changes over a while would eventually become the new normal. With increased hemoglobin levels, there is a probability that the host might be able to combat COVID-19 by maintaining its oxygen saturation level (SpO₂). This can also explain why many individuals remain asymptomatic without breathlessness or drop-in (SpO₂). Mask-associated hypoxia will worsen the conditions in anemic patients, but a gradual increase in hemoglobin concentrations due to the body's adaptation might be able to improve the condition to a certain extent. On the other hand, patients who already tend to have higher hemoglobin and hematocrit (e.g., polycythemia, heavy smokers, living at high altitude) are at risk of a further increase in the number of red blood cells causing increased blood viscosity leading to increased risk of blood clots, cardiac arrest, and stroke.

We also take this opportunity to propose recommendations for the highly vulnerable group of professionals. The concern authorizes of such professions should reduce the working hours of workers or introduces smaller working shifts so that employees can spend a significantly good amount of time without face masks in a safe environment. The individuals associated with such occupations should make it compulsory to practice breathing exercises every day to reduce the future impact of chronic low-grade hypoxia and related complications.

Mask-associated hypoxia is emerging as a major concern with already hypothesized acute manifestations as well as possible chronic manifestations. In the present paper, we focused mainly on manifestations related to chronic low-grade hypoxia. Studies need to be focused on this type of hypoxia and it is of utmost importance to decipher whether it will have a transient effect or prolong effects on mankind. Finally, we would like to declare that face mask is a mandatory proposition and can save millions of lives in this pandemic and we strongly advocate its usage. However, for certain professions, judicious use of face mask is imperative to avoid long-term futuristic consequences.

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