

Peripheral oxygen saturation is not influenced by the use of face masks in exercise

A saturação periférica de oxigênio não é influenciada pelo uso de máscaras faciais em exercício

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ABSTRACT

In many cities worldwide the use of face masks in public spaces became mandatory to prevent dissemination of COVID-19. The closure of public parks, gymnasiums and other areas designed for the practice of physical exercise may contribute to inactivity. **Objective:** The aim of this experience report was to evaluate peripheral oxygen saturation with the use of different face masks at rest and at outdoor exercise. **Methods:** A single healthy female subject (41 years old, body mass index 18.5 kg/m²), experienced in outdoor jogging, was subjected to running sessions with 4 different types of face masks (surgical, double cloth, triple cloth and N95) and without mask, in 5 non-consecutive days. Sessions lasted 50 minutes, where 5,8km were covered at an average speed of 7km/h. Peripheral oxygen saturation (SpO₂, %) and heart rate (HR, bpm) were registered at rest, at every 5 minutes of exercise and after 5 minutes of recovery. **Results:** Data revealed that no desaturation occurred at any moment with any mask, even at high intensity. There were no differences in mean SpO₂ or HR with either type of face mask during exercise when compared to the use of no mask. **Conclusion:** Setting aside the discomfort of training with face masks and the possible interference of this in performance, face masks seem not to prevent adequate gas exchange during exercise in healthy subjects.

Keywords: Exercise, Oxygen Level, Masks, Coronavirus Infections

RESUMO

Em muitas cidades do mundo o uso de máscaras faciais em espaços públicos tornou-se obrigatório para prevenir a disseminação da COVID-19. O fechamento de parques públicos, academias e outras áreas destinadas à prática de atividade física podem contribuir para o sedentarismo. **Objetivo:** Avaliar a saturação periférica de oxigênio com o uso de diferentes máscaras faciais em repouso e durante exercício ao ar livre. **Método:** Uma única participante (41 anos, índice de massa corporal 18.5 kg/m²), experiente em corrida ao ar livre, foi submetida a sessões de corrida com 4 tipos diferentes de máscaras faciais (cirúrgica, tecido duplo, tecido triplo e N95) e sem máscara, em 5 dias não consecutivos. As sessões tiveram duração de 50 minutos, onde 5,8km eram percorridos em uma velocidade média de 7km/h. A saturação periférica de oxigênio (SpO₂, %) e a frequência cardíaca (FC, bpm) foram registradas em repouso, a cada 5 minutos de exercício e após 5 minutos de recuperação. **Resultados:** Os dados revelaram que não ocorreu desaturação em nenhum momento com qualquer das máscaras, mesmo em alta intensidade. Não houve diferença nas médias de SpO₂ ou FC com nenhuma das máscaras durante o exercício quando comparadas com o uso de nenhuma máscara. **Conclusão:** Deixando de lado o desconforto de treinar com máscaras faciais e a possível interferência disso na performance, as máscaras faciais parecem não impedir uma adequada troca gasosa durante o exercício em indivíduos saudáveis.

Palavras-chave: Exercício Físico, Nível de Oxigênio, Máscaras, Infecções por Coronavirus

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In December 2019, transmission of the novel coronavirus that causes coronavirus disease (COVID-19) progressed in China and the virus began to be transmitted from person to person.¹ Restrictive measures imposed undesirable changes in lifestyle of most individuals, especially the ones suffering from non-communicable chronic diseases (NCCD).²

Physical exercise has been shown effective to counteract most NCCD, with direct effects on both mental and physical health.² Special attention must be paid to the elderly population group, as additional benefits such as the prevention of falls, sarcopenia and cognitive impairment may arise from the regular practice of exercise.³

It is recommended that people do not interrupt their physical activities during the social isolation period, as it is substantive not only for the health of the overall population, but especially for those with additional risk factors, like NCCD or older age.²

In many cities worldwide the use of face masks in public spaces became mandatory to prevent the spread of the infection.⁴ Together with the closure of public parks, gymnasiums and shared areas in residential buildings, this may negatively impact the practice of physical activities.

Thus, the aim of this experience report was to evaluate peripheral oxygen saturation with the use of different face masks at rest and at outdoor exercise. Our hypothesis was that the use of face masks would impair proper ventilation and contribute to oxygen desaturation in high intensity exercise.

A single healthy female subject (41 years old, body mass index 18.5 kg/m²), experienced in outdoor jogging, was subjected to running sessions with 4 different types of face masks (surgical, double cloth, triple cloth and N95) and without mask, in 5 non-consecutive days. Sessions lasted 50 minutes, where 5,8km were covered at an average speed of 7km/h. Peripheral oxygen saturation (%) and heart rate (bpm) were registered at rest, at every 5 minutes of exercise and after 5 minutes of recovery with IMFtec-A pulse oximeter (Guangdong, China). Data were analyzed with one-way ANOVA in SPSS v.24 for Windows.

Data on SpO₂ and HR at rest, at peak exercise and at recovery, as well as minimum and maximal values of SpO₂ in each condition, are shown in Table 1.

Considering desaturation as a decrease in 4 or more percentage points in relation to resting values,⁵ our data revealed that absolutely no desaturation occurred at any moment. As resting SpO₂ was 98% in all occasions, and minimum registered SpO₂ was 96%, this represents a decrease of 2 percentage points only.

Table 2 shows that there were no differences in mean SpO₂ or HR with either type of face mask during exercise when compared to the use of no mask.

Mean HR registered during exercise represents an average of 84.9-88.3% of maximal HR, which stands for a high intensity exercise.⁶ Even at this intensity, desaturation did not occur. Although patients with pulmonary fibrosis or pulmonary arterial hypertension may experience oxygen desaturation in submaximal exercise, it is rather uncommon in healthy persons, as physical exercise improves ventilation and alveolar recruitment.⁷

Oxygen desaturation is more pronounced in whole body exercises and in exercises with lower limbs (as it is the case of

running), as the amount of muscle mass involved may influence the development of exercise hypoxia even in healthy individuals.⁸ Exercise-induced hypoxia is multifactorial: the presence of obesity, reduced lung capacity, reduced diffusion capacity, ventilation or oxygen transport impairments may all interfere in oxygen saturation. In the present study, involving a healthy subject, this was not observed with any type of face mask, consequently we refuse our original hypothesis.

This study has some limitations. Due to the several difficulties to conduct field research during the COVID-19 pandemics, this was an experience report conducted with a single subject and may not reflect population data. Subject was an experienced runner; hence our findings may not replicate the condition of sedentary, elderly persons or the ones with NCCD.

Table 1. Absolute values of peripheral oxygen saturation and heart rate at rest, at peak exercise and at recovery with different masks

Mask	Rest		Peak exercise		Recovery		SpO ₂	
	SpO	HR	SpO	HR	SpO	HR	min	max
None	98	84	98	168	98	103	97	99
Surgical	98	76	98	172	99	109	96	99
Double cloth	98	83	98	177	98	108	97	99
Triple cloth	98	103	99	169	98	105	98	99
N95	98	92	98	173	98	108	96	98

HR: heart rate; SpO₂: peripheral oxygen saturation; min: minimum; max: maximal. Data are expressed as means \pm standard deviations. SpO₂ values are expressed in percentages (%). HR values are expressed in beats per minute (bpm)

Table 2. Comparison of mean peripheral oxygen saturation and heart rate with different masks at exercise

Mask	SpO ₂ (%)	p	HR (bpm)	p
None	98.3 \pm 0.7	0.08	156.9 \pm 18.0	0.90
Surgical	98.2 \pm 0.9		152.4 \pm 18.9	
Double cloth	98.1 \pm 0.5		156.1 \pm 15.4	
Triple cloth	98.4 \pm 0.5		152.6 \pm 15.0	
N95	97.4 \pm 1.2		157.8 \pm 8.9	

Final Comments

To the best of our knowledge, this is the first study involving the use of face masks during outdoor exercise, however this may become a reality as far as the pandemics lasts. Setting aside the discomfort of training with face masks (as they get wet, create a warm environment around the mouth and nose, and may also increase nasal secretions) and the possible interference of this in performance, face masks seem not to prevent adequate gas exchange during exercise in healthy subjects.

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REFERENCES

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020;395(10223):497-506. Doi: [https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5)
2. Jiménez-Pavón D, Carbonell-Baeza A, Lavie CJ. Physical exercise as therapy to fight against the mental and physical consequences of COVID-19 quarantine: Special focus in older people. *Prog Cardiovasc Dis*. 2020;63(3):386-388. Doi: <https://doi.org/10.1016/j.pcad.2020.03.009>
3. Martínez-Velilla N, Casas-Herrero A, Zambom-Ferraresi F, Sáez de Asteasu ML, Lucia A, Galbete A, et al. Effect of exercise intervention on functional decline in very elderly patients during acute hospitalization: a randomized clinical trial. *JAMA Intern Med*. 2019;179(1):28-36. Doi: <https://doi.org/10.1001/jamainternmed.2018.4869>
4. Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. *Lancet Respir Med*. 2020;8(5):434-436. Doi: [https://doi.org/10.1016/S2213-2600\(20\)30134-X](https://doi.org/10.1016/S2213-2600(20)30134-X)
5. Prefaut C, Durand F, Mucci P, Caillaud C. Exercise-induced arterial hypoxaemia in athletes: a review. *Sports Med*. 2000;30(1):47-61. Doi: <https://doi.org/10.2165/00007256-200030010-00005>
6. Katch VL, McArdle WD, Katch F. *Essentials of exercise physiology*. 4th ed. Baltimore: Wolters Kluwer, Lippincott Williams and Wilkins; 2011.
7. Seixas DM, Seixas DM, Pereira MC, Moreira MM, Paschoal IA. Dessaturação em indivíduos saudáveis submetidos ao *incremental shuttle walk test*. *J Bras Pneumol*. 2013;39(4):440-6. Doi: <https://doi.org/10.1590/S1806-37132013000400007>
8. Nielsen HB. Arterial desaturation during exercise in man: implication for O₂ uptake and work capacity. *Scand J Med Sci Sports*. 2003;13(6):339-58. Doi: <https://doi.org/10.1046/j.1600-0838.2003.00325.x>