

## Effects and Implications of Wearing a Face Mask on Cardiopulmonary Performance During Exercise

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### ABSTRACT

The coronavirus disease 2019 (COVID-19) pandemic has prompted the use of a face mask (FM) to minimize the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes COVID-19. The use of an FM being an accepted precautionary measure to reduce viral transmission, there is a need for examining the physiological effects of wearing an FM, specifically during exercise. **PURPOSE:** To assess the impact of wearing a surgical FM on cardiopulmonary parameters and exercise performance. **METHODS:** Nine males and 9 females (age =  $21.6 \pm 2.5$  yrs; BMI =  $24.4 \pm 3.1$  kg/m<sup>2</sup>) participated in 2 laboratory visits where they completed a graded maximal exercise test using a modified Bruce Protocol. Participants were randomized to which laboratory visit they would complete first, with face mask (WFM) or without face mask (WOFM), which were performed at least 48 hours apart. Expired gases, blood pressure, heart rate, blood O<sub>2</sub> saturation including perfusion index, and the Borg Rating of Perceived Exertion (RPE) were measured and compared between the WFM and WOFM trials at 6 different intensities (rest, 40%, 55%, 70%, 80%, and 100% VO<sub>2max</sub>), using a two-way repeated measures ANOVA. **RESULTS:** There was a significant difference in VO<sub>2</sub> ( $p = 0.001$  and  $n^2 = 0.73$ ) between the WFM ( $38.5 \pm 6.8$  mL/kg/min) and WOFM ( $44.3 \pm 7.4$  mL/kg/min) trials only at the 100% VO<sub>2max</sub> intensity, where significantly lower values were also found during the WFM trial for respiratory rate ( $40.0 \pm 6.8$  vs  $47.8 \pm 8.9$  bpm,  $p = 0.001$ ,  $n^2 = 0.62$ ), respiratory exchange ratio ( $1.07 \pm 0.08$  vs  $1.14 \pm 0.64$ ,  $p = 0.001$ ,  $n^2 = 0.52$ ), and the partial pressure of expired oxygen ( $125.7 \pm 3.5$  vs  $129.4 \pm 3.1$  mmHg,  $p = 0.0001$ ,  $n^2 = 0.54$ ). In contrast, the partial pressure of expired carbon dioxide ( $32.8 \pm 3.1$  vs  $30.8 \pm 3.3$  mmHg,  $p = 0.01$ ,  $n^2 = 0.33$ ) was significantly higher during the WFM trial only at 100% VO<sub>2max</sub> intensity. No other parameters significantly differed at any of the intensities. **CONCLUSION:** Oxygen consumption was lower with face masks only as participants advanced from 80% to maximal effort. Notably, participants had a slower respiratory rate and exhaled a higher concentration of carbon dioxide with face masks. This result suggests that expired carbon dioxide accumulated under the face masks and participants subsequently rebreathed this expired carbon dioxide. There is no evidence that suggests exercise below 80% of VO<sub>2max</sub> while wearing face masks will cause any concerning changes in cardiopulmonary parameters. However, it is recommended that future studies examine how different types of face masks may affect cardiopulmonary function during exercise in a variety of subject populations.