

The Interaction Between High-Altitude Hypoxia and COVID-19 Injury: Dissociation of Ventilatory Efficiency and Oxygen Uptake

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Abstract

Background: Both high-altitude hypoxia and COVID-19 can independently induce cardiopulmonary dysfunction, with multiple pathophysiological intersections theoretically existing between the two. **Methods:** This cross-sectional study recruited 290 Han Chinese residents living in Lhasa, comprising 89 COVID-19 convalescents (COVID group) and 201 non-infected controls (N-COVID group). All participants underwent standardized cardiopulmonary exercise testing (CPET), muscle strength assessment, and completed the FACIT-Fatigue, IPAQ, and Pittsburgh Sleep Quality Index questionnaires. **Results:** No significant differences were observed between the COVID and N-COVID groups in age, height, body weight, BMI, duration of high-altitude residence, FACIT-Fatigue score, IPAQ score, or Pittsburgh Sleep Quality Index score ($P > 0.05$). Additionally, no significant between-group differences were found in FVC, FEV₁, VO_{2peak}, or VO_{2peak}/kg ($P > 0.05$). However, the COVID group demonstrated significantly elevated VE/VCO₂ (43.66 ± 4.49 VS 40.92 ± 4.40), VE/VCO₂ slope (43.18 ± 5.95 VS 40.47 ± 5.49), and RER (1.08 ± 0.046 VS 1.06 ± 0.046) compared to the N-COVID group ($P < 0.05$). Furthermore, the N-COVID group exhibited significantly better grip strength and balance performance than the COVID group ($P < 0.05$). **Conclusions:** Ventilatory efficiency may serve as a more specific indicator for evaluating cardiopulmonary function in this population. Clinical assessment should not rely solely on traditional metrics such as VO_{2peak}. For rehabilitation, interventions targeting respiratory pattern training to improve ventilatory efficiency and proprioceptive training to enhance neuromuscular control are recommended.

Keywords

High-altitude Hypoxia, Covid-19, Cardiopulmonary Exercise Testing, Ventilatory Efficiency, Oxygen Uptake