

## Effects of Altitude on Step Test Performance

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Aerobic capacity ( $VO_{2max}$ ) is reduced upon acute exposure to high altitude, yet measuring  $VO_{2max}$  with calorimetry is expensive and may be impractical for use in the field. The 3-minute step test is a popular method for estimating  $VO_{2max}$ . However, it has not been widely used at high altitude. **PURPOSE:** To examine the effect of altitude on step test performance. **METHODS:** Fourteen undergraduate students enrolled in a 10-day study abroad to Peru that included a two-day hike on the Inca trail. Prior to traveling, all students underwent a symptom-limited Bruce treadmill protocol with breath-by-breath analysis to determine  $VO_{2max}$ . In Peru, students performed a Queens College step test at sea level (Lima). They stepped at a predetermined cadence for 3 minutes, after which recovery heart rate was recorded and entered into a standardized regression equation to estimate  $VO_{2max}$ . The test was repeated at 3800 meters (Paucarcancha) and again at 2040 meters (Aguas Calientes). **RESULTS:** Ten students (age  $21 \pm 1.7$  years; M:1, F:9) completed all aspects of the study. The measured  $VO_{2max}$  was  $42.2 \pm 6.1 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ . Measured  $VO_{2max}$  was associated with estimated  $VO_{2max}$  at sea level ( $r = 0.81$ ,  $p = 0.005$ ). Estimated  $VO_{2max}$  was reduced from  $38.0 \pm 6.5 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$  at sea level to  $34.2 \pm 4.7 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$  at 3800 meters ( $p < 0.001$ ). No difference was observed between estimated  $VO_{2max}$  at 2040 meters and sea level. **CONCLUSION:** We found that the Queens College step test provides a valid estimate of  $VO_{2max}$ . Step test performance at 3800 meters was reduced by 11% compared to sea level, whereas no change was observed at 2040 meters. These data corroborate previous findings that indicate a threshold at which altitude adversely affects aerobic capacity.