

Oxygen transport phenotypes and the adaptive modes of Andean versus Tibetan highland native populations

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High altitude native populations exhibit physiological adaptations to environmental hypoxia. It has been hypothesized that two of these populations, Andeans and Tibetans, demonstrate distinct adaptive modes with the former characterized by increased blood oxygen content, and the latter characterized by increased blood flow. To investigate this hypothesis, we recruited two groups of healthy adults (ages 18-35) with highland ancestry who were born and currently reside at high altitude. The groups were: Andean Quechuas recruited in Cerro de Pasco, Peru (AND, n = 301) and Tibetan Sherpas recruited in Pheriche, Nepal (SHP, n = 64). Participants were tested in field laboratories using identical equipment and protocols, at nearly identical altitudes (4,330m and 4,371m, respectively). We assessed a wide variety of physiological variables at rest, submaximal exercise, and maximal exercise. We found that although some phenotypes aligned with the above hypothesis, the majority did not. For example, as predicted, AND displayed significantly lower ($p < 0.001$) ventilatory equivalents for oxygen (V_E/V_{O_2}) at rest. However, this trend reversed at maximal exercise, with AND displaying significantly higher ($p < 0.001$) V_E/V_{O_2} than SHP. Further, contrary to the above hypothesis, we found no statistically significant differences in flow-mediated dilation between the groups. These results suggest that the adaptive modes of these populations are perhaps not as distinct as previously supposed. Given that this hypothesis was formulated on the basis of data taken at rest, our data highlights the importance of assessing physiology both at rest and exercise, to gain a more complete understanding of adaptation to high altitude.

This work was supported by the National Science Foundation (BCS, Award Number 2141893).