Tibetan and Han Chinese oxygen transport at 2200 m and simulated 4200 m during peak exercise

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Tibetans, compared to Han Chinese, exhibit unique adaptations at high altitude. Whether these distinct responses to hypoxia are maintained at intermediate altitude and/or acute hypobaric hypoxia during rest and exercise are unknown.

Thirty-seven healthy, non-smoking subjects of Tibetan (N_{male} = 10; N_{female} = 9) or Han Chinese (N_{male} = 8; N_{female} = 10) ancestries were studied under ambient conditions at 2200 m and simulated altitude of 4200 m in a hypobaric chamber. Oxygen consumption (VO2), cardiac output (QT), ventilation (VE), hemoglobin ([Hb]), blood oxygen saturation (SaO2), and arterial blood gases were measured at rest, submaximal, and peak exercise and diffusing capacity in lung (DL) and muscle (DM) were calculated.

At 2200 m at rest, Tibetan males had 2.40 g/dL less [Hb] compared to their Han Chinese male counterparts ($p < 0.03$), which was less pronounced in females (1.05 g/dL less for Tibetan females, $p > 0.06$).

Compared to Han Chinese, Tibetan females had significantly higher VO2max at both 2200 m and 4200 m (both $p < 0.03$) whereas this trend in males is not significant ($p > 0.09$, $p > 0.31$).

At 2200 m, there was a trend toward higher QTmax in Tibetan males and females ($p > 0.15$, $p > 0.18$) and higher heart rate in Tibetan females at both 2200 m and 4200 m ($p > 0.09$, $p > 0.16$) with no significant difference between males.

Tibetan males had a significantly higher diffusing capacity in lung (DL) compared to Han Chinese ($p < 0.03$ for males; $p > 0.19$ for females).

Compared to Han Chinese, Tibetans tended to have higher diffusing capacity in muscle (DM). However, in both males and females, the difference is more pronounced at 2200 m ($p > 0.11$, $p > 0.09$) than at 4200 m ($p > 0.33$, $p > 0.20$).

Tibetan compared to Han Chinese females exhibited higher VE during peak exercise at both 2200 m and 4200 m ($p < 0.03$, $p < 0.02$, respectively). This trend persisted in males, though less pronounced at 2200 m than at 4200 m ($p > 0.54$, $p > 0.20$, respectively).

In addition, Tibetans had significantly higher carboxyhemoglobin compared to Han Chinese at 2200 m ($p < 0.005$) independent of sex. Considering Tibetans had lower [Hb] than Han Chinese, higher CO content might suggest increased red blood cell destruction in Tibetans.

In summary, among Tibetans, who exhibit significantly lower [Hb] and elevated COHb, females exhibit increased exercise capacity and ventilation compared to Han Chinese females at 2200m and when acutely exposed to simulated 4200 m, while similar trends were exhibited in males. Male Tibetans exhibited greater DL than Han Chinese counterparts. Trends were further noted for increased QT and

DM in Tibetans. Whether differences between hypoxic-exercise responses of Tibetans and Han Chinese are innate has yet to be elucidated.