

A three-week traditional altitude training increases hemoglobin mass and red cell volume in elite biathlon athletes

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Int J Sports Med. 2005 Jun;26(5):350-5

Abstract:

It is well known that altitude training stimulates erythropoiesis, but only few data are available concerning the direct altitude effect on red blood cell volume (RCV) in world class endurance athletes during exposure to continued hypoxia. The purpose of this study was to evaluate the impact of three weeks of traditional altitude training at 2050 m on total hemoglobin mass (tHb), RCV and erythropoietic activity in highly-trained endurance athletes. Total hemoglobin mass, RCV, plasma volume (PV), and blood volume (BV) from 6 males and 4 females, all members of a world class biathlon team, were determined on days 1 and 20 during their stay at altitude as well as 16 days after returning to sea-level conditions (800 m, only males) by using the CO-rebreathing method. In males tHb (14.0 +/- 0.2 to 15.3 +/- 1.0 g/kg, $p < 0.05$) and RCV (38.9 +/- 1.5 to 43.5 +/- 3.9 ml/kg, $p < 0.05$) increased at altitude and returned to near sea-level values 16 days after descent. Similarly in females, tHb (13.0 +/- 1.0 to 14.2 +/- 1.3 g/kg, $p < 0.05$) and RCV (37.3 +/- 3.3 to 42.2 +/- 4.1 ml/kg, $p < 0.05$) increased. Compared to their sea-level values, the BV of male and female athletes showed a tendency to increase at the end of the altitude training period, whereas PV was not altered. In male athletes, plasma erythropoietin concentration increased up to day 4 at altitude (11.8 +/- 5.0 to 20.8 +/- 6.0 mU/ml, $p < 0.05$) and the plasma concentration of the soluble transferrin receptor was elevated by about 11 % during the second part of the altitude training period, both parameters indicating enhanced erythropoietic activity. In conclusion, we show for the first time that a three-week traditional altitude training increases erythropoietic activity even in world class endurance athletes leading to elevated tHb and RCV. Considering the relatively fast return of tHb and RCV to sea-level values after hypoxic exposure, our data suggest to precisely schedule training at altitude and competition at sea level.