LONGITUDINAL CHANGES IN HAEMOGLOBIN MASS AND VO2MAX IN ADOLESCENTS

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PURPOSE Previous studies have demonstrated a high correlation between haemoglobin mass (Hbmax) and maximum oxygen consumption (VO₂max) amongst elite athletes (Gore et al. 1997), yet this relationship has not been examined in younger athletes. Therefore the purpose of this study was to assess the relationship between Hbmax and VO₂max in adolescents, and secondly to quantify the change in these variables as a result of vigorous physical training and maturation.

METHODS Twenty-three subjects aged 11-15 yr participated in the study. Twelve subjects were involved in 12 months of cycle training (Cyclists) and 11 subjects did minimal activity during the same period (Controls). All subjects were measured for VO₂max and Hbmax on 5 occasions (initial value and then every 3 months thereafter) during the 12 month period. VO₂max was assessed on dynamically-calibrated cycle ergometers and a 2-minute carbon monoxide rebreathing procedure (Schmidt and Prommer, 2005) was used to determine Hbmax. The VO₂max and Hbmax data were analysed with linear regression and repeated measures analysis of variance for the effects of Group (Cyclists versus Controls) and Time (0, 3, 6, 9, 12 months).

RESULTS There was a high correlation between relative VO₂max (ml.kg⁻¹.min⁻¹) and relative Hbmax (g.kg⁻¹) for all 23 subjects (r=0.82, p<0.0001, SEE 5.5 ml.kg⁻¹.min⁻¹). During the 12 months there was a significant increase in relative VO₂max of the Cyclists from (mean ± SD) 57.3 ± 7.2 to 64.2 ± 8.6 ml.kg⁻¹.min⁻¹, but not in the Controls from 45.2 ± 7.4 to 43.3 ± 10.7 ml.kg⁻¹.min⁻¹ (GroupxTime F(4,84) = 9.4, p =< 0.0001). Relative Hbmax was significantly higher in the Cyclists than the Controls at the start of the study (p=0.03) however, in the subsequent 12 months there was not a significant increase in relative Hbmax of the Cyclists (from 10.6 ± 1.1 to 10.6 ± 1.2 g.kg⁻¹) or the Controls (from 9.7 ± 1.0 to 9.4 ± 1.0 g.kg⁻¹, GroupxTime F(4,84) = 0.5, p=0.75). Body mass increased significantly (p<0.0001) in both Cyclists (5.7 ± 4.8%) and Controls (9.8 ± 8.7%) throughout the study. The correlation between % change in relative VO₂max and % change in relative Hbmax for all 23 subjects was not significant (r= 0.37, p=0.87, SEE 12.5%).

CONCLUSION Our results suggest that measurement of Hbmax using CO rebreathing can identify adolescents who have the potential to develop a high aerobic capacity. It may also be concluded that 12 months of cycle training does not increase relative Hbmax in adolescents despite a large increase in relative VO₂max, which suggests a key role for heredity. Given the key role of haemoglobin for oxygen transport, these findings indicate that increases in VO₂max in adolescent athletes may be due to factors other than Hbmax.


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