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Hemoglobin mass (Hb-mass), blood volume (BV) and maximum oxygen uptake (VO2max) in 12 years old endurance athletes

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2 • TREINO DESPORTIVO/SPORT TRAINING

HEMOGLOBIN MASS (HB-MASS), BLOOD
VOLUME (BV) AND MAXIMUM OXYGEN
UPTAKE (VO₂MAX) IN 12 YEARS OLD
ENDURANCE ATHLETES

INTRODUCTION

The purpose of this study was to examine the relationship between hemoglobin mass (Hb-mass), blood volume (BV) and maximum oxygen uptake (VO_{2max}), and to get an overview of normal values for these parameters in 12 years old endurance athletes.

METHODS

Twenty-three 12 years old endurance trained athletes (11 girls and 12 boys) participated in this study. They were recruited from cross country skiing- and football clubs. VO_{2max} was determined by a graded exercise test conducted on a treadmill. Hb-mass was measured using a slightly modified version of the traditional carbon monoxide rebreathing method (CO-rebreathing method) (Burge & Skinner, 1995) red blood cell volume, and blood volume and was appraised in normal volunteers. A body size-related dose of CO (50-90 ml. Venous blood was sampled from the antecubital vein. Pubertal status was determined by using a modified version of Tanner's criteria (Tanner, 1973) and the subjects were classified as pre-pubertal or early pubertal.

RESULTS

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There were no significant differences between boys and girls for neither VO_{2max} , hematological nor anthropometric variables. Mean VO_{2max} was measured to 2,43 (0,27) l·min⁻¹, 57 (4) ml·kg·min⁻¹ and 2,50 (0,25) l·min⁻¹, 60 (5) ml·kg·min⁻¹ for girls and boys, respectively. The girls had a total Hb-masse and Hb-masse relative to body weight of 471 (56,3) g and 11,0 (0,9) g·kg⁻¹, and the boys' values were 482 (60,4) g and 11,4 (0,9) g·kg⁻¹. BV was calculated to 4116 (508) ml and 96 (8) ml·kg⁻¹ for girls, and 4037 (463) ml and 96 (7) ml·kg⁻¹ for boys.

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DISCUSSION

There was a strong correlation between body weight and BV ($r=0,78$), Hb-mass ($r=0,71$) and VO_{2max} ($r=0,69$). There was also a strong correlation between VO_{2max} and BV and Hb-mass. Our results indicate that the variation in body weight can explain 51% of the variation in Hb-mass, 61 % of the variation in BV and 48 % of the variation in VO_{2max} . Further, 72 % and 66 % of the variation in VO_{2max} can be explained by variation in Hb-mass and BV respectively.

To our knowledge there are no published data for 12 years old endurance trained children on BV or Hb-mass. Some studies have included groups of children of different ages, but training status and inclusion criteria have varied in the different studies. Our values are higher than reported in other studies, and that may be due to the fact that different methods have been used to measure and calculate Hb-mass and BV. We may also have a possible selection bias in our group of children, as they were recruited from an area with a high proportion of academics and very physically active inhabitants. Few subjects and the potential selection bias in our group must be taken into account before generalizing and considering the results as representative for 12 years old endurance trained children.

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