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Indirect methods of estimating maximal oxygen uptake on the rowing ergometer

A Klusiewicz, J Faff

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The aim of the present study was to develop an indirect method of estimating maximal oxygen uptake in oarsmen and oarswomen on the rowing ergometer based on both the submaximal exercises and the commonly used in this sport maximal exercise-type test that simulates rowing the distance of 2000 m. Forty-four oarsmen and 27 oarswomen from both the national team and the direct back-up were enrolled in the investigations. Two exercise tests on the Concept II rowing ergometer were employed: the submaximal test with incremental power output (anaerobic threshold test) and the maximal test, simulating rowing the distance of 2000 m in the shortest possible time (2-km test). During both tests, oxygen uptake and heart rate were recorded and the highest values of these parameters registered during the 2-km test were regarded as the VO<sub>2</sub>max and HRmax indices, respectively. The linear relation of the oxygen uptake to the power output (W) on the ergometer was detected in both the male (VO<sub>2</sub>=1.1328+0.0113W) and female (VO<sub>2</sub>=0.6652+0.0128W) athletes. Comparison of the regression lines demonstrated statistically significant differences between the oarsmen and oarswomen with respect to the intercept and the slope of the lines. Mean values of the directly measured VO<sub>2</sub>max equaled to 5.48±0.59 and 3.68±0.31 l•min<sup>-1</sup> in the groups of oarsmen and oarswomen, respectively. The most accurate predicted values of VO<sub>2</sub>max were obtained based on the linear regression of VO<sub>2</sub>max against the mean power output (WM) in the 2-km test using the following formulas: VO<sub>2</sub>max (l•min<sup>-1</sup>) in the males = 1.682+0.0097 WM; VO<sub>2</sub>max (l•min<sup>-1</sup>) in the females = 1.631+0.0088 WM. In the males, the difference between the measured and predicted VO<sub>2</sub>max (D %), correlation coefficient (r), standard estimation error (SEE), and total error (TE%) equaled to 0.12±4.96 (NS), 0.889 (P<0.001), 0.274, and 4.9, respectively. In the females, these values equaled to 0.43±5.02 (NS), 0.801 (P<0.001), 0.19 and 4.95, respectively. Based on the submaximal exercises, the relatively accurate predicted values of VO<sub>2</sub>max were obtained from the linear regression of VO<sub>2</sub>max against PWC170 using the following formulas: VO<sub>2</sub>max (l•min<sup>-1</sup>) in the males = 3.2131+0.0076 (PWC170); VO<sub>2</sub>max (l•min<sup>-1</sup>) in the females = 2.4138+0.0071 (PWC170). In the males, the accuracy of prediction of VO<sub>2</sub>max was defined by the following indices: D % = 0.37±6.15 (NS), r = 0.826 (P<0.001), SEE = 0.279, TE% = 6.03. In the females, the respective values were as follows: D % = 0.30±6.22 (NS), r = 0.711 (P<0.001), SEE = 0.158, TE% = 5.82. The obtained results indicate that it possible to relatively precisely predict maximal oxygen uptake from the results of submaximal and maximal (2-km test) exercises performed on the rowing ergometer.

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