Establishing maximal oxygen uptake in young people during a ramp cycle test to exhaustion

Alan R. Barker, Andrew M. Jones, Craig A. Williams, Neil Armstrong

Children’s Health and Exercise Research Centre, Sport and Health Sciences, University of Exeter, UK.

**Background:** A ramp cycle test to exhaustion has become a standard protocol for determining $\dot{V}O_2$ peak in young people, yet its validity in establishing a ‘true’ maximum remains to be established. This study tested the hypotheses that: 1) secondary criteria used to verify a $\dot{V}O_2$ peak as a maximal parameter in children can result in the acceptance of a ‘sub-maximal’ value or falsely reject a maximal value; and 2) the $\dot{V}O_2$ peak recorded during a ramp test in children is comparable to the $\dot{V}O_2$ peak achieved during supra-maximal testing. **Methods:** Thirteen children (9-10 y) completed a ramp cycle test to exhaustion to determine their $\dot{V}O_2$ peak. After 15 min recovery, the participants performed a supra-maximal cycle test to exhaustion at 105% of their ramp test peak power. **Results:** Compared to the $\dot{V}O_2$ peak during the ramp test, a significantly lower was recorded at an RER of 1.00 (1.29 L·min⁻¹ [SD 0.27] vs. 1.68 L·min⁻¹ [SD 0.30], \(P<0.001\), \(n=12\)), and at a heart rate of 195 beats·min⁻¹ (1.56 L·min⁻¹ [SD 0.27] vs. 1.72 L·min⁻¹ [SD 0.32], \(P<0.001\), \(n=10\)) and at 85% of age predicted maximum (1.35 L·min⁻¹ [SD 0.23] vs. 1.69 L·min⁻¹ [SD 0.28], \(P<0.001\), \(n=13\)). Of the three children who failed to reach the 195 beat·min⁻¹ criterion, a clear plateau-like profile in $\dot{V}O_2$ at exhaustion was noted in two of these participants. Likewise, six children failed to reach the blood lactate criterion of $\geq6$ mmol·L⁻¹, two of which showed a clear plateau in their $\dot{V}O_2$ profile at exhaustion. Supra-maximal testing yielded a $\dot{V}O_2$ peak that was not significantly different from the ramp test (1.62 L·min⁻¹ [SD 0.31] vs. 1.69 L·min⁻¹ [SD 0.28], \(P=0.09\), respectively), despite exercising at a higher power output (127 vs. 120 W). **Conclusion:** The use of secondary criteria to validate a $\dot{V}O_2$ peak in young people during ramp cycling exercise may result in the acceptance of a ‘sub-maximal’ $\dot{V}O_2$ value or falsely reject a ‘true’ maximal score. As supra-maximal testing elicits a $\dot{V}O_2$ peak similar to the ramp protocol, thus satisfying the plateau criterion, it is recommended that the use of such tests should be adopted as the appropriate method of confirming a ‘true’ $\dot{V}O_2$ max in healthy young people.