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Title of the paper: **KINEMATIC PARAMETERS AND OXYGEN UPTAKE KINETICS DURING SUB-MAXIMAL EXERCISE IN SWIMMING**

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Introduction
Performance excellence in swimming is strongly influenced by physiological profile and swimming technique (Psycharakis et al. 2008). Faster oxygen uptake (VO2) kinetics is associated to a better tolerance to fatigue (Bailey et al. 2009) which begins to markedly manifest above maximal lactate steady state velocity (MLSSv) in swimming. The purpose of this study was to analyze the relationship between VO2 kinetics and kinematic parameters around MLSSv in swimming.

Methods
National level portuguese swimmers (n = 14; 16.6 ± 2.5 yrs) completed a 400-m all-out test for maximal aerobic velocity (MAV) estimation and 30-min at constant swimming velocity at 87.5, 90 and 92.5% of maximal aerobic velocity (MAV) for MLSSv determination. Two square-wave transitions of 500-m, 2.5% above and below MLSSv were completed to determine VO2 on-kinetics, using two exponential functions. All the tests were performed in front-crawl and data was collected during all tests, except the 400-m all-out test, using a respiratory snorkel and a breath-by-breath analyser (K4b2, Cosmed, Italy). Stroke rate (SR) was determined as the number of cycles per min (registered by the number of strokes in each 25 m), stroke length (SL) was calculated by dividing velocity by SR.

Results
SR was significantly lower below than above MLSSv (respectively, 34.3 ± 3.6 Vs. 38.0 ± 3.8 cycles.min-1), the contrary was observed for SL (2.29 ± 0.22 Vs. 2.16 ± 0.19 m.cycle-1). The amplitude of the primary phase (Ap) was significantly higher above than below MLSSv (respectively, 49.5 ± 6.9 Vs. 45.9 ± 6.7 ml.kg-1.min-1) and the time constant of the primary phase (taup) was not significantly different below and above MLSSv (21.2 ± 8.6 Vs. 19.0 ± 7.7-s, respectively). SR at 97.5% MLSSv was negatively correlated to Ap at the same exercise intensity ($r = - 0.60$, $p < 0.05$), a positive correlation was observed for SL and Ap at 97.5% MLSSv ($r = 0.67$, $p < 0.01$). MLSSv was negatively

correlated with taup at 97.5 and 102.5% MLSSv (respectively, $r = -0.64$ and $r = -0.55$; $p < 0.05$). MAV was also negatively correlated to taup at 97.5 and 102.5% MLSSv ($r = -0.67$, $p < 0.01$; $r = -0.56$, $p < 0.05$).

Discussion

MLSSv seems to represent the upper limit of stroke mechanics efficiency and the relationship between kinematic parameters and the primary phase of VO2 kinetics highlight the importance and pertinence of technical quality training in day-to-day swimming practice. Since 98% of the total VO2max is attained at four times taup (Burnley & Jones, 2007) and swimmers evidenced a taup of around 20-s, coaches may prescribe training sets below 80-s to endure VO2max.

References

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