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Relation between efficiency and energy cost with coordination in aquatic locomotion.

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Abstract

The aim of this study was to establish the relationships between the intracycle velocity variation (IVV) and Froude efficiency ($\eta(T)$), energy cost (C), and index of coordination (IdC) throughout a 200-m freestyle race. Ten male international level swimmers performed a maximum 200 m front crawl swim. Performance was recorded with four below- and two above-water synchronized cameras. Oxygen consumption was measured continuously during the effort, and blood samples were collected before and after the test. IdC, body center of mass' IVV (x, y and z), and $\eta(T)$ were also calculated. For assessing C swimmers performed also 50, 100 and 150 m at the same pace as in the 200-m splits to capture blood lactate samples after each 50-m lap of the 200-m effort. Swimmers attained a stable IVV (x, y, and z), as fatigue development along the 200-m effort induced a decrease in velocity, stroke length, stroke frequency, $\eta(T)$, and an increase of IdC. Direct relationships between C and IdC for the second and fourth lap were found: $R = 0.63$ and $R = 0.69$ ($P < 0.05$), respectively. Computing partial correlation, also IdC and $\eta(T)$ in the first lap were significantly correlated ($R = -0.63$, $P < 0.05$). IdC and $\eta(T)$ showed to be significant for the within-subjects correlation ($R = -0.45$, $P = 0.01$), and IdC and C for the between-subjects correlation ($R = 0.66$, $P = 0.04$). Patterns of coordination modified during the 200-m event in response to the task constraints, observed by the changes in the other studied parameters, and allowing the IVV stability along the effort.

PMID: 22903863 [PubMed - as supplied by publisher]