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Abstracts

Changes in classical kinematics and non-linear parameters after a maximal 100-m front-crawl bout

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In a linear system there is proportionality between input and output. Under this framework it is expected that the amount of change in sports performance must be proportional to variations in the inputs. However, as far as elite performance goes, this is not a straightforward assumption. Sometimes the variables selected are not sensitive enough. Hence, there is the need of having non-linear concepts underpinning such analysis. The aim was to compare classical kinematics and non-linear parameters after a maximal 100-m front-crawl bout. Twenty four subjects (12 males and 12 females; 22.38±1.68-y) were invited to perform a 100-m freestyle race at maximal pace. Before (pre-test, i.e. rested) and immediately after (post-test, i.e. under fatigue) the maximal bout, they performed two maximal 25m swims at freestyle with push-off start. A speedo-meter cord (Swim speedo-meter, Swimsportec, Hildesheim, Germany) was attached to the swimmer's hip (Barbosa et al., 2015) in the two 25m trials collecting the instantaneous speed. It was computed the speed fluctuation (dv; Barbosa et al., 2015), approximate entropy (ApEn; Barbosa et al., 2015) and fractal dimension (FD; Higuchi, 1988). Repeated measures ANOVAs (pre-test vs. post-test; $P \leq 0.05$), effect sizes (eta squared) and 95% of confidence intervals (95CI) were computed. The speed was 1.44±0.24 and 1.28±0.23m/s in the pre- and post/test, respectively ($F=55.136$, $P<0.001$). The dv increased from the pre- to the post-test with moderate effect sizes ($F=15.048$, $P<0.001$, $\eta^2=0.41$). The dv increased by 20.17%, shifting the 95CI band from 0.116-0.134 to 0.140-0.161. The ApEn showed trivial variations between the pre- and post-test ($F=0.037$, $P=0.85$, $\eta^2<0.01$). There was a trend for a decrease of the ApEn by 2.23% and the 95CI of pre- and post-test overlap (pre: 0.659-0.700; post: 0.641-0.682). The FD showed a significant effect due to the fatigue with a moderate effect size ($F=5.186$, $P=0.03$, $\eta^2=0.20$). The 95CI band moved from 1.954-1.965 to 1.933-1.951. All 24 subjects increased the dv from pre- to post-test. 21 out of 24 swimmers decreased the FD from pre- to post-test and 16 decreased the ApEn. There was an increase in the dv and a decrease of both ApEn and FD. All in all, fatigue led to a higher speed fluctuation amid a more predictable and less complex motor behaviour.

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Comparison of the fractal dimension among swimmers with different levels of expertise

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It is known that performance is strongly related to proportional changes in the inputs. The "marginal gains theory" in sports performance gained popularity a few years ago. It encompasses the assumption that small changes in the input (or the sum of several changes) may have a significant effect on the output. Yet, it is unclear if nonlinear parameters such as fractal dimension are able to distinguish subjects with different levels of expertise. The aim was to compare the fractal dimension in swimmers with different levels of swimming expertise. Seventy five subjects in accordance to their level of expertise (highly qualified experts, experts and non-experts) were invited to perform maximal 4x25m swims in each swim stroke after a push-off start. A speedo-meter cord (Swim speedo-meter, Swimsportec, Hildesheim, Germany) was attached to the swimmer's hip (Barbosa et al., 2015) collecting the instantaneous speed. Upon that, the fractal dimension (FD; Higuchi, 1988) was computed. Two-way repeated-measures ANOVAs (group x swim stroke; $P \leq 0.05$), effect size by the eta-squared (η^2) plus Cohen's d (d) and 95% confidence interval (95CI) were computed. There was an expertise x swim stroke interaction ($F_{6,72}=3.564$; $P<0.001$; $\eta^2=0.13$) in the swim speed. Front-crawl was the fastest stroke, followed by the Butterfly, Backstroke and Breaststroke ($P<0.001$). As far as FD goes, there was a non-significant expertise x stroke interaction ($P=0.13$; $\eta^2=0.03$) albeit a moderate effect of the swim stroke ($P<0.001$; $\eta^2=0.41$) and a small effect of the expertise level