28th ECSS Anniversary Congress, Paris/France, 4-7 July 2023

The interplay between active Drag, arm stroke efficiency and propulsive power as determinants of front crawl sprint performance

Peterson Silveira, R.1, Raineteau, Y.1,2, Pla, R.2, Bideau, B.1, Nicolas, G.1, Bideau, N.1

1 M2S Lab – Laboratoire Movement Sport Santé, Université Rennes 2, Rennes, France. 2 Féderation Française de Natation, Paris, France.

INTRODUCTION:
Swimming performance depends on the balance between mechanics and energetics. Athletes must maximize propulsion (thus increasing the metabolic input) while minimizing hydrodynamic resistance (thus decreasing the energy cost) (1). Moreover, identifying key predictors of performance obtained from field tests is of particular interest for coaches, performance analysts and athletes. Therefore, the aim of this study was to verify in-field the association between active drag coefficient, propulsive power, propelling efficiency, and maximal sprint performance in front crawl.
METHODS:
Male and female competitive swimmers of different levels participated in this study (n=51). They performed four all-out semi-tethered front crawl sprints with increasing loads (0.1, 2.0, 4.0, and 6.0 kg) using an electromechanical device (1080 Sprint, Sweden). To avoid major changes in the duration of each trial as the load increased, swimmers were asked to swim 25 m in the first trial (0.1 kg), 25 m in the second trial (2.0 kg), 20 m in the third trial (4.0 kg), and 15 m in the fourth trial (6.0 kg). Average swimming speed and semi-tethered force were obtained from ~10-20 m in the unloaded trial. The number of strokes executed before and within this window was computed and used as a reference to calculate the average speed and semi-tethered force in the other trials (i.e., 2.0-6.0 kg). A linear regression of the semi-tethered force vs swimming speed relationship was used to obtain input parameters to be included in the calculation of Drag, drag coefficient, and propulsive power using the Velocity Perturbation Method (2). The arm stroke efficiency was obtained from the ratio of the average forward speed and the average tangential hand speed (1,3). A stepwise regression was used to identify the association between the selected parameters and maximal sprint performance in front crawl swimming (α=5%).
RESULTS:
Two models predicting front crawl sprint performance were obtained from the stepwise regression: (i) including propulsive power (R^2=0.797; p<0.001), (ii) including propulsive power and active drag coefficient (R^2=0.965; p<0.001). The arm stroke efficiency was excluded by the stepwise regression and, individually, presented a negligible correlation with maximal swimming speed (r=-0.274; p=0.026).
CONCLUSION:
Propulsive power and active drag coefficient obtained using a coach-friendly semi-tethered swimming protocol are strongly related to maximal front crawl sprint performance. Despite its importance in converting the total mechanical power into useful propulsive power, and its known correlation with swimming economy (an important determinant of performance in longer distances) the arm stroke efficiency was not a strong predictor of sprint performance in front crawl.

REFERENCES
1) Peterson Silveira et al., IJERPH (2019)
2) Kolmogorov et al., JBiomech (1992)
3) Martin et al., JBiomech (1981)

Topic: **Training and Testing**

Presentation **Oral**

European Database of Sport Science (EDSS)

Supported by SporTools GmbH

35333