# Relationships between kinematics and neuromuscular parameters in breaststroke

Ana T. Conceição[1], António J. Silva[2], Tiago M. Barbosa[3], Mário J. Costa[2], Nuno Garrido[2], Hugo Louro[1]

[1]Sport Sciences School of Rio Maior, Rio Maior, Portugal./ CIDESD, Department of Sport Sciences, Bragança, Portugal
[2]University of Trás-os-Montes and Alto Douro, Vila Real, Portugal/ CIDESD, Department of Sport Sciences, Bragança, Portugal
[3]Sport Sciences Department, Polytechnic Institute of Bragança, Bragança, Portugal/ CIDESD, Department of Sport Sciences, Bragança, Portugal
anaconceicao@esdrm.ipsantarem.pt

**Key words: Swimming, Elite Swimmers, Kinematics, EMG**

**INTRODUCTION** The aim of this study was to develop an observation and characterization of a 200m breaststroke event, regarding the relationship between kinematic and neuromuscular parameters.

**MATERIALS AND METHODS** Surface electromyographic signals (EMG) were used to analyze the dynamics of neuromuscular activity muscles on the right side of the body of twelve national elite swimmers. The evaluated muscles were: *pectoralis major* (PM), *biceps brachii* (BB), *triceps brachii* (TB) and *anterior deltoid* (DA). A couple of cameras (underwater camera and another above the surface of the water) were used for providing a dual projection that permits analysis of kinematic variables (Speed, SF, SL) over the 200 m breaststroke and we also executed collections of blood lactate before and after the test.

**RESULTS** The swimming Speed decreases over 1.41 (0.07) to 1.16 (0.09) $m.s^{-1}$ ($P<0.05$). The stroke length decreased from 2.32 (0.37) to 1.96 (0.24) m, while the stroke frequency suffered a decrease of 37.52 (5.16) to 34.40 (3.58) cycle/min of 1st lap 50 m until the 3rd lap of 50 m, increasing slightly in the last lap to 35.82 (3.39) cycle/min. Blood lactate concentrations increased from the beginning to the peak of blood lactate of 1.12 (0.22) to 12.00 (3.23) $mmol.L^{-1}$. EMG results indicated an increase in frequency relative to amplitude for all muscles studied: BB, PM and TB, except for the DA. Negative correlation between the frequency were obtained and the Speed, SF and SL, i.e. to the muscles BB, TB and PM there was a strong correlation between Speed, SF and SL, meaning that as the kinematic variables increase the frequency decreases, while for the muscle DA the values lie very close to zero module, indicate that changes in kinematic variables are not reflected in the frequency of this muscle. The large correlations presented between the kinematic and the muscles studied variables suggests that the neuromuscular activation presents a direct relationship with the kinematic variables, in particular for a reduction of the frequency, in muscles BB, TB and PM, and to a high extent and strong correlation with the kinematic variables in a muscle PM.

**CONCUSSIONS** The relationship between the kinematic variables and EMG are decisive in observation and evaluation of performance in sports, such as swimming, in prescribing training exercises on dry to increase muscular endurance of muscles involved in breaststroke technique.